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General Comment

Please find attached an exhibit list and exhibits for comments by NRDC, CBG, PSR-LA, and SFBayPSR (tracking #1k4-9hxd-ldug). Because of the limitations of the number of files that can be included in a single submission at regulations.gov system, the remaining exhibits will be transmitted in a second submission.

Attachments

NRDC et al. Exhibit List

EX 1_ NAS Low-Level Radwaste Mgmt and Disposition 2017

EX 2_ Radiation Exposure_ MedlinePlus

EX 3_ Environmental Protection Standards for Yucca Mountain

EX 4_SCFS-CBG Papers to NAS copy

EX 5_ Environmental Monitoring Report for Commercial Low-Level Radwaste Disposal Sites

EX 6_ Envirocare prosecutors place focus on extortion - Deseret News

EX 7_ The Disposition Dilemma_ Controlling the Release of Solid Materials from NRC-Licensed Facilities

EX 8_ Energy Policy Act 1992

EX 9_ SECY-02-0133, Control of Solid Materials_ Options and Recommendations for Proceeding, October 25, 2002_

EX 10_ Rulemaking on Controlling the Disposition of Solid Materials_ Scoping Process for Environmental Issues and Notice 9602, February 28, 2003

EX 11_ SECY-05-0054, Proposed Rule_ Radiological Criteria for Controlling the Disposition of Solid Materials, March 31, 2005. ML050750495

EX 12_ Letter to NRC Commissioners from 120 organizations, March 31, 2005

EX 13_ Commission Voting Record, June 1, 2005, Disapproving Proposed Rulemaking, "Radiological Criteria for Controlling the Disposition of Solid Materials."

EX 14_ NRC, Scoping Study on "Very Low Level Waste." February 22, 2018, ML18040B304.

EX 15_ _Official Transcript of Proceedings, "Very Low-level Radioactive Waste Scoping Study and Greater than Class C Waste Public Meeting," February 22, 2018, ML18068A075._

EX 16_ NIRS, Comments on VLLW Scoping Study, NRC-2018-0026-0001, May 15, 2018_

EX 17_ D'Arrigo Powerpoint presentation "VLLW Radioactive Waste Equals Very Large Loophole Waste" delivered at NRC Regulatory Information Conference, March 13, 2018

EX 18_ Email from Marlayna Doell, Decommissioning Project Manager, NMSS_DUWP_LLWPB at NRC to Diane D'Arrigo, NIRS, June 9, 2020

NRDC *et al.* NRC VLLW Comment Exhibit List

1. National Academies of Sciences, Engineering, and Medicine 2017. Low-Level Radioactive Waste Management and Disposition: Proceedings of a Workshop. Washington, DC: The National Academies Press. https://doi.org/10.17226/24715

2. National Institutes of Health, Fact Sheet: http://www.nlm.nih.gov/medlineplus/radiationexposure.html (last visited July 18, 2020).

3. Environmental Radiation Protection Standards for Yucca Mountain, Nevada, 64 Fed. Reg. 46,976, 46,978 (Aug. 27, 1999).

4. Southern California Federation of Scientists and the Committee to Bridge the Gap, "The Proposed Ward Valley Radioactive Waste Facility: Papers Submitted to the National Academy of Sciences," October 12, 1994.

5. National Low-Level Waste Management Program, Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites (1960's Through Early 1990's), DOE/LLW-241, November 1996.

6. Joe Costanzo, "Envirocare prosecutors place focus on extortion," Deseret News, July 23, 1998. https://www.deseret.com/1998/7/23/19392670/envirocare-prosecutors-place-focus-on-extortion.

7. National Research Council/National Academy of Sciences, The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities, 2002.

8. The Energy Policy Act Of 1992. "Revocation Of Related NRC Policy Statements." The policy statements of the Nuclear Regulatory Commission published in the Federal Register on July 3, 1990 (55 Fed. Reg. 27522) and August 29, 1986 (51 Fed. Reg. 30839)

9. SECY-02-0133, Control of Solid Materials: Options and Recommendations for Proceeding, October 25, 2002. https://www.nrc.gov/docs/ML0214/ML021480494.pdf

10. Rulemaking on Controlling the Disposition of Solid Materials: Scoping Process for Environmental Issues and Notice of Workshop, 68 Fed. Reg. 9595 – 9602, February 28, 2003

11. SECY-05-0054, Proposed Rule: Radiological Criteria for Controlling the Disposition of Solid Materials, March 31, 2005. https://www.nrc.gov/docs/ML0507/ML050750495.pdf

12. Letter to NRC Commissioners from 120 organizations, March 31, 2005, Re: Opposition to Proceeding with Rulemaking on the Release of Currently Regulated Radioactive Waste and Materials to Unlicensed Destinations ("Controlling the Disposition of Solid Materials.")

13. Commission Voting Record, June 1, 2005, Disapproving Proposed Rulemaking, “Radiological Criteria for Controlling the Disposition of Solid Materials.”

14. NRC, Scoping Study on “Very Low Level Waste.” February 22, 2018, ML18040B304. https://adamswebsearch2.nrc.gov/webSearch2/view?AccessionNumber=ML18040B304

15. NRC, Official Transcript of Proceedings, “Very Low-level Radioactive Waste Scoping Study and Greater than Class C Waste Public Meeting,” February 22, 2018, ML18068A075. https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML18068A075

16. NIRS, Comments on VLLW Scoping Study, NRC-2018-0026-0001, May 15, 2018.

17. D’Arrigo Powerpoint presentation “VLLW Radioactive Waste Equals Very Large Loophole Waste” delivered at NRC Regulatory Information Conference, March 13, 2018.

18. Email from Marlayna Doell, Decommissioning Project Manager, NMSS/DUWP/LLWPB at NRC to Diane D’Arrigo, Radioactive Waste Project Director at the Nuclear Information and Resource Service, June 9, 2020.

19. U.S. NRC, “Waste classification (classes of waste),” “Page Last Reviewed/Updated Tuesday, June 30, 2020.” https://www.nrc.gov/reading-rm/basic-ref/glossary/waste-classification-classes-of-waste.html

20. Energy Solutions, Utah Clean Transfer Cell Permit Application, April 10, 2020.

21. Statement by Chris McKenney. Branch Chief for the Risk and Technical Analysis Branch, Division of Decommissioning, Uranium Recovery, and Waste Programs, Official Transcript of Proceedings: “Category 3 Meeting on Draft Interpretive Rule for Very Low-level Waste (VLLW) Disposal Activities,” March 30, 2020, ML20112F441. https://www.nrc.gov/docs/ML2011/ML20112F441.pdf

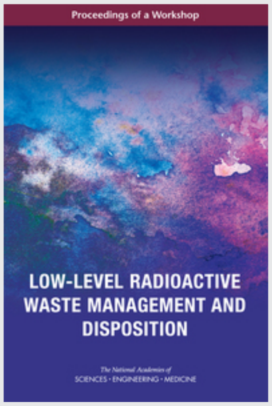
22. USNRC Management Directive 5.9, Adequacy and Compatibility of Program Elements for Agreement State Programs, ML18081A070, April 26, 2018. https://www.nrc.gov/docs/ML1808/ML18081A070.pdf

23. Electronic mail exchange between NRC's Marlayna Doell and CBG's Daniel Hirsch, March 29, April 7, and April 8, 2020.

24. **A.** Email from Patricia K. Holahan, Ph.D. Director, Division of Decommissioning, Uranium Recovery, and Waste Programs to Diane D'Arrigo, Radioactive Waste Project Director, June 12th, 2020, and attachment thereto: "10 CFR 20.2002 Alternative Disposal Requests Received by the NRC since 2005."
B. 10 CFR 20.2002 Alternative Disposal Requests Received by the NRC since 2005.

25. WESTINGHOUSE ELECTRIC COMPANY LLC, "Copy of Letter from L. Camper to J. Weismann approving use of USEI SSDA for 10 CFR 20.2002 Alternate Disposal Authorization Requests," August 24, 2015, p. 2, ML15125A364. https://adamswebsearch2.nrc.gov/webSearch2/view

26. US NRC, "Guidance for the Reviews of Proposed Disposal Procedures and Transfers of Radioactive Material Under 10 CFR 20.2002 and 10 CFR 40.13(a)," ML18296A068, April 2020. https://www.nrc.gov/docs/ML1829/ML18296A068.pdf



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LOW-LEVEL RADIOACTIVE WASTE MANAGEMENT AND DISPOSITION

Proceedings of a Workshop

Jennifer Heimberg, *Rapporteur*

Planning Committee on Low-Level Radioactive Waste
Management and Disposition:
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Nuclear and Radiation Studies Board

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This Proceedings of a Workshop was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published Proceedings of a Workshop as sound as possible and to ensure that the Proceedings of a Workshop meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process. We wish to thank the following individuals for their review of this Proceedings of a Workshop:

- John S. Applegate, Indiana University
- Miklos (Mike) Garamszeghy, Canadian Nuclear Waste Management Organization (NWMO)
- Christine Gelles, Longenecker and Associates
- Roger Seitz, Savannah River National Laboratory
- Mark Yeager, South Carolina Department of Health and Environmental Control

Although the reviewers listed above have provided many constructive comments and suggestions, they did not see the final draft of the Proceedings of a Workshop before its release. The review of this Proceedings of a Workshop was overseen by Patricia J. Culligan, Columbia University. She was responsible for making certain that an independent examination of this Proceedings of a Workshop was carried out in accordance with institu-

tional procedures and that all review comments were carefully considered. Responsibility for the final content of this Proceedings of a Workshop rests entirely with the rapporteur and the institution.

Contents

1

Introduction

The Department of Energy's Office of Environmental Management (DOE) is responsible for the safe cleanup of sites used for nuclear weapons development and government-sponsored nuclear energy research. Established in 1989, DOE's cleanup program originally encompassed more than 100 sites. Cleanup is planned to last another 40-50 years with total lifecycle costs approaching or exceeding $350 billion. The annual cleanup budget is around $6 billion.[1]

Low-level radioactive waste (LLW[2]) is the most volumetrically significant waste stream generated by the DOE cleanup program (approximately 17 million cubic meters per year[3]). LLW is also generated through commercial activities such as nuclear power plant operations and medical treatments. DOE disposes of LLW at its own sites as well as at some commercial facilities. Commercial LLW is, with some exceptions, disposed of at commercial facilities.

In the United States, LLW is not necessarily defined by low levels of radioactivity. The Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPA amendments[4]) defines LLW as

[1]This value is an average of the past four annual budgets for DOE's Office of Environmental Management (Regalbuto, 2016).

[2]"LLW" and "LLRW" are commonly used acronyms for low-level radioactive waste. "LLW" is used throughout this proceedings unless "LLRW" is included in a quote from other sources.

[3]This average was calculated from a DOE complex-wide disposal rate for LLW and mixed LLW (Marcinowski, 2016). LLW containing hazardous chemicals is referred to as mixed LLW.

[4]"Low-Level Radioactive Waste Policy Amendments Act of 1985," accessed February 24, 2017, https://www.gpo.gov/fdsys/pkg/STATUTE-99/pdf/STATUTE-99-Pg1842.pdf.

low-level radioactive material that:

(A) is not high-level radioactive waste, spent nuclear fuel, or byproduct material (as defined in section 11.e (2) of the Atomic Energy Act of 1954 . . . [[5]]); and

(B) the Nuclear Regulatory Commission, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste.

Thus, LLW is defined by exclusion (i.e., by what it is not).[6] LLW is physically and chemically diverse, ranging from lightly contaminated soils and building materials to highly irradiated nuclear reactor components.

The laws and regulations related to the disposal of LLW in the United States have evolved over time and across agencies and states (see Box D-2 in Appendix D), resulting in a complex regulatory structure. This structure has provided adequate guidance for the successful disposal of the majority of LLW streams, but there are some types of LLW streams—many of which were not anticipated when LLW regulations were created—that lack an obvious pathway to disposal or whose disposition could be considered incommensurate with the hazard of the waste. "Challenging LLW streams," as used in this proceedings, have potentially non-optimal or unclear disposition pathways due to their origin, content, or incompatibility with existing standards, orders, or regulations.

DOE asked the National Academies of Sciences, Engineering, and Medicine (National Academies) to organize this workshop to discuss approaches for the management and disposition of LLW. The workshop explored the following two issues:[7]

- the key physical, chemical, and radiological characteristics of LLW that govern its safe and secure management and disposal in aggregate and in individual waste streams, and
- how key characteristics of LLW are incorporated into standards, orders, and regulations that govern the management and disposal

[5] "[B]yproduct material . . . as defined in Sec. 11.e (2)" is provided in the Atomic Energy Act of 1954 as amended: "Sec. 11 DEFINITION . . . e. The term 'byproduct material' means . . . 2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. . . ." See "Atomic Energy Act of 1954 as amended by Public Law 114-92, Enacted November 25, 2015," accessed March 1, 2017, https://legcounsel.house.gov/Comps/Atomic%20Energy%20Act%20Of%201954.pdf.

[6] The definition of LLW is complicated, requiring one to understand the definitions of other waste categories such as high-level radioactive waste and byproduct material. The full list of byproduct materials as well as definitions of other waste categories mentioned in this chapter are provided in Appendix D, Box D-1.

[7] Appendix A contains the full statement of task.

of LLW in the United States and in other major waste-producing countries.

This proceedings provides a factual description of the workshop presentations and discussions and is limited to the views and opinions of those participating in the event. Further, the viewpoints and comments from the workshop attendees are their own and are neither necessarily attributable to the organizations for which they work or support nor necessarily representative of the views of all workshop participants, the planning committee, or the National Academies. This proceedings does not contain consensus findings or recommendations.

1.1 WORKSHOP PLAN

A committee of four members was appointed by the National Academies to plan the workshop.[8] The planning committee met once to develop the workshop format and agenda and to identify speakers. In addition, a white paper developed by the rapporteur was distributed to participants prior to the workshop to provide background information on LLW.[9] The workshop was held at the National Academies' Keck Center on October 24-25, 2016.

The workshop began by defining the "universe" of LLW within the United States and elsewhere—first by introducing the types of LLW that exist and then by discussing the standards, orders, regulations, and laws that define and control their disposal. Next, case studies were presented to highlight the successful disposal of a variety of wastes that previously lacked a clear disposition pathway—these case studies are referred to as "success stories." The studies were selected from within and outside of the United States.

The participants explored common themes that led to success within the case studies such as: the use of existing regulations and standards (i.e., waste classification) to provide an anchor for disposal decisions; the identification of lessons learned from similar or analogous problems such as Canada's or France's approach to managing and disposing of very low-level waste (VLLW); and the importance of site characteristics for disposal decisions. These themes were organized into an approach to guide future discussions and disposition decisions for challenging LLW streams—a "common themes approach."[10] The approach is described in Chapter 4.

[8]The planning committee's role was limited to planning and participating in the workshop. See Appendix B for the planning committee member biographies.

[9]The workshop agenda and white paper can be found in Appendices C and D, respectively.

[10]The "common themes approach" was developed as a discussion tool; it was not intended or presented as a consensus statement by the planning committee or the workshop participants.

The common themes approach was applied to a set of five pre-selected challenging LLW streams that spanned a variety of waste characteristics:

- Greater-Than-Class C (GTCC) and commercial transuranic waste (TRU) waste in excess of 100 nCi/g
- Sealed Sources
- Very Low-level and Very Low-activity Waste[11]
- Incident Waste
- Depleted Uranium

Each of these waste streams presents a unique set of challenges for disposal. For example, "GTCC waste and commercial TRU waste in excess of 100 nCi/g" lack a clear disposition pathway (as will be discussed in Chapter 4), while "Very Low-level and Very Low-activity Waste" have a disposition pathway in which the level of protection may be considered incommensurate with the hazard, or a potentially non-optimal disposition pathway (discussed in Chapters 2 and 4). The application of the common themes approach to these diverse waste streams was intended to explore how adaptable this approach would be as a tool in discussing or presenting a variety of disposal options.

One leader from each breakout group introduced a specific challenging LLW stream to the full workshop and later summarized the breakout group's results of applying the common themes approach to the issues associated with the disposal of this waste stream. Several participants identified short-term actions or "next steps" that could be taken to show progress in addressing each challenging waste stream in the final session of the workshop.

Presenters and attendees provided perspectives from academia, industry, federal agencies (including those outside of DOE), state governments, international organizations, public interest groups, and national laboratories. All participants were encouraged to contribute to the workshop discussions.

Several major topics emerged during the discussions throughout the workshop: complexity of regulations; communication among stakeholders; diversity of the type, source, and hazard of LLW; and integration of knowledge gained from operations. These topics are described below.

1.2 COMPLEXITY OF REGULATIONS

The complexity of the current U.S. LLW regulatory structure was mentioned in several presentations and discussions. Participants noted that the current regulatory structure is the result of "tweaks" and "adjustments"

[11] The planning committee proposed "exempt waste" as a category for the subgroup, but the topic of the subgroup's discussion focused on very low-level waste and very low-activity waste.

to regulations to address unanticipated types of wastes or other challenges. Several participants argued that the current LLW regulatory system should be thrown out and that a new system should be "developed from scratch." This "revolution instead of an evolution" of the LLW regulatory structure was raised several times during the workshop. Participants also discussed the complexity of the definition and regulation of TRU waste, noting that multiple laws and regulations contain definitions of TRU waste that can be inconsistent with each other.[12] It was also noted that the current LLW regulatory system has the flexibility to deal with unanticipated waste streams through case-by-case exceptions—which adds to the system's complexity. The unintended impacts of this complex system include the following: potential loss of public trust and confidence; mounting costs for disposal that are passed on to rate payers; and levels of regulation that are disproportionate to the hazards posed by LLW.

1.3 COMMUNICATION AMONG STAKEHOLDERS

Several participants noted that the complexity of the current LLW regulatory system leads to communication problems with stakeholders. Many stakeholders assume that LLW must be dangerous because the regulations are so strict and complex.

The appropriateness of the language used when discussing stakeholder or public concerns was also questioned by several participants. Some noted a move away from the use of "stakeholder"—which is a term that is difficult to define—to "concerned" or "interested parties" to be inclusive of a wider group including waste producers, academics, and other members of the public. Other phrases often used by experts that raise concern include: "Talking to the public," which implies a one-way flow of information, instead of "talking with the public." Or "educating the public," which was identified as denigrating; its use presupposes that the public is uneducated and also that, if given education, the public would agree with the experts doing the educating. Improving communications among stakeholders involves a change in mindset in addition to a change in language. Decisions on the final disposition of challenging wastes could be informed by a continuing conversation with stakeholders throughout the lifetime of a project.

[12]The Waste Isolation Pilot Plant Land Withdrawal Act provides the definition for defense TRU waste. The USNRC's document, *Statutory Language and Regulatory History of Commercial Transuranic Waste Disposal* (USNRC, 2015a), provides an example of conflicting definitions of TRU waste, which highlights the complexity of the topic (p. 5): "According to section (A)(i) of the [Low-level Radioactive Waste] Amendments Act, TRU waste is LLRW. Based on (A)(ii) of the Amendments Act, the [US]NRC can set the definition of LLRW. Consistent with (A)(ii) of the Amendments Act and because the 10 CFR Part 61 definition of LLRW excludes TRU, TRU is not LLRW."

The topic of accepting responsibility for the waste streams now to ensure safe disposal for future generations was repeatedly discussed at the workshop. Several participants noted that discussions with stakeholders on the final disposition of LLW were aided when the origins and social value of the activities that produced the wastes (i.e., medical treatments, electricity generation) were described.

1.4 DIVERSITY OF LOW-LEVEL WASTE TYPE, SOURCE, AND HAZARD

Participants noted that the "universe" of LLW in the United States is large due to its definition by exclusion. In the United States, high-activity wastes such as irradiated metals and sealed sources of high activity are considered LLW. Also, very low-activity wastes in the United States are subject to disposal requirements that many participants believed exceeded the hazard of the waste. Participants noted that characteristics such as half-life and activity levels (or hazards) of the waste are used in other countries to define waste categories and disposal options. Participants also noted that other countries have a "cleared" or "exempt" category of waste that allows for less protective disposal—an approach that is commensurate to the hazard of the waste—while there is no low-end threshold of activity for LLW in the United States. Also, in the United States, the states have regulatory authority for some radioactive wastes and regulations can be inconsistent across state boundaries even though the characteristics and hazard of the waste remain the same.

1.5 INTEGRATION OF KNOWLEDGE GAINED FROM OPERATIONS

The United States and other countries have been managing and disposing of nuclear waste for at least six decades. Several comparisons of early to modern LLW disposal concepts and facilities were presented at the workshop including: the EnergySolutions LLW Disposal Facility, Barnwell (South Carolina), Waste Control Specialists (Texas), and the Centre de la Manche (CSM) and Centres de stockage de l'Aube (CSA) (France) disposal facilities. These comparisons highlighted the improvements in modern facilities that resulted from applying the knowledge gained from the construction and operation of earlier facilities. Another point that was repeatedly raised by participants at the workshop was the importance of site characteristics of modern facilities in the United States, many of which are located in arid regions of the country. Several participants noted that the United States should find a way to integrate this new knowledge into the regulations and rules that govern the management and disposal of LLW.

1.6 ORGANIZATION OF THE PROCEEDINGS

This proceedings is organized following the general structure of the workshop:

- Chapter 2 includes introductory remarks by the chair and an overview of the scope of the LLW challenge (or the "universe" of LLW),
- Chapter 3 presents the case studies of successful LLW disposition,
- Chapter 4 identifies common themes for finding successful disposition solutions, applies them to a set of five challenging LLW streams, and summarizes concrete next steps towards a disposition pathway that might be taken for each.

2

Describing the Universe of Low-Level Waste

John Applegate, the planning committee chair and executive vice president for University Academic Affairs of Indiana University, welcomed the workshop attendees and provided short introductory remarks prior to initiating the panel presentations and discussions. His remarks are summarized below.

The workshop's objective was to identify approaches that might facilitate the disposition of challenging low-level waste (LLW) streams. These proceedings define "challenging LLW streams" as LLW streams that have potentially non-optimal or unclear disposition pathways due to their origin or content and incompatibility with existing standards, orders, or regulations. These approaches could possibly be used by the Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (USNRC), U.S. states, and others to find safe and acceptable disposition pathways for challenging LLW streams.

Two critiques of the current U.S. LLW regulatory system have significance for this workshop: The first is that the U.S. LLW category is broad and provides limited guidance for dispositioning unusual or unanticipated LLW waste streams. The second is that standards, orders, and regulations tied to the management and disposition of LLW are not sufficiently tied to risk.

With respect to the first critique, the LLW category is defined by exclusion.[1] LLW is *not* high-level radioactive waste, spent nuclear fuel, or

[1]See Chapter 1 for a discussion on the statutory definition of LLW. Also, Appendix D, Box D-1 provides a more detailed definition.

uranium or thorium mill tailings and waste (also referred to as "11.e (2) byproduct material"[2]). Consequently, the LLW category covers a wide and very heterogeneous range of waste streams and, also, disposal requirements.

The fundamental problem with a broad LLW category is the lack of specific guidance for unanticipated LLW streams. Waste generators want to be able to plan for waste disposition; they need to know where their waste will go for disposal, how it needs to be processed and managed to make it acceptable for disposal, how to get it to where it is going to be disposed of, and how much it will cost. The waste recipients (i.e., the operators of disposal facilities and their stakeholders) also need to plan for acceptance of the waste; they want to know what the regulatory requirements are for acceptance; and they want to be able to reassure their stakeholders about the safety of waste disposition. One solution to the problem of unanticipated waste streams is to create new waste classifications that include them. Another option is to use case-by-case exceptions that are based on specific and known criteria and that can be applied in a consistent and predictable way.

With respect to the second critique, that LLW disposition regulations are not consistently tied to the risk, National Academies reports have consistently recommended that disposal of LLW focus on risk as opposed to waste origins.[3] These reports have urged greater attention to risk and a closer relationship between risk and regulatory requirements in the management of radioactive waste.

The report *Improving the Regulation and Management of Low Activity Radioactive Waste* (National Research Council, 2006b) concludes that a risk-informed approach provides the best option for improving the regulation and management of low-activity waste.[4] However, the current LLW regulatory system in the United States is based primarily on waste origins rather than risk. The report found that certain categories of low-activity waste have not received consistent regulatory management, and that current regulations for low-activity waste are not based on a systematic consideration of risk. The report acknowledged that changes to the regulatory structure would likely take many years, require coordination among many federal and state agencies, be highly individualized, and would need many assessments of individual situations. The report recommended adopt-

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[2]"[B]yproduct material…as defined in Sec. 11.e (2)" is provided in the Atomic Energy Act of 1954 as amended. See "Atomic Energy Act of 1954 as amended by Public Law 114-92, Enacted November 25, 2015," accessed March 1, 2017, https://legcounsel.house.gov/Comps/Atomic%20Energy%20Act%20Of%201954.pdf.

[3]See National Research Council 1997, 2000, 2001, 2005, 2006a, 2006b, and 2011a.

[4]The term "low-activity waste" in these proceedings refers to waste having very low radioactivity. This is different from DOE's use of "low-activity waste," which refers to a component of tank waste that is not highly radioactive.

ing a tiered approach, identifying a set of changes that could be implemented in order of increasing complexity, resources, and time, to make progress toward converting the current regulatory system into one that is risk-informed.[5]

The objective of LLW regulations is to protect human health and the environment, so consideration of risk is likely to be an important focus of the discussions in the present workshop. Human health effects of radiation are one important aspect of risk. Other factors that contribute to risk include fate and transport of contaminants, site geology, institutional controls, and the longevity of engineered barriers of disposal facilities.

Mr. Applegate asked the participants to balance the two aforementioned critiques against the following. First, the regulatory system reflects the problems it was originally created to solve. As the problems are better understood and/or change over time, the regulations must be adjusted accordingly, resulting in increased regulatory complexity. Challenging LLW streams are examples of such changing problems. New challenging LLW streams can be treated as exceptions to existing regulations and addressed in a case-by-case manner, or regulations can be modified to address them. In any case, the decision-making process is time-consuming, not standardized or predictable, and inconsistent across regulatory agencies, states, or even within individual agencies. Nor do these approaches leverage experience from previous cases.

Second, despite its complexity, the United States has a system for regulating the disposal of LLW that works well in the great majority of cases as demonstrated by the large volumes and variety of LLW streams that have been efficiently and successfully disposed of. However, the challenging LLW streams are not trivial—by volume and/or hazard—and many of these waste streams attract controversy when decisions are made regarding storage, transportation, and disposal. Therefore, one of the goals of the workshop is to examine the methods for addressing such waste in a rational, consistent, and coherent way.

Mr. Applegate ended his introductory remarks with a charge to the workshop attendees. We should ask ourselves questions such as the following: Should there be new classifications for these challenging waste streams? Should we develop criteria for a “below regulatory concern” LLW waste classification? Do we need new regulatory classifications and/or subcategories for LLW? Should those classifications or categories be differentiated from each other by source, risk, and/or inherent characteristics? We should consider how to balance flexibility and individual tailoring of a

[5]Specifically, Recommendation 2 in the report suggests “a four-tiered approach: (1) changes to specific facility licenses or permits and individual licensee decisions; (2) regulatory guidance to advise on specific practices; (3) regulation changes; or if necessary, (4) legislative changes” (National Research Council, 2006b, p. 7).

particular waste stream against predictability and consistency of the regulatory system.

2.1 THE SCOPE OF THE LLW CHALLENGE

The first session of the workshop consisted of two panels.

- The first panel focused on categories and characteristics of LLW; it was moderated by Nina Rosenberg, a member of the workshop planning committee and program director at Los Alamos National Laboratory.
- The second panel focused on the regulations, standards, orders, and guidance that have been developed for LLW; it was moderated by Larry Camper, also a member of the workshop planning committee and recently retired from the USNRC.

The moderators opened each panel with brief presentations of background information, which are summarized below. Invited panelists then presented more detailed information on specific topics. A discussion was held after each panel.

The comments from the moderators, panelists, and other workshop participants are their own. They do not necessarily represent official views of their employers, governments, or other organizations that may be mentioned in their presentations and discussions.

2.2 CLASSIFICATION, CATEGORIES, AND CHARACTERISTICS OF LLW

Dr. Rosenberg moderated the session on the classification, categories, and characteristics of LLW. Her remarks are below. She reminded the participants that, in the United States, LLW is defined "by exclusion." Civilian (usually commercial) LLW is regulated by the USNRC based on specific activity concentrations of radionuclides deposited in a waste matrix and intended for final disposition: Classes A, B, C, and Greater-Than-Class C (GTCC), with Class A requiring the lowest and GTCC requiring the greatest levels of protection (see Tables D-1 and D-2). Near-surface disposal is appropriate for Class A, B, and C wastes but is not appropriate for GTCC wastes.[6] There are currently four commercial sites for LLW disposal using near-surface disposal methods in the United States; they are located in Utah, Texas, South Carolina, and Washington. These facilities are constructed to

[6]The disposal of GTCC is a federal responsibility.

meet generic performance objectives defined by USNRC regulations and have defined waste acceptance criteria.

Government-owned LLW[7] is regulated by DOE. It is DOE policy to dispose of these wastes if possible at the sites where they were generated or are stored. There are currently four DOE sites that dispose of their own wastes: Idaho National Laboratory, Oak Ridge National Laboratory in Tennessee, Savannah River Site in South Carolina, and Los Alamos National Laboratory (Area G) in New Mexico. Two additional DOE sites dispose of offsite LLW in addition to their own wastes: US Ecology, Inc., LLW Disposal Facility at the Hanford Site, Washington, and the Nevada National Security Site (NNSS, previously named the Nevada Test Site). DOE relies on waste acceptance criteria derived from site-specific performance assessments to manage and dispose of LLW at all of its facilities. These DOE facilities use a variety of near-surface disposal methods with engineered structures and surface barriers, depending on site characteristics and waste acceptance criteria.

Both the DOE and commercial sites listed above are located in different climate zones, varying from very wet and humid (South Carolina and Tennessee) to very dry and arid (New Mexico, Nevada, Idaho, Texas, Utah, and eastern Washington). Further information about these sites can be found in Appendix D.

International schemes for managing LLW differ from U.S. approaches in some important ways. The International Atomic Energy Agency (IAEA) bases its guidance[8] on radioactive waste classification on disposal considerations in six categories from exempt, very short-lived waste, VLLW, LLW, intermediate-level waste, and high-level waste.

Three panelists having different backgrounds and with different perspectives were invited to discuss LLW types. They were specifically asked to address the following two questions:

- What are the greatest challenges that you have observed in the management of LLW?
- What key technical criteria and/or waste characteristics are most important to consider in the management and disposal of these wastes?

Miklos (Mike) Garamszeghy, design authority and manager of technology assessment and planning for the Canadian Nuclear Waste Management Organization (NWMO), provided a Canadian perspective; Lisa Edwards,

[7]This has previously been referred to as "defense LLW."

[8]The IAEA provides guidance on the regulation—but does not regulate—the nuclear wastes of its member states.

senior program manager for Electric Power Research Institute (EPRI),[9] provided perspectives from the commercial nuclear industry (as waste generators); and Daniel (Dan) Shrum, senior vice president of regulatory affairs at EnergySolutions, provided perspectives from the U.S. commercial disposal industry.[10]

LLW Challenges—The Canadian Context

Mr. Garamszeghy began his presentation by describing the main difference between the U.S. and Canadian approaches to the management of LLW: in Canada, waste owners are responsible for managing their own waste, from generation to disposal. There is no national organization that looks after waste disposal, but there is a national regulator. Similarly, there are no commercial entities whose sole focus is waste disposal.

Prior to 2008, the Canadian radioactive waste classification scheme was similar to that for the United States—defining LLW by exclusion and using the following waste categories: nuclear fuel waste (used fuel), uranium mining and milling waste, and LLW (everything else). The current classification scheme, established in 2008, follows the IAEA's *General Safety Guide GSG-1* (IAEA, 2009a) for establishing waste categories: exempt, VLLW, LLW, intermediate-level waste, and high-level waste. The Canadian scheme does not establish numerical boundaries between the different waste classes; the values of the boundaries are determined and justified by the waste owners. This classification scheme provides consistency in terms of the IAEA terminology, but the actual distinction between different waste classes is less clear.

Unlike the U.S. approach, the system in Canada allows clearance of waste through the exempt category. Waste can be exempted in two ways: A generic regulation allows waste to be cleared if its activity is below a very conservative limit based on IAEA's *Safety Guide RS-G1.7* (IAEA, 2004). Alternatively, for wastes having slightly higher activities, waste owners may perform case-by-case analysis for the higher limit.

Canada's VLLW and LLW are currently generated from a number of sources, similar to waste generation in the United States. Waste characteristics vary widely based on waste source. Intermediate-level waste, for example, is generated by day-to-day operations at nuclear power plants (NPPs); refurbishment and decommissioning of power reactors; and isotope production.

Mr. Garamszeghy provided the following list of questions that are typically considered by waste owners in Canada when making decisions on the disposition of their radioactive waste:

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[9]EPRI is a nonprofit research entity supported by the electricity industry.
[10]The biographies for the speakers and panelists can be found in Appendix E.

- What type of waste needs disposal?
- Who owns the waste?
- How much waste is there?
- Where is the waste located?
- What are the community preferences?
- What are the total system costs for managing the wastes?
- What other hazards are associated with the waste?
- How is the waste currently packaged and stored?
- How well is the waste characterized?

Mr. Garamszeghy noted that Canada does not currently have any licensed and operational disposal facilities for low- and intermediate-level waste or spent fuel. However, a number of facilities are in various stages of licensing or construction. In Canada, the NWMO has the mandate for the long-term management, including disposal, of spent fuel. There is no national entity for disposal of low- and intermediate-level waste, as mentioned at the start of his presentation. All of the waste is stored by the waste owners in facilities of various designs (i.e., above and below ground) and locations. Figure 2-1 is a map that shows the locations of some of these facilities. Note that these facilities are distributed throughout Canada.

Overview of Commercial Power Plant Wastes

Ms. Edwards' presentation focused on LLW produced by U.S. NPPs. Two types of wastes are produced, dry active and wet waste. Dry active waste consists predominantly of papers, plastic, and cloth, for example the protective clothing worn in facilities. It can also include tools, wiring, and metals that are not compactable. Wet waste is principally made up of resin, charcoal, and filters. Wet wastes are generated during NPP operations, primarily during the cleanup of water systems. Boiling water reactors also produce irradiated hardware LLW streams; however, this waste stream is not included in this discussion because it represents a small fraction of waste.

Figure 2-2a shows the volume of waste types (i.e., dry active and wet wastes) generated by U.S. NPPs between 2003 and 2007; and Figure 2-2b shows the volume of resin wastes generated during this same time period grouped by USNRC waste class (i.e., Class A, B, or C). It is clear that the vast majority (almost 90 percent) of the waste generated is dry active waste or Class A waste. Class B waste is 13 percent, and Class C is 1 percent of the total (Figure 2-2b).

At the time these data were collected, filters made up almost the entire volume of Class C waste, and resins made up the majority of Class B waste. However, once NPPs implement the new concentration averaging requirements from the updated USNRC *Branch Technical Position on Concentra-*

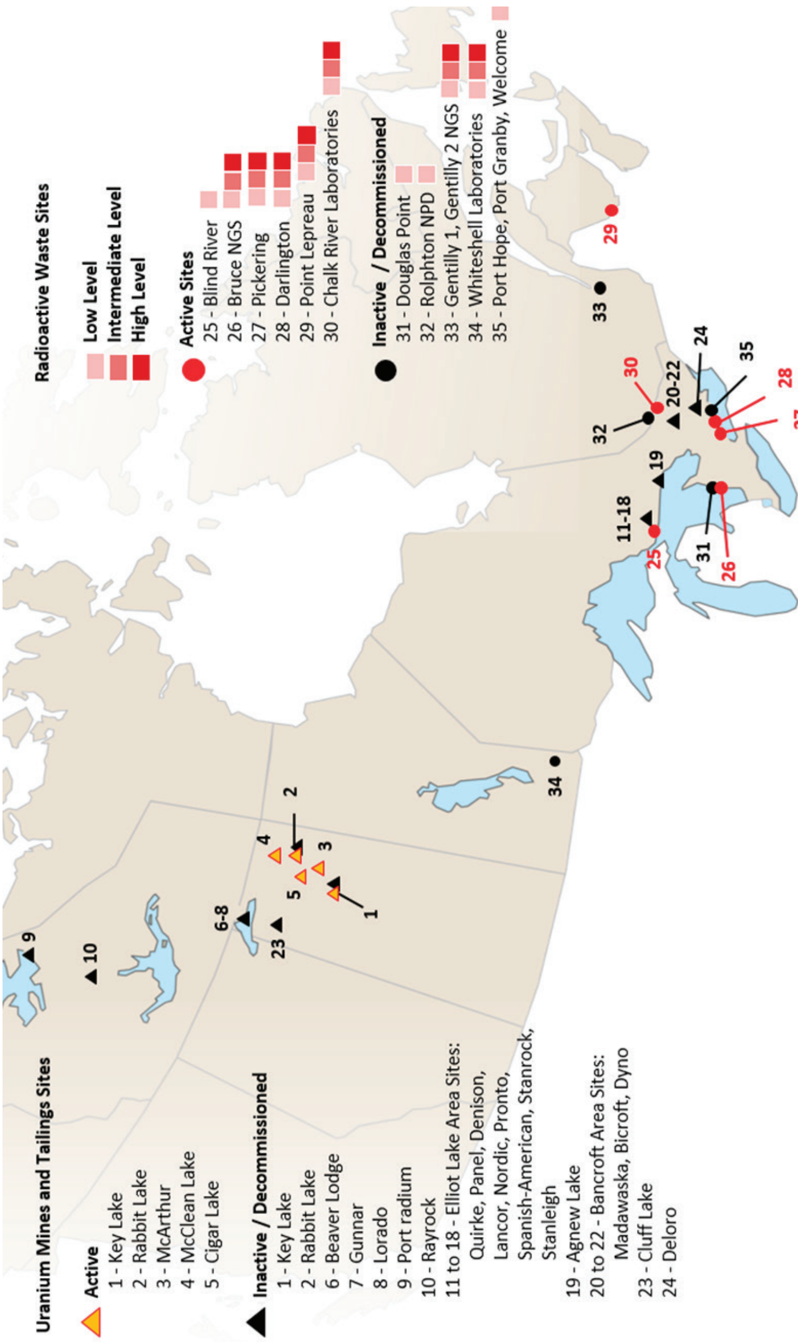

FIGURE 2-1 Major radioactive waste management sites in Canada.
SOURCE: Canadian Nuclear Safety Commission.

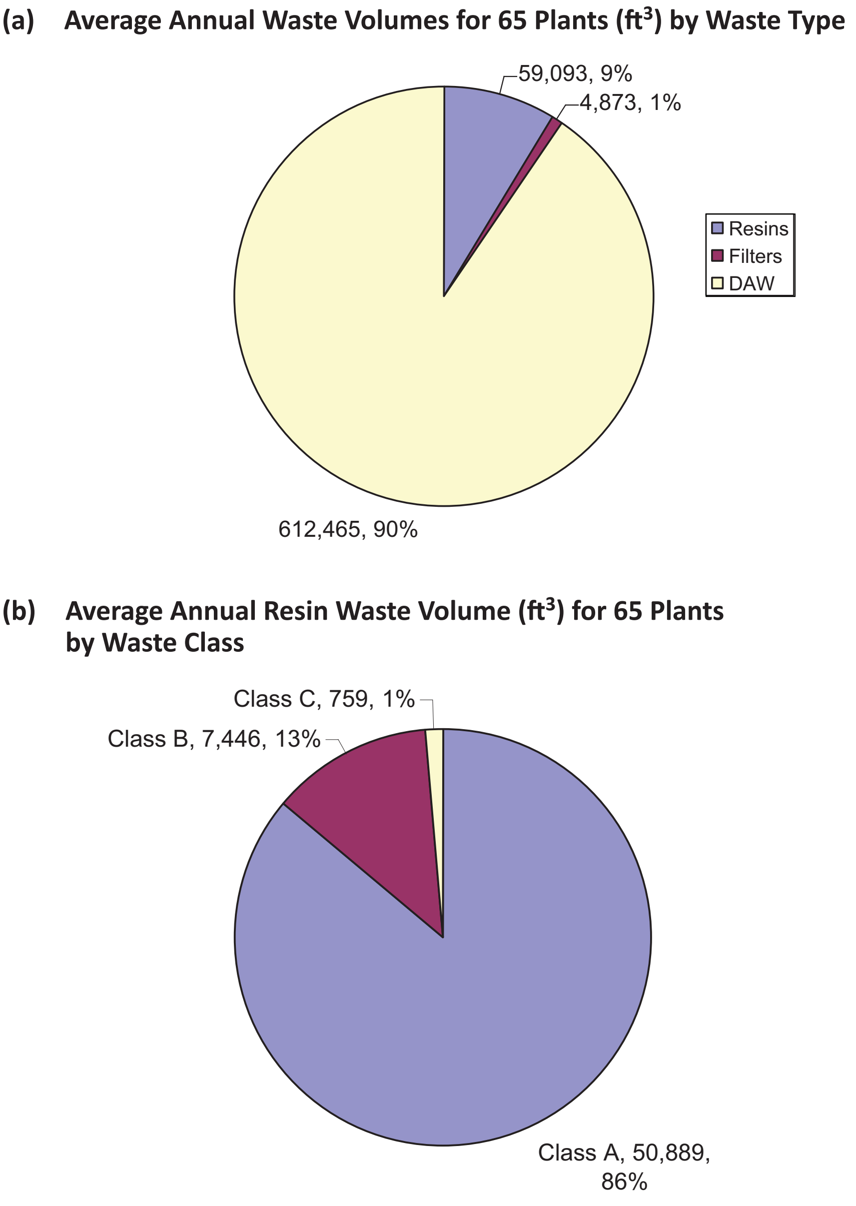

FIGURE 2-2 Historic average annual waste volumes by (a) waste type and (b) waste class (volumes listed in cubic feet).
NOTE: DAW refers to dry active waste.
SOURCE: Courtesy of the Electric Power Research Institute.

tion Averaging and Encapsulation,[11] it is likely that Class C waste will become virtually nonexistent outside of irradiated hardware. Ms. Edwards suggested that the combined Class B and C slice of the pie (Fig. 2-2b) may approach zero once concentration averaging is implemented.

Recent data from an EPRI database, RadBench,[12] show the trends in the generation of dry active and wet wastes from NPPs. There has been a steady reduction in dry active waste (at a rate of approximately 10,000 pounds per year) beginning in 2008. For wet wastes, there was a slight reduction between 2007 and 2011 followed by a near-equivalent increase. The reduction may have occurred for two reasons: (1) the LLW disposal site at Barnwell, South Carolina, stopped accepting LLW from all states except those within its compact,[13] and (2) an EPRI report (Edwards, 2010) released near this time highlighted techniques and practices for reducing the volume of Class B and greater operational waste (which is primarily wet waste). The volume of wet waste began to increase in 2011 when the Waste Control Specialists (WCS) facility in Texas was licensed and began accepting LLW.

LLW management and disposition do not affect the generation of electricity and are not a NPP's primary business. The managers of NPPs make disposal decisions based on the most economical and safe alternatives. The cheapest option that meets safety (and other) disposal requirements is nearly always selected. A rough analogy is the choice that a member of the public makes on who picks up his/her household garbage. The individuals responsible for the packaging and management of radioactive waste are internally motivated; other plant workers may not understand the potential impact of waste management mistakes. Those individuals who are involved in waste management consider themselves to be the environmental guardians of the plant, making sure the NPPs do not encounter problems over the waste management and disposition decisions.

Ms. Edwards noted the lack of a "very low-level waste" category in the U.S. regulatory system but its inclusion in the classification systems of other countries such as Canada. VLLW is defined differently throughout the world, but it is generally characterized as having a very small percentage of the activity defined by other waste class limits and a very low radiation hazard.

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[11]For more details on concentration averaging, see "Branch Technical Position on Concentration Averaging and Encapsulation," last updated October 26, 2016, https://www.nrc.gov/waste/llw-disposal/llw-pa/llw-btp.html.

[12]RadBench is used by NPPs around the world to self-report the volumes of waste that they generate, prior to conditioning and disposal. The disposal volumes may be smaller. See "EPRI Product Abstract: WasteLogic RadBench Web Application (RadBench) v3.0.2," accessed March 1, 2017, http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002003994.

[13] See Appendix D for a brief explanation of the U.S. state compact system.

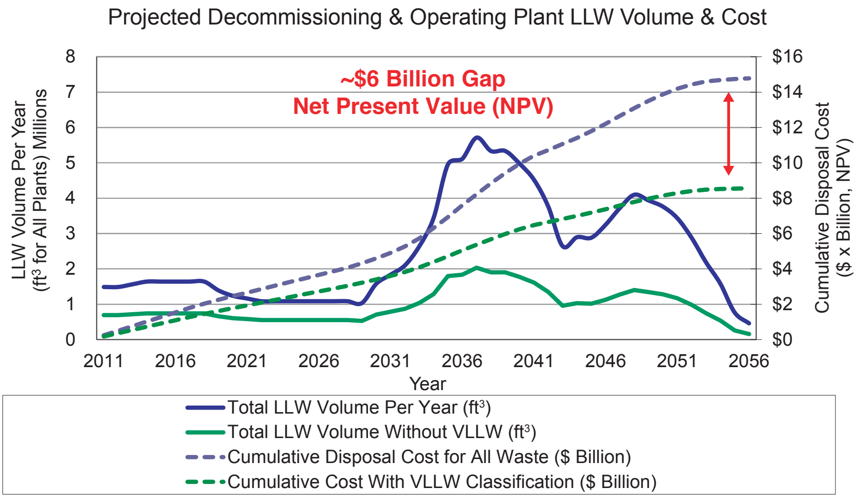

FIGURE 2-3 Potential very low-activity waste cost savings projections. The solid blue line respresents the projected volume of LLW through 2056 that will be produced as NPPs are decommissioned. The solid green line represents the projected volume of LLW minus the lowest activity fraction. The dotted blue and green lines are cumulaitve disposal costs. The difference between the blue and green dotted line by 2056 is roughly $6 billion. The projections for decommissioning wastes change nearly yearly, so the estimates in this figure should be considered rough.
NOTE: ft^3 = cubic feet; LLW = low-level waste; NPV = net present value; VLLW = very low-level waste.
SOURCE: Courtesy of the Electric Power Research Institute.

A strong argument can be made that U.S. regulatory requirements for wastes classified as very low-level (or very low-activity) in other countries are overly burdensome and costly (see Figure 2-3) (EPRI, 2012). Very low-activity waste makes up approximately 80 percent of the volume of waste that is generated during NPP decommissioning; the cost of decommissioning is passed along to the public.

There are regulatory pathways for reducing the costs of disposing of this very low-activity waste, even though a VLLW category does not exist in the United States. For example, an exemption under the USNRC's *Code of Federal Regulations 10 CFR* 20.2002 (referred to as the "20.2002 exemption")[14] allows for specific waste streams to be approved for disposal

[14] A brief explanation of the exemption is provided on the USNRC's website: "10 CFR 20.2002 is available for use by licensees for wastes that typically are a small fraction of the

at Resource Conservation and Recovery Act (RCRA) disposal sites instead of LLW-licensed facilities. The 20.2002 exemption process is not transparent and it is cumbersome (see Chapter 3 and 4 for more discussions on this). Exemptions are granted on a case-by-case basis and implemented differently from state to state.[15]

In Ms. Edward's opinion, the 20.2002 exemption process and case-by-case approvals are subject to political whims, so that they might be affected by the release of a newspaper article or by an election. Adding a classification and set of requirements for the lowest activity of Class A would be more transparent and beneficial.

Figure 2-3 illustrates the potential economic impact of defining a new VLLW classification. The blue solid line represents the total expected LLW to be generated at U.S. NPPs through the year 2056, including generation of very low-activity waste. As current NPPs begin decommissioning, the volume of LLW waste generated will increase. The green solid line excludes the very low-activity portion of the waste that could potentially be diverted to RCRA facilities instead of LLW disposal facilities. The cost of disposing of this waste in RCRA facilities is significantly lower—EPRI estimates the total savings would be in the $6 billion range—than disposing of the waste in a LLW facility. The cost savings is the difference between dotted blue and green lines in the figure.

Low-Level Radioactive Waste

Mr. Shrum began his prepared remarks by commenting on the previous presentation. He agreed that the question raised by Ms. Edwards of how to best address the disposal of the expected large quantity of very low-activity waste from NPP decommissioning (see Figure 2-3) should be answered sooner than later, and also that the United States should have a more uniform standard for addressing very low-activity radioactive waste (see Chapter 3 for more discussion on VLLW and exempt or clearance waste).

Mr. Shrum noted that EnergySolutions (his employer) operates two

Class A limits contained in Part 61, and for which the extensive controls in Part 61 are not needed to ensure protection of public health and safety and the environment. Thus, 10 CFR 20.2002 provides an alternative, safe, risk-informed disposal method for these materials, which are frequently called 'low-activity waste.' Although these materials could be disposed of in a licensed low-level radioactive waste facility, if a licensee chose to do so, disposal at another type of facility under 10 CFR 20.2002 may significantly reduce transportation distances (often on the order of one to two thousand miles), provide for more disposal options, and lower disposal costs, while still providing for protection of public health and safety and the environment. . . ." (See "Low-Level Waste Disposal Under 10 CFR 20.2002," accessed April 9, 2017, https://www.nrc.gov/waste/llw-disposal/10cfr20-2002-info.html.)

[15] The commercial LLW facilities are regulated by individual Agreement States (see Appendix D), which results in differences between the licensing requirements that they impose.

of the four commercial LLW disposal facilities in the United States: one in Clive, Utah, and another in Barnwell, South Carolina.

The LLW waste classification system in the United States (i.e., Class A, B, C, and GTCC) is based on activity and hazard.[16] The USNRC provides criteria for near-surface disposal of LLW:

- The external exposure to a member of the public resulting from release of the waste shall not exceed 25 millirem/year (mrem), effective dose equivalent (10 CFR Part 61.41);[17] and
- the dose to a person who inadvertently intrudes into the disposal site after loss of institutional control (100 years) shall not exceed a one-time commitment of 500 mrem or an annual dose of 100 mrem for the first 1,000 years after emplacement (10 CFR Part 61.42).

For Class A waste, the hazard is minimal after 100 years; for Class B waste, the hazard timeframe increases to 300 years; and for Class C waste, it is 500 years. Because of its higher hazard, Class C waste must be buried at least 5 meters below the surface and have an engineered barrier.[18]

EnergySolutions has received a wide variety of LLW streams at its disposal facilities including paper, rags, plastic, glassware, syringes, protective clothing, cardboard, packaging material, spent pharmaceuticals, water-treatment residues, contaminated ion exchange resins, filters, tools, irradiated metals from nuclear power plants, and animal carcasses. The animal carcasses have to be incinerated because the facilities cannot directly dispose of organic materials.

Mr. Shrum stated that the main challenge of LLW disposal in the United States is not technical. The main challenge is political. Prior to the enactment of the Low-Level Radioactive Waste Policy Act of 1980 (LLRWPA),[19]

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[16] See the USNRC classifications at "Part 61.55 Waste classification," accessed April 9, 2017, https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/part061-0055.html.

[17] Note that 10 CFR Part 61.42 does not list dose limits for an inadvertent intruder. However, the concentrations of radionuclides established in Part 61 Tables 1 and 2 assumed a (maximum) dose of 5 millisievert/year (500 mrem/year). For more information see "Technical Basis for Proposed Rule to Amend 10 CFR Part 61 to Specify Requirements for the Disposal of Unique Waste Streams, including Large Quantities of Depleted Urainum (FSME-10-XXXX)," accessed April 9, 2017, https://www.nrc.gov/docs/ML1110/ML111040419.pdf. Note that the average annual exposure for a member of the public in the United States is 620 mrem/yr, including medical procedures (see "NCRP Report No. 160, Ionizing Radiation Exposure of the Population of the United States," accessed March 27, 2017, available for purchase at http://ncrponline.org/publications/reports/ncrp-report-160/).

[18] Mr. Shrum noted here that transuranic (TRU) waste is an exception and can be considered LLW in some instances (see LLW definition and notes in Box D-1). During the discussion session, a participant asked for further clarification on Mr. Shrum's statement about TRU waste.

[19] See Box D-2 in Appendix D for a description of the LLRWPA, its amendment in 1985, and other laws related to LLW regulation.

FIGURE 2-4 Locations of the four U.S. commercial LLW disposal facilities; compare the number and distribution to Canadian facilities shown in Figure 2-1.
SOURCE: U.S. Nuclear Regulatory Commission.

there were three operating disposal facilities in the United States: Beatty, Nevada; Barnwell, South Carolina; and Hanford, Washington. The governors of these states testified to Congress that they should not bear the burden of LLW disposal for the whole nation. Congress agreed and established the LLRWPA.

The purpose of the LLRWPA was to distribute LLW disposal obligations across the United States by establishing a state compact system[20]—assuming that regional disposal would be the safest and most efficient and equitable means for managing LLW. The United States now has four operating disposal facilities for commercial LLW (see Figure 2-4 and Table D-1 in Appendix D):

- EnergySolutions LLW Disposal Facility, Barnwell, South Carolina, accepts Class A, B, and C waste;

[20]See Appendix D for further descriptions of Agreement States and the state compact system. Table D-1 lists the state compacts that are associated with each commercial LLW facility.

- EnergySolutions LLW Disposal Facility, Clive, Utah, accepts Class A and 11.e (2) waste;[21]
- WCS, Texas, accepts Class A, B, and C and 11.e (2) waste; and
- US Ecology, Inc., LLW Disposal Facility, Hanford Site, Washington, accepts Class A, B, and C waste.

Since the LLRWPA was enacted, the EnergySolutions LLW Disposal Facility in Clive and WCS in Texas have opened. Clive accepts Class A waste from all 50 states. Both WCS, Texas and the EnergySolutions, Clive facilities can accept DOE waste.

Mr. Shrum noted that when the LLRWPA was enacted, there was no analysis to determine whether there was enough LLW generation to support multiple state compact disposal facilities. Currently, all states have access to some disposal capacity, and waste does not have to be transported very far, which keeps transport risk low—Mr. Shrum stated that the transportation of LLW has a great safety record and is one of the safest aspects of the LLW disposal system.

2.3 DISCUSSION: CLASSIFICATION, CATEGORIES, AND CHARACTERISTICS OF LLW

The content of the discussion sessions is grouped by topic in these proceedings and may not appear in the same order as they occurred during the workshop. The main topics are highlighted in bold headings.

Very Low-Level and Clearance Waste in the United States

Several participants asked questions about the criteria for VLLW and clearance (or exempt) waste, referring to presentations by Mr. Garamszeghy and Ms. Edwards and comments by Mr. Shrum.

Participants asked for more details related to the cost savings of using a VLLW category for decommissioning. Specifically, Francis X. "Chip" Cameron, currently with CameronGray LLC and an ex-USNRC assistant general counsel, asked for an estimated cost difference to send the expected volume of very low-activity waste to a Class A versus RCRA site for the San Onofre NPP decommissioning. Ms. Edwards recalled the cost savings between disposals at a Class A versus a RCRA facility to be approximately a factor of 10. However, she also noted that waste disposal does not make up the majority of decommissioning costs. The main cost for decommissioning is labor (personnel). Gérald Ouzounian, international director at

[21] The Atomic Energy Act, Section 11.e, defines byproduct material "11.e (2)" refers to the tailings or waste produced by the processing of ore to extract uranium or thorium. See Box D-1 in Appendix D for more information.

ANDRA,[22] added that, in France, VLLW has been disposed of in a facility separate from LLW since 2003. The cost savings for disposal is between a factor of 15 and 18. Dr. Ouzounian also noted that the French are moving toward optimization of the full system costs as opposed to the separate costs for dismantling and disposing of the waste.

Scott Kirk, director of regulatory affairs for BWXT, asked Ms. Edwards whether the $6 billion in projected cost savings shown in Figure 2-3 represented the total number of plants that are planned for decommissioning over the timeframe represented in the figure. How was this cost savings calculated?

Ms. Edwards explained that the exact shape and height of the solid blue and green lines in Figure 2-3 could change if there are changes in the assumed scheduling of future NPP shutdowns. However, the area under each of the curves (i.e., the total volume of LLW generated from reactor decommissioning) will be more or less the same regardless of when the reactors are decommissioned. EPRI assumed that the cost of disposing of decommissioning wastes will be the same regardless of the exact timing of decommissioning. In summary, the cost estimate shown in Figure 2-3 represents the total number of reactors that are expected to be decommissioned over the timeframe represented in the figure.

Mr. Camper asked what criteria should be specified in a regulation that would replace the case-by-case exemption process described by Ms. Edwards for VLLW. Ms. Edwards responded by referencing two publicly available EPRI reports, as noted in her presentation. The report, *A Generic Technical Basis for Implementing a Very Low Level Waste Category for Disposal of Low Activity Radioactive Wastes* (EPRI, 2013), analyzed how the VLLW category is applied outside of and within the United States. A comparison between U.S. RCRA disposal facilities and VLLW disposal facilities that exist in France and Spain concluded that the sites compare favorably in terms of protectiveness.

Another EPRI report, *Basis for National and International Low Activity and Very Low Level Waste Disposal Classifications* (EPRI, 2012), proposed a definition for VLLW based on dose and isotopic limits from existing definitions of VLLW in countries in which that waste stream is recognized. The report also considered the characteristics of the waste in which the 20.2002 exemption process was used. Additionally, doses for intruder and other scenarios were developed to postulate criteria and limits. The resulting criteria are more conservative than what is used in other countries. Ms. Edwards noted that the reports were written to provide information to "start a conversation" about this new waste category.

Mr. Shrum noted that very low-activity waste disposal is one of

[22] ANDRA is the French acronym for National Radioactive Waste Management Agency.

EnergySolutions' top priorities. USNRC 10 CFR Part 61 addresses the disposal of LLW. In addition, there is a new ~500-page guidance document for 10 CFR Part 61. Mr. Shrum asked that a guidance document be created to add clarity to the reference of a "few millirem" in the 20.2002 exemption. This detail is important to the waste disposal industry because more very low-activity waste is disposed of under exemption than is disposed of at LLW facilities. Whether intentional or not, the current reality is that regulation of very low-activity waste is occurring through exemption. Additional guidance would help to clarify criteria, for example the "few millirem" reference above, for the industry and practitioners.

Mr. Camper recalled that several years ago, the USNRC's Office of General Counsel asked the USNRC staff to identify a basis for using a "few millirem" for a lower threshold. It was determined then that the USNRC staff was at liberty to use a higher number, but first it needed to alert the Commission. Mr. Camper agreed that it would be good to embody this criterion within regulation.

Both the USNRC and the Environmental Protection Agency (EPA) have spent considerable time and effort considering VLLW, as noted by several participants.[23] Mr. Camper asked John Greeves, USNRC retired, to provide further background on the USNRC's work on the clearance of very low-activity waste. Mr. Greeves noted that there is no lower threshold for LLW classification in the United States. The IAEA document, *Application of the Concepts of Exclusion, Exemption and Clearance Safety Guide* (referenced previously by Mr. Garamszeghy) has a clearance definition that the USNRC staff (including Mr. Greeves and others at the time) had supported but the USNRC never adopted. France has done an outstanding job of resolving this problem and provides an excellent case study on how to manage and dispose of VLLW. The USNRC staff completed an environmental impact statement (EIS) in 2005 to evaluate approaches for managing certain types of VLLW, but no action was taken. Mr. Greeves noted that the federal government and Congress have not focused on addressing this issue.

Mr. Camper recalled that the USNRC and EPA conferred in 2003 as EPA prepared an Advance Notice of Public Rulemaking (ANPR) on very low-activity waste. Mr. Camper asked Mr. Daniel Schultheisz, EPA, Office of Radiation, whether EPA considered developing criteria for VLLW at the time of the ANPR and, if so, how it aligned with what EPRI proposed in the generic technical basis report (EPRI, 2013). Mr. Schultheisz explained that EPA has been looking at the issue of VLLW for quite some time. The ANPR referenced above was released in 2003 and was, in fact, an iteration

[23]While not discussed during the workshop, it is worth noting that DOE utilizes a similar option (called the "authorized limits process") for waste with low concentrations of radioactivity through disposal at on-site Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cells.

of previous work. EPA had originally considered a VLLW disposal option when it considered ways to make it easier for generators to dispose of mixed waste at RCRA facilities. This was broadened in the early 2000s to include working with the USNRC staff—Mr. Greeves in particular offered his staff to provide assistance.

EPA's approach is conceptually similar to what is proposed in the EPRI report (EPRI, 2013). The approach in the rulemakings before the ANPR was to establish specific concentration limits on radionuclides based on certain exposure scenarios. The limits were calibrated to particular dose levels and could be adjusted, allowing states the flexibility to implement as they saw appropriate. The states would not be required to adopt the dose levels.

The EPA received many public comments after the ANPR was released. However, at the same time, EPA staff were significantly distracted by the Yucca Mountain rulemakings. Mr. Schultheisz recalled that there was not significant support within the EPA at the time for a rulemaking on VLLW. Mr. Schultheisz noted that the EPA has continued to perform some modeling of different exposure scenarios—perhaps similar to what EPRI has done. The results are in a draft report, which has not yet been released.

The EPA is considering the application of the VLLW concept to wastes created by a radiological incident, such as a dirty bomb, or a nuclear accident such as occurred at Fukushima and Chernobyl. The EPA is establishing a planning process whereby clearance or VLLW designations could be implemented (see later discussion of this waste type in Chapter 3).

Kevin Crowley, director of the Nuclear and Radiation Studies Board at the National Academies, asked Mr. Garamszeghy whether the Canadian public had accepted the idea of clearance waste and whether there has been a difference in the ease or cost of disposing of this waste. Mr. Garamszeghy responded that in terms of public acceptance, certain members of the public are ideologically opposed. Regardless, clearance of the waste is allowed under regulation. He also noted that allowing for cleared waste has reduced the volumes of radioactive waste that have to be managed. All major nuclear waste producers, such as NPPs and research facilities, have implemented a "likely clean" program. The program is based on the separate collection and monitoring of waste, which, for operational reasons such as the location in the plant of its generation, is considered "likely clean." Those wastes are bulk collected and monitored. They can then be released for conventional recycle or disposal, depending on the waste type. In a number of cases, this resulted in a reduction of more than 50 percent in the amount of waste that has to be treated as radioactive waste.

The "likely clean" program has been in practice for more than 15 years and is very cost-effective. Most of the waste that gets diverted in this fashion is nonradioactive. The release criterion is basically background activity.

Background activity is a very conservative limit, so the waste is essentially clean.

New Rules in Averaging and Reduction in Class B and C Wastes

Ms. Edwards was asked by Diane D'Arrigo, the radioactive waste project director of the Nuclear Information and Research Service, whether her estimate or projection of future volumes of Class B and C wastes being reduced to zero was because of new calculations, physical mixing, or both. Ms. Edwards responded that she suspects that volumes of Class B and C wastes will approach zero due to the updated method for concentration averaging. Not all LLW containers or packages contain homogenous mixtures of waste. Some waste packages have "hot spots"[24] created by waste components that cannot be evenly distributed throughout the package such as filters or irradiated metals. In this case, a calculation determines the allowable activity level for these components of the waste. The term "concentration averaging" refers to this calculation.

The 1995 USNRC guidance on concentration averaging was intended to limit the concentrations of specific radionuclides within a given waste package as compared to the average activity of that package.[25] Updated guidance released in 2015 allows the concentration of the hot spot to be compared to the waste classification limit instead of the average concentration of the package.[26]

Ms. Edwards further explained that the important quantity for waste disposal is the total activity that goes into a single package. If a package meets the averaging constraints described above, then the higher activity from the hot spot is averaged with the other constituents over the total volume. This is the reason for Ms. Edwards' prediction that nearly all Class B and C waste from the utilities will be packaged as Class A waste in the future.

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[24]The USNRC defines a hot spot as (USNRC, 2015b, p. 11) "a portion of the overall waste volume whose radionuclide concentrations are above the class limit for the entire container [or package]."

[25]See 10 CFR Part 61.55, Table 2 for the list of radionuclides and their concentration limits. For the text of the 1995 guidance, see "Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revisions in Part to Waste Classification Technical Position," accessed April 9, 2017, https://www.nrc.gov/docs/ML0336/ML033630732.pdf.

[26]For the new "factor of 10" rule: the concentration of each radionuclide of concern in each item [or waste package] should be less than 10 times the classification limit for that radionuclide.

Waste Classification of LLW Containing TRU Nuclides

Dr. Crowley asked Mr. Shrum to clarify a comment made during his presentation on how TRU waste might be considered LLW. Mr. Shrum responded that, by definition, TRU waste is not LLW; nevertheless, 10 CFR 61.55 allows for near-surface disposal for waste containing TRU nuclides based on its characteristics. Dr. Crowley suggested that disposal of TRU as LLW might not be a problem because it is apparently allowed by regulation.

Mr. Camper noted two concerns with disposal of TRU as LLW: The first is that TRU waste is not included in the definition of LLW in 10 CFR Part 61 so it is disconnected from the LLRWPA Amendment. The second and larger concern is that Table 1 in 10 CFR 61.55 states that the Class C limit allows up to 100 nanocuries per gram (nCi/g) for waste containing TRU nuclides but it does not explicitly define waste containing more than 100 nCi/g of TRU nuclides.[27] The problem is that some of the waste defined in the final EIS for GTCC[28] waste is non-defense TRU waste for which there is no disposal pathway at present. This is the problem that the Commission directed USNRC staff to address via rulemaking.

Legacy (Historic) Wastes

Jennifer Heimberg, rapporteur and National Academies staff, asked the panel how legacy wastes are handled in Canadian and U.S. regulations and whether they are disposed of at commercial LLW facilities. Mr. Garamszeghy noted that the legacy wastes can be a challenge to address. In Canada, these wastes are the result of a number of activities (research, mining, industrial) dating back to the early 1940s. Many legacy waste streams are not well characterized in terms of radionuclide content, physical forms, or volumes. They have been stored or disposed of in facili-

[27]The following documents provide history and further background on the TRU waste problem (USNRC, 2015a and 2015c): "SECY-15-0094: Historical and Current Issues Related to the Disposal of Greater-than-Class C Low-Level Radioactive Waste," accessed March 28, 2017, https://www.nrc.gov/docs/ML1516/ML15162A807.pdf and "SECY-15-0094, Enclosure 3: Statutory Language and Regulatory History of Commercial Transuranic Waste Disposal," March 28, 2017, https://www.nrc.gov/docs/ML1516/ML15162A828.pdf.

The USNRC makes the following statement (Footnote 4, p. 2, USNRC, 2015a): "TRU waste is explicitly excluded from the definition of LLRW [low-level radioactive waste]. However, the [US]NRC has determined that LLRW containing TRU nuclides meeting certain criteria may be suitable for disposal within a 10 CFR Part 61 disposal facility. See 10 CFR § 61.55(a)(3), Table 1."

[28]See "DOE: Greater-Than-Class C Low-Level Radioactive Waste Environmental Impact Statement (GTCC EIS) Documents," accessed March 1, 2017, http://www.gtcceis.anl.gov/documents/index.cfm#final.

ties that do not meet modern standards. Consequently, there are uncertainties in the characteristics, quantities, and locations of these wastes. The Canadian federal government is ultimately responsible for managing these wastes; the government has a number of programs in place to characterize and manage them. For example, Mr. Garamszeghy recalled from his presentation that there were ~2.1 million cubic meters of VLLW in Canada.[29] This is largely historic waste from contaminated soil, decommissioning of legacy facilities, and similar activities. There is a proposal by Canadian Nuclear Laboratories, a contractor that operates the government's nuclear facility near Chalk River, Ontario, to develop near-surface disposal facility at that site for disposal of Canada's legacy wastes. Most of Canada's legacy waste resides at that site.

Mr. Shrum responded that EnergySolutions receives legacy waste, mostly from DOE. This waste is often referred to as "look what we found" waste because of its unpredictable characteristics. Mr. Shrum noted that DOE has a different waste classification scheme than the one used by the USNRC. If DOE legacy waste is identified and planned for disposal at a commercial facility, DOE will typically use waste processors or brokers to first characterize the waste, confirm that it meets the facility's waste acceptance criteria, and that the waste meets the requirements in 10 CFR Part 61.55.

2.4 REGULATIONS, STANDARDS, ORDERS, AND GUIDANCE CRITERIA

Mr. Camper began the session by providing an overview of the U.S. LLW regulatory process. His remarks are summarized below. The regulatory process has a proven track record and has been shown to adequately protect health and safety. However, the process is complicated (a "regulatory mosaic"), may be difficult to understand or explain, and lacks exact alignment with other international regulatory frameworks. There is room for improvement.

A number of key pieces of legislation directly impact the management and disposal of LLW. These are identified and briefly described in Box 2-1 and in Appendix D.

Mr. Camper identified the key regulators of radioactive waste within the United States and stressed the key role that Agreement States play in regulating the four commercial LLW disposal facilities. The EPA develops standards applicable to LLW disposal. The USNRC has regulatory oversight of commercial radioactive waste in the United States under the

[29]This estimate uses the IAEA GSG-1 classification of VLLW; however, the waste is currently termed "LLW" by the waste owners.

BOX 2-1
Key Legislation for LLW

Atomic Energy Act (1954):
the original statute from which the USNRC derives its authority.

National Environmental Policy Act (1969):
describes the environmental analyses that are performed for licensing actions, including the licensing of LLW disposal facilities.

Transportation Safety Act (1974):
sets forth criteria for the transport of LLW for disposal.

Resources Conservation and Recovery Act (1976):
created the framework for the management of hazardous and non-hazardous solid wastes.

Low Level Radioactive Waste Policy Act (1980) and amendment (1985):
defined the compact system (see Mr. Shrum's presentation and Appendix D) and enables the states to dispose of their LLW.

Nuclear Waste Policy Act (1982) and Amendment (1987):
requires the USNRC to ensure that licensees providing for the disposal of LLW provide adequate financial arrangements to permit disposal site closure and reclamation of sites, structures, and equipment.

Comprehensive Environmental Response Compensation and Liability Act (1986):
contains standards that apply to hazardous waste facilities, also referred to as Superfund (see also the Resource Conservation Recovery Act [RCRA]).

Energy Policy Act of 2005:
extended authority of the USNRC as it pertains to discrete sources of NORM (naturally occurring radioactive material).[a]

Ronald Reagan Defense Authorization Act (2005):
addressed DOE's disposal of waste incidental to reprocessing for the Idaho National Laboratory and the Savannah River Site.

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[a]The EPAct of 2005 adds the following to the list of byproduct materials: "any discrete source of naturally occurring radioactive material, other than source material, that—(A) the [Nuclear Regulatory] Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and (B) before, on, or after the date of enactment of this paragraph is extracted or converted after extraction for use in a commercial, medical, or research activity."

Atomic Energy Act. The DOE is self-regulating for the wastes it generates and stores. Mr. Camper noted that the Department of Transportation also has regulations for transporting LLW, but these regulations are enforced by the USNRC.

DOE regulates its radioactive wastes through two orders:[30]

- Order 458.1—*Radiation Protection of the Public and the Environment,* and
- Order 435.1—*Radioactive Waste Management*.

The key USNRC regulations are the following:

- 10 CFR Part 20—*Standards for Protection against Radiation*
- 10 CFR Part 61—*Licensing Requirements for Land Disposal of Radioactive Waste*
- 10 CFR Part 62—*Criteria and Procedures for Emergency Access to Non-Federal and Regional Low-Level Waste Disposal Facilities*

10 CFR Part 62 was created when there was no access to disposal for Class B and C wastes for 36 states. This provision has not been used to date.

Mr. Camper listed other entities that influence the regulatory process, including the Compact Commissions for the states, Conference of Radiation Control Program Directors, Inc. (CRCPD),[31] International Commission on Radiological Protection (ICRP),[32] Low-Level Radioactive Waste Forum, Inc.,[33] National Council on Radiation Protection and Measurements (NCRP),[34] and

[30]DOE Orders are described as a type of Directive: "Orders establish management objectives and requirements and assign responsibilities for DOE Federal employees consistent with policy and regulations. Requirements must be unique to DOE and must avoid duplicating information from other directives or any existing legal source." These orders and DOE policies provide for site-specific performance assessments and site-specific waste acceptance criteria to establish an envelope of acceptable LLW forms and packages between waste generators and waste disposal sites. See: "DOE: DIRECTIVES HELP," accessed March 1, 2017, https://www.directives.doe.gov/directives-help.

[31]The mission of CRCPD is "to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education." For more information, see "An Introduction to CRCPD," accessed March 1, 2017, http://www.crcpd.org/page/About.

[32]According to its website, ". . . the International Commission on Radiological Protection (ICRP) helps to prevent cancer and other diseases and effects associated with exposure to ionising radiation, and to protect the environment." For more information, see "About ICRP," accessed April 9, 2017, http://www.icrp.org/.

[33]The Low-Level Radioactive Waste Forum, Inc. is focused on helping the states and interstate compacts implement the requirements of the Low-Level Radioactive Waste Policy Amendments Act (see Box 2-1). For more information, see "About Us," accessed April 9, 2017, http://llwforum.org/about/.

[34]For more information, see "National Council on Radiation Protection and Measurements: About," (accessed April 9, 2017) http://ncrponline.org/about/.

Organization of Agreement States (OAS).[35] The ICRP and NCRP develop protection criteria that may be used in various statutes and/or guidance. The OAS assists the Agreement States and coordinates actions with the USNRC.

Mr. Camper provided further background on the Agreement States program. The program was established by the Atomic Energy Act (AEA), as amended. Section 274b of the Act allows the USNRC to relinquish portions of its regulatory authority to an Agreement State.[36] The state governor and the chairman of the USNRC must sign an agreement recognizing "the State shall have authority to regulate the materials covered by the agreement for the protection of the public health and safety from radiation hazards" (AEA, Section 274b). The USNRC conducts an integrated management performance evaluation program through inspections and licensing to regularly confirm that the Agreement States' programs are sufficient and compatible with federal regulations.

The states' role in LLW management and disposal have evolved in response to the LLRWPA (see Box 2-1) in three important aspects: first, each state must dispose of LLW generated within its borders, either individually or through compacts. Second, states may assume regulatory authority as discussed above. Third, states have the authority to regulate naturally occurring radioactive material (NORM) and technically enhanced naturally occurring radioactive material (TENORM). Regulatory authority for these materials was not specified in the AEC.

Mr. Camper noted that the United States is fortunate to have four LLW disposal facilities; many countries have not yet determined a long-term solution to storage and disposal of LLW. The fact that the IAEA has safety standards, disposal requirements, and a general safety guide was mentioned by Mr. Camper; these are discussed in further detail later in these proceedings.

Mr. Camper noted that the U.S. regulatory process for LLW relies on an integrated safety system approach, which has proven effective in protecting human health and the environment but is technically complex. The approach involves many considerations such as site selection, site design, facility closure, post-closure stabilization, and institutional controls.

Finally, Mr. Camper noted that these are interesting times for regulation of LLW in the United States. U.S. regulators are addressing complex waste streams that were not included in the original analyses in 1982 for 10 CFR Part 61, including some waste streams identified for discussion in this workshop such as depleted uranium (DU), GTCC, and commercial TRU wastes. USNRC staff have been asked by the Commission to consider

[35]The purpose of the OAS is to "provide a mechanism for these Agreement States to work with each other and with the United States Nuclear Regulatory Commission ([US]NRC) on regulatory issues associated with their respective agreements." For more information, see "About OAS," accessed April 9, 2017, http://www.agreementstates.org/page/about-oas.

[36]Note: Kentucky became the first Agreement State in 1962.

changes to regulations for some of these wastes. There will likely continue to be great stakeholder interest in these regulatory changes.

In introducing the session, Mr. Camper explained that the three invited speakers were asked to address the following questions in their presentations:

- What are the health, environmental safety, and security bases that led to the generally applicable standards and regulations in your line of work?
- What are the strengths and weaknesses of the respective approaches?

Andrew Orrell, section head of waste management and environmental safety, IAEA, provided an international regulatory perspective; Thomas Magette, managing director of PricewaterhouseCoopers, provided an industry perspective; and Mark Yeager, environmental health manager for South Carolina Department of Health and Environmental Control (DHEC), provided perspectives from an Agreement State regulator.

LLW Management and the IAEA, Regulations, Standards, Orders, and Guidance

Mr. Orrell addressed the following topics in his presentation: IAEA statute (authority), IAEA safety standards, supporting guidance, and the Joint Convention. The statute that created the IAEA specifically authorizes it to develop and promote the application of safety standards for the benefit of its member states. These standards are intended to be an expression of international consensus about what constitutes a high-level of safety.[37] However, the IAEA is not a regulator, so its safety standards are not legally binding. They are used in different ways in different countries because the regulation and enforcement of safety is the sole responsibility of each IAEA member state.

The IAEA has produced more than 200 documents related to safety standards that cover nuclear technologies and the full nuclear fuel cycle. The wheel diagram in Figure 2-5 shows all of the current safety standards.[38] The overarching safety fundamentals are the highest in the hierarchy (a single document at the center of the wheel in blue), followed by the safety requirements (seven documents in red) and the more detailed safety guides (more numerous documents shown in green).

[37] The IAEA currently has 168 member states. The statute governing its operation can be found at: "The Statute of the IAEA," accessed April 9, 2017, https://www.iaea.org/about/statute.

[38] For a list of all of the safety standards shown in Figure 1-5, see: "Safety Standards applicable to all facilities and activities," accessed April 9, 2017, http://www-ns.iaea.org/standards/documents/general.asp.

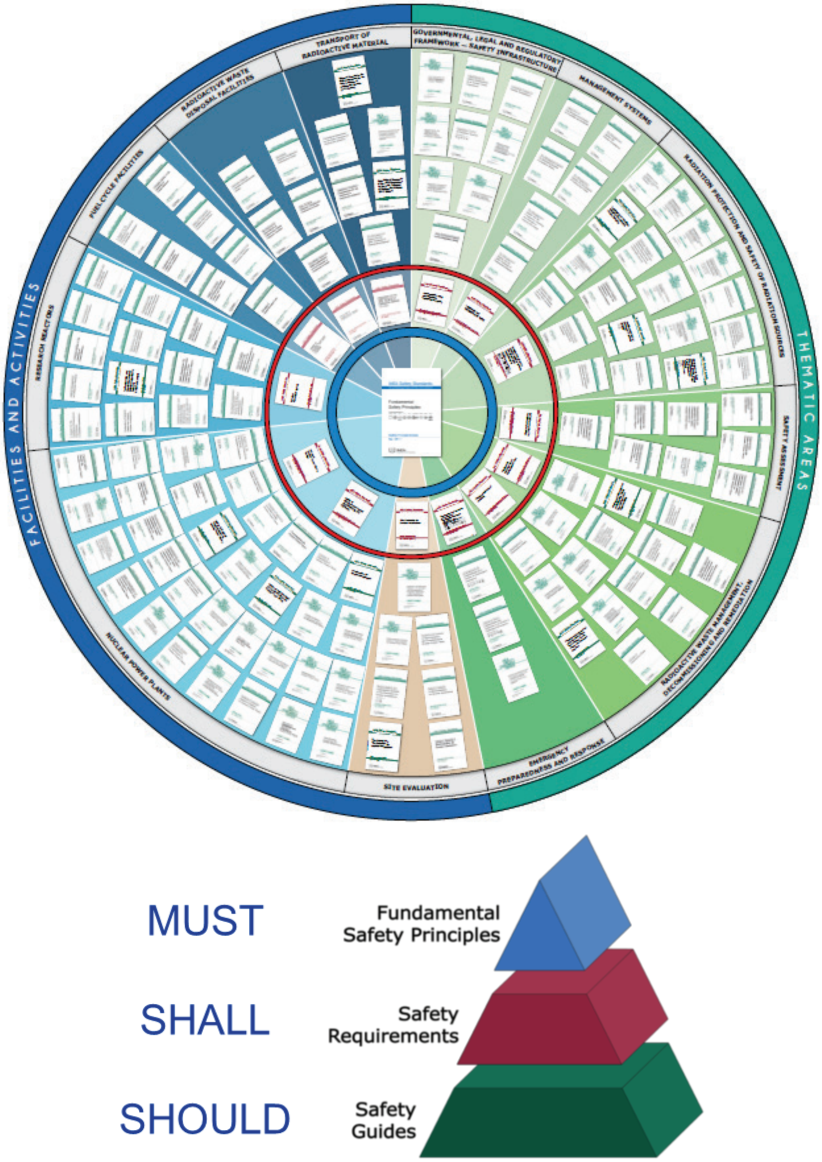

FIGURE 2-5 Safety standards developed by the IAEA. Fundamental Safety Principles are the highest level in the hierarchy (top blue triangle and the blue center of the wheel). Safety requirements are the middle level of the hierarchy (in red). Safety guides are the bottom level of the hierarchy (in green and in the outer rim of the wheel). The small script in the figure does not allow one to read the titles of each document; rather, the figure is meant to illustrate the number and hierarchy of the standards.
SOURCE: Courtesy of the International Atomic Energy Agency.

The safety fundamentals lay out the fundamental safety objective: to protect people and the environment from the potential harm of radioactivity.[39] "People" refers to both the worker and the public.

The safety fundamentals lay out 10 safety principles of protection and safety and provide the basis for the underlying safety requirements:

1. Responsibility for safety
2. Role of government
3. Leadership and management for safety
4. Justification of facilities and activities
5. Optimization of protection
6. Limitation of risks to individuals
7. Protection of present and future generations
8. Prevention of accidents
9. Emergency preparedness and response
10. Protective actions to reduce existing or unregulated radiation risks

These principles are constructed to use "must" statements and are at least notionally binding on member states.

Safety requirements elaborate on the fundamental safety objective and the 10 safety principles. Key safety requirement documents include one each for predisposal and disposal of radioactive waste.[40] The guides are meant to be concise and indicate "what," "by whom," and "when" actions should be taken and "why" the requirement exists. The safety requirements are constructed to use "shall" statements and are also at least notionally binding on member states.

At the bottom of the hierarchy in Figure 2-5 are the safety guides—captured in general and specific guides that provide recommendations on "how" to comply with the upper-tier requirements. The guides cite present international good practices and increasingly reflect best practices. The safety guides are constructed to use "should" statements.

Mr. Orrell's presentation included examples of a number of safety guides relevant to radioactive waste management, predisposal, storage, and disposal. He highlighted a few guides of particular relevance to the workshop: the classification of waste, management systems for predisposal and disposal frameworks, guidance on constructing a safety case and safety

[39]See "The IAEA Safety Standard: Fundamental Safety Principles, No. SF-1," accessed April 9, 2017, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1273_web.pdf.

[40]"Predisposal" is a term used to describe the (IAEA, 2009b, p. 1) "management of radioactive waste from its generation up to disposal, including processing (pretreatment, treatment, and conditioning), storage and transport." For the general safety requirement guide on predisposal of radioactive waste (GSR Part 5), see (IAEA, 2009b). For the specific safety requirement guide for disposal of radioactive waste, see (IAEA, 2011).

assessment (which are crucial to the demonstration of safety of the radioactive waste management), and several specific guides on predisposal and disposal in near-surface and deep-geologic settings.

In addition to the official safety standard series, the IAEA also publishes a large number of supporting documents; these documents elaborate on best practices and/or good international practices for implementing radioactive waste management and also capture the results of technical meetings, conference proceedings, and workshops. All publications are developed by representatives of member states to benefit from their breadth and depth of available expertise.

Mr. Orrell noted that the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management[41] is a legal instrument to the 75 contracting parties that obligates each to implement the principles contained in the IAEA safety standards.[42] The Joint Convention went into force in 2001. Many of the technical obligations in the Joint Convention have strong parallels to the subjects covered in the safety standard series.

Mr. Orrell also noted that the IAEA safety standards represent six decades of experience and expertise, and they provide international consensus on what is needed to achieve a high level of safety. He noted that there is a common commitment to the protection of people and the environment regardless of the scale of a member state's activities. He presented a photograph of a VLLW disposal cell for a small European country with a very small nuclear footprint (Figure 2-6). This one cell has a capacity for 30,000 cubic meters of VLLW. The cleanup from the Fukushima Daiichi accident has generated more than 10 million cubic meters of contaminated soils to date—which would fill roughly 400 of the disposal cells in the small European country.

Complications in the Process of Creating and Revising Regulations

Mr. Magette noted, as have others, that the USNRC is in the midst of updating 10 CFR Part 61. He reviewed the complications of revising and creating regulations to account for challenging LLW streams such as DU and TRU. The update, originally proposed as a "tweak" 8 years ago, was needed to account for the large quantities of DU waste expected to be sent to commercial disposal facilities. Mr. Magette suggested that the level of

[41]For more information, see "IAEA: Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management," accessed March 1, 2017, http://www-ns.iaea.org/conventions/waste-jointconvention.asp.

[42]The number of parties and signatories was last updated on March 3, 2017; see "Joint Convention status," accessed April 27, 2017, http://www.iaea.org/Publications/Documents/Conventions/jointconv_status.pdf.

FIGURE 2-6 An operational disposal site for very low-level waste (VLLW). This facility is one cell (approximately 150 meters in length, 40 meters in width with a capacity of 30,000 cubic meters). Note the small gray cubes at back of facility; each is one cubic meter of VLLW.
SOURCE: Courtesy of Andrew Orrell.

effort required to modify the regulations thus far has been disproportionate to the risk posed by DU waste.

He identified several reasons for his opinion. The first is that Agreement States have been given the authority to regulate LLW. If one were to redesign a system to regulate LLW with our current understanding of the variety and volumes of LLW streams, it is hard to imagine a system that would allow individual states to regulate LLW because there is no distinction in health and safety benefit as one crosses state lines. Mr. Magette explained that the transition of authority from the USNRC to the states was not as clear as suggested previously by Mr. Camper. For example, updating the compatibility category tables,[43] which help to define how states may

[43]Compatibility category tables define how states may interpret USNRC regulations—these should not be confused with the tables used to classify wastes as Class A, B, C or GTCC.

interpret USNRC regulations, has further complicated the recent update process.

Several of the USNRC Commissioners recently and informally asked Mr. Magette if he thought a uniform regulatory regime would be a disincentive for states to develop disposal sites. He responded that it would have little impact because the debates about the development of such facilities are rarely focused on regulations. He also noted that changes to regulations are not a high-priority issue for most of the states because there are only four that host such facilities. Finally, disposal facilities are sited and developed by private entities, not by states and compacts.

Mr. Magette argued that it is necessary to adjust the LLW regulatory system to the situation in which we find ourselves. A small change to the regulations was proposed 8 years ago to address the increasing quantities of DU. The effort expanded to consider the revision of the classification tables in 10 CFR Part 61.55 for DU, GTCC, and TRU—a much more difficult effort than making a small change to the tables to account for DU only. One might reasonably ask whether the process has become overly complicated relative to the risks or hazards posed by the disposal of these materials. The LLW disposal system works today, but it is not clear whether the updates will improve it.

Mr. Magette highlighted several specific waste streams for which the existing regulatory system has become overly complicated. The radioactive emissions from DU increase slowly over time due to a build-up of daughter products—reaching a maximum value in approximately 1 million years. This growth in emissions necessitated a review of the length of the current compliance period for disposal of DU. The USNRC staff proposed to the Commission a two-tiered compliance process: a compliance period of 1,000 years or 10,000 years, depending on whether a facility accepts long-lived waste. However, this proposed change would double the compliance period from 500 years for Class C waste and increase it by a factor of 10 for Class A waste. Mr. Magette pointed out that there is no good technical basis to support this increased regulatory compliance period for non-long-lived waste.

The other complication is the period of institutional control following the closure of the LLW disposal facility. The public debate with USNRC staff focused on institutional controls and whether it was reasonable to maintain such control beyond 100 years. Mr. Magette suggested that the discussion should have focused on acknowledging that the risk diminishes over time; an increased period of institutional control resulted in much lower risk at the end.

Agreement State Programs

Mr. Yeager reviewed the Agreement State programs, addressing the two questions posed at the start of this session. He noted that Texas, Utah, Washington, and South Carolina regulate the four commercial LLW disposal facilities in the United States. These are Agreement States, and each works within similar regulatory structures.

In general, the Agreement States adopt the requirements in these regulations in their state regulations. For example, South Carolina's radiation protection standards for LLW waste disposal are compatible with the USNRC's 10 CFR Part 20, *Standards for Protection against Radiation*. South Carolina's radiation protection requirements are set forth in *Regulation 61-63, Title A, Part III* (State of South Carolina, 2014). The regulations apply to the public, workers, and vendors who provide services at the sites, and they establish occupational dose limits, surveys and monitoring, precautionary procedures, and required records and reports.

The conditions and operational procedures that commercial LLW licensees implement to comply with state and federal regulations are incorporated within their respective radioactive material licenses. In South Carolina, DHEC conducts radiological surveys and the physical inspection of the Barnwell Disposal Facility (BDF) biannually to document that license conditions and corresponding procedures are compliant. The BDF's LLW receipt and disposal operations are inspected weekly, as needed. Weekly inspections are conducted of general site, active disposal trench conditions, and enhanced trench cap conditions resulting from preliminary site closure activities. The review of submittals for new disposal trench construction and on-site inspection of this activity is also conducted by department technical staff.

Mr. Yeager pointed to 10 CFR 61, *Licensing Requirements for Land Disposal of Radioactive Waste*, which are implemented in South Carolina's *Regulation 61-63, Part VII*. As was previously mentioned, Part 61 has recently been revised. As a result, the sited Agreement States will need a guidance document to help implement the changes—hopefully to be released with the updated Part 61. Mr. Yeager agreed with previous comments about the need to account for the costs of the changes. DHEC has not yet determined how the implementation of the changes to Part 61 will affect its program.

The final rule for Part 61 includes the following change (highlighted in the previous presentation by Mr. Magette): the existing technical analysis for protection to the general public will either have a 1,000-year or a 10,000-year compliance period, depending on the quantities of long-lived radionuclides that are planned for disposal or have already been disposed of. The technical analysis should include a new safety case analysis to identify defense in-depth protections and to describe the capabilities of the

disposal system. Therefore, the Agreement States will have to provide a new technical analysis for the protection of inadvertent intruders that includes the revised compliance period and corresponding dose limit. In addition, the Agreement States will have to perform a post-10,000-year performance year analysis. This will add a new requirement to update the technical analysis at the time of site closure.

The USNRC *Branch Technical Position on Concentration Averaging and Encapsulation* (BTP) has been an essential tool in assessing proper waste classification, packaging, and disposal trench selection. The recent update of the BTP has affected the volume of LLW received at the BDF by allowing the blending down of Class B and Class C to higher concentrations of Class A. It is also important to mention that each commercial LLW disposal facility has established Waste Acceptance Criteria which both allows and restricts certain waste forms. Examples include radium, DU, and mixed waste.

One of the questions posed to the presenters was related to physical security. Mr. Yeager noted that South Carolina regulations follow the USNRC's 10 CFR Part 37, the *Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material*. The licensee and DHEC determined that some shipments of Class B and C waste, such as irradiated hardware, require security during staging for disposal at the EnergySolutions BDF site. As a result, DHEC worked with a licensee to implement this protection so that it met the Part 37 requirements. Mr. Yeager concluded that EnergySolutions performed well in this respect.

Finally, with regard to regulations related to transportation, South Carolina implements and enforces the provisions of 49 CFR Part 173, *Subpart I for Class 7 (Radioactive) Materials*, and also the applicable provisions of 10 CFR Part 20. All incoming LLW shipments are all inspected to assure that communication requirements and the conveyance meets physical and radiological regulatory standards; the shipment manifest and waste description are reviewed to ensure compliance with waste acceptance criteria; and the packaging is adequate.

With regard to packaging, Mr. Yeager noted that DHEC has been delegated authority to conduct engineering reviews of proposed High-Integrity Containers utilized to assure adequate LLW containment (primarily for the disposal of dewatered ion-exchange resin) for a minimum of a 300-year disposal lifetime. Upon conclusion of construction and mandated testing, DHEC is authorized to issue Certificates of Compliance.

Mr. Yeager noted that one strength of the Agreement States is the opportunity for collaboration during periodic reviews conducted through the USNRC's Integrated Materials Performance Evaluation Program (IMPEP). Each IMPEP team includes an Agreement State member. The oversight by another regulatory program is usually beneficial for both Agreement State programs.

An important challenge faced by Agreement State programs is providing technical assistance to other regulatory programs that find themselves with issues involving the disposition of various solid wastes containing or contaminated with radioactive constituents. Examples of these wastes include, but are not limited to, discrete radium sources (mostly of military origin), radium residuals resulting from water or mineral processing, and tritium resulting from improper disposal of generally licensed devices in solid waste landfills. South Carolina is the home of multiple military installations. As a result, DHEC receives many calls from scrap metal dealers that have come across discrete sources of radium and some byproduct material from improperly disposed of licensed sources. Most dealers are small businesses and do not have the financial resources to properly dispose of these disused or orphan sources. Some sources containing byproduct material can be traced back to the licensee. Fortunately, programs such as DOE's Source Collection and Threat Reduction (SCATR) Program allow for disposal of these sources at minimal or no cost to the generator.

Radium in drinking water and the residuals from ion exchange and filter media present additional disposal challenges. Water providers who are not accustomed or experienced under a regulatory regime have difficulty dealing with the required physical protections for their workers. Also, the water providers are not accustomed to the extreme expense of disposing of radium-contaminated filter media. DHEC has issued Reg. 61-63, Part IX, *Licensing of Naturally Occurring Radioactive Material (NORM)*, to assist in the regulatory oversight of this activity and the resulting radiological wastes.

Finally, it was noted that tritium, due to its elemental form, is an insidious environmental contaminant common in all LLW disposal sites and some solid waste landfills. One area of concern with LLW shallow-land burial at the BDF and other disposal facilities, including some solid waste facilities, is the presence of tritium in off-site environmental monitoring wells. One way the facility operator manages this issue is to restrict access by potential receptors at the release point. At the BDF, construction of enhanced trench cap covers has been very successful in mitigating the percolation of precipitation and the resulting transport of tritium through groundwater off-site.

2.5 DISCUSSION: REGULATIONS, STANDARDS, ORDERS, AND GUIDANCE CRITERIA

Several topics (highlighted in bold) were brought up during the Session 1b discussion. Questions, answers, and general comments pertaining to a specific topic are grouped below. As for the Session 1a discussion overview, this overview does not follow the chronological order of the discussion.

Likelihood of Significant Changes to the U.S. Regulatory System

The panelists were asked about the likelihod of large-scale changes to the U.S. regulatory framework for LLW. All three panelists agreed that large-scale changes were very unlikely. Mr. Magette noted that such changes were "extraordinarily unlikely," and he cited another example of the USNRC's approach to tweaking its regulations to address an evolving problem: the decommissioning rule for NPPs. The USNRC is considering the application of regulations originally written to ensure worker and public health and safety during NPP operations to their decommissioning. He also recalled the failed effort to develop regulations for material below regulatory concern (i.e., exempt or cleared material) originally requested by Congress in the LLRWPA as amended in 1985.

Mr. Orrell provided perspectives both as an IAEA employee and a U.S. citizen. He agrees that the LLW regulatory framework is "not very likely" to change substantially, certainly not in his lifetime. However, he noted that he has seen, both in the U.S. and other nations' regulatory systems, regulatory creep over time. Regulations get more complicated with time as regulators adjust their regulations to address evolving problems, typically by adding to instead of removing standards. Eventually, the regulations become unwieldy, prompting a revolution instead of an evolution to change them. Whether the U.S. nuclear regulatory framework will undergo a revolution is difficult to predict, but other industries such as banking and airlines have gone through punctuated efforts to revise, wholesale, their regulatory frameworks.

Mr. Yeager added another example from his time as chairperson of the Committee on Radioactive Waste Management of the CRCPD. Mr. Yeager described an overly optimistic but failed attempt, at his first meeting as the chair, to obtain consensus on a uniform approach by the states and federal agencies. But he also cited a successful multi-agency effort that created a unified approach to radiological characterization as a reason to be hopeful for a similar effort in LLW management. The EPA's *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)[44] was a collaborative effort by the EPA, USNRC, DOE, and the Department of Defense.

Another is for LLW disposal organizations responsible for regulatory oversight to consider oversight for each other. For example, the four commercial LLW disposal facilities in the United States are currently regulated by Agreement States. Each respective regulatory program is subject to peri-

[44] *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) "provides detailed guidance on how to demonstrate that a site is in compliance with a radiation dose- or risk-based regulation." More information can be found at: "EPA: Radiation Protection: Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," https://www.epa.gov/radiation/multi-agency-radiation-survey-and-site-investigation-manual-marssim, accessed March 1, 2017.

odic review by the USNRC to assure compatibility with applicable federal regulations. The IMPEP inspection team is comprised of USNRC inspectors and an Agreement State inspector. DOE, as a self-regulating agency, might benefit from an assessment of its LLW disposal regime by other regulatory entities.

Consensus on a unified approach to LLW disposal across Agreement States and federal jurisdictions is also needed, noted Mr. Yeager. Such a consensus could encourage buy-in from stakeholders and the public and possibly reduce disposal costs. Currently, there are several federal and state regulatory regimes; it can sometimes be frustrating for a LLW (or LLW of very low activity) generator to move from one to another. In South Carolina, for example, the EnergySolutions' BDF is a commercial LLW site regulated by the South Carolina DHEC; RCRA facilities in the state that contain mixed waste are regulated by the EPA; Savannah River is regulated by DOE; but the Mixed Oxide (MOX) Fuel Fabrication Plant at Savannah River is regulated by the both the USNRC and DOE.

Mr. Magette further commented that site-specific regulations are based in part on performance assessments because each site is different. This makes uniform regulations across Agreement States more difficult to develop.

Containment Approach to Addressing the Isolation Period

Ms. Edwards noted that although a substantial revision of current U.S. LLW regulations is unlikely, workshop attendees might consider approaches that extend beyond regulatory changes. In the spirit of the workshop, Ms. Edwards presented such an approach and asked for participants' perspectives.

From a strictly technical viewpoint, LLW poses a hazard with a finite lifetime. It is a fairly straightforward calculation to determine the lifetime of the hazard of the LLW inventory of any disposal site. Ms. Edwards suggested that if society is willing to impose institutional controls for the duration of the LLW hazard, there would be no need to consider exposure to the waste after that period (i.e., intrusion scenarios)—similar to Mr. Magette's comments that an increased institutional control period resulted in lower risk at the end.

The development of intrusion scenarios leads to disagreements that are difficult to resolve, primarily because one must hypothesize about the characteristics of intruder scenario, for example when and how the intrusion occurs and the characteristics of intruder exposures. There are differing viewpoints on what intruder scenarios are "reasonable" to consider; for example, how should one estimate the behavior of an intruder who lives 10,000 years in the future, and how does one determine whether the intru-

sion would have significant health effects given likely future medical advances? It is difficult to defend a dose analysis for an intruder scenario given these future uncertainties. If LLW is isolated for the duration of its hazard, there would be no reason to consider intruder scenarios. Ms. Edwards acknowledged that there may be cases where longer-term institutional controls are not workable and suggested that a different set of regulations could be developed for those cases.

Mr. Orrell offered a technical perspective based on his experiences in performing and managing many of the safety and performance assessments for the Waste Isolation Pilot Plant (WIPP) and Yucca Mountain. In these analyses, it was assumed that all repositories, near-surface or otherwise, fail when there is an intrusion. Intrusion scenarios are informative in and of themselves to understand the consequences of such failures. Other countries use the results of intrusion scenarios to inform their regulatory processes. In Mr. Orrell's opinion, the intruder scenario serves as a pass/fail element of the U.S. regulatory system rather than as an information-input to the system.

Mr. Orrell agreed that, unless there is a reasonable argument for increasing the characterization of risk or adding to public confidence, extending the isolation period may not make a lot of difference. Mr. Orrell noted it would be straightforward to recalculate an isolation period from 500 to 1,000 years. In practice, however, the uncertainty of the result would need to be reduced by an order of magnitude (or two) to significantly improve the characterization of risk for increasing the isolation period from 500 to 1,000 years.

Mr. Orrell also stressed the importance of the terminology being used in Ms. Edwards' question. For example, WIPP has a containment standard, whereas other repositories have dose standards. There is an assumption that most repositories will have a release over some (long) time period, so a containment standard may drive one to particular disposition solutions that may not always be readily available or achievable.

"Regulatory Morass"

Paul Black, chief executive officer of Neptune and Company, Inc., provided a summary of his thoughts from the session. He recalled Mr. Camper's characterization of the complex framework as a "regulatory mosaic" and suggested another term which he believes is more accurate: a "regulatory morass." Dr. Black highlighted several examples to support this opinion including containment requirements, the compliance period for DU, and overly complicated LLW regulations (Black et al., 2014). His concern is that the complexity and associated costs with disposal of LLW has an upstream effect on the nuclear industry.

He noted that there remains some question on the appropriate regulation for small amounts of DOE TRU waste that may be present in the disposal sites at NNSS and Los Alamos National Laboratory (LANL). There is a question of whether the EPA's containment requirements of 40 CFR 191 (Subpart B Section 191.13) apply or whether other regulations would be more appropriate. Dr. Black explained that 40 CFR 191 was written for deep geologic repositories which allows a small amount of the inventory to escape while still meeting regulatory requirements. Dr. Black argued that containment regulations are ill-suited for the level of risk posed by DOE's TRU waste in this example. The EPA and DOE have not yet determined which regulations apply, so no decision can be made.

Another example is the compliance period for DU, discussed earlier. The performance assessments must meet a peak dose—or peak activity—requirement. Peak activity for DU is 2.1 million years. Compare this to the disposal of uranium mill tailings for which the compliance period is shorter due to the use of different approaches for inadvertent intrusion. Mill tailings waste emits significant radiation from radon, but it will take 100,000 years or more for radon to build up in DU. Additionally, oil and gas producers may dispose of NORM and TENORM waste outside of the radioactive waste regulatory regime.[45]

Long compliance periods and other requirements add to the cost of radioactive waste disposal, which in turn can impact nuclear energy generation and nuclear medicine use. Dr. Black judges that overly conservative radioactive waste regulations are having a severe impact on the nuclear industry.

[45]National Research Council (2006b) also cites this example.

3

Successful Disposition Case Studies

Rebecca Robbins, planning committee member and predisposal unit head at the International Atomic Energy Agency (IAEA), moderated this session, which used case studies to highlight examples of successful low-level waste (LLW) management and disposal within current regulatory frameworks. The case studies presented situations in which previously challenging LLW streams[1] were successfully managed and disposed of. The first two presentations in this session provided case studies from the United States; the next two presentations focused on case studies from outside the United States. A discussion was held after all of these case studies had been presented.

The comments from the moderators, the panelists, and other workshop participants are their own. They do not necessarily represent official views of their employers, governments, or other organizations that may be mentioned in the presentations or discussions.

Dr. Robbins began the session by requesting the workshop participants, as they listened to each case study, to identify the "key characteristics" that contributed to its success. Key characteristics include the practices, activities, attitudes, and actions with respect to the case studies and associated regulatory frameworks.

Melanie Pearson Hurley, headquarters liaison in the Office of Field Operations within the Department of Energy (DOE), presented a DOE case study. Greg Lovato, deputy administrator at the Nevada Division of

[1] "Challenging LLW streams" are defined as LLW streams that have potentially non-optimal or unclear disposition pathways due to their origin or content and incompatibility with existing standards, orders, or regulations.

Environmental Protection (NDEP), provided examples of key characteristics for successful disposition from the perspective of a state regulator. For international case studies, Miklos (Mike) Garamszeghy, design authority and manager of technology assessment and planning for the Canadian Nuclear Waste Management Organization, provided two examples from Canada and Gérald Ouzounian, international director for the National Radioactive Waste Management Agency (ANDRA), provided a case study from France.

3.1 UNITED STATES CASE STUDIES

Case Study 1: Separations Process Research Unit Tank Waste Sludge

Mrs. Hurley presented the Separations Process Research Unit (SPRU) project as DOE's case study. In the early 1950s, research on plutonium and uranium separation techniques such as PUREX and REDOX[2] was performed at SPRU within the Knolls Atomic Power Laboratory (KAPL).[3] KAPL, now an active naval nuclear laboratory, is located near Schenectady, New York, adjacent to the Mohawk River. The inactive SPRU facilities occupy about 5 acres of land immediately adjacent to KAPL.

The research at SPRU was performed on a laboratory scale and supported larger operations at both the Hanford Site in Washington and the Savannah River Site in South Carolina. Radioactive liquid and sludge wastes resulting from the SPRU research were stored in seven tanks located on site. The SPRU project timeline was established by the demolition dates for the buildings in which the research was performed and the wastes were stored. There was a strict requirement that the sludge waste be removed and disposed of by spring 2014.

Figure 3-1 provides a cross-section and plan view of two facilities at SPRU. The top drawing is a cross-section of the G2 building, which housed the laboratories, hot cells, and separations processing and testing equipment, and the H2 building, which was used for liquid and solid waste processing. The G2 and H2 buildings are connected by an underground tunnel. The lower drawing in Figure 3-1 shows the plan view of buildings G2 and H2. The tank farm in the lower-right corner of the figure is the focus of this presentation.

The radioactive waste from chemical processing was stored in the H2 tank farm (seven underground concrete-enclosed stainless steel tanks). This waste included about 200 cubic feet (5.7 cubic meters) of sludge consisting

[2]REDOX (reduction oxidation) and PUREX (Plutonium and Uranium Recovery by Extraction) are processes for separating uranium and/or plutonium from irradiated fuel and targets.

[3]In the 1950s, KAPL was a government research laboratory created by the U.S. Atomic Energy Commission (a predecessor agency to DOE).

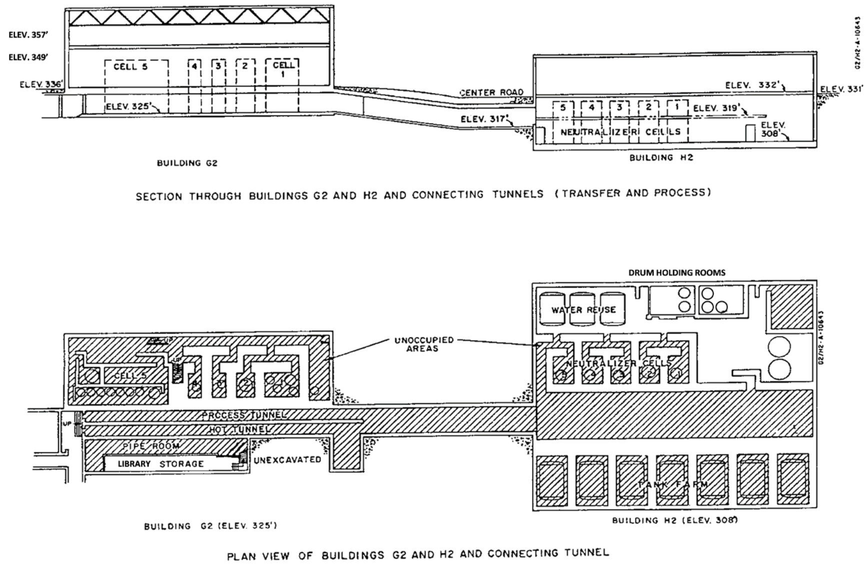

FIGURE 3-1 Schematic of SPRU facility showing cross-sections (top drawing) and plan views (bottom drawing) of Buildings G2 and H2.
SOURCE: Courtesy Jeff Selvey, AECOM.

of fine particulates and liquids containing fission products, mostly cesium and strontium, and long-lived transuranic (TRU) radionuclides, primarily plutonium-239. The sludge contained 36 curies of total radionuclides, including 2.5 to 6.5 curies of TRU radionuclides. The concentration of the long-lived TRU radionuclides in the final waste packages ranged from 11.5 to 65.5 nanocuries per gram (nCi/g).

The total mercury content of the sludge was more than 1 percent, and it contained high levels of lead, chromium, and cadmium. This led to an initial determination that the sludge may be a Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste[4] for metals. This waste classification would have complicated the management of the sludge because the hazardous component would be regulated by the Environmental Protection Agency (EPA) in addition to DOE's regulation of the radioactive component. However, two toxicity characteristic leaching pro-

[4] "EPA: Defining Hazardous Waste: Listed, Characteristic and Mixed Radiological Wastes," accessed February 25, 2017, https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes#character.

cedures (TCLP)[5] confirmed that the hazardous component of the waste was only at 0-3 percent of regulatory levels, due to the low solubility of the metals in the sludge. Consequently, the sludge was determined to not contain hazardous waste and could more simply be managed under DOE orders.

DOE Order 435.1, *Radioactive Waste Management*, was used to guide decisions on disposing of the sludge from SPRU. The Order allows for the disposition of LLW in federal or commercial facilities. An exemption request must be approved by DOE headquarters for waste to be disposed of in a commercial disposal facility. Approval will be given if commercial disposal demonstrates compliance with regulations and waste acceptance criteria (WAC), is cost-effective, and is determined to be "in the best interests of the United States government."

There were two disposal options for the SPRU sludge: the Nevada Nuclear Security Site (NNSS), a DOE disposal site in Nevada, and Waste Control Specialists (WCS), a commercial disposal site in Texas. Both disposal options were explored, and WCS was selected, in part due to the compressed schedule[6] for completing cleanup of the SPRU tanks (spring 2014).

DOE worked closely with Texas regulators and WCS on establishing the waste profile[7] through the standard process described in the WCS Waste Acceptance Plan.[8] Texas regulators accepted DOE's policy that waste is not formally classified until all processing is completed and a stabilized waste form is produced. Mrs. Hurley identified this close collaboration as a "key characteristic" for successful disposition of the sludge.

The plan was to have the waste stabilized using a mixture of cement, fly ash, and slag that was then solidified in the final waste package for transportation and final disposal. The sludge solidification system at SPRU was designed and cold tested off site by the vendor and then installed in the H2 tank vault area. Cold-test operations were conducted on site prior to hot operations to ensure the system would perform as designed.

Figure 3-2 is a schematic of the H2 tank vault area and processing systems. Mrs. Hurley noted that there was an airborne release of radioac-

[5]TCLP testing determines the mobility of organic and inorganic chemical species within in liquid, solid, and multiphasic wastes. TCLP testing follows specific guidelines established by EPA.

[6]DOE had an existing contract with WCS, and WCS allowed for a shorter waste profile review time.

[7]"Waste profiles" are required documents for shipping and acceptance of waste. The waste generator must submit a waste profile of each waste package for approval by the disposal facility prior to shipment. The disposal facility reviews the waste profiles to confirm the waste is compliant with the WAC of the disposal site.

[8]"Application for License to Authorize Near Surface Disposal of Low-level Radioactive Waste, Appendix 5.2-1: Waste Acceptance Plan Revision 9," see Section 5.2: Waste Profile Approval, accessed February 25, 2017, http://www.wcstexas.com/wp-content/uploads/2016/01/Waste-Acceptance-Plan.pdf.

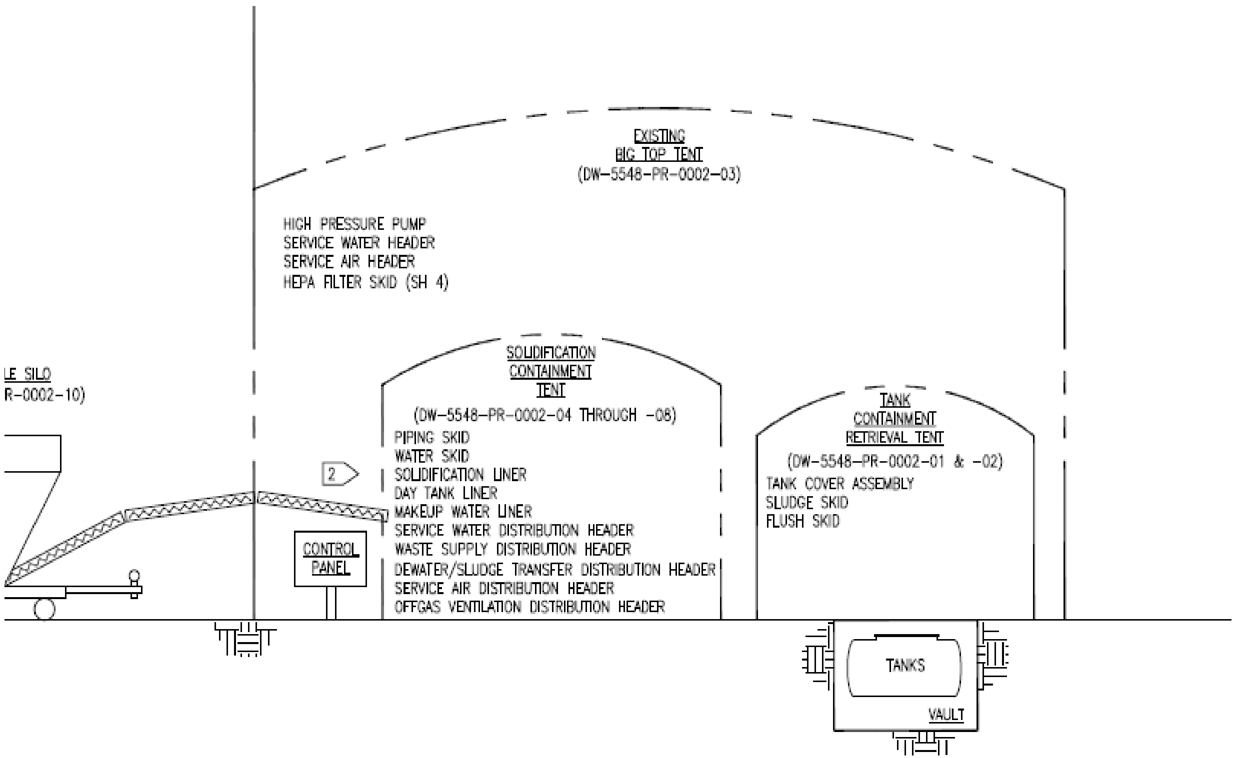

FIGURE 3-2 Schematic of the H2 tank vault area including SPRU processing contamination enclosures consisting of the outer enclosure (Area H2 Tent), the existing Big Top Tent, and two smaller tents for the sludge waste retrieval and processing (the Tank Containment Retrieval and Solidification Containment Tents).
SOURCE: Courtesy Jeff Selvey, AECOM.

tive material at SPRU in 2010. As a consequence of this event, the EPA required DOE to construct a tent enclosure over the H2 facility with portable ventilation units (contained in the outer tent, Area H2 Tent, shown in Figure 3-2). Underneath this larger tent is another tent (Existing Big Top Tent in Figure 3-2) that originally served as a weather enclosure over the tank farm. This weather-enclosure tent was retained when the larger enclosure was constructed to add another level of protection.

Within the Big Top Tent are two additional tents, the Tank Containment Retrieval and Solidification Containment Tents (see Figure 3-2). The sludge retrieval, mixing, processing, and characterization operations were carried out in these tents. Batches of sludge were retrieved from the 509E Tank,[9] mixed to suspend the solids in the waste, transferred to the final waste package, and then combined with cement, fly ash, and slag. The mixture was periodically checked by a penetration test to determine when it was solidified. If there was any remaining free water, additional cement mix was added.

The waste package was moved into a shielded temporary storage area set up in the G2 building (Figure 3-1).[10] The cement mixture curing times were long because the storage area was unheated. Once fully cured, the waste packages were shipped to WCS for disposal.

Sludge processing began on September 9, 2013, and the final shipments to WCS were completed on February 27, 2014.[11] Nearly 10,000 gallons of sludge were processed and solidified in 28 liners. The liners were shipped to WCS via trucks. (There were two liners per truckload and a total of 14 truck shipments.) This campaign removed the majority of the radionuclides from the SPRU site and allowed DOE's deactivation activities to continue in the H2 basement as scheduled.

While this case study highlights many successes, there were obstacles to overcome, including the following:

- Working within a decades-old facility with limited physical and onsite storage. There was no lay-down area where more than one liner could cure at the same time, and the temporary storage area in the G2 building allowed for 3 to 4 liners at a maximum.
- Retrieving sludge from the 509E Tank, including cleaning out solids near the bottom of the tank.
- Working with a waste stream (sludge) that is difficult to characterize and process. A continuous mixing system was used to keep

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[9]In 2010, the sludge was consolidated into a single tank, the 509E tank, in preparation for waste processing and disposition.

[10]Mrs. Hurley noted that, at the same time the liners were temporarily stored there, deactivation activities were also taking place to prepare for demolition of the G2 building.

[11]The schedule accounted for the fact that concrete would not fully cure during the winter months (the SPRU tanks were covered by an unheated processing tent).

solids suspended in the waste so that the final waste form was homogenous.

- Performing the sludge processing work immediately adjacent (less than 25 feet or 7.6 meters) to a currently operating research and development laboratory and during deconstruction of the G2 building.
- Performing this work in a tent-type containment structure (Figure 3-2). Portable ventilation units and the HEPA[12] filters were used to ensure that safe working conditions were maintained.
- Addressing waste classification uncertainties. DOE performed historical research and additional evaluations to show that the sludge waste was not high-level waste and could be managed as LLW.

Several key management practices contributed to the success of this project:

- A dedicated and technically competent workforce that understood the mission objective and the importance of safety, including an excellent DOE federal project director.
- Frequent communications among the DOE participants, DOE staff from headquarters, NNSS, DOE's consolidated business center in Cincinnati, and KAPL, the adjacent research and development laboratory. Support from a "Senior Integrated Project Team" was also key to the success of the project.
- Cold testing of the treatment system at the vendor site and on site prior to operation enabled the right combination of nozzles, sluicing, and camera angles to confirm that the solids were removed from the 509E Tank.
- Early and frequent communication and engagement with the waste disposal experts from WCS.
- Coordination with the expertise throughout the DOE complex on packaging and transportation.

A participant asked Mrs. Hurley how DOE verified that solidification was adequate during cold testing. She responded that the cold testing was primarily to confirm the pump's ability to mix the solids and liquids and to confirm homogeneous mixing. Solidification was not tested or verified during cold testing; rather, a cement and fly ash "recipe" that was used successfully at other sites was used to solidify the SPRU sludge.

[12]HEPA is the acronym for high-efficiency particulate air.

Case Study 2: Low-Level Radioactive Waste Streams Reviewed for Disposal at the NNSS: Key Characteristics, Variation, and Management

Mr. Lovato's presentation included an overview of the waste disposal sites at the NNSS, the waste profile review process, key waste stream characteristics and their variation, and key management steps taken to address some of those different characteristics.

Mr. Lovato explained that NDEP was participating in the workshop because of a memorandum of understanding between the governor of Nevada and the secretary of DOE. One of the goals of the agreement is to hold a workshop to bring more transparency and predictability to DOE's waste disposal decisions. Mr. Lovato expressed thanks that the workshop was taking place. He noted the desire by Nevada citizens for context and predictability in DOE disposal decisions and asked the workshop participants for help in developing a LLW classification system that would foster greater confidence in future disposal decisions; he also admitted that these requests were tall orders.

Mr. Lovato suggested one way to think about Nevada's participation in this workshop is illustrated by a famous line from the movie *Jerry Maguire*, in which the sports agent, played by Tom Cruise, is trying to negotiate a contract for a professional athlete, played by Cuba Gooding, Jr. The sports agent repeatedly asks the athlete to "Help me, help you." The goal of the memorandum of understanding between Nevada and DOE is to "Help us, help you."

The NNSS is located about 65 miles northwest of Las Vegas. The Area 5 disposal facility is a secure, 740-acre site located in the southeast corner of the NNSS (see Figure 3-3). The disposal facility is used to dispose of mixed LLW[13] under a RCRA permit with the state of Nevada. The waste is disposed at depths of up to 24 feet (7.3 meters).

Area 5 receives less than 5 inches (13 centimeters) of annual rainfall, and depth to groundwater is 770 feet (235 meters). Infiltration of precipitation below the plant root zone ceased between 10,000 and 15,000 years ago. Consequently, migration of the waste to groundwater is less of a risk than surface erosion from thunderstorms.

NNSS accepts approximately 1.0-1.5 million cubic feet (28,000-43,000 cubic meters) of LLW, mixed LLW, and classified waste[14] per year from more than 25 different DOE facilities. This amounts to between 5 and 10

[13]LLW containing hazardous chemicals is referred to as "mixed LLW."

[14]DOE defines "classified waste" in Order 435.1 as (DOE, 1999, p. I-2): "Radioactive waste to which access has been limited for national security reasons and cannot be declassified shall be managed in accordance with the requirements of DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*, and DOE 5633.3B, *Control and Accountability of Nuclear Materials*."

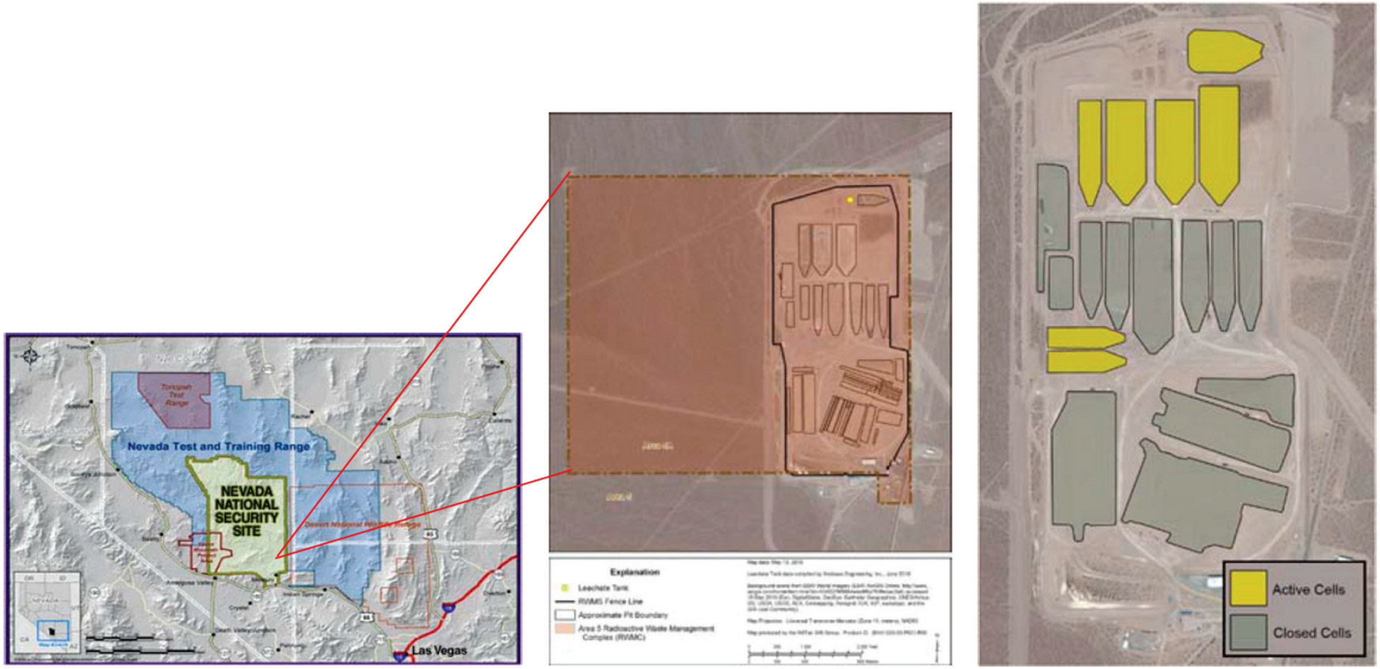

FIGURE 3-3 Maps of the NNSS (left image) and the location of Area 5 (middle image), and Area 5's active (yellow) and closed (gray) cells (right image).
SOURCE: Modified from DOE Office of Environmental Management.

percent of the volume of wastes disposed of across the DOE complex, including DOE wastes disposed of at commercial disposal sites (Marcinowski, 2016).

NDEP is a member of the Waste Profile Review Team. The team includes DOE, contractors, and three members of NDEP and meets weekly to review waste profiles against the NNSS WAC. If a waste stream does not meet the WAC, it will not necessarily be rejected for disposal at the NNSS. The performance assessment for the facility can be reanalyzed to determine whether the waste stream under consideration would meet the facility's performance objectives.

LLW can have a broad spectrum of characteristics. Table 3-1 provides a list of key characteristics of the LLW and mixed-waste streams considered for disposal at the NNSS. (This list was developed by Mr. Lovato based on his experiences at the NNSS.) The table shows that these waste streams have a wide range of half-lives, activities (expressed as a ratio to WAC thresholds), and plutonium equivalent grams.

Using a "plutonium equivalent grams" (PE-g) is a way to normalize the activity of different isotopes in a single package to a single standard (the activity of plutonium-239). This normalization allows for the easy determination of whether a package meets the WAC for the NNSS. (The WAC specifies a PE-g limit for each package.) The WAC for the Waste Isolation Pilot Plant (WIPP) also contains a plutonium equivalency criterion. The list of radionuclides in the WAC for the NNSS is far longer than that for WIPP, suggesting that the NNSS deals with a more diverse range of waste streams. In fact, waste characteristics at the NNSS can have a 6-17 order-of-magnitude range in values (see Table 3-1).

Waste management decisions are usually handled on a case-by-case basis to ensure that waste streams are appropriate for disposal at the NNSS and that stakeholder concerns are addressed. Some of the management steps used at the NNSS include decisions to adjust burial depth or transportation routing, conducting exercises in outreach and notification, and ensuring conditions on any waste profile approvals are met.

Case-by-case decisions can seem ad hoc, subjective, and reactive with-

TABLE 3-1 Variation of Key Characteristics in NNSS LLW Profiles.

CHARACTERISTIC	Radionuclide Half-Life (years)	Ratio of Waste Isotope Activity Level to WAC Thresholds (unitless)	Plutonium Equivalent Grams (g/m^3)
NNSS LLW RANGE	5 to 700,000,000	10^{-9} to 2×10^{6}	2.1 to 3,000,000

SOURCE: Modified from G. Lovato, Nevada Division of Environmental Protection.

out a reference system to compare the decisions to—especially when viewed from the outside. Nevada is interested in facilitating alternatives to disposal at the NNSS, for example by the preventing waste streams from being created and finding alternative disposal locations.

Mr. Lovato suggested a potential categorization scheme for LLW that could aid in final disposition decisions (Table 3-2). This scheme proposes a few key physical, chemical, and radiological characteristics and hazards of LLW that should be considered for its safe and secure management and disposal. Also included are key characteristics of a disposal site (i.e., location, security, and control options such as inherent and engineered barriers of a site). A new regulatory framework would break down these characteristics based on the variety of potential LLW streams and transparently list the proposed disposal criteria.

Mr. Lovato suggested that the regulatory framework should be scalable when considering new LLW streams: concerns about the new LLW stream from the waste generators, recipients, public, and DOE should be captured; options for addressing those concerns should be identified using characteristics similar to those in Table 3-2; and options for the management and disposal of a new LLW stream should be compared against each other in a transparent way. The idea is that this new framework could be created a priori without having knowledge of the LLW streams. This type of regulatory framework would be helpful in providing context on LLW disposal decisions.

Mr. Lovato encouraged the participants not to lose heart in terms of trying to develop a better LLW categorization scheme. He acknowledged that past LLW disposal decisions were likely made for expediency and were weighed against what disposal options and regulatory frameworks were available at the time. But it is incumbent upon us in the present day to improve the system, so that future stakeholders have much-needed context for the decision-making process, which may ultimately improve stakeholder confidence in LLW management and disposal decisions.

TABLE 3-2 Potential Categorization Scheme of LLW to Guide Disposition Decisions

Characteristic	Location	Potential Hazards	Control Options Criteria
Half-Life Activity Fissile Content PE-g Surface Dose Leachability	Where? (Transport?) (Disposal?)	Long Term Protection Radiation Exposure Nuclear Criticality Security	What control options should be evaluated? What criteria should be examined?

SOURCE: Nevada Division of Environmental Protection.

Dr. Robbins asked a clarifying question related to Nevada's desire to facilitate alternatives to the creation of waste streams. Was there a particular waste stream that does not fall within the NNSS' remit to accept? If so, can the NNSS discuss the possible acceptance of this waste stream with the waste generator?

Mr. Lovato explained that it is important to the NNSS and Nevada to not only look for alternative disposal options, but also alternative technologies for generating wastes. For example, the NNSS is seen as the disposal facility for sealed sources. But in Nevada's view, disposal of sealed sources should not default to a single location. So, Nevada is considering alternatives, such as reducing the use of sealed sources to begin with or by considering alternative disposal pathways, so that the NNSS is not relied on for disposal of all sealed sources.

3.2 INTERNATIONAL CASE STUDIES

Case Studies 3-4: Two Low-Level Waste Case Studies from Canada

Mr. Garamszeghy's presentation was split into three parts: background on Canadian nuclear regulation and management, a case study on the Port Hope Area Initiative (PHAI), and a case study on the Deep Geological Repository for low- and intermediate-level wastes. The PHAI disposal facility is currently under construction. The Deep Geological Repository facility for low- and intermediate-level wastes is still in the regulatory approvals phase.

There are 19 operational power reactors at four sites in Canada (three sites in Ontario and one in New Brunswick). All are CANDU[15] pressurized heavy water reactors, and all are owned by the provincially owned electric utilities (Ontario Power Generation [OPG] and New Brunswick Power). Eight of the reactors in Ontario are leased to a private firm for operation, but OPG retains the responsibility for the waste produced by these reactors and for their decommissioning. There are seven other power reactors in Canada in different stages of decommissioning. There are also seven research reactors in Canada, two reactors (one operating, the other shut down) at the Canadian Nuclear Laboratories (located near Chalk River, Ontario) and the others at universities.[16] There are numerous other historic and legacy sites undergoing decommissioning or remediation.

The Canadian Nuclear Safety Commission (CNSC) is the federal nuclear regulator, equivalent to the U.S. Nuclear Regulatory Commission

[15]CANDU refers to CANada Deuterium Uranium reactors. For more information, see: "Canadian Nuclear Association: CANDU Technology," accessed February 25, 2017, https://cna.ca/technology/energy/candu-technology/.

[16]"Canadian Nuclear Association: Research Reactors," accessed February 25, 2017, https://cna.ca/technology/research-development/research-reactors/.

(USNRC) in the United States. Unlike Agreement States in the United States, the CNSC has not devolved any regulatory responsibilities to Canadian provinces.[17] The Canadian Environmental Assessment Agency (CEAA) is the federal agency responsible for the environmental assessment process. In the past there was a Joint Review Panel, which was a project-specific panel set up jointly by the CNSC and the CEAA, to review environmental assessment applications and specific license applications. This process is no longer used for nuclear projects. The proponent or the project owner/operator also has responsibilities as the eventual license holder. The proponents prepare the environmental assessment, the safety report, and the thousands of pages of support documentation.

The CNSC takes its authority from the Nuclear Safety and Control Act of 2000. It is a "quasi-judicial administration tribunal" that reports directly to Parliament. The commission members are independent and mostly part-time. All of the commission hearings are open to the public and are webcasted.

The CNSC has federal jurisdiction over both nuclear facilities and activities, much the same as the USNRC. It also provides regulatory oversight of all the licensees and disseminates objective scientific, technical, and regulatory information to the public—a fairly important role when it comes to public engagement for nuclear- and waste-related projects. The decisions of the CNSC can only be challenged through judicial review in federal court. The CNSC's decision making is transparent and science-based, at least in theory.

Risk assessments that apply to waste disposal include both a normal evolution scenario (climate change and gradual loss of engineered barriers) and disruptive scenarios (such as human intrusion). The assessment timeframe encompasses the time of maximum calculated impact (e.g., peak dose). In the case of a radioactive waste disposal facility, that time may be several million years in the future. The dose constraint for the normal evolution scenario is 0.3 milliseiverts per year (mSv/yr), equivalent to 30 millirem per year (mrem/yr). For disruptive scenarios, it is usually only a guideline of 1 mSv/yr (or 100 mrem/yr).

Canada has several types challenging LLW streams including:

- Higher activity wastes
  - significant amounts of carbon-14 from CANDU reactors,
  - irradiated/activated zirconium and niobium hardware from reactor refurbishments,
  - high-activity cobalt-60 waste, and

[17] Mr. Garamszeghy identified one exception as some uranium mines in Saskatchewan, which has a dual federal-provincial regulatory framework.

    — stored tritium (each storage canister holds about half a million curies of tritium).

- Waste from small waste generators who may have difficulty identifying disposal pathways, especially for intermediate-level waste; and
- Large volumes of historic wastes, of which characteristics and quantities not always well documented.

The PHAI will dispose of approximately 2 million cubic meters of waste, mostly soils, in engineered mound-type facilities with multicomponent caps. This disposal will take place in two locations near Port Hope and Port Granby, located east of Toronto. The Port Hope facility is expected to be in operation in 2017; the Port Granby facility is expected to be in operation in 2018. Most of the wastes to be disposed of in these facilities are located at these facilities or nearby.

The history of the sites that are hosting these facilities can be seen in Box 3-1. The Port Hope site was used first for radium refining and later for uranium refining. These activities contaminated the site and produced large volumes of waste. A task force was established in 1988 to find a site in Canada to dispose of the Port Hope wastes. The task force was unable to reach an agreement with a community in Canada to host a site primarily because of concerns about transporting large volumes of radioactive waste.

In 1997, Hope Township initiated a proposal to construct a long-term waste management facility near the Port Hope site. The PHAI was initiated in 2001, and environmental assessments were completed for Port Hope and Port Granby projects by 2009. Part of the agreement includes the Property Value Protection (PVP) program, which will compensate homeowners should the value of their property be reduced by the presence of the facilities.

The CNSC granted the construction license for the facility in Port Hope in 2009 and a construction license for Port Granby in 2011. The federal government made a major commitment of more than $1 Canadian billion to fund the construction of the two sites in 2012.

The Deep Geological Repository for low- and intermediate-level waste will be used to dispose of OPG-owned waste (i.e., waste from the operation and maintenance of OPG-owned facilities). The repository site is located near the Bruce Nuclear Generating Station on the eastern shore of Lake Huron in Ontario.

The community near the Bruce station volunteered to host the disposal facility. The community preferred that a single facility be used to dispose of all of OPG's waste. Accordingly, a deep geologic repository was designed for co-disposal of low- and intermediate-level wastes. A near-surface facility would not have been able to accept all of the intermediate-level wastes

BOX 3-1
History of Port Hope and Port Granby sites

- **1932:** Eldorado Gold Mine Ltd. opens radium refining facilities in Port Hope, Ontario
- **1942-1954:** Production emphasis shifts from radium to uranium refining
- **1930s-1970s:** Properties and sites in the Town of Port Hope become contaminated from spillage during transportation, unrecorded, unmonitored or unauthorized diversion of contaminated fill and materials, wind and water erosion, and spread from residue storage areas
- **1976-1981:** Atomic Energy Control Board (forerunner of CNSC) directs a large-scale radiation reduction program in the Town of Port Hope (over 100,000 tonnes of contaminated soil are transferred to a site at Chalk River Laboratories)
- **1982:** Low-Level Radioactive Waste Management Office (LLRWMO) is established by the federal government to manage historic waste in the Town of Port Hope and across Canada
- **1988:** The federal government establishes a Siting Task Force on Low-Level Radioactive Waste Management to site a permanent management facility for Port Hope area wastes
- **1988-1996:** Siting Task Force invites all Ontario municipalities to consider hosting a long-term management facility for low-level radioactive waste. A few communities initially volunteer, but no agreement is reached
- **1997:** Hope Township initiates a community proposal to construct a long-term waste management facility for wastes at the Welcome Waste Management Facility
- **1998:** Port Hope and Clarington also develop proposals to establish long-term management facilities for low-level radioactive wastes within their communities
- **2000:** The Government of Canada and Hope Township, Port Hope (now amalgamated to form the Municipality of Port Hope), and Clarington initial "Principles of Understanding" outlining terms for a project to clean up low-level radioactive waste
- **2001:** The Port Hope Area Initiative begins. A legal agreement is signed that commits the federal government and the municipalities to the safe cleanup, transportation, isolation, and long-term management of historic, low-level radioactive waste
- **2002-2009:** Environmental Assessments completed for Port Hope and Port Granby projects
- **2009:** CNSC grants initial Port Hope Project licence; in 2012, 10-year licence amendment granted to complete project
- **2011:** CNSC grants 10-year licence for Port Granby Project
- **2012:** Phase 2 construction begins when the government of Canada commits $1.28 Canadian billion to complete the Port Hope and Port Granby projects

SOURCE: M. Garamszeghy, LLW presentation, Session 2, slides 14-15.

currently stored on the site. Also, a single deep geologic repository is less costly than building two separate disposal facilities.

The repository has a design capacity of about 200,000 cubic meters as packaged for disposal at a reference depth of 680 meters. Operation was originally expected to begin in the mid-2020s. The repository is currently in the regulatory review process (which is taking longer than the originally scheduled 2 years).

The official hosting agreement was signed in 2004 and was approved by the community in 2005 based on an independent poll of all year-round and seasonal residents.[18] It provides approximately $30 million in compensation to both the official host town (Kincardine) and other surrounding communities. The compensation is tied to project milestones until the repository construction is complete. After disposal operations begin, the compensation is akin to an annual fee.

The environmental assessment and licensing documentation was submitted to the CSNC in April 2011, but Canadian federal elections delayed the appointment of the Joint Review Panel until January 2012. The Joint Review Panel then implemented a public comment period that was originally planned to last for 90 days. However, the period was repeatedly extended and lasted for more than 1 year. There were, in total, 31 days of public hearings, which created 20,000 pages of documentation and more information requests from the Joint Review Panel and public. The Panel's report was submitted to the CSNC in May 2015; it strongly recommended the repository proceed to the licensing phase.

CEAA then held a public comment period. A decision by the Minister of Environment was expected in September 2015 but was subsequently extended to December. Another Canadian federal election in fall 2015 resulted in a change in government. The new minister asked for more work to be done. The responses to the minister's request are expected to be submitted by the end of 2016 with a final decision by the minister on the environmental assessment in early 2017.[19] If the minister approves the project it will move to the licensing phase.

This project has had several successes. Throughout the public review—with extensive local, national, and international scrutiny—the scientific evidence remained sound and passed all credible challenges. Despite a number of changes in government, local leadership, and residents, the politicians

[18]There is a large contingent of weekend cottage owners in the area. When the poll was conducted, both full-time and part-time homeowners were contacted.

[19]Note: the most recent update on this process was posted on April 15, 2017. The public comment period was closed on March 7, 2017. On April 5, 2017, CEAA requested additional information from OPG. "CEAA: Deep Geologic Repository Project for Low and Intermediate Level Radioactive Waste," accessed April 27, 2017, http://www.ceaa-acee.gc.ca/050/details-eng.cfm?evaluation=17520.

and the local community remained supportive. The project delays have allowed some opposition groups in Canada and the United States to organize and gain some support. Some members of the public became confused between two nuclear waste disposal projects planned in the same area, one for OPG's low- and intermediate-level waste and the other for spent fuel. Public outreach continues, and OPG continues to respond to public questions and concerns. The formal decision by the Minister will define the project's next step.

Case Study 5: The French Case: Low-Level Radioactive Waste Management

Dr. Ouzounian's case study provided insight into the French approach to disposing of very low-level waste and LLW. He noted that his presentation focused mostly on the LLW because it is more challenging and more interesting in terms of approach and process.

ANDRA is responsible for the long-term management of all radioactive waste produced in France. The agency is independent from waste producers and reports to ministers in charge of the environment, energy, and research. It has approximately 650 employees with an annual budget of €250 million. ANDRA's work is performed within the framework of the *Planning Act of June 28, 2006* on the sustainable management of radioactive materials and wastes.[20]

Safety of the population and protection of the environment are set by a national framework law and are of the highest priority in determining disposal pathways for waste. Forecasts and inventories of waste lead to a National Management Plan, which is used to identify disposition pathways for all types of waste.

There is an effort to identify a safe disposition pathway proportionate to the hazard for each type of waste. French regulations do not allow for clearance of wastes from nuclear-related activities. France uses a policy of "waste zoning" at the generator's plant to segregate waste from zones that generate radioactive waste from those that do not.

The French radioactive waste classification scheme is shown in Figure 3-4 and described below:

- Intermediate-level and low-level wastes are generated by the day-to-day operations at the nuclear power plants (NPP; green box in Figure 3-4). These wastes, previously disposed of at the Centre de la Manche disposal facility (CSM), are currently being sent to the

[20] "ANDRA: Overview of national policy concerning radioactive waste management," accessed February 25, 2017, http://www.andra.fr/international/pages/en/menu21/national-framework/overview-of-national-policy-1593.html.

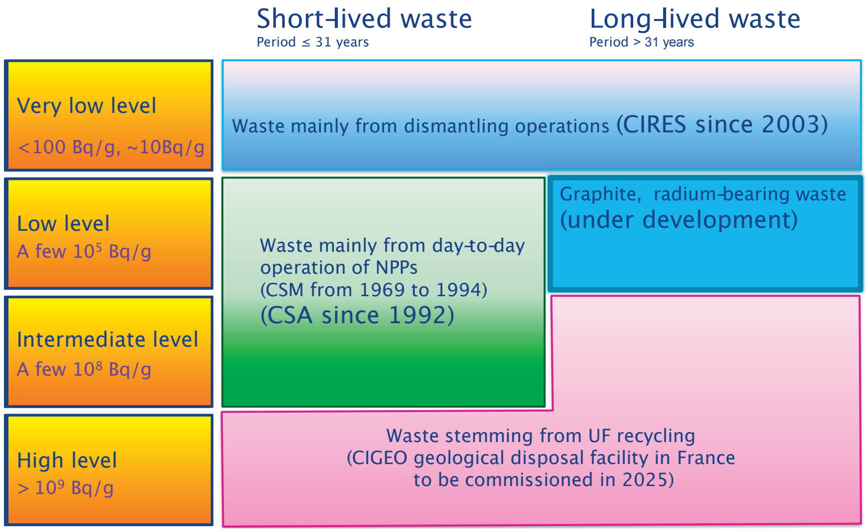

FIGURE 3-4 Classification of radioactive waste streams in France.
NOTES: Bq/g=becquerel per gram, CIGEO=Cigéo Project, CIRES= Centre industriel de regroupement, d'entreposage et de stockage facility, CSA= Centres de stockage de l'Aube, CSM=Centre de la Manche, NPP = nuclear power plant, and UF=used fuel.
SOURCE: Gérald Ouzounian, ANDRA.

Centres de stockage de l'Aube (CSA), which has been operational since 1992.

- Intermediate-level and high-level wastes are generated during uranium fuel recycling (i.e., reprocessing) (pink box in Figure 3-4). This waste will be stored in the geological disposal facility, the Cigéo Project.[21]
- Very low-level waste is generated from shut-down and decommissioning (or dismantling) operations. This waste is disposed of at the Centre Industriel de Regroupement, d'Entreposage et de Stockage (CIRES) facility (upper blue box in Figure 3-4).
- Low-level, but long-lived, waste, is generated from graphite gas-cooled reactors and, for example, from the production of rare earth metals (lower solid blue box in Figure 3-4).

[21]France has made progress toward addressing its intermediate- and high-level wastes through the Cigéo Project, constructed in a clay formation at 500 meters depth and expected to be commissioned by 2025.

Waste from small producers or other nuclear activities can span the range of waste types shown in Figure 3-4 but represents a minor part of the inventory.

There are two characteristics shown in Figure 3-4: activity levels and half-lives. Activity levels (rows in Figure 3-4) span orders of magnitude (less than 100 becquerels per gram [Bq/g] to more than 1 billion Bq/g) because there are specific threshold values for each radionuclide. Activity levels for very low-level waste range from 0 to 100 Bq/g with an average value of approximately 10 Bq/g. Waste is classified as "short-lived" or "long-lived" based on whether its half-life is less than or equal to or greater than 31 years, respectively (columns in Figure 3-4) . The 31-year half-life is approximately the half-life of cesium-137, which is 30.17 years.[22]

It is not possible from an operational standpoint to separate short-lived and long-lived radionuclides in NPP waste. There are always some long-lived radionuclides in this waste. WAC for very low-level and low-level disposal facilities in France allow for the disposal of waste containing certain amounts of long-lived radionuclides.

The principles behind radioactive waste disposal in France are, first, to contain and isolate the waste until it reaches a level of activity that does not represent significant hazard to the public or the environment (the monitoring phase in Figure 3-5). And, second, to limit the transfer of waste to the biosphere and to humans (the post-monitoring phase in Figure 3-5). As seen in Figure 3-5, the containment phase lasts for about 300 years for near-surface disposal of waste with low levels of activity and several hundreds of thousands of years for geological disposal of high-level waste.

Dr. Ouzounian described the CSA disposal facility for low-level and intermediate-level short-lived waste. The facility was licensed and commissioned in 1992 with a total capacity of 1 million cubic meters—enough capacity to contain all of the low- and intermediate-level radioactive waste generated by the present fleet of French NPPs (58 reactors). The CSA facility was designed to contain and isolate the waste for 300 years, as required by the monitoring requirement mentioned previously, and to meet the requirements for the long-term post-monitoring phase.

The French waste disposal system employs the "defense-in-depth" concept with a multi-barrier system. The system consists of the waste package, which includes a containment material enveloping the waste (the first barrier); the disposal vault, which includes a network control gallery to control water that may flow through the disposal facility and final cover (the second barrier); and the geological environment, which has natural barriers such as

[22]The *Planning Act of June 28, 2006* on the sustainable management of radioactive materials and waste specifies that the half-life cut-off between short-lived and long-lived waste is 31 years.

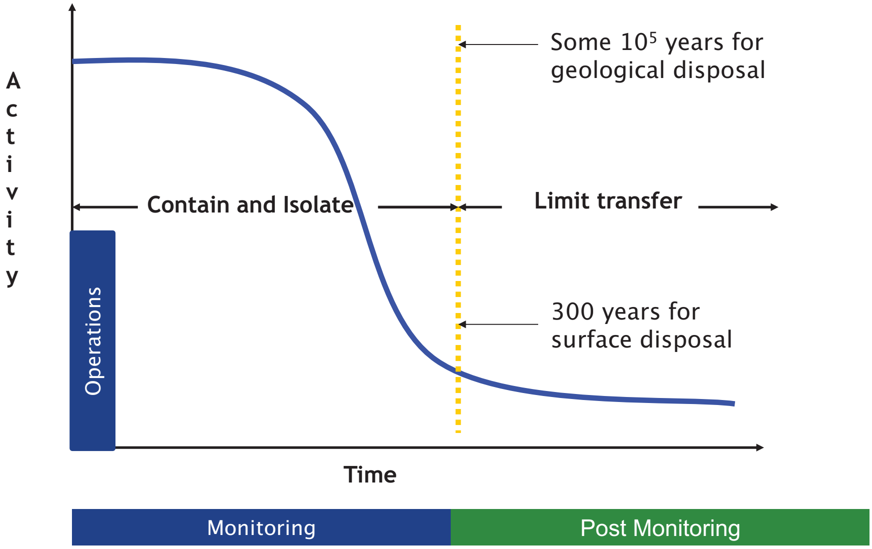

FIGURE 3-5 Disposal principles in the French radioactive waste management system.
SOURCE: Gérald Ouzounian, ANDRA.

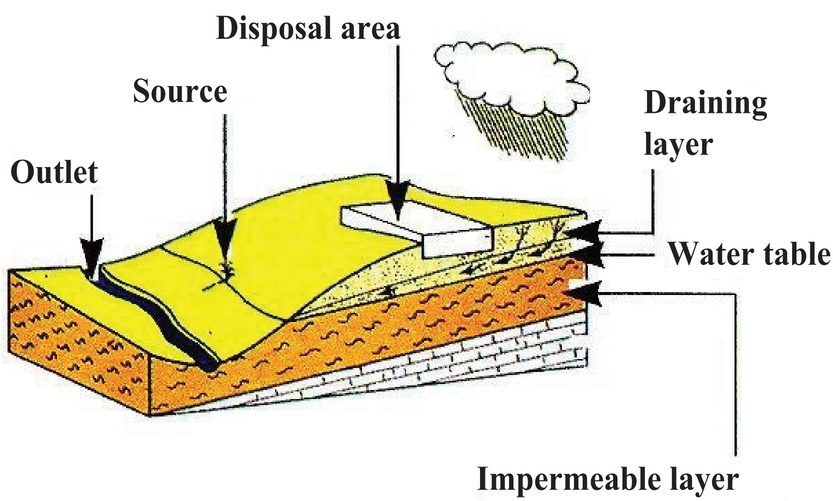

FIGURE 3-6 The French near-surface radioactive waste disposal concept.
SOURCE: Gérald Ouzounian, ANDRA.

clay to retard waste migration (the third barrier). This third barrier is the most important barrier in the post-monitoring phase.

Figure 3-6 is a schematic of the defense-in-depth disposal concept. A draining layer underlays the disposal facility, which in turn is underlain by an impermeable layer. The water table is shown with an outlet, labeled as "source" in the figure.

Inventory monitoring is essential for the effective management of radioactive waste—especially for managing long-lived radionuclides such as carbon-14, chlorine-36, and some beta emitters. NPP operators do not generally monitor for these isotopes because they do not impact daily plant operations. Therefore, the French regulator has established specific characterization requirements for these radionuclides for disposal purposes. For near-surface waste disposal, long-lived radionuclides are the major contributors to public doses in the post-monitoring phase.

Dr. Ouzounian's presentation also introduced France's approach to safety assessments, details on waste control acceptance criteria, and examples highlighting key aspects of safe operations and the defense-in-depth concept. Of particular relevance to this workshop was a discussion on the WAC for waste packages. These include:

- Radiological content
- Physical characteristics
- Chemical stability
- Gas generation
- Expected performance for long time periods
- Leaching rate
- Uniform distribution within the waste package (no hot spots)

Dr. Ouzounian provided historical perspective on the progression of safety rules, disposal concepts, and protection criteria in France. The safety rules were defined progressively, learning through the operational experiences of disposal facilities. Documents were updated and improved according to the experience of the operators—not the regulatory body. However, any changes to improve the safety rules are validated and endorsed by the regulatory body. General operational rules, and safety and radiation protection criteria, are also updated continuously.

John Applegate, the planning committee chair and executive vice president for University Academic Affairs of Indiana University, asked where the WAC (bulleted list above) came from and whether they had a risk basis. Dr. Ouzounian noted that the WAC were generated from safety assessments. Mr. Applegate also commented that experience at the prior disposal facility (CSM) appeared to be very helpful in designing the new facility (CSA), to which Dr. Ouzounian strongly agreed. All the incidents and malfunctions

that occurred with the first disposal facility—which was designed without the benefit of detailed computer models—allowed for improvements to the new facility. The first safety regulations (1984 and 1985) are the result of the experiences from the first facility.

Dr. Ouzounian also noted the importance of adapting to knowledge gained from waste disposal experience in general. The process of developing an approach for the management and disposition of nuclear waste began in 1969, and much has been learned progressively. For example, it is now clear that the physical processes likely to occur should be well-understood and well-described, which requires high-quality modeling due to the long timescales involved. It is not possible to run an experiment for 100 to 300 years (or longer) to determine what may happen. The values, characteristics, and sources of hazards that are used in our assessments are the result of the models. This is why waste disposition decisions are site-specific, and also why we cannot transpose from one site to the other.

Dr. Robbins asked for clarification on one aspect of the French waste classification scheme. Is the irradiated graphite shown in Figure 3-4 considered LLW or intermediate-level waste according to the French classification scheme? Dr. Ouzounian explained that it is considered to be low-level but long-lived radioactive waste. One of the disposal options being studied is to segregate different types of graphite for disposal in different types of facilities depending on its irradiation level and activity.

3.3 DISCUSSION: KEY CHARACTERISTICS OF LLW AND CHALLENGING LLW STREAMS

Workshop chair John Applegate moderated the closing discussion on the first day's presentations. He noted that three organizing elements for managing challenging LLW streams were discussed:

- *Characteristics of the waste*. Defining waste characteristics is a technical issue. Mr. Applegate suggested that one could identify which characteristics are most important for making LLW disposal decisions. Alternatively, one could identify which characteristics are not important and are unnecessarily complicating waste disposal decisions.
- *Waste management practices*. Mr. Applegate asked whether participants could identify management practices that were unnecessarily slowing waste management decisions.
- *Regulatory framework*. Mr. Applegate asked participants to identify aspects of the current U.S. regulatory framework that are perceived to be failing. What can we learn from the experiences of other nations and international bodies? Mr. Applegate noted that

regulatory flexibility is seen to be both useful as well as problematic. How do we manage that flexibility to make it useful, particularly with respect to increasing the predictability of the regulatory framework and/or eliminating requirements that aren't helpful?

Flexibility as a Double-Edged Sword

Kevin Crowley, director of the Nuclear and Radiation Studies Board at the National Academies, suggested that diversity and flexibility within disposal decision making is a double-edged sword. There is not much trouble handling diversity and flexibility from a technical standpoint. Where decision makers tend to fail is when they try to explain the diverse and flexible process to the people they serve. Dr. Crowley noted the importance of clearly communicating with the people who are served about the decision process: say what you are going to do, and do what you say you are going to do. Clear communication may be difficult when a system is too flexible and diverse.

Dr. Ouzounian argued that flexibility is crucially important, but it cannot be "free" flexibility. The flexibility needs to exist within a regulatory framework with clear rules, and one must be able to demonstrate that alternatives are safe and effective.

Mr. Applegate asked what a diverse and flexible framework might look like for LLW management. Mr. Garamszeghy responded that there are probably a couple approaches for establishing such a framework. One might use a performance standard, which requires a demonstration of how waste containment will be achieved. As long as the site is operated within an approved performance standard, there would be flexibility to make disposal decisions that meet that standard. This would be more flexible than a system that is based on compounding and conflicting regulations on allowable disposal options by waste type. Mr. Garamszeghy acknowledged that detailed regulations provide additional guidance to the user, but they also make it difficult to find innovative solutions when exceptions are presented.

Paul Black, chief executive officer of Neptune and Company, Inc., noted that although flexibility is critically important, cost-benefit analysis should also be considered in regulatory decisions and discussions. The current U.S. regulatory framework limits flexibility in strange ways because of competing regulatory structures. In order for the structure to change for the better, Dr. Black argued, one should strive for regulations that are simple and guidance that is process-oriented (rather than prescriptive) and based on cost-benefit considerations. The U.S. Office of Management and Budget (OMB) has the responsibility to evaluate new policies and rulemakings. As part of that evaluation, a cost-benefit analysis must be performed. OMB

has developed guidance on using cost-benefit analysis.[23] Dr. Black suggested that both DOE and the USNRC should consider this guidance.

Mr. Applegate offered ALARA[24] as an example of a cost-benefit construct. Dr. Black strongly agreed and suggested that sustainability is another example. Sustainability balances three pillars: costs/economics, sociopolitical factors, and environmental factors. Dr. Black suggested that a framework for regulatory decision-making should combine the sustainability context (National Research Council, 2011b) with OMB's approach and guidance. Dr. Ouzounian noted that before cost-benefit can be assessed, safety must first be robustly demonstrated with a defense-in-depth approach.

Jennifer Heimberg, rapporteur and National Academies staff, asked Mr. Lovato whether he found it beneficial to have flexibility with the way DOE regulates over the USNRC's approach. She asked for any specific examples that showed how DOE's flexibility was utilized. Mr. Lovato noted that the NNSS does not have advance information about the variety of waste streams that will require disposal, so the DOE Orders are a good management structure for evaluating different types of waste streams. As an example, he cited radioisotope thermoelectric generators (strontium-90 sources originally from the Air Force) that required disposal. This waste had to be evaluated slightly differently from other waste streams; the flexibility in the DOE Orders allowed for that. However, he noted that it is always helpful to have a framework (e.g., the USNRC waste classification system) that can be used to explain waste management decisions to members of the public. Mr. Lovato was not advocating that a USNRC framework be used for DOE waste, but he cited it as the type of framework that is helpful for discussions with the public.

Elevating the Importance of Site Characteristics

Mr. Garamszeghy previously suggested that performance assessments be used as a framework for allowing flexibility in decisions while also providing boundaries. Mr. Applegate took this idea a step further by suggesting the following: One of the criticisms of the current U.S. regulatory framework is that it focuses on waste sources. What if the framework

[23] "Circular A-4: Regulatory Impact Analysis: A Primer," accessed March 27, 2017, https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/regpol/circular-a-4regulatory-impact-analysis-a-primer.pdf. Circular A-4 is referenced in the Trump administration's interim guidance: https://www.whitehouse.gov/the-press-office/2017/02/02/interim-guidance implementing-section-2-executive-order-january-30-2017.

[24] ALARA is "as low as reasonably achievable" and refers to the practice of reducing exposure to ionizing radiation through every reasonable effort. "USNRC: ALARA," accessed February 25, 2017, https://www.nrc.gov/reading-rm/basic-ref/glossary/alara.html.

instead focused on disposal facilities? In other words, disposal decisions would be based on whether the waste could be safely disposed of in a facility as demonstrated by a performance assessment, irrespective of the waste source. For example, for waste potentially being sent to WCS, one would ask, "What does it take to make it safe there?"

Mr. Shrum supported this idea and restated it in another form: "Consider the waste. It can go here. It can't go there." He noted that performance assessments have been done at all of the U.S. disposal facilities and is required under 10 CFR Part 61. But Mr. Shrum noted a potential communication problem with this approach: those whom we serve do not necessarily understand the details of a performance assessment, so they will not necessarily trust the output of the analysis. He said that the members of the public often do not understand that performance assessments are used to guide—not make—decisions. He supported Mr. Applegate's approach, but he noted that effective ways would need to be developed to educate the public for this approach to be successful.

He also noted that scientific understanding of radioactive wastes and disposal facilities have grown significantly since the 1950s, when commercial radioactive wastes were first disposed of. Mr. Shrum argued that this new understanding must be used to inform current disposal decisions. The nuclear industry as a whole has not been very good at describing the technical rationale for disposal decisions to the public, and, Mr. Shrum believes, that will have to change as part of a new framework.

Dr. Crowley noted that the workshop was intended to focus on exceptions. There are many exceptions to the existing regulations and rules, and there are questions about the best way to handle exceptions in the future. One option is to change the rules to include the exceptions. But this is unlikely in the short term. Another option is to establish procedures to handle the exceptions, for example by establishing "mini rules" that may not be incorporated into the regulations. Those mini-rules could be implemented at disposal facilities using their WAC, which of course are based on performance assessments.

However, it is difficult to anticipate the full variety of wastes that might come to a facility during its design or construction stages. On the other hand, one could probably think about unanticipated wastes during the design and construction stages and determine how they might be handled. Facility-specific performance assessments are a reasonable way to proceed.

Mr. Applegate commented that Dr. Crowley appeared to have endorsed his idea of focusing on disposal facilities instead of the waste source. A disposal facility could develop WAC to which waste streams are matched. Dr. Crowley agreed that this approach could work as long as the analysis was done within the framework of the current regulations. A near-surface disposal facility is only going to take certain types of waste; the framework

suggested by Mr. Applegate should not be used to try to dispose of highly radioactive waste in near-surface facilities.

Dr. Black disagreed with the approach suggested by Mr. Applegate, primarily because he is not content with current regulations for radioactive waste disposal. They are overly conservative, so WACs developed using the existing regulations will also be overly constraining. For example, the inadvertent intrusion scenario in the regulations makes no sense for arid disposal sites according to Dr. Black.

Several years ago, Dr. Black developed a performance assessment for the Nevada Test Site (now NNSS), which allowed a user to enter the characteristics of a waste stream and get an answer within hours on whether it could be disposed of at the site (DOE, 2006 and Crowe et al., 2005). Dr. Black argued that this is a better approach than WACs for evaluating whether a waste stream can be disposed of in a particular facility.

Taking Advantage of Knowledge Gained

Mr. Shrum previously introduced the idea of taking advantage of knowledge gained over decades of disposal operations, and Dr. Ouzounian also mentioned this idea in his case study. Scott Kirk, director of regulatory affairs at BWXT, raised this issue for further discussion, noting that the nuclear waste disposal industry has matured over the past 40 years. Modern state-of-the-art disposal facilities such as the WCS facility in Texas are remarkably different in siting and design than older disposal facilities such as Barnwell, which was state of the art in 1969. The modern sites are in arid environments, far removed from water tables, and designed with insights from 40 years of operating experience. These modern sites might be suitable for disposal of challenging LLW waste streams that could not be disposed of in older facilities. It would be useful to assess the suitability of current regulatory requirements against these modern facilities.

Charles Maguire, director of the Radioactive Materials Division within the Texas Commission on Environmental Quality, highlighted the current state of regulations through an analogy. Most of the huge gothic cathedrals in Europe took approximately four generations to build. The last generation to work on the cathedral had little understanding of the reasons for the size, shape, or composition of the cornerstone. Yet the cathedral was built on it, and the generations of workers that followed improved their skills as cathedral construction progressed. Mr. Maguire noted that we are about to pass our nuclear knowledge on to a fourth generation of workers. But we are telling these workers to use the same tools and techniques as previous generations. We are not "getting better."

Mr. Maguire asserted that we have to get better and to apply what we learn. We now take without question what the generation before said was

essential, and we do not apply what has been learned about mitigating risk. He concluded that we need to make sure that as we build up the structure it becomes more beautiful or practical and that we are on a path to do better. Otherwise, we may end up with a regulatory framework that no one can afford to use.

From the Outside Looking In: Public Perception

Ms. Edwards suggested that terminology is important in communicating with the public, and that the LLW classification system makes clear communications difficult. Previously, one could refer to Class A LLW as a hazard that lasted about 100 years, Class C waste as a hazard that lasted 500 years, and high-level waste as a hazard that lasted tens of thousands of years. This hazard differentiation is important because the public can become confused between high-level and low-level waste. But the 1,000-year compliance period for certain types of LLW in the proposed 10 CFR Part 61 regulation blurs the previous hazard distinctions.

Mr. Camper noted that USNRC staff were trying to address the disposal of large amounts of depleted uranium and used this opportunity to add a requirement that was not previously embodied in the regulation (but should have been). The existing 10 CFR Part 61 does not specify a period of compliance but the proposed 10 CFR Part 61 rulemaking specifies a two-tiered approach to a period of compliance, i.e., Tier 1 at 1,000 years and Tier 2 up to 10,000 years.

Mr. Garamszeghy noted that the public perceives "nuclear" and "waste" as highly dangerous in part because of the complicated and prescriptive regulations that govern them. The thought is, "It must be dangerous because there are all these regulations to protect us."

Mr. Applegate asked Mr. Garamszeghy to expand on his presentation about compensating the communities in which the Port Hope and Port Granby LLW facilities were sited. Was there a "general sense of fairness" argument? Or was it seen as compensating for risk? Or simply paying for the privilege? Mr. Garamszeghy explained that the intent of the PVP program was never to, for lack of a better word, "buy" public support. Rather, it was recognized that building and operating the LLW facility would strain the local communities in terms of a number of new people coming in and wear and tear on public facilities, for example. The PVP program ensured that the local towns, communities, and people were no worse off after the facility was in place than they would be if the facility was not there.

Dr. Crowley commented on the recurring topic of public perceptions and communications. The term "educating the public" is often used. He finds this term to be denigrating because it suggests that the public is not educated and that, if it were, the public would agree with the experts'

conclusions—which is not always the case. Two-way communications are required to understand the concerns that the people who live around sites have about those sites.

Dr. Ouzounian noted that the term "stakeholders" is no longer used in France. Rather, the terms "concerned" or "interested parties" are used because this involves all parties, including waste producers and academics.

He also noted that the French Parliament passed a law in July 2016 as the result of a public debate on social benefits and responsibilities. The current generation benefits from the electricity generated by nuclear power plants, so it should be responsible for solving the waste management problem for following generations. The law required that a master plan describing all the major milestones of the lifetime of each disposal facility be developed and periodically reviewed. Initially, the planned review period was 10 years. However, Parliament decided that reviews will occur every 5 years with the involvement of all concerned or interested parties.

Dr. Ouzounian also commented on compensation to local communities. Compensation is provided because of expected damage to the infrastructure and the environment, resulting for example from large numbers of trucks on the roads during construction, not from increased risk. Parliament had another important debate in 2006. One side was arguing that nuclear industries were "buying the public" by giving money to communities. The other side was argued by the high commissioner for nuclear power in France. He pointed out that one community will accept the waste that belongs to all French people benefitting from electricity. This one community shows their solidarity with the country. He argued that, therefore, it was the responsibility of the rest of France to also show solidarity by supporting the community in developing its territory and its activities. This latter argument was accepted by the Parliament and ended comments about "buying the people."

Dr. Black also commented on communication and public perception. He recalled that Mr. Shrum said that issues with LLW are more political than technical. The politics really come down to stakeholders, which means everyone associated with the disposal facility or the potential facility and the affected communities. The different outcomes for the Yucca Mountain and WIPP facilities provide a good example. In both cases, decisions on facility siting and construction were influenced by stakeholders and the political environment rather than the technical analyses. Dr. Black believes it is important to understand and "get on top of" the stakeholder issues before addressing regulatory change.

Mr. Camper spoke about the evolution of stakeholder engagement on USNRC decisions. Earlier in his career at the USNRC, staff would create new regulations and guidance documents without public input. But that changed over time for a number of reasons, not the least of which were

regulatory failures. Stakeholders and interested parties demanded that decisions not be based entirely on the USNRC's scientific analyses. These demands have changed the way new regulations are developed and released.

"Regulatory Morass" Redux

Dr. Black commented that the "regulatory morass" that he referred to previously includes TRU waste. Defense TRU waste must be disposed of at WIPP, a deep geologic repository, but commercial waste containing less than 100 nCi/g of TRU nuclides can be disposed of in a near-surface disposal facility meeting the requirements of 10 CFR Part 61. Also, there are multiple regulations from DOE, USNRC, EPA, and the states for disposal facilities, some of which overlap or are in conflict.

4

The Common Themes Approach

A conceptual framework to guide future discussions and disposition decisions about challenging low-level radioactive waste (LLW) streams[1] was explored in the final session of the workshop. Case studies presented earlier in the workshop were discussed and "common themes" that led to successful disposition of previously challenging LLW streams were identified. Those themes were organized into a "common themes approach," which was initially presented by John Applegate, planning committee chair. Workshop participants were then divided into five subgroups, each focused on applying the common themes approach to a challenging LLW stream:

- Greater-Than-Class C (GTCC) waste and transuranic (TRU) waste
- Incident waste
- Sealed sources
- Very Low-level and Very Low-Activity Waste
- Depleted uranium (DU)

[1] "Challenging LLW streams," as used in these proceedings, are LLW streams that have potentially non-optimal or unclear disposition pathways due to their origin or content and incompatibility with existing standards, orders, or regulations. This is an imperfect definition as demonstrated by several of the waste streams in the list on this page. For example, many sealed sources do have disposition pathways—this workshop focused on the waste streams that are difficult to dispose of. For example, very low-level waste streams can be disposed of in existing disposal facilities, but the level of protection is not commensurate with the hazard and is therefore not optimal.

These wastes are described later in this chapter and in Appendix D. The subgroups came together at the end of the session to report their results, and the common themes approach was updated during the final discussion.

4.1 THE COMMON THEMES APPROACH

Mr. Applegate opened the session by restating the purpose of the workshop: to identify key characteristics of LLW that govern its management and disposal and to explore how those characteristics are used within existing regulatory frameworks. The workshop planning committee was not charged with inventing a new regulatory framework for LLW. Rather, the workshop used case studies to highlight successful examples of LLW management and disposal within existing regulatory frameworks.

Common themes within the case studies that led to successful disposition of the wastes were identified such as: the use of existing regulations and standards—such as the U.S. Nuclear Regulatory Commission's (USNRC's) Class A, B, and C classification scheme—to provide an anchor for disposal decisions; the identification of lessons learned from similar or analogous approaches such as Canada's or France's approach to managing and disposing of very LLW; and acknowledgement that the disposal site characteristics are as important for safe disposal as the inherent characteristics of the waste. These common themes were organized into a common themes approach that could be used within the current LLW regulations as an aid to guide decisions and direct discussions. The approach has three key elements: anchors, analogies, and adjustments:[2]

- *Anchors*: The current regulatory framework that governs LLW disposal provides a starting point for decisions about the disposition of challenging LLW streams.
- *Analogies*: Learn from successful disposition of similar wastes. Examples of past decisions for successful disposition of challenging LLW streams offer additional guidance for future waste disposal decisions.
- *Adjustments*: Use flexibility within current regulatory frameworks for making decisions about disposing of challenging LLW streams.

Existing U.S. regulations, as well as regulations and standards from international organizations, offer valuable guidance for making decisions

[2]Current USNRC regulations and the Department of Energy (DOE) policies allow for additional analyses and variances to accommodate a variety of waste characteristics. The approach described above and in Figures 4-1 and 4-3 is intended as a clarifying tool, not as a new concept.

about dispositioning challenging LLW streams. One need not write on a blank slate when making such decisions.

The common themes approach also makes use of the roughly proportional relationship between the hazard of a LLW stream and the required protectiveness of the facility that will be used for its disposal. This graphical representation could aid in discussions on identifying the levels of protection for a given level of hazard. This relationship is illustrated conceptually in Figure 4-1. The inherent hazard of the waste stream is represented on the x-axis of Figure 4-1. These hazards arise from the physical, chemical, and radiological properties of the waste stream (e.g., radiation types, activities, half-lives, and chemical toxicity).

The protectiveness of the disposal system is represented on the y-axis of Figure 4-1. The protectiveness characteristics include disposal depth, length of protection, and the number and types of barriers. Barriers can be

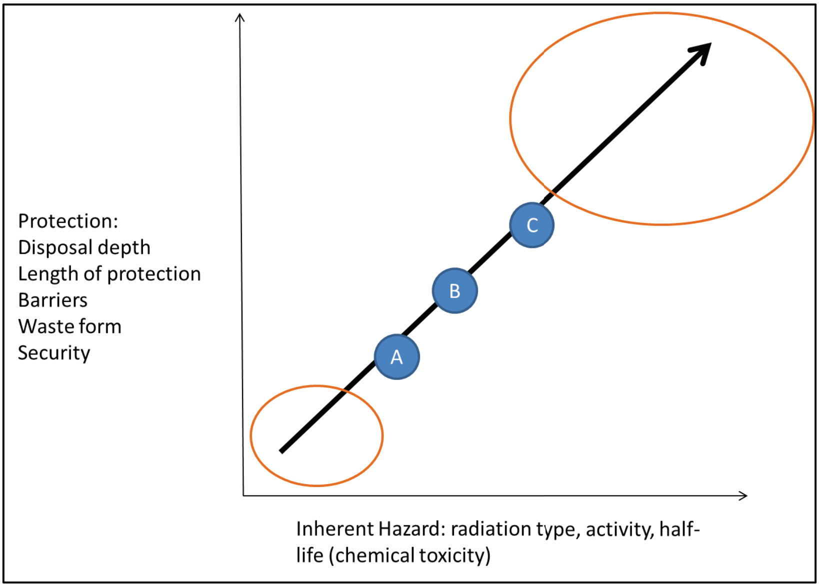

FIGURE 4-1 Conceptual representation of the "sliding scale" relationship between hazard and protection. The common themes approach for disposing of challenging LLW streams acknowledges the roughly proportional relationship between the inherent hazard of a waste stream and the level of protection required from the facility that will be used for its disposal. This proportionality is represented by the solid black line on the figure. Existing classification schemes are notionally identified by Class A, B, and C on the line and can be used as "anchors" (see text); orange circles at the upper and lower ends of the line represent the ranges of challenging LLW streams.

engineered (e.g., the waste form, engineered caps to retard water infiltration into the facility) and natural (e.g., impermeable formations underlying a disposal facility that retard waste migration). Physical security barriers (i.e., guns, gates, and guards) can also be considered if a waste stream poses a security hazard.

The solid line in Figure 4-1 is intended to be a conceptual representation of the proportional relationship between waste hazard and required disposal facility protectiveness. Class A, B, and C wastes (shown in shaded circles in Figure 4-1) have, respectively, increasingly higher levels of hazard and therefore need to be disposed of in facilities having increasingly higher levels of protectiveness. Challenging LLW streams can also be plotted on the conceptual line based on their hazards and needed levels of disposal facility protectiveness.

This type of graphical representation could help guide disposition decisions for wastes without clear or potentially non-optimal disposition pathways and could also help explain disposal decisions to non-experts. This representation is risk informed—a concept advocated by reports from the National Academies and others (National Research Council 1997, 2000, 2001, 2005, 2006b, 2011a, and Omnibus, 2015)—and is relatively easy to comprehend because it uses a small number of readily understood characteristics and shows the relationship between hazard and protection measures. This representation can also help to improve decision-making consistency for challenging LLW streams.

Mr. Applegate noted that there are not an infinite number of unknown LLW streams. Most LLW streams have been identified after many decades of nuclear activities. The waste streams that have been identified are amenable to treatment using the conceptual representation in Figure 4-1.

Planning committee member Nina Rosenberg noted that the barriers in Figure 4-1 are both natural (e.g., site characteristics) and engineered (e.g., waste forms or facility covers). Committee member Larry Camper provided guidance to the subgroups in applying the framework during the breakout session: when determining where each challenging LLW stream falls on the line in Figure 4-1, consider how that location translates to protection criteria.

4.2 DISCUSSION: THE COMMON THEMES APPROACH

Mr. Applegate asked participants for comments, criticisms, changes, or refinements to the proposed common themes approach. Lisa Edwards, senior program manager at the Electric Power Research Institute (EPRI), wondered whether the list of challenging LLW streams developed by the committee was consistent with the wastes that Department of Energy (DOE) is facing. Is very low-activity waste (or "very low-level waste" [VLLW] as

previously described by Gérald Ouzounian, international director for ANDRA[3]) a big challenge for DOE, more so than for the commercial sector? Are there other volumetrically large waste streams that have not been identified for discussion in this workshop?

Doug Tonkay, director of waste disposal at DOE, stated that the list appeared to be representative of both DOE's and the USNRC's challenging waste streams. He also stated that VLLW is important to DOE because of its large volume and consumption of available disposal space. The goal for DOE is to find the best deal for the taxpayer for the safe disposal of waste.

Communications

Mr. Tonkay recalled the Session 2 discussions on communications, noting that it is very important for DOE to improve communications with its stakeholders. The tool proposed in Figure 4-1 could help. DOE has expanded communication with the state of Nevada over the past couple of years, meeting quarterly to share information about waste that is anticipated for disposal at the Nevada Nuclear Security Site (NNSS). DOE has also augmented the technical information provided in the waste profiles for potentially challenging LLW streams such as sealed sources; for example, describing how the wastes that need to be disposed of have benefitted society. Mr. Tonkay stressed that he sees communications as a key component of any future approach to guide decision making. LLW has been defined by a patchwork of laws and regulations, resulting in a wide variety of waste streams. Clear decision frameworks are needed to explain how disposal decisions are made to address the wide range of characteristics of the wastes.

Other participants also stressed the importance of communication and suggested that it be a third axis in Figure 4-1. Daniel Goode, research hydrologist at the U.S. Geologic Survey (USGS), commented on the importance for the public to understand the benefits derived from the activities that produced the waste and noted that value judgments and popular opinions within populations evolve over time.

Shape of the Line in Figure 4-1

Several participants questioned whether the shape of the line in Figure 4-1 was linear or nonlinear. Participants noted that if the curve was nonlinear, then extrapolations at its ends—where the challenging LLW streams would fall—would be difficult. Further, Class A, B, and C wastes might better be described by horizontal bars in Figure 4-1 rather than dis-

[3]ANDRA is the French acronym for National Radioactive Waste Management Agency.

crete points. One of the planning committee members noted that the figure is conceptual and intended to convey the message that the need for disposal system protectiveness increases as waste hazard increases. The common themes approach and the figure are helpful for explaining management and disposal decisions on challenging LLW streams.

Commercial Disposal Costs

Participants with commercial disposal experience noted that the costs for disposal will affect disposal decisions, particularly when there is more than one disposal option. For example, Class B waste is usually co-disposed with Class C waste, but Class B waste could potentially be disposed of separately to reduce costs. Disposal costs are a nontechnical constraint (similar to communication) that is not directly captured in Figure 4-1.

Dr. Ouzounian noted that France's approach to managing and disposing of radioactive wastes is consistent with the common themes approach and sliding scale illustrated in Figure 4-1. France has separate facilities for disposal of VLLW and LLW. The site itself is considered protective enough for disposal of VLLW—no additional barriers or protections need to be added. This leads to the factor of 15 to 18 cost savings for disposal as discussed previously in the workshop. In contrast, the protectiveness of both the waste form and the site are considered for the disposal of LLW.

Compatibility with Performance Assessment

A participant noted that the proposed common themes approach might lead to confusion or questions about the legitimacy of using performance assessment to guide decisions. A planning committee member commented that the proposed approach is meant to also guide decision making and could be used in conjunction with (and help with the communications related to) performance assessment.

Use of Chemical Toxicity in Figure 4-1

There were several questions from workshop participants about chemical toxicity and how this characteristic might be represented in Figure 4-1. Dr. Crowley noted that toxicity is a function of oxidation state, for example, and is mutable. The committee agreed that toxicity was not useful as a key characteristic and agreed to remove it from the key characteristics list in Figure 4-1. However, another participant suggested that waste mobility be added instead.

4.3 CHALLENGING LOW-LEVEL WASTE STREAMS

Mr. Applegate moderated the session on challenging LLW streams that would be discussed by the subgroups: GTCC and TRU, sealed sources, very low-activity waste, incident waste, and DU. These waste streams were described by experts from each of the subgroups in plenary session.

Lawrence "Rick" Jacobi, Jr., president of Jacobi Consulting, introduced GTCC and TRU wastes. Tameka Taplin, federal program manager in the National Nuclear Security Administration (NNSA[4]), introduced sealed sources. Lisa Edwards, senior program manager for EPRI, discussed very low-activity waste. William "Will" Nichols, principal environmental engineer at INTERA, provided an introduction to incident waste. Scott Kirk, director of regulatory affairs at BWXT, introduced depleted uranium and its disposal challenges. The biographies for these experts can be found in Appendix E.

GTCC and Commercial TRU Waste Greater than 100 nCi/g

Mr. Jacobi's overview focused mainly on technical challenges for disposing of GTCC and TRU waste. The USNRC defines GTCC waste as waste that is generally not acceptable for near-surface disposal (within 30 meters of the surface). Its waste forms and disposal methods must be more stringent than those for Class C waste. DOE has "GTCC-like" waste,[5] which is waste that is generated and owned by DOE and includes non-defense TRU waste. This GTCC-like waste has characteristics similar to commercial GTCC waste that is regulated by the USNRC. In 2015, USNRC staff recommended to the Commissioners to allow the state of Texas to license the disposal of GTCC waste (USNRC, 2015c).

TRU waste is defined in the WIPP Land Withdrawal Act as waste containing alpha-emitting transuranic nuclides (transuranic nuclides are elements with an atomic number greater than 92 in the periodic table) at concentrations greater than 100 nanocuries per gram (nCi/g) and with half-lives greater than 20 years.

In January 2016, DOE estimated the volume and activity of GTCC and GTCC-like waste in the United States to be about 12,000 cubic meters and 160 million curies, respectively. This is not a volumetrically large waste stream, but it contains a lot of radioactivity. Most of the waste is activated

[4]The NNSA is a semi-autonomous agency within DOE.

[5]GTCC-like waste is a descriptive term DOE adopted for purposes of the Environmental Impact Statement (EIS) for GTCC and GTCC-like waste. It is not a formal waste class within DOE order or U.S. regulation. This descriptive category includes both higher activity DOE LLWs and non-defense TRU wastes that do not currently have disposal pathways and that have characteristics similar to or meet the regulatory definition of GTCC LLW as defined in the 10 CFR 61 tables.

metals from the planned decommissioning of nuclear power reactors. This waste also includes sealed sources, sludge, resin, and contaminated soil. Mr. Jacobi noted that this waste inventory does not include a large number of sealed sources used by the oil and gas industries.

The DOE's final environmental impact statement (EIS) for GTCC and GTCC-like waste (DOE, 2016) proposed several disposal options for GTCC, GTCC-like, and commercial TRU waste, which include:

- A deep geologic repository, such as WIPP.
- A near-surface trench with engineered barriers.
- Above-grade vaults.
- Intermediate-depth boreholes.

Intermediate-depth (more than 30 meters below the surface) disposal is also discussed in the International Atomic Energy Agency *General Safety Guide* (IAEA, 2009a). Mr. Jacobi suggested that intermediate-depth disposal is an appropriate option and that a better name for GTCC waste might be "intermediate-depth waste."

Several participants mentioned the progressive improvement of disposal facilities over the past several decades. Early disposal practices were relatively primitive, waste forms were deficient, and performance assessment modeling was rudimentary. Waste was stored in boxes, drums, and sacks, which were dumped into trenches and covered with dirt. Modern-day disposal facilities are engineered to minimize waste. Operational practices are improved, and waste forms are more robust. Modeling capabilities and techniques are also much better.

As an example, the WCS facility in Andrews, Texas, is the United States' newest LLW disposal facility. The facility is located in an arid environment with low rainfall and a deep groundwater table; the site has low seismicity; the facility is underlain by a low-permeability clay; and the region surrounding the facility has a low population density. Additional engineered barriers have been added to the disposal facility, including compacted clay, concrete sidewalls, geo-synthetic liners, and intrusion barriers. The waste is disposed of in concrete canisters with limitations on void space in the waste as well as waste stability requirements.

Mr. Jacobi proposed that the type of reanalysis required under the USNRC's *Branch Technical Position on Concentration Averaging and Encapsulation* (BTP)[6] (see Chapter 2) would likely result in the reclassification of some portion of GTCC to Class C waste. The remaining GTCC (and possibly TRU waste) could be disposed of in a facility comparable to the

[6] "USNRC: Branch Technical Position on Concentration Averaging and Encapsulation," accessed February 26, 2017, https://www.nrc.gov/waste/llw-disposal/llw-pa/llw-btp.html.

WCS. He recommended that the United States should consider replacing "GTCC" nomenclature with "intermediate waste" following IAEA safety guidance (he noted that the rest of the world is using this nomenclature). He also recommended that future GTCC waste streams need to be considered and planned for—GTCC from Gen IV reactors is a good example. Finally, he recommended that performance assessments used to develop the USNRC waste classification system should be conducted with modern computer codes, newer standards, and data from modern LLW disposal facilities.

Sealed Sources

A sealed source is "[a] radioactive source in which the radioactive material is (a) permanently sealed in a capsule or (b) closely bounded and in a solid form" (IAEA, 2014, p. 423). There are thousands of sealed sources in use and in storage in the United States and around the world. Ms. Taplin explained that her role within the NNSA Off-Site Source Recovery Program (OSRP)[7] is to collect disused sealed sources from domestic and international locations and store and dispose of them in the United States. As mentioned previously by Mr. Tonkay, DOE provides information about the beneficial uses of sealed sources to stakeholders so that these societal benefits are considered in making disposal decisions.

Sealed sources can be highly radioactive (e.g., tens to hundreds of thousands of curies for radiotherapy or radioisotope thermoelectric generators [RTGs]), so proper packaging and transportation is a very important part of managing their disposal. Sealed sources normally have adequate documentation about their manufacture and use; this documentation is useful for planning for the disposal of these sources.

As an example of a challenge for the program, Ms. Taplin noted that occasionally the transportation certification for the packaging of a sealed source is found to be expired. This adds some complication to the recovery and for communication (i.e., the description of the process to others). DOE engages and communicates with communities along the planned transportation routes for these sources, including information about the beneficial uses of these sources.

Exempt and Very Low-Activity Waste

Ms. Edwards framed her presentation in the context of VLLW and very low-activity waste instead of clearance or exempt waste. She suggested a rough definition of VLLW as waste containing less than or equal to 10 per-

[7] OSRP's broader mission is to remove excess, unwanted, abandoned, and orphan radioactive sealed sources that pose a potential risk to national security, health, and safety.

cent of the Class A waste activity limits. She admitted that this was not a technically refined definition, but that it was a good-enough definition for the purposes of the workshop.

VLLW is a large-volume, low-activity waste stream with a low intrinsic hazard compared to other LLW streams, even most Class A waste streams. It falls on the lower part of the notional line on Figure 4-1 represented by the lower orange circle. VLLW is recognized in the IAEA radioactive waste classification scheme and in other countries as a formal waste classification. Dr. Ouzounian described how this waste classification has been successfully employed in France. Spain and other countries also use this waste classification.

One question to be discussed during the breakout session is whether the United States needs to develop a formal regulatory definition for VLLW. The USNRC exemption process (i.e., the 20.2002 exemption) is currently used to manage some VLLW streams. The exemption process allows lower-hazard waste to be disposed of in less-protective (but still adequately protective) disposal facilities than higher-hazard waste. However, the exemption process lacks transparency and can make it difficult to communicate with the public about waste-disposal decisions. The industry has asked the USNRC to publish the requirements it uses for making 20.2002 exemption decisions in a publicly available guidance document.

Some Agreement States have issued licenses to disposal facilities to accept certain VLLW streams. For example, some VLLW is approved for disposal in Resource Conservation and Recovery Act (RCRA) facilities.

Ms. Edwards argued that it would be preferable for the United States to develop a formal regulatory definition for VLLW (or very low-activity waste) that could be used to guide its disposal, rather than relying on the current exemption process. The regulatory definition would identify the key characteristics of this waste that could be used to determine its hazard for the purposes of selecting an appropriate disposal method. Having a formal regulatory definition would have a large economic impact. Ms. Edwards estimated that impact would be about $6 billion in cost savings for disposing of decommissioning wastes from U.S. nuclear plants (see Figure 2-3 in Chapter 2)—a cost savings that some have argued is a gross underestimation. The diversion of VLLW to other disposal facilities would free up capacity in LLW disposal facilities to dispose of higher-hazard waste. VLLW is expected to consume a large portion of currently available LLW disposal capacity in the United States, perhaps far into the future.

Incident Waste

For the purposes of this workshop, “incident waste” is defined as radioactive waste that would be generated from a nuclear accident or

nuclear/radiological terrorist attack, collectively referred to here as a nuclear/radiological emergency. Mr. Nichols recently participated in an IAEA consultancy that developed a technical guidance document on the management of large volumes of radioactive waste that would result from a nuclear/radiological emergency.[8] He provided highlights from the draft IAEA guidance document to scope the workshop's breakout discussions on incident waste.

Much can be learned about incident waste from previous nuclear/ radiological. The most important examples are the Chernobyl and Fukushima accidents, but less well-known examples can also provide important insights. For example, the 1987 Goiânia accident in Brazil resulted in extensive environmental contamination after a teletheraphy source was removed from its protective housing in a device that was left behind in an abandoned clinic. The breached source contaminated several people and sites. The Chernobyl and Fukushima nuclear accidents further highlight the need for planning for the management of large quantities of incident wastes that would be very suddenly generated following such emergencies.

The nature, scale, and timing of nuclear/radiological emergencies cannot be predicted. However, one can plan for the impacts of such emergencies, including health and safety, environmental, societal, and financial impacts. A large-scale emergency would place instant demands on national resources and present key challenges for managing incident wastes. These include characterizing and managing the waste during the emergency response and responding to public concerns about those wastes. Mr. Nichols noted that the decision making and regulatory frameworks were severely strained in the nuclear/radiological emergencies studied during the IAEA consultancy, particularly when there was no pre-planning or regulatory framework to cope with incident wastes.

Key challenges for managing incident waste are the need for (1) rapid characterization to assess its hazard and (2) waste segregation by those characterized hazard levels. Incident waste must be segregated by hazard level to be managed effectively. Otherwise, all of the waste must be managed to the highest hazard level of any of its components. Mr. Nichols suggested that proposed regulatory framework illustrated in Figure 4-1 was a good way to quickly and clearly segregate incident wastes.

Incident waste management is unlikely to get much attention in the initial stages of a nuclear/radiological emergency. But early decisions and actions could potentially have long-term, unintended consequences for waste management and disposal if not considered in planning and preparation for such emergencies.

[8]This guidance report has not yet been released.

Depleted Uranium

DU is depleted in the isotope uranium-235 relative to uranium-238. It is produced during the uranium enrichment process. Mr. Kirk provided background and history on the DU waste stream in the United States. In 1982, the USNRC promulgated 10 CFR 61, which defined uranium-containing waste as Class A waste. The analysis supporting the rulemaking considered typical or expected waste streams that were in existence at that time, such as small quantities of DU from commercial generators. In 2003, Louisiana Energy Services (now URENCO USA) proposed construction of a national uranium enrichment facility near Eunice, New Mexico, which would produce much larger quantities of DU than previous generators. DU had been determined to be more hazardous than previously thought when this enrichment facility was proposed. The USNRC commissioners directed agency staff to determine whether DU could be safely disposed of in a near-surface (i.e., within 30 meters of the surface) disposal facility. The commissioners later directed agency staff to begin a rulemaking to develop requirements that would be site specific and could be used to demonstrate that disposal of large quantities of DU could be done safely (USNRC, 2008). The final rulemaking is expected to be sent to the USNRC commissioners in the near future.

The USNRC also developed guidance for Agreement States to process requests for disposal of DU received prior to the completion of the rulemaking. This guidance suggested that disposal of DU may be appropriate in a near-surface disposal facility under certain conditions, such as when robust engineered barriers were used and/or the uranium was disposed of at greater depths.[9]

Mr. Kirk explained why DU is more hazardous than previously thought. Figure 4-2 shows the activity ratio (i.e., the activity at the waste at some future time divided by its initial activity) for typical LLW streams (solid blue line in Figure 4-2). The activity of the typical LLW stream decays to 1/100th of its original value after approximately 1,000 years. The activity ratio for DU increases almost tenfold due to ingrowth of daughter products (dotted blue line in Figure 4-2).[10] Therefore, the risk to public health and safety for disposal of depleted uranium is substantially different from other types of LLW.

The USNRC's analyses show that disposal of DU in facilities located at arid sites is adequate to protect public health and safety if the DU is

[9]This guidance has been used by Waste Control Specialists, LLC (WCS) to amend its license to allow for DU disposal at increased burial depths (i.e., 100 feet). "License Amendment Enhances Disposal Options," August 28, 2014, http://www.wcstexas.com/2014/license-amendment-enhances-disposal-options/.

[10]The decay of uranium-235 and uranium-238 produces a number of radioactive daughter products that slowly build up (or grow into) the DU, increasing its activity ratio.

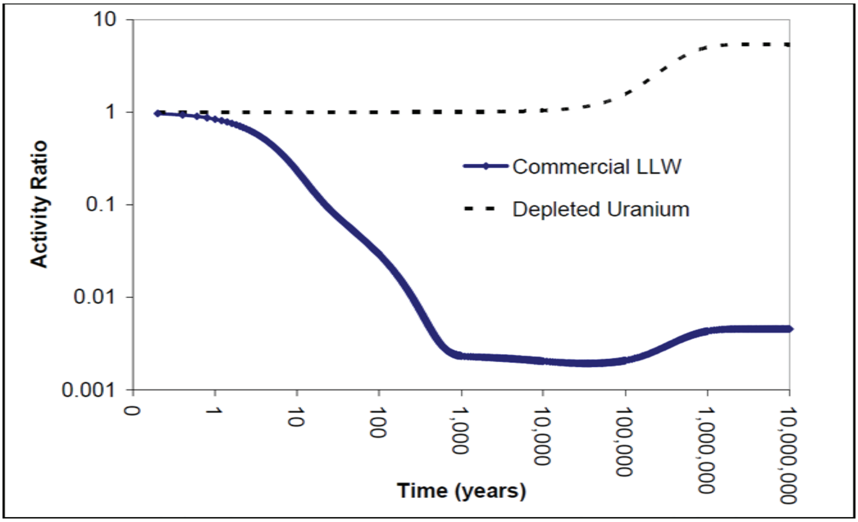

FIGURE 4-2 The activity ratio of DU as a function of time (years).
NOTE: Activity ratio is the activity of the DU at some future time divided by its initial activity. LLW = low-level waste.
SOURCE: Courtesy of James Scott Kirk, BWXT.

disposed of at appropriate depths using appropriate engineered barriers. The USNRC's proposed rule for disposal of DU suggests three tiers of protection: a 1,000-year period of compliance, 1,000-to 10,000-year assessment period, and greater-than-10,000-ear period of performance. The rule requires performance assessments to demonstrate less than 25 millirem per year (mrem/yr) (less than 0.25 milliseivert per year [mSv/yr]) exposure, an intruder analysis to show less than 500 mrem/yr (5 mSv/yr), and an analysis to show site stability.

Mr. Kirk used the WCS license application for disposing of DU to highlight examples of natural and engineered barriers. The site characteristics in the application included red clay beds (nearly as impermeable as concrete and 600 to 800 feet [180-240 meters] in thickness), the water table (about 600 to 1,000 feet [183-305 meters] below grade), and annual rainfall (approximately 15 inches [38 centimeters]) per year, with a potential evapotranspiration of about 60 inches [150 centimeters] per year). The only expected exposure pathway after disposal is through intrusion. Engineered barriers include a cover system (about 33 feet [10 meters] in thickness to retard migration of radon) and a reinforced concrete barrier surrounding the disposal site. The Texas regulator mandated that WCS dispose of DU at the deepest depth possible—which is about 120 feet (37 meters) below grade.

4.4 SUMMARIES FROM BREAKOUT SESSIONS

The discussion of breakout session summaries was moderated by Mr. Applegate. He first presented an update to and further explanation of the common themes approach in response to the earlier discussion. To recapitulate, the common themes approach consists of three steps:

- Consideration of four elements: anchors, analogies, adjustments, and anticipation, the latter element added after the earlier discussion,
- Use of an updated sliding scales graph (Figure 4-3) to connect the hazard of the waste to protectiveness of the disposal system, and
- And a new step: Review of "further dimensions," which are not included in the sliding scales graph of Figure 4-3, such as communication.

"Anticipation" was added to the original three key elements (i.e., anchors, analogies, and adjustments) in recognition that surprises can be avoided through anticipation of future waste streams. The dotted lines in

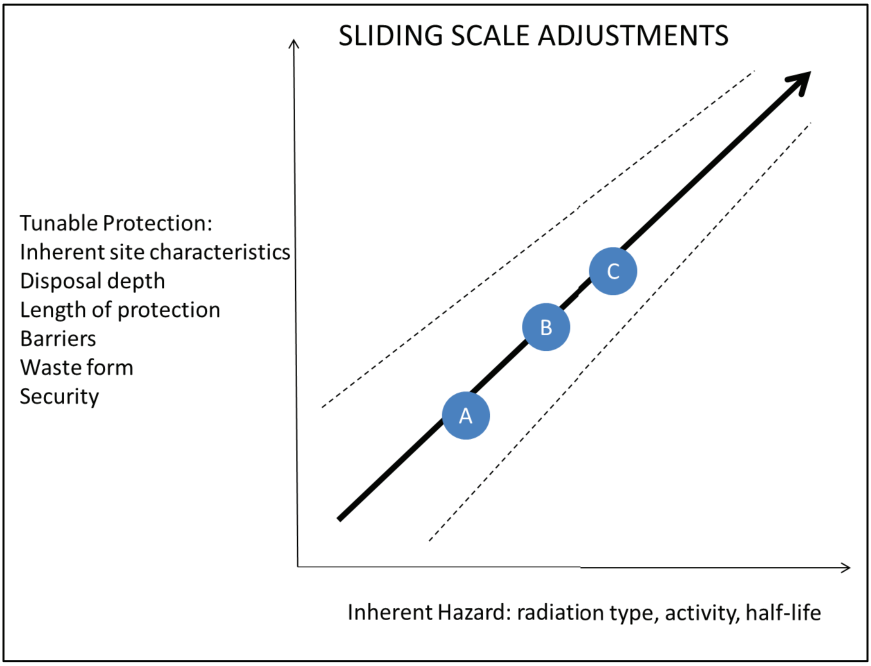

FIGURE 4-3 Updated sliding scale of hazards versus protections of the common themes approach. Changes made to Figure 4-1 based on discussion and input from workshop participants.

the updated graph (Figure 4-3) reflect the flexibility of current LLW regulatory frameworks. Note that chemical toxicity was dropped from the x-axis of the figure, and the y-axis includes both inherent site characteristics and engineered barriers for site protections.

The y-axis label was also updated to reflect the fact that the protectiveness of the disposal facility can be adjusted ("tuned") to match the waste hazard. In other words, the solid line in the graph becomes a sliding scale that can adjust waste hazard to disposal facility protectiveness.

The "further dimensions" are not shown on the updated figure. Nevertheless, they need to be considered when making disposal decisions. Such dimensions can include chemical hazards, sustainability, the beneficial activities that generated the waste (i.e., waste source), and political and public concerns.

Experts from each subgroup summarized the subgroup's discussions on applying the common themes approach to the previously identified challenging LLW streams. Subgroup members offered additional comments and identified actions that could lead to finding management and disposal decisions for challenging LLW streams.

Subgroup 1: GTCC/TRU

Mr. Jacobi summarized the discussion of the GTCC/TRU subgroup. The subgroup recognized that the USNRC, state of Texas, and WCS are currently involved in the ongoing 10 CFR Part 61 rulemaking for GTCC/TRU wastes and that each of these entities has a different perspective and approach to the problem. The USNRC's approach to updating Part 61 is to be generic in identifying characteristics and criteria, because the agency cannot create regulations with specific disposal sites in mind. However, a likely site for the GTCC/TRU wastes is WCS in Texas, which does have specific characteristics—both inherent and engineered—that make it potentially suitable for disposal of these wastes.

The subgroup concluded that Part 61 should strive to have specific technical criteria that form a baseline for analysis (i.e., the "anchor" in the common themes approach), but also that Part 61 needs to be as generic as possible—an admitted paradox. Once a site is selected, the "generic technical criteria" can be converted to site-specific technical criteria in a formal performance assessment. This would be the "adjustments" element of the common themes approach.

Several "further dimensions" were identified during the subgroup discussions. Communications and engagement with the public need to be part of the approach. Institutional challenges must not be overlooked, either. Charles Maguire, director of the Radioactive Materials Division within the Texas Commission on Environmental Quality, explained that the jurisdiction for

GTCC waste decisions in Texas has not yet been clarified by the USNRC. Until that happens, GTCC, GTCC-like, and/or TRU waste cannot be accepted at WCS.

There was a short clarifying discussion about the origin of the classification that specified the TRU waste 100 nCi/g activity level between Class C and GTCC waste. A lower threshold established in the early 1980s (10 nCi/g) was increased to the current value (100 nCi/g) because the lower value was difficult to measure and verify with then-existing survey equipment. Additionally, a "fudge factor" was added so that the application of the new threshold would result in very limited amounts of GTCC or TRU waste above the Class C threshold, or so it was thought at that time.

Mr. Kirk noted that it was recognized early on that a repository would suffice for GTCC and TRU disposal, but exceptions (described below) were provided so that a percentage of lower-hazard GTCC and TRU waste could be disposed of in a Part 61-like (i.e., near-surface) facility. Specifically, the Land Withdrawal Act for the Waste Isolation Pilot Plant defined TRU waste as waste containing transuranic elements that exceeded 100 nCi/g with a half-life longer than 20 years. But the Act provided three exceptions [WIPP, 1996, pp. 1-2]:

A. High-level radioactive waste;

B. Waste that the Secretary [of Energy] has determined, with the concurrence of the [Environmental Protection Agency] Administrator, does not need the degree of isolation required by the disposal regulations; or

C. Waste that the [US] Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with Part 61 of Title 10, Code of Federal Regulations.

Some participants pointed to the increasing complexity of the regulations as problematic for disposing of these wastes. There should be a calculation of the risk of "doing nothing" when updating or creating regulations, especially when the volumes of the wastes are significant. A few participants noted that there is no immediate pressure from nuclear power plants to dispose of their commercial GTCC wastes, but DOE is pursuing the disposal of these wastes. Regardless, the USNRC rulemaking needs to move forward because the commercially stored wastes will eventually need to be disposed of.

Mr. Camper and Theresa Klickzewski, DOE, identified the following near-term next steps. Mr. Camper's suggestion was to provide comments on the GTCC rulemaking when requested by USNRC staff through Federal Register notices or public meetings. He made a similar suggestion for the expected (in the next year or so) rulemaking for TRU waste.

Ms. Klickzewski provided a few suggestions related to DOE's next actions. A DOE report required by the *Energy Policy Act of 2005* (EPAct of 2005)[11] on GTCC disposal options will soon be delivered to Congress. The Act requires DOE to await Congressional action, but it does not specify what form that action will take. DOE and Congress have agreed to hold a meeting to determine how Congress will provide its recommendations to DOE (e.g., by letter, verbally). After the recommendation is received from Congress, DOE will be able to issue a record of decision (ROD) that defines the acceptable disposal pathway(s).

Another "next step" that DOE will take in parallel is to continue to work with the USNRC as part of the 10 CFR Part 61 update process. DOE will need to receive USNRC's technical criteria for GTCC to be able to dispose of its GTCC waste.

Subgroup 2: Sealed Sources

Ms. Taplin provided a brief summary of the sealed sources subgroup discussions. Sealed sources are distinct from the other types of wastes discussed today. Sealed sources come in a variety of shapes, sizes, and activity levels. Those that contain very high-activity sources, for example sources used in irradiators, are usually doubly encapsulated and stored in heavily shielded containers. These containers can weigh thousands of pounds. The risks of radioactive material leakage from these very large sealed sources during normal handling and use is nearly nonexistent, and scenarios to calculate exposure risks are restricted to individuals with malicious intent.

An example of a challenging sealed sources waste stream is high-activity cesium sources that contain greater than 130 curies of cesium-137. This waste stream is challenging because it requires additional analysis before a disposition can be made. The upcoming USNRC *Branch Technical Position on Concentration Averaging and Encapsulation* (BTP) for Class A, B, and C waste may affect how these types of sealed sources are managed and disposed of. The determination of final disposition for this type of sealed

[11]DOE has a statutory responsibility from the LLWPA amendment to site a GTCC LLW disposal facility and explicit direction to proceed with the EIS from the *Energy Policy Act of 2005* (EPAct). From the EPAct, Sec. 631: "(B) ANALYSIS OF ALTERNATIVES.—Before the Secretary [of Energy] makes a final decision on the disposal alternative or alternatives to be implemented, the Secretary shall—

(i) submit to Congress a report that describes all alternatives under consideration, including all information required in the comprehensive report making recommendations for ensuring the safe disposal of all greater-than-Class C low-level radioactive waste that was submitted by the Secretary to Congress in February 1987; and

(ii) await action by Congress."

For more details, see "Energy Policy Act of 2005," accessed April 9, 2017, https://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf.

source would be a good test of the common themes approach presented by Mr. Applegate. In fact, Figure 4-3 was used by the subgroup as a way to discuss risk reduction for a potential malicious intruder by increasing the disposal depth (but no specific depths were suggested).

Subgroup participants noted that site-specific characteristics and protections will ultimately determine whether disposal is allowable for a given type of sealed source. The subgroup agreed with the GTCC subgroup that specific technical criteria that form a baseline for analysis should be as generic as possible. For example, sealed source waste generators—hospitals, for example—would welcome an approach that did not require detailed, site-specific technical analysis for every disposal decision. If the regulations become too unwieldy for waste generators, the likelihood of the sealed sources remaining on site in storage increases, which also increases the potential risk that the sources could be stolen or weaponized in place.

Ms. Taplin and David Martin, a contractor for the NNSA, suggested a next step by the USNRC would be clear implementation guidance on the Branch Technical Position mentioned previously. It provides guidance on what can be disposed of at USNRC-regulated facilities. Sources that have activities above certain thresholds (e.g., 130 curies for cesium) require additional special analysis for disposition.

Mr. Martin noted that challenging sealed source waste streams are limited in number and identifiable (the "anticipation" step outlined in the updated common themes approach). He suggested the creation of a forum to review these challenging source waste streams and to identify what additional protections, such as inherent site characteristics, depth of disposal, and/or engineered barriers (i.e., the y-axis of Figure 4-3) would be necessary to allow these sources to be disposed of in near-surface facilities. Waste generators could use the information generated by the forum to guide disposal of these sources. Mr. Applegate suggested that disposal pathways for these sources could be explicitly identified by the forum.

Subgroup 3: Clearance or Very Low-Activity Waste

Ms. Edwards explained that this subgroup's discussion focused on very low-activity waste (i.e., VLLW) and the current approaches to disposing of it, including an exemption process within current USNRC regulations (i.e., the 20.2002 exemption discussed in Chapter 2). The subgroup did not discuss clearance or exempt waste.[12]

The 20.2002 exemption is currently used by many Agreement States and their licensed disposal facilities to dispose of large volumes of VLLW

[12]To clarify terms, "exempt waste" is not waste that has been subjected to the 20.2002 exemption process. Further, the 20.2002 exemption process does not reclassify the waste—it remains LLW.

in RCRA-like facilities. For example, WCS is currently authorized through this exemption process to dispose of LLW by means other than those defined in 10 CFR Part 61 as long as certain requirements are met, such as the waste streams have very low activities. The process grants an exemption to RCRA facilities to receive VLLW, subject to certain requirements by the state regulator.

Other organizations have different ways of managing VLLW. DOE, which is self-regulating, uses the "authorized limits process" to dispose of wastes with low levels of radioactivity at on-site disposal cells. France has a separate classification and disposal process for VLLW as discussed earlier in the workshop.

One could point to the 20.2002 exemption, or the authorized limits process, as "anchors" for VLLW. Alternatively, the French classification system could be used as an "anchor" or "analogy" should the United States decide to add a classification level for VLLW. In fact, Ms. Edwards noted that the subgroup supported the idea of adding a new classification category for this waste type.

The subgroup thought it would be easier to describe VLLW disposal decisions to stakeholders and the public through a new classification than through the current exemption process, which is complicated, granted on a case-by-case basis, and lacks transparency. The terminology is also confusing: VLLW is reviewed through an exemption process for disposal at a RCRA facility, but the waste is not "exempt" waste. There is also the need to reserve space in LLW disposal sites for wastes that pose a higher hazard than VLLW as noted previously.

Dr. Goode suggested that an independent study be commissioned to review the current status and processes for disposing of VLLW. The study should identify the volumes and activities of VLLW in the United States and its possible disposal pathways. The study would provide a broad but thorough picture of the U.S. approach to the disposal of this waste and would inform the scientific community and the public.

Andrew Orrell, section head for waste and environmental safety at the IAEA, identified a slight tension between the interests of DOE and commercial parts of the disposal system, specifically with respect to the introduction of a new waste category versus anxiety by commercial facilities, for example, about changes to the current regulatory structure. He recommended the creation of a task force to help decide whether creating another waste category would actually result in cost savings for industry and enhance public understanding.

Subgroup 4: Incident Waste

Mr. Nichols summarized the subgroup's discussion and attempted to link it directly to the common themes approach, outlined by Mr. Applegate at the start of the session. What are the characteristics of the anticipated waste? Incident waste is highly heterogeneous, including radioactively contaminated biological materials (e.g., plants, agricultural products, and animals), infrastructure (e.g., buildings, vehicles), liquids,[13] and ion exchange resins used to remove contamination from liquids. The quantity of waste is potentially large, rapidly produced, and geographically distributed. Incident waste potentially covers the range of hazards in Figure 4-3.

The challenges for disposing of incident waste are many:

- Characterization and segregation of the waste will be challenging given its volume and distribution. Waste management will not be the highest priority during the initial response to a nuclear/radiological emergency, but early decisions on segregation could have long-term impacts on disposal options.
- Identifying the disposition endpoints (i.e., how clean is clean enough?) will require input from stakeholders and will help determine what areas are cleaned up and to what extent.
- Waste storage sites will need to be found or designated until the waste can be disposed of.
- The capacity of existing LLW disposal sites could easily be overwhelmed by a single large-scale nuclear/radiological emergency.

The subgroup identified preplanning as a critical component in addressing these challenges. The wastes would initially be characterized and segregated by activity level to manage the threat/hazard, but it should not be subject to waste classification at this initial stage. In fact, some in the subgroup thought that "incident waste" ought to be established as a separate waste classification and that performance assessment be used to guide its management.

Mr. Tonkay noted that the right of eminent domain should be added to the challenges for management of incident waste—or perhaps to the "further dimensions" step. Citizens' property could become contaminated as a result of the event. Initially, it might be clear that property owners and citizens should evacuate, but preplanning could help to clarify when they can be allowed to return and how their contaminated property will be dispositioned.

Mr. Nichols suggested that a next step would be to consider creating a special category for incident waste, recognizing of course that such wastes

[13] For example, contaminated liquid wastes from building decontamination and waste removal activities.

would have to be managed using a risk-informed approach. Also, a regulatory analysis needs to be included in the emergency planning to determine how the classification might hinder or help recovery actions.

Dr. Crowley added a few comments. He noted that the Environmental Protection Agency (EPA) has done significant work on Protective Action Guidelines (PAGs), which at least provide a conceptual understanding of what to do from a protective standpoint. However, there is less understanding of how to deal with the waste itself. There have been a couple of unintentional experiments, the Chernobyl and Fukushima accidents. A next step, if not already done, would be to see how incident waste from those accidents was handled and what lessons could be learned. This information could be used to develop guidance for policy makers in the United States about how to respond to future nuclear/radiological emergencies. He also noted that incident waste is not likely to be a problem for DOE unless there was an accident at a DOE site. Rather, an accident/attack was more likely to occur in the civilian sector, for example a nuclear plant accident or a terrorist attack on a major city.

Mr. Orrell noted that the IAEA is almost ready to release two publications on incident waste: a safety guide and a technical document on preparing for and managing incident waste. Dr. Ouzounian noted that in France they have prepared and practiced a concept for managing waste from emergency situations, a concept that has been in place for a few years.

Subgroup 5: Depleted Uranium

Mr. Kirk noted that there is a well-known amount of DU and that work has focused on identifying the right waste form. Most DU is in the form of uranium hexafluoride (UF_6)[14] in cylinders. DOE recognized early on that UF_6 would have to be converted into a more stable solid such as uranium oxide (e.g., U_3O_8) to make it suitable for disposal.

Mr. Kirk noted that the newly added dashed lines in Figure 4-3, representing the flexibility of existing regulatory frameworks, were also appropriate "anchors" for DU, which grows more radiotoxic (from Class A waste to higher classes) as daughter products grow in over time (Figure 4-2). Pathways for disposition of a significant amount of DU have already been determined—for example, DU has been disposed of at the EnergySolutions LLW disposal facilities at Hanford, Washington, and Barnwell, South Carolina. DU may also be appropriate for disposal at more modern LLW disposal facilities, for example the WCS facility in Andrews, Texas—subject to the completion of the final 10 CFR Part 61 rulemaking.

[14] At atmospheric temperature and pressure, UF_6 is a solid. It will sublime into a gas at 134°F (57 °C) and ambient pressure.

Existing regulatory protection standards were discussed as "analogies" within the common themes approach. For example, the WCS license contains a general prohibition against disposal of large quantities of DU, but there was also an activity limit of 10 nCi/g—meaning that DU could be disposed of if its activity is less than 10 nCi/g.

The rulemaking poses some regulatory hazard to facilities that have already disposed of DU. It is possible that the rulemaking will require that additional protections be added at older facilities that have disposed of DU as Class A waste. (The rulemaking could affect other waste streams that have been disposed of as Class A waste.) Mr. Garmaszeghy noted that the wastes currently disposed of at disposal facilities are subject to changes in regulations. Daniel (Dan) Shrum, senior vice president of regulatory affairs at EnergySolutions, noted that facilities have to comply with changes in USNRC regulations, even for waste that has already been disposed of, on a case-by-case basis.[15]

Mr. Kirk suggested two steps that could be taken to advance the decision-making process for disposal of DU. The first is for DOE to complete its National Environmental Policy Act (NEPA) review[16] and, second, for the USNRC to finish the 10 CFR Part 61 rulemaking. The NEPA review is a requirement before federally owned DU can be disposed of at commercial facilities. The facilities will need to review the updated Part 61 rulemaking to determine its meaning and impacts. Mr. Shrum noted that the EnergySolutions LLW Disposal Facility in Clive, Utah, is working on a DU performance assessment to amend its existing license to accept large quantities of DU. The assessment had been dropped to a lower priority, but there is renewed focus by EnergySolutions to finish the assessment so that the state regulator can evaluate it.

Mr. Camper commented that 10 CFR Part 61 is based on an EIS that was prepared at the time the regulation was created, but the EIS has never been updated. Facility design and operation assumptions that were used in the original EIS may be different from modern facility designs and operations. For example, the EIS did not envision disposal facilities like WCS in Texas or EnergySolutions in Clive, or even the changes to facility designs and operations that have occurred at the EnergySolutions LLW disposal facility in Barnwell, South Carolina. Also, the volumes and types of LLW

[15]See USNRC 10 CFR 61.1: "(a) … Applicability of the requirements in this part to Commission licenses for waste disposal facilities in effect on the effective date of this rule will be determined on a case-by-case basis and implemented through terms and conditions of the license or by orders issued by the Commission." Accessed March 29, 2017, https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/part061-0001.html.

[16]"DEPARTMENT OF ENERGY Notice of Intent To Prepare a Supplemental Environmental Impact Statement for Disposition of Depleted Uranium Oxide Conversion Product Generated From DOE's Inventory of Depleted Uranium Hexafluoride," posted August 26, 2016, https://energy.gov/sites/prod/files/2016/08/f33/EIS-0360-S1-NOI.pdf.

being disposed of at these facilities are remarkably different from original assumptions. The USNRC should update the EIS to represent actual waste streams and disposal facility designs and operations. The existing EIS is difficult to amend, and a new EIS is expensive to develop. If a new EIS is not feasible, then an independent study or analysis could be carried out to more accurately capture modern LLW disposition practices. Such a study could be funded from DOE, USNRC, and possibly industry. The general public, as well as other countries, would also benefit from this analysis.

4.5 FINAL THOUGHTS: REVIEW OF THE COMMON THEMES APPROACH

Mr. Applegate asked the participants for final thoughts on using the decision framework (or, as he referred to it, the Common Themes approach). Ms. Klickzewski's comment was that federal agencies should *do something*. They should take an action to show movement and progress. Whether it is the BTP from the USNRC, or a ROD from DOE on GTCC waste, or the NEPA for DU, action is needed. Mr. Applegate agreed with her comment. He was surprised at the activity that has already taken place for many of the waste streams and wondered why they are seen as "challenging" by DOE and the USNRC. He hypothesized that perhaps the final disposition decisions are actually close to being made—or closer than it was assumed when the workshop was requested by DOE.

Mark Yeager, division of waste management at South Carolina's Department of Health and Environmental Control, noted that states deal with multiple regulatory regimes: DOE, the USNRC, and the EPA. He suggested that these three agencies come together to develop an integrated approach for regulation of LLW, perhaps using the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) as a model. He stressed that until there is a consistent and complete regulatory framework across the regulatory agencies, it will continue to be difficult to gain confidence from the public. Ming Zhu, acting budget director for DOE's Office of Environmental Management, agreed with the need for integration across agencies and noted that this was a key finding from a recent omnibus risk review,[17]

[17]The Consolidated Appropriations Act, 2014 (referred to as the "Omnibus") (Omnibus, 2015, p. v) directed DOE to "retain a respected outside group . . . [to] undertake an analysis of how effectively [DOE] identifies, programs, and executes its plans to address risks [to public health and safety from the DOE's remaining environmental cleanup liabilities], as well as how effectively the Defense Nuclear Facilities Safety Board (DNFSB) identifies and elevates the nature and consequences of potential threats to public health and safety at the defense environmental cleanup sites." See "A Review of the Use of Risk-Informed Management in the Cleanup Program for Former Defense Nuclear Sites," accessed March 2, 2017, http://www.tri-cityherald.com/news/local/hanford/article33023001.ece/BINARY/Omnibus%20Risk%20Review%20Report_FINAL.

which also concluded that within EPA there is need to integrate regulatory requirements, policies, and guidance under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, known also as Superfund) and RCRA (Omnibus, 2015, pp. viii-ix). Dr. Zhu further commented that agencies are already actively engaging in the use of performance assessments to guide risk-informed decisions on managing wastes. He noted that agencies have come together in recent years to compare processes and develop lessons learned and best practices in conducting performance and risk assessments for supporting decision making, including on disposal facility operations.

Ms. Edwards agreed that a comprehensive picture of the regulations across agencies would be valuable. To be able to show that there is a single framework guiding decisions on LLW disposal would be useful. Such a framework might also be able to show how different rules and regulations across the agencies work (or do not work) together.

4.6 FINAL THOUGHTS: COMMUNICATION

Mr. Applegate started the discussion about communications by talking about the meaning of the term "stakeholder." He noted that there are many people involved with or affected by LLW disposal who have many different perspectives, levels of understanding of the issues, and objectives. He asked participants to describe what steps could be taken to improve communications with these different groups.

Ms. Edwards responded that communication and transparency with the public are important throughout the entire lifecycle of LLW. We are deficient in communicating about LLW not only because the system is difficult to explain, but also because radioactive waste is portrayed as a "boogeyman." One approach is to avoid public discussion altogether, but this is a very short-sighted perspective. It may be difficult to communicate about the good protective measures that are being taken with radioactive waste, but it is our job to do so.

She recalled Dr. Goode's comments about the public's perception of a waste being affected by the perception of how the waste was generated or stored. For example, there may be more public support for disposal of radioactive waste from medical treatments than from weapons development or for the disposal of sealed sources to reduce terrorist threats. Even if the waste characteristics and hazards are similar, the fact that it was generated from different processes influences public perceptions. Perhaps there is an opportunity to communicate with the public about wastes it perceives as being generated from processes that are acceptable or valuable. It would at least open the possibility of a discussion of actual hazards and technical solutions that could be used to address those hazards. One could then

explain how waste from other processes could be managed. It would also be an opportunity to discuss disposal options that are commensurate with the level of hazard posed by the wastes.

Dr. Crowley noted that we have to change the way we talk to our stakeholders, as he explained earlier in the workshop (i.e. "educating the public"). He provided several suggestions. The first is to understand that there is not *a* public, there *are* publics. There are many different people at different levels that we need to communicate with, for example state legislators, city councils, concerned citizens, or even the League of Women's Voters. We have to understand who those audiences are, and then we have to understand what they are interested in. And to do that, we have to go out and ask them. Communication begins with discussions with the publics to find out what their interests are and what their questions are. And then you have to try to answer those questions. A true dialogue is needed.

These concepts are well understood but difficult to implement. Dr. Crowley explained that the National Academies try to implement this approach for communicating with the public in some of the studies that they carry out, and he knows from these experiences that this type of communication is very difficult to do because we operate in a very low-trust environment, particularly with respect to the government. Dr. Crowley suggested that improving communications will be a long-term effort, and that it will take a long time to establish sufficient trust to have a useful dialogue.

Mr. Garamszeghy noted that the use of the term "talking to the public," which has repeatedly been raised throughout the workshop, is indicative of the wrong attitude. Talking "at the public" or "to the public" turns people off. As mentioned by Dr. Crowley, it is necessary to talk *with* members of the public to understand what their concerns and issues are. Ask them what their needs are. Communication is a two-way street. Members of the public want to know and feel that they are being respected, their views are respected, and their input is valued.

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Appendix A

Statement of Task

The National Academies of Sciences, Engineering, and Medicine will convene a workshop of domestic and international technical, regulatory, and policy experts to discuss the safe and secure management and disposition of low-level radioactive waste. The workshop presentations and discussions will address the following topics:

- Identification of key physical, chemical, and radiological characteristics of low-level radioactive waste that govern its safe and secure management (i.e., packaging, transport, storage) and disposition, in aggregate and for individual waste-streams.
- How key characteristics of low-level waste are incorporated into standards, orders, and regulations that govern the management and disposition of low-level radioactive waste in the United States and in other major waste-producing countries.

A summary of the workshop discussions will be prepared by a designated rapporteur. The summary will not contain consensus findings or recommendations.

Appendix B

Biographies of Planning Committee and Staff

JOHN S. APPLEGATE (*Chair*) is executive vice president for University Academic Affairs of Indiana University (IU) and the Walter W. Foskett Professor of Law in the IU Maurer School of Law. He has served as a vice president for IU since 2008. He teaches and has written extensively in the fields of environmental law, administrative law, regulation of chemicals and hazardous wastes, international environmental law, risk assessment, and the management of radioactive waste. He chaired the Fernald Citizens Advisory Board at the Department of Energy's (DOE's) Fernald facility in Ohio from 1993 to 1998, and he served on the DOE Environmental Management Advisory Board from 1994 to 2001. He has also served on several Academies studies. A member of the American Law Institute, Professor Applegate has also taught at the University of Paris (Panthéon-Assas) and University of Erlangen-Nürnberg and has been a research fellow at Cardiff University. Before moving to Indiana, he was the James B. Helmer, Jr., Professor of Law at the University of Cincinnati College of Law and was a visiting professor at Vanderbilt University Law School. He was a judicial law clerk for the U.S. Court of Appeals for the Federal Circuit and an attorney in private practice in Washington, D.C. Professor Applegate received his B.A. in English from Haverford College in 1978 and his J.D. from Harvard Law School in 1981.

LARRY W. CAMPER is an executive consultant with Advoco Professional Services, LLC, and senior nuclear safety consultant with Talisman International. Mr. Camper retired from the U.S. Nuclear Regulatory Commission (USNRC) in September 2015, as the director of the Division of Decommissioning, Uranium Recovery and Waste Programs. For the preceding 10

years, Mr. Camper served as the director of the Division of Waste Management and Environmental Protection in the Office of Federal and State Materials and Environmental Management Programs. Prior to assuming that position, Mr. Camper served in several Senior Executive Service positions within the USNRC including: 2 years as the deputy director, Spent Fuel Project Office; 4 years as the chief, Decommissioning Branch; and 4 years as the chief, Materials Safety Branch. Mr. Camper also served for 10 years as the U.S. Representative to the Waste Safety Standards Advisory Committee of the International Atomic Energy Agency in Vienna, Austria. Mr. Camper is an experienced health physicist, radiation safety expert, environmental remediation expert, and executive. He has more than 40 years of professional experience with various aspects of the nuclear industry within both the private and public sectors including: radiation safety; medical, research and academic uses; commercial uses; industrial uses; environmental assessment and management; LLW oversight; uranium recovery; decommissioning of reactors and complex material sites; and spent fuel management and performance assessment. Mr. Camper received a B.S. degree in radiological science and administration (School of Medicine and Health Care Sciences) and an M.S. degree in administration (School of Business), both from George Washington University. Mr. Camper also completed graduate course work in applied health physics at Oak Ridge Associate Universities, and he completed a graduate-level Certificate in Implementation of the National Environmental Policy Act from Duke University, co-sponsored by the Council on Environmental Quality. Mr. Camper completed a certificate in Strategic Management of Regulatory and Enforcement Agencies at Harvard University, John F. Kennedy School of Government, Executive Education.

JENNIFER A. HEIMBERG is a senior program officer in the Division of Earth and Life Studies (DELS) and the Division of Behavioral and Social Sciences and Education (DBASSE). In her work for the Nuclear and Radiation Studies Board in DELS, she has focused on nuclear security, nuclear detection capabilities, and environmental management issues, and she has directed studies and workshops related to nuclear proliferation, nuclear terrorism, and the management of nuclear wastes. She directed a DBASSE study on assessing approaches for updating the U.S. metric known as the Social Cost of Carbon. Previously, she worked as a program manager at the Johns Hopkins University Applied Physics Laboratory, where she established its nuclear security program with the Department of Homeland Security's Domestic Nuclear Detection Office. She has a B.S. in physics from Georgetown University, a B.S.E.E. from Catholic University, and a Ph.D. in physics from Northwestern University.

REBECCA A. ROBBINS is currently the predisposal unit head at the International Atomic Energy Agency (IAEA) in Vienna, Austria. In this role she is responsible for working with IAEA member states to develop and disseminate IAEA guidance in all aspects of the processing, packaging, and storage of all type of radioactive waste. She has more than 20 years of experience in the nuclear industry in both the United Kingdom (UK) and the United States. Dr. Robbins has supported and led projects related to the cleanup of legacy wastes including transuranic waste at Idaho National Laboratory site and Hanford tank waste. She earned a Ph.D. in inorganic chemistry from the University of Leeds, UK.

NINA D. ROSENBERG has 25 years of experience in both technical and leadership roles at two of DOE's National Nuclear Security Administration national laboratories. She is currently the program director of Nuclear Nonproliferation and Security at Los Alamos National Laboratory (LANL). Dr. Rosenberg previously worked at Lawrence Livermore National Laboratory from 1998 to 2011. Also, she was a staff scientist in the Earth and Environmental Sciences Division at LANL from 1991 to 1998. Dr. Rosenberg is a geoscientist with experience in subsurface contaminant transport and remediation, water resources, and geologic repositories for nuclear waste. She received a B.A., summa cum laude, in geological and geophysical sciences from Princeton University and an M.A. and Ph.D. in geological sciences from the University of California, Santa Barbara.

Appendix C

Workshop Agenda

Low-Level Radioactive Waste Management and Disposition: A Workshop

October 24–25, 2016
Keck Center
500 5th Street, NW
Washington, DC 20001

Monday, October 24

9:00 am Welcome
John Applegate, organizing committee chair
Executive Vice President for University Academic Affairs, Indiana University

Jenny Heimberg, study director
Nuclear and Radiation Studies Board, The National Academies

Opening Remarks
Douglas Tonkay
Director, Office of Waste Disposal, Office of Environmental Management, Department of Energy (DOE)

9:15 am Workshop Background and Objective
John Applegate, organizing committee chair

Session 1: The Scope of the LLW Challenge

9:45 am Categories and Characteristics of Low-Level Waste (LLW)
Moderator:
Nina Rosenberg, organizing committee member
Program Director, Nuclear Nonproliferation and Security, Los Alamos National Laboratory

Each of three panelists will outline the variety of LLW streams, followed by a moderated, full-panelist discussion.

Questions for panelists:
- What are the greatest challenges that you have observed in the management of LLW?
- What key technical criteria and/or waste characteristics are most important to consider?

Miklos (Mike) Garamszeghy
Design Authority and Manager, Technology Assessment & Planning Nuclear Waste Management Organization (NWMO), Canada

Lisa Edwards
Electric Power Research Institute (EPRI)

Daniel B. Shrum
Senior Vice President Regulatory Affairs, EnergySolutions

11:00 am BREAK

11:15 am Regulations, Standards, Orders, and Guidance Criteria
Moderator:
Larry Camper, organizing committee member
Nuclear Safety Consultant, Advoco Professional Services, LLC; U.S. Nuclear Regulatory Commission (USNRC), retired

Each of three panelists will answer a set of questions, followed by a moderated discussion.

Questions for the panelists:

- What are the health, environmental safety, and security bases that led to the generally applicable standards and regulations in your line of work?
- What are the strengths and weaknesses of the respective approaches?

Andrew Orrell
Section Head for Waste and Environmental Safety, International Atomic Energy Agency (IAEA)

Thomas Magette
Managing Director, PricewaterhouseCoopers Advisory Services, LLC

Mark A. Yeager
Environmental Health Manager, South Carolina Department of Health and Environmental Control

12:30 pm LUNCH

Session 2: Lessons Learned in Establishing LLW Disposition Pathways

1:30 pm Case Studies of Successful LLW Disposal Solutions
Moderator:
Rebecca Robbins, organizing committee member
Predisposal Unit Head, IAEA

United States case studies

Case Study 1:
Separations Process Research Unit (SPRU) Tank Waste Sludge Case Study
Melanie Pearson Hurley, DOE-EM Headquarters Site Liaison for the SPRU project

Case Study 2:
Low-Level Radioactive Waste Streams Reviewed for Disposal at Nevada National Security Site—Key Criteria, Variation, and Management
Greg Lovato
Deputy Administrator, Nevada Division of Environmental Protection

Questions for the panelists:

- What were the key characteristics of the waste stream that affected management decisions for waste processing, transportation, storage, and disposal?
- Why did it work? Lessons learned for management from each example.
  - —waste characteristics (technical)
  - —management practices (process)
  - —regulatory structure (manageable, predictable, consistent)
- Were there instances in which it almost did not work?
- What were the obstacles to successful waste management and disposal?
  - —waste characteristics
  - —management practices
  - —regulatory structure

2:30 pm BREAK

2:45 pm Case Studies of Successful LLW Disposal Solutions (continued)
Moderator:
Rebecca Robbins, organizing committee member

International case studies

Case Study 3:
Canada, Licensing a Low-Level Waste Facility
Case Study 4:
Deep Geologic Repository for Low- and Intermediate-Level Waste Repository
Mike Garamszeghy, NWMO

Case Study 5:
France, Very-Low-Level and Intermediate-Low-Level Waste facilities
Gérald Ouzounian, Director, International Division, ANDRA-Agence nationale pour la gestion des déchets radioactifs

Questions for the panelists: (see questions for U.S. case studies

Full Workshop Discussion

3:45 pm Key Characteristics of LLW and Challenging LLW Streams: Initial Discussions
John Applegate, organizing committee chair

4:45 pm Wrap-up
John Applegate, organizing committee chair

5:00 pm ADJOURN

Tuesday, October 25

9:00 am Welcome
John Applegate, organizing committee chair, and
Jenny Heimberg, study director

9:10 am Common Themes from Yesterday's Discussions (Characteristics and Methodologies)
Moderator:
John Applegate, organizing committee chair

10:10 am BREAK

Session 3: Applying Common Themes to Problem Cases

10:25 am Moderator:
John Applegate, organizing committee chair

Description of the problem case studies by experts:

1. Greater than Class C (GTCC) and Commercial Transuranic (TRU) Waste > 100 nCi/g
   Lawrence R. Jacobi, Jr., Jacobi Consulting
2. Sealed Sources
   Temeka Taplin, NNSA
3. Clearance or Exempt Waste and Low-Activity Waste (e.g., lowest 10% Class A Waste)
   Lisa Edwards, Electric Power Research Institute (EPRI)
4. Incident Waste
   Will Nichols, INTERA
5. Depleted Uranium (DU)
   Scott Kirk, BWXT

10:50 am BREAK-OUT Session

Evaluating the Usefulness of Common Themes Applied to Problem Cases

Organizing committee members and study director to each lead a breakout group.

Each group will be encouraged to think about the challenges of one particular waste stream in light of previous remarks.
- What are the characteristics of the wastes?
- What are the challenges to disposal?
- How might the proposed methodology or approaches be applied to this WWP category?

12:00 pm LUNCH

1:00 pm Summary of Morning Session by Each Group Lead

2:15 pm BREAK

Session 4: Concluding Discussion

2:30 pm Full Workshop Discussion
Moderator:
John Applegate, organizing committee chair

- What have we learned? Do we have the pieces here for an integrated solution/system for LLW without a disposition pathway?
- Is there information missing that keeps us from developing an integrated solution?

4:00 pm Concluding Remarks/Reactions from Agencies
Douglas Tonkay, DOE-EM

4:15 pm Wrap-up
John Applegate, organizing committee chair

4:30 pm ADJOURN

Appendix D

Low-Level Radioactive Waste Management and Disposition: Background Information

The Department of Energy's Office of Environmental Management (DOE) is responsible for the cleanup of sites used by the federal government for nuclear weapons development and nuclear energy research. DOE "cleanup" involves the retrieval, treatment, storage, transportation, and disposal of a wide variety of radiological and hazardous wastes and materials. Low-level radioactive waste (LLW) is the most volumetrically significant radiological waste stream in the DOE cleanup program, consisting of millions of cubic meters per year.

LLW is defined by exclusion in the United States—that is, it is a residual category for radioactive waste material that is not otherwise categorized—and has no lower or upper activity limits (see Box D-1). As a result, its physical, chemical, and radiological characteristics are extremely diverse. Examples range from lightly contaminated soils and building materials to highly activated nuclear reactor components and sealed sources.

This workshop is charged to explore:

- the key physical, chemical, and radiological characteristics of LLW that govern its safe and secure management (i.e., packaging, transport, storage) and disposal, in aggregate and for individual wastestreams, and

NOTE: An earlier draft of this paper was provided as background material to the workshop participants. The draft was updated and edited after the workshop to produce the document shown in this appendix.

BOX D-1
U.S. Definitions for Nuclear Materials and Wastes

See Box D-2 for summaries of the laws noted below.

Source material:

Defined by the Atomic Energy Act of 1954, as amended (AEA),[a] "The term 'source material' means (1) uranium, thorium, or any other material which is determined by the [Nuclear Regulatory] Commission pursuant to the provisions of section 61 to be source material; or (2) ores containing one or more of the foregoing materials, in such concentration as the Commission may by regulation determine from time to time."

Special nuclear material:

Defined by Section 11 of the AEA;

"(1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Nuclear Regulatory Commission, pursuant to the provisions of section 51, determines to be special nuclear material, but does not include source material; or

(2) any material artificially enriched by any of the foregoing, but does not include source material."

Spent nuclear fuel:

Defined by Section 2 of the Nuclear Waste Policy Act of 1982[b]; "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing."

High-level waste (HLW):

Defined by the AEA and the NWPA as amended in 2004;[c]

"(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation."

Transuranic waste (TRU):

Defined by the Waste Isolation Pilot Plant Land Withdrawal Act;[d] "waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for:

1) high-level radioactive waste,
2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations; or
3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with the Code of Federal Regulations (CFR), 10 CFR Part 61."

Byproduct material:

From the AEA, Section 11;

"The term 'byproduct material' means—

(1) any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content;

(3)(A) any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after the date of enactment of this paragraph for use for a commercial, medical, or research activity; or

(B) any material that—

(i) has been made radioactive by use of a particle accelerator; and

(ii) is produced, extracted, or converted after extraction, before, on, or after the date of enactment of this paragraph for use for a commercial, medical, or research activity; and

(4) any discrete source of naturally occurring radioactive material, other than source material, that—

(A) the Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(B) before, on, or after the date of enactment of this paragraph is extracted or converted after extraction for use in a commercial, medical, or research activity."

Low-level waste:

The Low-Level Radioactive Waste Act (LLRWPA) of 1980 and the Low-Level Radioactive Waste Amendments Act (LLRWPA amendments) of 1985[e] define LLW as "radioactive material that—

(A) is not high-level radioactive waste, spent nuclear fuel, or byproduct material[f] (as defined in section 11.e (2) of the Atomic Energy Act of 1954…); and

(B) the Nuclear Regulatory Commission, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste."

This waste classification has no lower or upper activity limits. USNRC 10 CFR 61.2 defines LLW similarly but adds byproduct materials (3) and (4).

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[a]"Atomic Energy Act of 1954, as amended through Public Law 114-92, enacted November 25, 2015," accessed February 24, 2017, https://legcounsel.house.gov/Comps/Atomic%20Energy%20Act%20Of%201954.pdf.

continued

BOX D-1
Continued

[b]"Nuclear Waste Policy Act of 1982," accessed February 24, 2017, http://www.epw.senate.gov/nwpa82.pdf.

[c]"Nuclear Waste Policy Act, as amended, 2004," accessed February 24, 2017, http://www.energy.gov/sites/prod/files/edg/media/nwpa_2004.pdf.

[d]The DOE and USNRC definitions of TRU waste are not consistent.

DOE's definition follows the WIPP Land Withdrawal Act (accessed February 24, 2017, http://www.wipp.energy.gov/library/cra/baselinetool/documents/regulatory%20tools/10%20wipplwa1996.pdf). The USNRC is reviewing its current definition ("Statutory Language and Regulatory History of Commercial Transuranic Waste Disposal," accessed February 24, 2017, https://www.nrc.gov/docs/ML1516/ML15162A828.pdf).

[e]"Low-Level Radioactive Waste Policy Amendments Act of 1985," accessed February 24, 2017, https://www.gpo.gov/fdsys/pkg/STATUTE-99/pdf/STATUTE-99-Pg1842.pdf . Note that the NWPA, as amended 2004, defines LLW differently by adding "transuranic waste" to the list of what LLW is not ("is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or by-product material as defined in section 11.e (2)…").

[f]"[B]yproduct material…as defined in Sec. 11.e (2)" is provided in the Atomic Energy Act of 1954 as amended: "Sec. 11 DEFINITION…e. The term 'byproduct material' means . . . (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content…" See "Atomic Energy Act of 1954 as amended by Public Law 114-92, Enacted November 25, 2015," accessed March 1, 2017, https://legcounsel.house.gov/Comps/Atomic%20Energy%20Act%20Of%201954.pdf.

- how key characteristics of LLW are incorporated into standards, orders, and regulations that govern the management and disposal of LLW in the United States and in other major waste-producing countries.

To accomplish this task, case studies will be presented to show how LLW previously without clear or non-optimal disposition pathways have been successfully managed in the United States and internationally. Lessons to be learned from these successes will be highlighted and discussed, particularly with respect to how they can be applied to LLW waste streams that currently lack clear or have potentially non-optimal disposition pathways—referred to as challenging wastes[1] in these proceedings.

The LLW "universe" contains numerous examples of challenging waste streams whose management and disposal pathways do not align directly with the existing U.S. regulatory regime. This workshop will consider waste characteristics, classification, and criteria that have promise for matching

[1]This proceedings refers to LLW without a clear or potentially non-optimal disposition pathway due to their origin, content, or incompatibly with existing regulations and rules as "challenging LLW."

challenging waste streams with appropriate disposition options and could be applied more broadly to other LLW streams in the United States. International classification schemes and case studies will also be presented.

This white paper is intended to inform the workshop discussions and provides background information on the following:

- Entities responsible for the management and disposal of LLW,
- Classification of wastes,
- Current disposal options for LLW,
- Current regulatory landscape for LLW,
- Previous relevant Academies studies, and
- An overview of case studies and challenging LLW.

D.1 ENTITIES RESPONSIBLE FOR THE MANAGEMENT AND DISPOSAL OF LOW-LEVEL WASTE

The main agencies that regulate and oversee LLW disposal in the United States are DOE, the U.S. Nuclear Regulatory Commission (USNRC), and the Environmental Protection Agency (EPA). The states also serve an important role, including regulatory oversight of the four commercially operating LLW disposal facilities in the United States.

The mission of DOE is to safely address the environmental legacy brought about from five decades of nuclear weapons development and government-sponsored nuclear energy research.[2] During the Manhattan Project and the Cold War, LLW was generated through the production and utilization of special nuclear materials, including uranium enrichment, reactor fuel and target fabrication, reactor operations, and plutonium production and recovery. In addition, DOE continues to generate LLW through cleanup activities such as facility decommissioning, tank waste retrieval and immobilization, and soil and groundwater cleanup. This waste is referred to as "government-owned LLW" (previously referred to as "defense LLW").

DOE manages the largest, most diverse, and technically complex environmental cleanup program in the world. While it has completed the cleanup of more than 90 of the original 108 sites in its cleanup program,[3] the remaining sites present some of the most difficult technical and regulatory challenges—including those posed by the diversity and volumes of LLW. For example, in fiscal year 2015 the DOE complex-wide disposal rate

[2] "Mission and Functions Statement for the Office of Environmental Management," accessed February 24, 2017, http://energy.gov/em/downloads/mission-functions-statement-office-environmental-management.

[3] A site may still contain radioactive and chemical contamination after cleanup is completed. These sites will continue to be managed by DOE into perpetuity.

for LLW and mixed LLW (MLLW[4]) was 16.67 million cubic feet per year (Marcinowski, 2016).

The USNRC regulates the civilian use of radioactive materials within the United States under the Atomic Energy Act[5] and also has the responsibility to ensure safe and protective disposal of commercial radioactive waste. Commercial LLW is generated through the maintenance and decommissioning of nuclear power facilities, and through industrial, medical, and research activities. The USNRC may relinquish a portion of its regulatory and licensing authority to Agreement States.[6]

The EPA has the authority to set limits on radiation exposure and issue guidelines for radiation protection to federal agencies, including the USNRC and DOE. The EPA also has authority to regulate hazardous chemicals through the Resource Conservation and Recovery Act (RCRA) and the Toxic Substances Control Act (TSCA). MLLW contains hazardous chemicals and is subject to regulation by the EPA and states that host DOE facilities.

LLW is generated in nearly every U.S. state. The Low-Level Radioactive Waste Policy Act of 1980 and its amendment in 1985 (see Box D-2) assigned to each state the responsibility of disposing of its own LLW. Disposal may also be facilitated through state compacts (congressionally ratified agreements among groups of states).

D.2 CLASSIFICATION OF LOW-LEVEL WASTE

LLW is defined by U.S. law, but there is no standard classification system for LLW across federal agencies. For example, DOE identifies requirements for LLW to be disposed of in near-surface disposal facilities using waste acceptance criteria. The USNRC utilizes a classification system based on the content and concentration of specific radionuclides: Class A, B, and C wastes and Greater-than-Class C (GTCC) wastes. Moreover, international regulatory schemes, discussed in a later section, follow a different system.

Most LLW generated in the United States readily aligns with current LLW classification system and regulatory structure. However, some types of LLW were not anticipated or in existence when the classifications,

[4]MLLW is LLW that contains hazardous chemicals.

[5]In addition, the Energy Policy Act 2002 gave the USNRC the authority for regulating discrete sources of radium and accelerator-generated material.

[6]Section 274b of the Atomic Energy Act allows the USNRC to relinquish portions of its Act-derived regulatory authority to states for source materials, byproduct materials, and small quantities of special nuclear materials. An Agreement State has agreed to take responsibility of licensing commercial storage facilities under authority of the USNRC through a written agreement between the state's governor and the USNRC.

BOX D-2
Laws that Govern the Regulation and Management of LLW

1954: Atomic Energy Act (AEA) of 1954, as amended

The AEA requires that civilian uses of nuclear materials and facilities be licensed, and it empowers the USNRC to establish, by rule or order, and to enforce standards to govern these uses. Section 274b of the Act allows the USNRC to relinquish portions of its Act-derived regulatory authority to states for source materials, byproduct materials, and small quantities of special nuclear materials. An amendment to the Act[a] established compensation for, and limits on, licensee liability for injury to off-site persons or damage to property caused by nuclear accidents.

1969: National Environmental Policy Act (NEPA) of 1969, as amended

NEPA requires federal agencies to prepare a detailed environmental impact statement for every major federal action that may significantly affect the quality of the human environment. Such a statement includes a discussion of alternatives to the action and of measures to avoid or minimize any adverse effects of the action.

1982: Nuclear Waste Policy Act (NWPA) of 1982, as amended

The NWPA established statutory definitions for high-level radioactive waste, spent nuclear fuel, and LLW.

1985: Low-Level Radioactive Waste Policy Act (LLRWPA) of 1980, as amended in 1985

The LLRWPA established state (including state compacts) and federal responsibilities for the disposal of commercial LLW, assigned responsibility for managing GTCC wastes to the federal government (DOE EM was later assigned the responsibility), and requires disposal of GTCC LLW at a facility licensed by the USNRC. Recent conclusions and recommendations by USNRC staff for GTCC wastes have been summarized in SECY-15-0094, *Historical and Current Issues Related to Disposal of GTCC LLW* (USNRC, 2015). USNRC staff conducted an analysis of an Agreement State's (specifically Texas') authority to license and regulate the disposal of GTCC, GTCC-like, and TRU waste.[b]

1986: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986

CERCLA authorizes the EPA and state regulators to investigate and remediate sites placed on the National Priorities List;[c] several USNRC-licensed and DOE-managed sites contaminated with radioactive material have been placed on the NPL.

2005: Energy Policy Act (EPAct) of 2005

This Act requires DOE to submit a report to Congress on alternatives for disposing of GTCC LLW. DOE must await action by Congress before issuing a Record of Decision on a preferred disposal alternative.

continued

BOX D-2
Continued

[a]Also known as "The Price-Anderson Amendments Act of 1988," accessed February 24, 2017, http://uscode.house.gov/statutes/pl/100/408.pdf.

[b]"SECY-15-0094: Historical and Current Issues Related to Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste," accessed February 24, 2017, http://www.nrc.gov/docs/ML1516/ML15162A849.html.

[c]The National Priorities List (NPL) is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation ("Superfund: National Priorities List," accessed February 24, 2017, https://www.epa.gov/superfund/superfund-national-priorities-list-npl).

regulations, and laws were developed and do not readily conform to existing classification systems. Some examples include GTCC and transuranic (TRU) wastes, sealed sources, and incident wastes. Thus, the appropriate disposition pathway and destination for permanent disposal are difficult to plan and the final decisions can be contentious. These and other examples are discussed in a later section.

D.3 CURRENT LOW-LEVEL WASTE DISPOSAL OPTIONS

It is DOE policy to reduce, manage, and dispose of government-owned LLW at its site of generation (i.e., onsite generated LLW) to the extent allowable by site conditions. Government-owned LLW that cannot be disposed of onsite will be disposed of at offsite DOE-managed facilities—except that DOE may also dispose of government-owned LLW in commercial facilities when appropriate for cost reduction or as needed to supplement DOE's capabilities. There are currently six DOE facilities available for the disposal of government-owned LLW: four allow for the storage and disposal of onsite generated LLW, and two allow for disposal of LLW and MLLW generated offsite.

The four DOE sites that allow for disposal of onsite generated LLW are the Idaho National Laboratory; Los Alamos National Laboratory, New Mexico; Oak Ridge Reservation, Tennessee; and Savannah River Site, South Carolina. The other two sites—the Hanford Site near Richland, Washington, and the Nevada National Security Site (NNSS)—allow for disposal of both onsite and offsite generated LLW and MLLW, as long as the waste

meets each sites' waste acceptance criteria.[7] In addition, there are two commercial sites that can accept government-owned LLW: EnergySolutions LLW Disposal Facility in Clive, Utah; and Waste Control Specialists (WCS) in Andrews, Texas.

There is currently no disposal capability in the United States for GTCC LLW. However, DOE published the final environmental impact statement for the "Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste" in January 2016 (DOE, 2016);[8] it identifies land disposal at generic facilities and/or the Waste Isolation Pilot Plant (WIPP) as preferred options for the disposal of GTCC LLW and GTCC-like waste.[9]

There are four commercial LLW disposal sites in the United States. They are located in Barnwell, South Carolina, and operated by EnergySolutions; in Clive, Utah, also operated by EnergySolutions; the Hanford site in Washington, operated by U.S. Ecology; and Andrews, Texas, operated by WCS LLC (see Table D-1). Each of these sites is located in an Agreement State and are licensed by their host states under authority provided by the USNRC. Three of the sites (Barnwell, Hanford, and WCS) serve state compacts, and the fourth site (Clive) accepts Class A waste from all U.S. states. The Agreement States determine the types of LLW allowed for disposal in the facilities. Refer to Table D-1 for additional information.

D.4 CURRENT REGULATORY LANDSCAPE FOR LOW-LEVEL WASTE

Several U.S. federal laws govern the regulation and management of LLW; see Box D-2.[10] DOE is self-regulating and implements its responsibilities and authorities for waste management and disposal through directives and orders. These are incorporated into government contracts and enforced through contract and federal oversight (e.g., the Low-level Waste Disposal

[7] "Disposal Information," accessed February 24, 2017, http://www.hanford.gov/page.cfm/DisposalInformation and "Nevada National Security Site Waste Acceptance Criteria," accessed February 24, 2017, http://www.osti.gov/scitech/servlets/purl/1080356/.

[8] "Greater-Than-Class C Low-Level Radioactive Waste Environmental Impact Statement (GTCC EIS) Documents," accessed February 24, 2017, http://www.gtcceis.anl.gov/documents/index.cfm#final.

[9] "GTCC-like waste" is waste generated or owned by DOE that contains concentrations of radionuclides that are similar to commercially generated GTCC LLW.

[10] See also *Improving the Regulation and Management of Low-Activity Radioactive Wastes* (National Research Council, 2006), for descriptions of other U.S. laws that are not listed in Box D-1 (see Sidebars 2.1 and 2.2, Appendix A, available as https://www.nap.edu/catalog/11595/improving-the-regulation-and-management-of-low-activity-radioactive-wastes [accessed April 9, 2017]).

TABLE D-1 Facilities Available for Commercial LLW Disposal

	Class	Barnwell, SC (EnergySolutions)	Clive, UT (EnergySolutions)	Hanford, WA (U.S. Ecology)	Andrews, TX (WCS)
Types of commercial LLW accepted	**A**	x	x and 11e.(2)	x	x and 11e.(2)
	B	x		x	x
	C	x		x	x
Available to		Atlantic Compact: South Carolina, Connecticut, and New Jersey	All states	Northwest Compact (Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington, and Wyoming) and Rocky Mountain Compact (Colorado, Nevada, and New Mexico)	Texas Compact (Texas and Vermont) and other states on a case-by-case basis
Accepts DOE LLW			yes		yes

SOURCE: Data from “USNRC Information Digest, 2016-17,” NUREG-1350, Volume 28, Section 5: Radioactive Waste, accessed February 24, 2017, http://www.nrc.gov/docs/ML1624/ML16245A052.pdf).

Facility Federal Review Group [LFRG]). The directives and orders may be revised over time.

There are two DOE orders that govern radioactive waste management and disposal:

- DOE Order 458.1, *Radiation Protection of the Public and the Environment*, requires DOE to establish requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of DOE.[11]
- DOE Order 435.1, *Radioactive Waste Management*, provides requirements for the management and disposal of HLW, TRU, government-owned LLW, DOE-accelerator produced waste,[12] and the radioactive component of mixed waste.[13]

Under DOE Order 435.1, for instance, a Disposal Authorization Statement (DAS) is required for design and operation of a LLW disposal facility. The DAS consists of a variety of technical documents, including a performance assessment and composite analysis.[14] Waste acceptance criteria are required on a case-by-case basis for each site to meet the order's performance objectives.

The Atomic Energy Act (AEA) (see Box D-2) assigns the USNRC the responsibility for regulating and licensing commercial disposal facilities. The USNRC regulations in 10 CFR Part 61: *Licensing Requirements for Land Disposal of Radioactive Waste* apply to all commercial LLW containing source, special nuclear, or byproduct material (see Box D-1 for definitions) suitable for near-surface land disposal. A subsection within this regulation, Part 61.55,[15] defines three LLW classes from lowest radioactivity levels to highest: Class A, B, and C (see Tables D-2 and D-3). LLW with concen-

[11] "DOE O 458.1, Radiation Protection of the Public and the Environment," accessed February 24, 2017, https://www.directives.doe.gov/directives-documents/400-series/0458.1-BOrder.

[12] "DOE-accelerator produced waste" is radioactive waste produced as a result of operations of DOE accelerators. Accelerator-produced waste is not included in the AEA or NWPA.

[13] "DOE O 435.1 Chg 1, Radioactive Waste Management," accessed February 24, 2017, https://www.directives.doe.gov/directives-documents/400-series/0435.1-BOrder-chg1.

[14] From the "LFRG DOE Order 435.1," accessed February 24, 2017, https://energy.gov/em/lfrg-doe-order-4351, p. IV-12:

> "(3) Composite Analysis: For disposal facilities which received waste after September 26, 1988, a site-specific radiological composite analysis shall be prepared and maintained that accounts for all sources of radioactive material that may be left at the DOE site and may interact with the low-level waste disposal facility, contributing to the dose projected to a hypothetical member of the public from the existing or future disposal facilities."

[15] "USNRC: Part 61.55 Waste Classification," accessed February 24, 2017, https://www.gpo.gov/fdsys/pkg/CFR-2011-title10-vol2/pdf/CFR-2011-title10-vol2-sec61-55.pdf.

TABLE D-2 Near-Surface Disposal for Allowable Concentrations of Long-Lived Radionuclides

Radionuclide	Concentration (curies per cubic meter)
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	[a]100
Pu-241	[a]3,500
Cm-242	[a]20,000

[a]Units are nanocuries per gram.

TABLE D-3 Allowable Concentrations of Short-Lived Radionuclides for Near-Surface Disposal

	Concentration, (curies per cubic meter)		
Radionuclide	Class A	Class B	Class C
Total of all nuclides with less than 5-year half-life	700	([a])	([a])
H-3	40	([a])	([a])
Co-60	700	([a])	([a])
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

[a]There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table D-2 determine the waste to be Class C independent of these nuclides.
SOURCE: for Tables D-2 and D-3, "USNRC Part 61.55: Waste Classification," Tables 1 and 2, accessed February 24, 2017, https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/part061-0055.html.

trations of radionuclides that exceed the Class C limits are referred to as GTCC wastes.

Federal laws have assigned three responsibilities to the states related to LLW management and disposal:

- Each state must dispose of LLW generated within its borders, either within the state or through state compacts.
- States may assume portions of the USNRC's regulatory authority for LLW by becoming an Agreement State.
- States regulate non-AEA wastes under authority provided by the state legislature (non-AEA wastes are not covered by federal laws).

The International Atomic Energy Agency (IAEA) issues safety standards to protect health and minimize danger to life and property. The IAEA uses these standards in its own operations, and its member states incorporate these standards in whole or part into their own regulations. The *IAEA Classification of Radioactive Waste—General Safety Guide, No. GSG-1* (IAEA, 2009) presents a scheme for classification and management of radioactive waste based on specific radionuclides, their half-lives, and activity levels in the waste. The standards define six categories of waste (listed here from lowest to highest level of radioactivity):

- exempt waste (EW),
- very short-lived waste (VSLW),
- very low-level waste (VLLW),
- low-level waste (LLW),
- intermediate-level waste (ILW), and
- high-level waste (HLW).[16]

The objective of the IAEA's classification system is to ensure the long-term safety of the public and the environment through the proper management and disposal of the waste. Therefore, the waste is classified according to the degree of containment and isolation required based on the activity content and half-lives of the contained radionuclides.

DOE has previously requested the advice of the National Academies on its waste management programs. *Improving the Regulation and Management of Low-activity Radioactive Wastes* (National Research Council, 2006), funded in part by DOE, is particularly relevant to the current workshop. The report recommended a tiered approach to clarify and simplify

[16]See Figure 1: Conceptual illustration of the waste classification scheme (IAEA, 2009), "Classification of Radioactive Waste," accessed April 9, 2017, http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1419_web.pdf.

the current system for managing low-activity waste[17] by converting it to a risk-informed system. The tiered approach, which identified a set of options in order of increasing complexity, resources, and time, acknowledged that changes to regulations would likely take many years and would require coordination among many federal and state agencies.

The report also found that current laws and regulations for low-activity wastes provide adequate authority for protection of workers and the public (FINDING 1) (see National Research Council, 2006, Appendix A). However, the current system of managing and regulating low-activity waste—as described partially above—is complex (FINDING 2). The report's summary notes that classification systems are becoming more complex as unanticipated waste streams are identified. Indeed, this is one of the motivating factors for the current workshop.

The report further found that certain categories of low-activity wastes have not received consistent regulatory oversight and management (FINDING 3) and that current regulations for low-activity wastes are not based on systematic consideration of risk (FINDING 4). These last two findings pertain primarily to uranium and thorium mill tailings, naturally occurring radioactive material (NORM), and technologically enhanced radioactive material (TENORM). TENORM can contain significant concentrations of radioactive materials. NORM and TENORM wastes are not generally regulated by federal agencies; moreover, their regulation by the states is inconsistent.

The National Academies also published a workshop summary that is relevant to LLW management and disposal: *Best Practices for Risk-Informed Decision Making Regarding Contaminated Sites—Workshop* (National Research Council, 2014), funded by DOE. This workshop explored long-term remediation decisions for contaminated sites based on sustainability principles (balancing between the environmental, societal, and economic goals) rather than purely risk-based or regulation-based approaches.

The National Academies report *Waste Forms Technology and Performance* (National Research Council, 2011) provided guidance on improving current methods for processing radioactive wastes and producing waste forms for disposal. The report found that laws and regulations governing DOE wastes do not establish specific requirements for waste form performance in disposal systems, therefore allowing DOE flexibility in the selection of waste forms.

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[17]The 2006 committee intended the term "low-activity waste" (LAW) to be more inclusive than LLW, which has a specific definition through the NWPA. DOE often uses the term LAW to describe lower-activity fractions of tank waste; National Research Council (2006) did not use the term in that sense.

D.5 CASE STUDIES AND EXAMPLES OF CHALLENGING LOW-LEVEL WASTES

The following five case studies will be discussed during the workshop. They represent instances in which an appropriate and acceptable disposal pathway was found for the LLW involved. The presentations on the first day of the workshop will consider these case studies in greater detail, with an eye to drawing lessons for other challenging waste streams for which clear disposal pathways do not currently exist or which are potentially not optimal.

Case Study 1: Separations Process Research Unit Tank Waste Sludge

In the early 1950s, research on plutonium and uranium separation techniques such as PUREX and REDOX[18] was performed at the Knolls Atomic Power Laboratory's[19] (KAPL's) Separation Process Research Unit (SPRU). Radioactive liquid and sludge wastes resulting from the research were stored in seven tanks located onsite. The separations research ended in 1953, and the liquids were retrieved from the tanks in the 1960s, but the sludge wastes remained in the tanks. DOE completed solidification of the sludge and removal of the tanks from KAPL in 2014.[20] The cleanup required coordination among several organizations: DOE, its contractor (URS Corporation), the Office of Naval Reactors (the site's landlord), and WCS. WCS accepted the tank sludge waste and the remediated tanks at its LLW disposal facility in Andrews, Texas.

Case Study 2: Disposal of Low-Level Radioactive Waste at the NNSS

The secure shallow-land burial (to 24 feet [7.3 meters] below ground surface) in the Area 5 Radioactive Waste Management Site at the NNSS accepts LLW, MLLW, and classified waste[21] from more than 25 different sites within the DOE Complex. Per agreement with DOE, Nevada's Division of Environmental Protection (NDEP) participates in the review of waste

[18] REDOX (reduction oxidation) and PUREX (Plutonium and Uranium Recovery by Extraction) are processes for separating plutonium and uranium from irradiated fuel and targets.

[19] The Knolls Atomic Power Laboratory is located in upstate New York. It is a research and development laboratory for the U.S. Navy Nuclear Propulsion Program.

[20] "EM's SPRU Celebrates Waste Removal Success, Safety Milestone," accessed February 24, 2017, http://energy.gov/em/articles/em-s-spru-celebrates-waste-removal-success-safety-milestone.

[21] DOE Order 435.1-1 defines classified waste as "Radioactive waste to which access has been limited for national security reasons and cannot be declassified shall be managed in accordance with the requirements of DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*, and DOE 5633.3B, *Control and Accountability of Nuclear Materials*."

profiles proposed for disposal at the NNSS and in the review of the NNSS Waste Acceptance Criteria.

NDEP's perspectives on the variation in certain key criteria with the broad spectrum of LLW reviewed for disposal at the NNSS will be presented at the workshop, including:

- isotope half-life duration;
- radionuclide activity concentrations as compared to concentrations shown by the existing site performance assessment to meet site performance objectives; and
- plutonium equivalent gram activity.

NDEP will also review general measures that have been taken by DOE, the state of Nevada, and others to address stakeholder concerns associated with transportation and disposal of this LLW.

Case Study 3: Canada: Port Hope Area Initiative

The Port Hope Area Initiative (PHAI)[22] is focused on the cleanup of approximately 1.2 million cubic meters of historic low-level radioactive waste currently stored across sites within the municipality of Port Hope. These wastes, primarily contaminated soil, resulted from radium and uranium refining activities in the 1930s through the 1950s. Construction of a long-term waste management facility (an engineered above-ground mound) is under way. Its location will be within an existing LLW management facility. Waste at the existing site and specified wastes from other sites in Port Hope will be placed in the above-ground mound.[23]

Case Study 4: Canada: Deep Geologic Repository for Low- and Intermediate-Level Waste

Canada does not have an operating disposal facility for low- or intermediate-level wastes (L&ILW).[24] Each waste generator is responsible for

[22]The PHAI Management Office is a tripartite organization involving Atomic Energy of Canada Limited, Natural Resources Canada, and Public Works and Government Services Canada (PWGSC). This office is responsible for carrying out the LLW disposal and cleanup projects in the Port Hope area.

[23]"Port Hope Area Initiative," accessed February 24, 2017, http://www.phai.ca/en/home/default.aspx.

[24]Canadian definitions of low- and intermediate-level wastes are different from U.S. definitions. Current Canadian definitions were adopted in 2008 and are consistent with the IAEA GSG-1 classification system (IAEA, 2009). Canada previously recognized three classes of waste: nuclear fuel waste, uranium mining and milling waste, and low-level waste—the latter defined similarly to the U.S. definition as wastes not included in the first two categories.

the long-term management of their wastes. A new L&ILW disposal facility, a deep geologic repository, in Kincardine (Ontario) is currently undergoing licensing. Ontario Power Generation (OPG), a major Canadian utility and nuclear waste generator, owns and operates the site on which this repository will be built. The repository will be located on an existing nuclear site—the Bruce Nuclear Power Generating Station, adjacent to OPG's Nuclear Waste Management Organization facility. The repository will have a reference depth of 680 meters and has a potential waste capacity totaling approximately 200,000 cubic meters. The municipality of Kincardine is a willing volunteer host for the facility. The hosting agreement specifically excludes the possibility of disposing of used reactor fuel in the facility.

Case Study 5: France: Very LLW and Intermediate LLW Facilities

The management and disposal of LLW in France differs in important ways from approaches used in the United States, even though the waste characteristics are similar in both countries. The French approach considers the physical characteristics of the waste and its hazard, based on half-lives and activities of radionuclides, in determining treatment and disposal options. The French classification makes a distinction between:

- very short-lived, short-lived, and long-lived waste, and
- very low-, low-, intermediate-, or high-level waste (VLL, LL, IL or HL waste).

Approximately 96 percent by volume of nuclear waste in France is VLL and LL short- and long-lived waste and IL short-lived waste. This waste contains less than 0.1 percent of the overall waste activity. Conversely, approximately 4 percent of France's waste by volume is IL long-lived waste and HL short- and long-lived waste containing more than 99.9 percent of the activity.[25]

France has two disposal facilities of relevance to the current workshop. For waste that has a very low-activity level (between 0 and 100 becquerels per gram [Bq/g] or 0 to 2.7 nanocuries per gram [nCi/g]), the waste is managed at the ANDRA CSTFA (Centre de stockage des déchets à très faible activité) disposal facility located in the Aube district, southeast of Paris.[26] This facility has been operational since 2003 and is the first disposal facility in the world for this type of waste. Low- and intermediate-level short-lived

[25] "ANDRA: Waste Classification," accessed February 24, 2017, https://www.andra.fr/international/pages/en/menu21/waste-management/waste-classification-1605.html.

[26] "ANDRA: Very-low-level waste," accessed February 24, 2017, https://www.andra.fr/international/pages/en/menu21/waste-management/waste-classification/very-low-level-waste-1607.html.

waste, such as waste related to maintenance (i.e., clothes, tools, gloves, filters) and the operation of nuclear facilities (i.e., residues from the treatment of gaseous and liquid effluents) has been disposed of at the ANDRA CSFMA (Centre de stockage des déchets à faible et moyenne activité et à vie courte) waste disposal facility since 1992.[27] France currently does not have a facility to dispose of low-level long-lived waste but plans to commission a repository by 2019.[28] Cigéo, a geological disposal facility for intermediate- and high-level and long-lived waste, is expected to be commissioned in 2025.

D.6 CHALLENGING LOW-LEVEL WASTE STREAMS

As noted previously, challenging LLW streams lack clear or have potentially non-optimal disposition pathways. They will be discussed during the breakout sessions on the second day of the workshop.

GTCC and Commercial TRU Waste Exceeding 100 nCi/g

There are three types of GTCC waste considered in DOE's final environmental impact statement analysis (DOE, 2016): Activated metals (generated from the decommissioning of nuclear reactors including core shrouds and core support plate), sealed sources, and other waste (contaminated equipment, debris, scrap metal, filters, resins, soil, and solidified sludge). The combined GTCC LLW and GTCC-like waste inventory is projected to be about 12,000 cubic meters (~420,000 cubic feet) and will contain a total activity of about 160 million curies (MCi); about 75 percent of this waste is commercial GTCC LLW and 25 percent is DOE-owned GTCC-like LLW.[29]

DOE evaluated five alternatives in the final environmental impact statement for the disposal of the GTCC LLW and DOE-owned GTCC-like waste (DOE, 2016). As noted previously, the preferred alternative for the disposal of GTCC LLW and GTCC-like waste is land disposal at generic commercial facilities and/or disposal at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico.

[27] "ANDRA: Low and intermediate level short-lived waste," February 24, 2017, https://www.andra.fr/international/pages/en/menu21/waste-management/waste-classification/short-lived-low--and-intermediate-level-waste-1609.html.

[28] "ANDRA: Low-level long-lived waste," February 24, 2017, https://www.andra.fr/international/pages/en/menu21/waste-management/waste-classification/low-level-long-lived-waste-1616.html.

[29] "Supplement to Greater-Than-Class C (GTCC) Low-level Radioactive Waste and GTCC-like Waste Inventory Reports," accessed February 24, 2017, http://www.gtcceis.anl.gov/documents/docs/Supplemental-Inventory-Report.pdf.

Sealed Sources

Sealed sources are used in industry, medicine, research, and oil exploration. Some examples include cobalt-60 for medical therapy; cobalt-60 and cesium-137 for bulk irradiation (e.g., medical equipment and food); americium-241/Be for well logging (e.g., for petroleum exploration); and iridium-192 and cobalt-60 for industrial radiography. Disused or unwanted sealed radiation sources range in activity from micro- to kilo-curies; these sources meet USNRC's definition for Class C or GTCC LLW. They can cause acute radiation effects in humans and serious contamination incidents if not managed properly (Cuthbertson et al., 2014).

Clearance or Exempt Waste and Low-Activity Waste

Waste that has very low activity levels is referred to as "clearance" or "exempt" waste by the IAEA (IAEA, 1996). The United States does not have a clearance or exempt classification category. The activity level of this type of waste falls into the lower end of the USNRC Class A designation. This type of LLW may occur in very large volumes. Examples include lightly contaminated wastes generated from decommissioning of nuclear facilities at DOE and civilian sites and from site cleanup activities, including debris, rubble, construction materials, and soils.

Incident Waste

These are wastes resulting from a nuclear incident,[30] for example a severe nuclear accident or nuclear or radiological terrorist attack. Examples of incident wastes include agricultural materials and soils, concrete, asphalt (roads), rubble, debris, metal, activated components, emergency responders' equipment, and cleaning materials. There is potential for very large amounts of waste with low- to high-levels of radioactivity, depending on the type of incident.

Depleted Uranium (DU)

DU waste is a created through the enrichment of uranium, for both commercial and defense applications. DU is unique in its disposal requirements because the activity (and exposure risk) of DU increases with time

[30] Section 11q of the AEA defines a nuclear incident as "any occurrence, including an extraordinary nuclear occurrence, within the United States causing, within or outside the United States, bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of source, special nuclear, or byproduct material."

due to the ingrowth of decay products. Most DU exists as a hexafluoride (DUF_6) and must be converted to DU oxide (e.g., DU_3O_8) for disposal.

Small quantities of DU are currently being disposed of as a Class A waste. However, more than 1 million metric tons (MT) of DU (up to 800 kMT DU at Paducah and Portsmouth and ~300 kMT commercial DU) will require disposal.

There are currently two LLW disposal facilities that are authorized to dispose of uranium oxide: WCS in Texas and the NNSS. A third site, EnergySolutions in Utah, is seeking a permit to authorize disposal of DU in its Class A LLW disposal facility. DOE is currently preparing a supplemental environmental impact statement to analyze the environmental impacts of DU oxide disposition.[31] A USNRC staff review (USNRC, 2008) concluded that existing regulations need to be amended to ensure that commercial DU is disposed of safely.

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Appendix E

Biographies of Panelists and Speakers

LISA EDWARDS is the senior program manager for the Nuclear Chemistry, Radiation Safety and Used Fuel/HLW Management Programs at the Electric Power Research Institute (EPRI). Before joining EPRI in 2006, Ms. Edwards had more than 18 years of experience in commercial nuclear utilities at Duane Arnold, Comanche Peak, Cooper, and St. Lucie. She received her USNRC Senior Reactor Operator license in 2001. She has extensive experience in both solid and liquid radioactive waste processing and management. Ms. Edwards received a B.S. in chemistry from Cornell College, Mount Vernon, Iowa, where she was elected to Phi Beta Kappa and graduated magna cum laude.

MIKLOS (MIKE) GARAMSZEGHY is a chemical/nuclear engineer with more than 35 years of experience in the research, design, and operation and planning of radioactive waste management facilities. He is currently design authority and manager of technology assessment and planning at the Canadian Nuclear Waste Management Organization (NWMO), a utility-owned consortium that has a federal government mandate to develop and implement a program for the long-term management of used nuclear fuel. He has contributed to numerous International Atomic Energy Agency (IAEA), Organisation for Economic Co-operation and Development-Nuclear Energy Agency (OECD-NEA), and International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) reports, as well as international peer reviews and projects for more than 30 years, dealing with varied aspects of radioactive waste, advanced fuel cycles, and used nuclear fuel management. He is a past chair of the Canadian Standards

Association N292 technical committee (which deals with radioactive waste standards); current chair of the Canadian Advisory Committee for the ISO TC-85/SC-5 technical committee (which deals with nuclear fuel cycle and waste standards); current Canadian representative on ISO TC85/SC5/WG5 (Waste Characterization); the ISO representative on the IAEA's Waste Safety Standards Committee (WASSC); a member of the Canadian government's External Advisory Panel on Gen-IV reactors; and serves on the technical program advisory boards for several international conferences dealing with radioactive waste management. He holds BASc and MASc degrees in chemical/nuclear engineering from the University of Toronto (Canada) and is a registered professional engineer in Ontario (Canada).

MELANIE PEARSON HURLEY has more than 25 years' experience at the Department of Energy in regulatory compliance and oversight, and program and project management. She has worked in the environmental discipline for the past 35 years in local, state, and federal government agencies. Mrs. Hurley joined the Office of Environmental Management in 2009 after 18 years with the former DOE Office of Environment, Safety and Health (now Environment, Health, Safety and Security). She is currently a headquarters liaison in the Office of Field Operations for the eight Environmental Management Consolidated Business Center Projects. Mrs. Hurley has a B.S. in biology from Virginia Polytechnic Institute and State University and a masters in administration from Central Michigan University.

LAWRENCE "RICK" JACOBI, JR. is the owner and principal consultant at Jacobi Consulting. He is an experienced nuclear industry executive with more than 40 years of front-line experience in project management, licensing, and handling of radioactive material, environmental sciences, legal and regulatory matters, and governmental and media affairs. As a licensed nuclear engineer, health physicist, and member of the State Bar of Texas, Mr. Jacobi provides technical assistance to a variety of nuclear and radiological facilities including waste disposal companies, industrial users, uranium miners, transportation companies, oil and gas exploration and production companies, and investment companies who are seeking an expert opinion on the acquisition of nuclear facilities. He offers hands-on technical assistance in the licensing, construction, operation, and decommissioning of nuclear and radiological facilities, including expert guidance on radiation risk assessment, licensing and permitting of nuclear facilities, environmental assessments, nuclear facility closure and decommissioning plans, radiological and nonradiological environmental monitoring programs, and nuclear facility operating procedures. Mr. Jacobi is an internationally recognized expert on the management of radioactive waste storage, processing, and

disposal facilities. He has a B.S. and M.Sc. in nuclear engineering from Texas A&M University and a J.D. from South Texas College of Law.

SCOTT KIRK recently joined BWX Technologies and serves as the director of regulatory affairs for its Technical Service Group. In this capacity, Mr. Kirk provides guidance on a variety of regulatory affairs matters, focusing on radioactive waste management. Prior to his employment with BWX Technologies, Mr. Kirk served as the vice president of licensing and regulatory affairs for Waste Control Specialists during the past 10 years, working on disposal options for complex waste streams such a large quantities of depleted uranium and Greater-Than-Class C low-level waste. Mr. Kirk was also employed by Nuclear Fuel Services and served as the principle liaison with USNRC for more than 10 years. He was responsible for obtaining licensing approval for processing highly enriched uranium for the U.S. Naval Nuclear Propulsion Program and a major nuclear-nonproliferation program for DOE. Mr. Kirk was recently selected by the Southeast Compact Commission for Low-Level Radioactive Waste Management as the recipient of 2017 Richard S. Hodes M.D. Honor Lecture Award for his contributions and innovations in the field of radioactive waste management. He has a M.Sc. in environmental health from East Tennessee State University and a B.S. in geology and physics from Appalachian State University. He is certified in the comprehensive practice of health physics by the American Board of Health Physics.

GREG LOVATO is deputy administrator at the Nevada Division of Environmental Protection (NDEP), where he oversees the Mining, Environmental Cleanup, Waste Management, and Federal Facilities programs. He started his career in at U.S. Environmental Protection Agency (EPA) Region 9 as an environmental engineer working on cleanup, brownfields, and hazardous waste permitting projects in Nevada and California, including 3 years at NDEP in Carson City and 6 years at the Los Angeles Regional Water Quality Control Board. Mr. Lovato holds a B.S. in civil engineering from Stanford University and a B.A. in management-engineering from Claremont McKenna College. Mr. Lovato is a licensed professional engineer (civil) in Nevada and California.

THOMAS E. MAGETTE has more than 30 years' experience managing and conducting nuclear safety, licensing, siting, and environmental assessment programs for energy generation and transmission, national defense, and radioactive waste disposal facilities. He served as the director of the Nuclear Safety Division in DOE's Office of New Production Reactors and was the manager of nuclear programs for the Maryland Power Plant Research Program. His experience covers a wide spectrum of the nuclear

industry, including operating reactors, decommissioning, decommissioning funding, transportation, low-level radioactive waste, spent nuclear fuel, and import-export of radioactive material. Mr. Magette currently manages nuclear consulting offerings for PricewaterhouseCoopers (PwC) Capital Projects and Infrastructure in the United States. Mr. Magette holds B.S. and M.S. degrees in nuclear engineering from the University of Tennessee and is a registered professional engineer in Maryland and Virginia.

WILLIAM "WILL" NICHOLS' professional experience as a water resources engineer has focused on hydrology, environmental site characterization, fate and transport modeling, pathway and exposure modeling, uncertainty and sensitivity analysis, integrated risk assessment, probabilistic modeling and simulation, and software quality assurance. He has applied his expertise to help solve problems of national importance in the areas of Resource Conservation and Recovery Act (RCRA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), remedial investigations and feasibility studies, radioactive waste disposal facility licensing, National Environmental Policy Act (NEPA) reviews, and environmental impact statement development. Mr. Nichols' expertise has been applied in support of environmental restoration, dose reconstruction for legacy radioactive waste practices, and demonstration of compliance with applicable waste disposal regulatory requirements. He received a B.S. and M.S. from Oregon State University.

ANDREW ORRELL is the section head for Waste and Environmental Safety at the International Atomic Energy Agency (IAEA) where he is responsible for the development and promulgation of internationally accepted standards, requirements, and guides for the safe management of radioactive waste and spent fuel, decommissioning, remediation, and environmental monitoring. In addition, Mr. Orrell oversees the planning and execution of support to the IAEA Member States for the implementation of the IAEA Safety Standards and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Prior to joining the IAEA, Mr. Orrell was the director of nuclear energy programs for Sandia National Laboratories. With more than 25 years of professional experience in nuclear fuel cycle and radioactive waste management for the U.S. and several international programs, Mr. Orrell is versed in the complex interdependencies between nuclear energy development, waste management, decommissioning, remediation, and disposal. Mr. Orrell routinely advises government and industry leaders on the technical and policy implications for radioactive waste management, including repository development and licensing, national policy development and regulation, site characterization

and safety case development, storage, transportation, and the securing of public confidence.

GÉRALD OUZOUNIAN has been the international director for ANDRA, the French national radioactive waste management agency, since October 2006. Previously, he served as the deputy director for the scientific department at ANDRA for 16 years. He was also in charge of modelling policy and of its implementation in ANDRA. In these functions, he has prepared and implemented studies for low- and intermediate-level activity waste disposal and for used nuclear fuel and high-level waste management, including strategic studies and scientific and technical assessment of the different options. Dr. Ouzounian is a member of the Nuclear Energy Agency's Radioactive Waste Management Committee and the IAEA's Waste Technology Committee. He received a Ph.D. from the Paris University.

DANIEL "DAN" B. SHRUM has worked for EnergySolutions for 19 years. He is the senior vice president for regulatory affairs at EnergySolutions and is responsible for the overall corporate environmental, radiation safety, quality assurance, and security culture, obtaining and updating EnergySolutions numerous permits and licenses, and ensuring that the regulations are followed at all facilities. He has more than 24 years of professional experience including investigations and remedial actions at numerous CERCLA and RCRA sites in Utah, North Dakota, Alaska, and California. Mr. Shrum has designed and installed monitoring well compliance and groundwater extraction systems and has conducted and interpreted aquifer test data for many groundwater investigations. He has successfully managed field teams conducting site characterizations, remedial investigations, and treatability studies. He is experienced in all aspects of drilling and monitoring well completion methods, appropriate air, soil, and groundwater sampling protocol, and quality assurance/quality control procedures. Mr. Shrum has authored or co-authored many soil and groundwater work plans and sampling protocols in addition to investigation reports. Mr. Shrum's academic experience emphasized the geology, hydrogeology, and geochemistry of the several mountain systems in Utah and Idaho.

TEMEKA TAPLIN is the federal program manager for the Off-Site Source Recovery Program within the National Nuclear Security Administration's Office of Radiological Security. During her 5 years of federal service she has worked on numerous radiological security programs dealing with disused, unwanted, and orphaned radiological sources. Under her tenure, thousands of radiological sources have been recovered for final disposition or brought back under regulatory control. She also works with national laboratories and university partners to build educational programs

that will increase the number of radiation security experts for the next generation. Ms. Taplin has an M.H.P. and is a graduate of Texas A&M University.

DOUG TONKAY is the director of the Office of Waste Disposal within the Department of Energy's Office of Environmental Management (EM). He manages staff responsible for a portfolio of EM mission activities, including strategic planning and disposal policy for DOE LLW/mixed LLW, a share of the DOE's LLW Federal Review Group, disposition planning for depleted uranium, and planning for Greater-Than-Class C LLW disposition. During his 25-year career at DOE he has worked on a variety of assignments in low-level radioactive waste and transuranic waste management. He also leads the U.S. interagency working group implementing activities for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and is also the U.S. country coordinator for two IAEA projects. He earned B.S. and M.Sc. degrees in nuclear engineering from the Pennsylvania State University.

MARK YEAGER is environmental health manager in the Division of Waste Management with the South Carolina Department of Health and Environmental Control. He began his career in 1980 in the Department's Radiological Laboratory while attending the University of South Carolina. In addition to conducting environmental monitoring at the state's various fixed nuclear facilities, Mr. Yeager performed environmental monitoring and sample analyses at the Energy Solutions/Chem-Nuclear Systems LLW disposal facility located in Barnwell, SC. In 1987, Mr. Yeager transferred to the state's Agreement State program as an onsite inspector at the Barnwell facility. He is currently the program's senior health physicist and inspector. Some of his achievements within the field of radioactive waste management and transportation include: contributing member of the Conference of Radiation Control Program Director's (CRCPD's) E-26 Committee on Radioactive Material Transportation; active member and former chairperson of the CRCPD's E-5 Committee on Radioactive Waste Management; providing technical assistance and regulatory oversight to the EPA and U.S. Navy during the radiological decommissioning of the Charleston Naval Shipyard; providing regulatory oversight of the final decommissioning and resulting waste disposal operations of the former Carolinas-Virginia Training Reactor located in Jenkinsville, SC; assisting in the development and subsequent publication of the American National Standard Institute's *Standard N14.36: Measurement of Radiation Levels and Surface Contamination for Packages and Conveyances*; administering the state's transportation inspection program for DOE's Foreign Research Reactor Spent Nuclear Fuel Recovery Program and the Savannah River

Site/Waste Isolation Pilot Plant TRU waste disposal program; assisting in the implementation of the USNRC's initial orders and subsequent security requirements in 10 CFR Part 37 at the Barnwell Disposal Facility; and the Organization of Agreement State's representative on the USNRC's 10 CFR Part 61 Working Group.

Appendix F

Acronyms

AEA	Atomic Energy Act of 1954
ALARA	As low as reasonably achievable
ANDRA	Agence nationale pour la gestion des déchets radioactifs (National Agency for Radioactive Waste Management, France)
ANPR	Advance Notice of Public Rulemaking
BDF	Barnwell Disposal Facility
Bq/g	Becquerels per gram
BTP	U.S. Nuclear Regulatory Commission's *Branch Technical Position on Concentration Averaging and Encapsulation*
BWXT	BWX Technologies, Inc.
CANDU	CANada Deuterium Uranium reactor
CEAA	Canadian Environmental Assessment Agency
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*, known also as Superfund
CFR	Code of Federal Regulations
CIRES	Centre industriel de regroupement, d'entreposage et de stockage facility (France)
CNSC	Canadian Nuclear Safety Commission
CRCPD	Conference of Radiation Control Program Directors, Inc.
CSA	Centres de stockage de l'Aube (France)
CSFMA	Centre de stockage des déchets à faible et moyenne activité et à vie courte

CSM	Centre [de stockage] de la Manche (France)
CSTFA	Centre de stockage des déchets à très faible activité
DAW	Dry active waste
DHEC	South Carolina Department of Health and Environmental Control
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DUF_6	Depleted uranium hexafluoride
DU_3O_8	Depleted uranium oxide
EIS	Environmental impact statement
EPAct	*Energy Policy Act of 2005*
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
g/m^3	Gram per cubic meter
GSG	IAEA General Safety Guide
GSR	IAEA General Safety Requirement
GTCC	Greater-Than-Class C
HEPA	High-efficiency particulate air
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IMPEP	U.S. Nuclear Regulatory Commission's Integrated Materials Performance Evaluation Program
ILW	Intermediate-level waste
KAPL	Knolls Atomic Power Laboratory
L&ILW	Low- and Intermediate-Level Wastes
LANL	Los Alamos National Laboratory
LLRW	Low-level radioactive waste
LLRWMO	Low-Level Radioactive Waste Management Office
LLRWPA	*Low-Level Radioactive Waste Policy Act of 1980*
LLRWPA amendments	*Low-Level Radioactive Waste Policy Act Amendments of 1985*
LLW	Low-level radioactive waste or low-level waste
MARSSIM	U.S. Environmental Protection Agency's *Multi-Agency Radiation Survey and Site Investigation Manual*

MLLW	Mixed low-level waste
MOX	Mixed oxide
mrem/yr	Millirem per year
mSv/yr	Milliseiverts per year
MT	metric ton
nCi/g	Nanocuries per gram
NCRP	National Council on Radiation Protection and Measurements
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NORM	Naturally occurring radioactive material
NPP	Nuclear power plant
NPV	Net present value
NRC	U.S. Nuclear Regulatory Commission
NWMO	Nuclear Waste Management Organization
NWPA	*Nuclear Waste Policy Act of 1982*
OAS	Organization of Agreement States
OMB	U.S. Office of Management and Budget
OPG	Ontario Power Generation
OSRP	National Nuclear Security Administration's Off-Site Source Recovery Program
PAG	U.S. Environmental Protection Agency's Protective Action Guideline
PE-g	Plutonium equivalent grams
PHAI	Port Hope Area Initiative
PUREX	Plutonium and uranium recovery by extraction
PVP	Property Value Protection
RCRA	*Resource Conservation and Recovery Act*
REDOX	Reduction oxidation process
ROD	Record of decision
RTG	Radioisotope thermoelectric generator
SCATR	U.S. Department of Energy's Source Collection and Threat Reduction (Program)
SECY	Office of the Secretary (of the U.S. Nuclear Regulatory Commission)
SPRU	Separations Process Research Unit

TCLP	Toxicity characteristic leaching procedures
TENORM	Technically enhanced naturally occurring radioactive material
TRU	Transuranic
TSCA	Toxic Substances Control Act
UF	Used fuel
UF_6	Uranium hexafluoride
U_3O_8	Uranium oxide
U.S.	United States
USGS	U.S. Geological Survey
USNRC	U.S. Nuclear Regulatory Commission
VLLW	Very low-level waste
WAC	Waste acceptance criteria
WCS	Waste Control Specialists, LLC
WIPP	Waste Isolation Pilot Plant

COVID-19 is an emerging, rapidly evolving situation. x

Get the latest public health information from CDC: https://www.coronavirus.gov

Get the latest research information from NIH: https://www.nih.gov/coronavirus

Radiation Exposure

What is radiation?

Radiation is energy. It travels in the form of energy waves or high-speed particles. Radiation can occur naturally or be man-made. There are two types:

- **Non-ionizing radiation,** which includes radio waves, cell phones, microwaves, infrared radiation and visible light
- **Ionizing radiation,** which includes ultraviolet radiation, radon [https://medlineplus.gov/radon.html] , x-rays [https://medlineplus.gov/xrays.html] , and gamma rays

What are the sources of radiation exposure?

Background radiation is all around us all the time. Most of it forms naturally from minerals. These radioactive minerals are in the ground, soil, water, and even our

bodies. Background radiation can also come from outer space and the sun. Other sources are man-made, such as x-rays, radiation therapy [https://medlineplus.gov/radiationtherapy.html] to treat cancer, and electrical power lines.

What are the health effects of radiation exposure?

Radiation has been around us throughout our evolution. So our bodies are designed to deal with the low levels we're exposed to every day. But too much radiation can damage tissues by changing cell structure and damaging DNA. This can cause serious health problems, including cancer.

The amount of damage that exposure to radiation can cause depends on several factors, including

- The type of radiation
- The dose (amount) of radiation
- How you were exposed, such as through skin contact, swallowing or breathing it in, or having rays pass through your body
- Where the radiation concentrates in the body and how long it stays there
- How sensitive your body is to radiation. A fetus is most vulnerable to the effects of radiation. Infants, children, older adults, pregnant women, and people with compromised immune systems are more vulnerable to health effects than healthy adults.

Being exposed to a lot of radiation over a short period of time, such as from a radiation emergency [https://medlineplus.gov/radiationemergencies.html] , can cause skin burns [https://medlineplus.gov/burns.html] . It may also lead to acute radiation syndrome (ARS, or "radiation sickness"). The symptoms of ARS include headache and diarrhea. They usually start within hours. Those symptoms will go away and the person will seem healthy for a little while. But then they will get sick again. How soon they get sick again, which symptoms they have, and how sick they get depends on the amount of radiation they received. In some cases, ARS causes death in the following days or weeks.

Exposure to low levels of radiation in the environment does not cause immediate health effects. But it can slightly increase your overall risk of cancer.

What are the treatments for acute radiation sickness?

Before they start treatment, health care professionals need to figure out how much radiation your body absorbed. They will ask about your symptoms, do blood tests, and may use a device that measures radiation. They also try get more information about the exposure, such as what type of radiation it was, how far away you were from the source of the radiation, and how long you were exposed.

Treatment focuses on reducing and treating infections, preventing dehydration [https://medlineplus.gov/dehydration.html] , and treating injuries and burns. Some people may need treatments that help the bone marrow [https://medlineplus.gov/bonemarrowdiseases.html] recover its function. If you were exposed to certain types of radiation, your provider may give you a treatment that limits or removes the contamination that is inside your body. You may also get treatments for your symptoms.

How can radiation exposure be prevented?

There are steps you can take to prevent or reduce radiation exposure:

- If your health care provider recommends a test that uses radiation, ask about its risks and benefits. In some cases, you may be able to have a different test that does not use radiation. But if you do need a test that uses radiation, do some research into the local imaging facilities. Find one that monitors and uses techniques to reduce the doses they are giving patients.
- Reduce electromagnetic radiation [https://medlineplus.gov/electromagneticfields.html] exposure from your cell phone. At this time, scientific evidence has not found a link between cell phone use and health problems in humans. More research is needed to be sure. But if you still have concerns, you can reduce how much time you spend on your phone. You can also use speaker mode or a headset to place more distance between your head and the cell phone.
- If you live in a house, test the radon levels, and if you need to, get a radon reduction system.
- During a radiation emergency, get inside a building to take shelter. Stay inside, with all of the windows and doors shut. Stay tuned to and follow the advice of emergency responders and officials.

Environmental Protection Agency

Start Here

- Contamination vs. Exposure [https://emergency.cdc.gov/radiation/contamination.asp] (Centers for Disease Control and Prevention)
  Also in Spanish [https://emergency.cdc.gov/es/radiation/healtheffects.asp]
- Does the Product Emit Radiation? [https://www.fda.gov/medical-devices/classify-your-medical-device/does-product-emit-radiation] (Food and Drug Administration)
- Get the Facts about Radiation [https://newsinhealth.nih.gov/2012/10/looking-inside] NIH (National Institutes of Health)
- Radiation Basics [https://www.epa.gov/radiation/radiation-basics] (Environmental Protection Agency) - PDF

Prevention and Risk Factors

- Radiation Protection [https://www.epa.gov/radiation] (Environmental Protection Agency)

Treatments and Therapies

- DTPA (Diethylenetriamine pentaacetate) [https://emergency.cdc.gov/radiation/dtpa.asp] (Centers for Disease Control and Prevention)
  Also in Spanish [https://emergency.cdc.gov/es/radiation/dtpa.asp]
- Filgrastim (Neupogen) [https://www.cdc.gov/nceh/radiation/emergencies/neupogenfacts.htm] (Centers for Disease Control and Prevention)
  Also in Spanish [https://emergency.cdc.gov/es/radiation/neupogenfacts.asp]
- Frequently Asked Questions on Potassium Iodide (KI) [https://www.fda.gov/drugs/bioterrorism-and-drug-preparedness/frequently-asked-questions-potassium-iodide-ki] (Food and Drug Administration)
- Potassium Iodide ("KI"): Instructions to Make Potassium Iodide Solution for Use During a Nuclear Emergency (Liquid Form) [https://www.fda.gov/drugs/bioterrorism-and-drug-preparedness/potassium-iodide-ki] (Food and Drug Administration)
- Potassium Iodide (KI) [https://emergency.cdc.gov/radiation/ki.asp] (Centers for Disease Control and Prevention)

Also in Spanish [https://emergency.cdc.gov/es/radiation/ki.asp]

- Prussian Blue [https://www.cdc.gov/nceh/radiation/emergencies/prussianblue.htm] (Centers for Disease Control and Prevention)
  Also in Spanish [https://emergency.cdc.gov/es/radiation/prussianblue.asp]

Related Issues

- Airport Screening [http://hps.org/documents/airport_screening_fact_sheet.pdf] (Health Physics Society) - **PDF**
- Food Irradiation: What You Need to Know [https://www.fda.gov/food/buy-store-serve-safe-food/food-irradiation-what-you-need-know] (Food and Drug Administration)
  Also in Spanish [https://www.fda.gov/food/buy-store-serve-safe-food/la-irradiacion-de-alimentos-lo-que-usted-debe-saber]
- Non-Medical Sources of Man-Made Radiation [https://www.cancer.org/cancer/cancer-causes/radiation-exposure/x-rays-gamma-rays/other-man-made-sources.html] (American Cancer Society)
- Nuclear Radiation and the Thyroid [https://www.thyroid.org/wp-content/uploads/patients/brochures/NuclearRadiation_brochure.pdf] (American Thyroid Association) - **PDF**
  Also in Spanish [https://www.thyroid.org/wp-content/uploads/patients/brochures/espanol/radiacion_nuclear_y_la_glandula_tiroides.pdf]
- Sun and Other Types of Radiation [https://www.cancer.org/cancer/cancer-causes/radiation-exposure.html] (American Cancer Society)
  Also in Spanish [https://www.cancer.org/es/cancer/causas-del-cancer/sol-y-otras-formas-de-radiacion.html]

Specifics

- Accidents at Nuclear Power Plants and Cancer Risk [https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/nuclear-accidents-fact-sheet] NIH (National Cancer Institute)
  Also in Spanish [https://www.cancer.gov/espanol/cancer/causas-prevencion/riesgo/radiacion/hoja-informativa-accidentes-plantas-nucleares]
- Acute Radiation Syndrome [https://emergency.cdc.gov/radiation/ars.asp] (Centers for Disease Control and Prevention)
  Also in Spanish [https://emergency.cdc.gov/es/radiation/ars.asp]

- Cell Phones and Cancer Risk [https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet] (National Cancer Institute)
  Also in Spanish [https://www.cancer.gov/espanol/cancer/causas-prevencion/riesgo/radiacion/hoja-informativa-telefonos-celulares]
- Consumer Products Containing Radioactive Materials [http://hps.org/documents/consumerproducts.pdf] (Health Physics Society) - **PDF**
- Frequently Asked Questions about Cell Phones and Your Health [https://www.cdc.gov/nceh/radiation/cell_phones._FAQ.html] (Centers for Disease Control and Prevention)
- Non-Ionizing Radiation Used in Microwave Ovens [https://www.epa.gov/radtown/non-ionizing-radiation-used-microwave-ovens] (Environmental Protection Agency)
- Radiation Exposure from Medical Exams and Procedures [http://hps.org/documents/Medical_Exposures_Fact_Sheet.pdf] (Health Physics Society) - **PDF**
- Radiation Exposure in X-Ray and CT Examinations [https://www.radiologyinfo.org/en/info.cfm?pg=safety-xray] (American College of Radiology, Radiological Society of North America)
  Also in Spanish [https://www.radiologyinfo.org/sp/info.cfm?pg=safety-xray]
- Radiation from Cardiac Imaging Tests [https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.112.146043] (American Heart Association)
- Radionuclide Basics: Iodine [https://www.epa.gov/radiation/radionuclide-basics-iodine] (Environmental Protection Agency)
- Radionuclide Basics: Plutonium [https://www.epa.gov/radiation/radionuclide-basics-plutonium] (Environmental Protection Agency)
- TENORM (Technologically Enhanced Naturally Occurring Radioactive Materials) [https://www.epa.gov/radiation/technologically-enhanced-naturally-occurring-radioactive-materials-tenorm] (Environmental Protection Agency, Office of Air and Radiation)

Clinical Trials

- ClinicalTrials.gov: Radiation Exposure [https://clinicaltrials.gov/search/open/condition=%22Radiation+Exposure%22] (National Institutes of Health)

Journal Articles

References and abstracts from MEDLINE/PubMed (National Library of Medicine)

- Article: Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses. [https://www.ncbi.nlm.nih.gov/pubmed/32581288]
- Article: Ultraviolet Germicidal Irradiation to Decontaminate Filtering Face Piece Respirators During COVID-19... [https://www.ncbi.nlm.nih.gov/pubmed/32579801]
- Article: Pathogen reduction of SARS-CoV-2 virus in plasma and whole blood using... [https://www.ncbi.nlm.nih.gov/pubmed/32470046]
- Radiation Exposure -- see more articles [https://pubmed.ncbi.nlm.nih.gov/?term=radiation,ionizing[majr]+NOT+(X-rays[majr]+OR+food+irradiation[mh]+OR+radiotherapy[mh])+AND+english[la]+AND+humans+[mh]+NOT+(letter[pt]+OR+editorial[pt]+OR+case+reports[pt]+OR+comment[pt])+AND+%22last+1+Year%22[edat]]
- Radiation pollution -- see more articles [https://pubmed.ncbi.nlm.nih.gov/?term=radioactive+pollutants[majr]+NOT+radon[mh]+AND+english[la]+AND+humans[mh]+NOT+(letter[pt]+OR+editorial[pt]+OR+comment[pt])+AND+%22last+1+Year%22[edat]]

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- National Institute of Environmental Health Sciences [https://www.niehs.nih.gov/]
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  Also in Spanish [https://www.niehs.nih.gov/health/scied/teachers/educacion/]

Children

- What Parents Should Know about Medical Radiation Safety [https://www.imagegently.org/Portals/6/Parents/Image_Gently_8.5x11_Brochure.pdf] (Alliance for Radiation Safety in Pediatric Imaging) - **PDF**
- What You Should Know About Pediatric Nuclear Medicine and Radiation Safety

[https://www.imagegently.org/Portals/6/Nuclear%20Medicine/Parent%20Brochure%208th%20Grade.pdf] (Alliance for Radiation Safety in Pediatric Imaging) - PDF

Teenagers

- RadTown USA: Basic Information [https://www.epa.gov/radtown] (Environmental Protection Agency)

Women

- X-Rays, Pregnancy and You [https://www.fda.gov/radiation-emitting-products/medical-x-ray-imaging/x-rays-pregnancy-and-you] (Food and Drug Administration)

Patient Handouts

- Radiation sickness [https://medlineplus.gov/ency/article/000026.htm] (Medical Encyclopedia)
  Also in Spanish [https://medlineplus.gov/spanish/ency/article/000026.htm]

MEDICAL ENCYCLOPEDIA

Hyperbaric oxygen therapy [https://medlineplus.gov/ency/article/002375.htm]

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National Institutes of Health

The primary NIH organization for research on *Radiation Exposure* is the National Institute of Environmental Health Sciences [http://www.niehs.nih.gov/]

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Page last updated on 16 July 2020

Topic last reviewed: 22 March 2017

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 197

[FRL–6427–5]

RIN 2060–AG14

Environmental Radiation Protection Standards for Yucca Mountain, Nevada

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: We, the Environmental Protection Agency (EPA), are proposing public health and safety standards for radioactive material stored or disposed of in the potential repository at Yucca Mountain, Nevada. Section 801 of the Energy Policy Act of 1992 (EnPA) directed the Administrator of EPA to develop these standards. The EnPA also required EPA to contract with the National Academy of Sciences (NAS) to conduct a study to provide findings and recommendations on reasonable standards for protection of the public health and safety. On August 1, 1995, NAS released its report (the NAS Report) entitled, "Technical Bases for Yucca Mountain Standards." We have taken the NAS Report into consideration as directed by the EnPA.

After we finalize these standards, the Nuclear Regulatory Commission (NRC or "the Commission") will incorporate them into its licensing regulations. The Department of Energy (DOE or "the Department") will be responsible for demonstrating compliance with these standards. The Commission will use its licensing regulations to determine whether the Department has demonstrated compliance with our standards prior to receiving the necessary licenses to store or dispose of radioactive material in Yucca Mountain.

DATES: *Comments.* We must receive your comments at the address given below on or before November 26, 1999 to assure their consideration.

Hearings. We will hold public hearings upon today's action in Amargosa Valley, Nevada, Las Vegas, Nevada, and Washington, DC. The dates will be announced in the **Federal Register** as soon as they are determined.

ADDRESSES: *Comments.* Send two copies of your comments to the Central Docket Section (6102), ATTN: Docket A–95–12, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, D.C. 20460–0001.

Documents relevant to the rulemaking. Materials relevant to this rulemaking are contained in: (1) Docket No. A–95–12, located in Room M–1500 (first floor in Waterside Mall near the Washington Information Center), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460–0001; (2) an information file in the Government Publications Section, Dickinson Library, University of Nevada-Las Vegas, 4504 Maryland Parkway, Las Vegas, Nevada 89154; and (3) an information file in the Public Library in Amargosa Valley, Nevada 89020.

Background documents for this action. We have prepared additional documents that provide more detailed technical background in support of these proposed standards. You may obtain copies of the draft background information document (BID), the draft economic impact evaluation, and the Executive Summary of the NAS Report by requesting them in writing from the Office of Radiation and Indoor Air (6602J), U.S. Environmental Protection Agency, Washington, DC 20460–0001. We have also placed these documents into the docket and information files. You may also find them on our Internet site for Yucca Mountain (see the *Additional Docket and Electronic Information* section later in this notice).

FOR FURTHER INFORMATION CONTACT: Ray Clark, Office of Radiation and Indoor Air, U.S. Environmental Protection Agency, Washington, D.C. 20460–0001; telephone 202–564–9300.

SUPPLEMENTARY INFORMATION:

Who Will Be Regulated by These Standards?

The Department is the only entity directly regulated by these standards. To utilize the Yucca Mountain repository, DOE must obtain licensing approval from NRC. Thus, DOE will be subject to our standards which NRC will implement through its licensing proceedings. The NRC is only affected because, under the Energy Policy Act of 1992 (EnPA, Pub. L. 102–486), it must modify its licensing requirements, as necessary, to be consistent with our final standards.

Additional Docket and Electronic Information

When may I examine docket information? You may inspect the Washington, D.C. docket (phone 202–260–7548) on weekdays (8 a.m.–5:30 p.m.). As provided in 40 CFR part 2, the docket personnel may charge a reasonable fee for photocopying docket materials.

The information file located in the University of Nevada-Las Vegas, Government Publications Section (702–895–3409) may be inspected when classes are in session, Monday through Thursday (9 a.m.–8 p.m.), Friday (9 a.m.–6 p.m.), Saturday (9 a.m.–9 p.m.), and Sunday (11 a.m.–8 p.m.). However, since the hours vary based upon the academic calendar, you should call ahead to be certain of the time.

The information file in the Public Library in Amargosa Valley, Nevada (phone 775–372–5340) may be inspected Monday through Thursday (11 a.m.–7 p.m.) and Friday (9 a.m.–5 p.m.). The library is closed from 12:30 p.m.–1 p.m. each day. It is also closed Saturday and Sunday.

Can information be accessed by telephone or the Internet? Yes, we have established a toll-free information line that is accessible 24 hours per day. By dialing 800–331–9477, you can listen to a brief update describing our rulemaking activities for Yucca Mountain, leave a message requesting that your name and address be added to the Yucca Mountain mailing list, or request that an EPA staff person return your call. You can also find information on the World Wide Web at http://www.epa.gov/radiation/yucca.

Acronyms

There are many acronyms used in this notice. They are listed below for your reference and convenience.

ALARA—as low as reasonably achievable
BID—background information document
CAA—Clean Air Act
CEDE—committed effective dose equivalent
CG—critical group
DOE—U.S. Department of Energy
EIS—environmental impact statement
EnPA—Energy Policy Act of 1992
EPA—U.S. Environmental Protection Agency
GCD—greater confinement disposal
HLW—high-level radioactive waste
IAEA—International Atomic Energy Agency
ICRP—International Commission on Radiological Protection
LLW—low-level radioactive waste
MCL—maximum contaminant level
MCLG—maximum contaminant level goal
NAS—National Academy of Sciences
NCRP—National Council on Radiation Protection and Measurements
NEPA—National Environmental Policy Act
NESHAPs—National Emission Standards for Hazardous Air Pollutants
NID—negligible incremental dose
NIR—negligible incremental risk
NRC—U.S. Nuclear Regulatory Commission

NRDC—Natural Resources Defense Council
NTS—Nevada Test Site
NTTAA—National Technology Transfer and Advancement Act
NWPA—Nuclear Waste Policy Act of 1982
NWPAA—Nuclear Waste Policy Amendments Act of 1987
OMB—Office of Management and Budget
RCRA—Resource Conservation and Recovery Act
RME—reasonable maximum exposure
RMEI—reasonably maximally exposed individual
SDWA—Safe Drinking Water Act
SNF—spent nuclear fuel
TDS—total dissolved solids
UIC—underground injection control
UMRA—Unfunded Mandates Reform Act of 1995
USDW—underground source of drinking water
WIPP LWA—Waste Isolation Pilot Plant Land Withdrawal Act of 1992

Outline of Proposed Action

I. What Led up to Today's Action?

Spent nuclear fuel (SNF) and high-level radioactive waste (HLW) have been produced since the 1940s, mainly as a result of commercial power production and defense activities. Since then, the proper disposal of these wastes has been the responsibility of the Federal government. The Nuclear Waste Policy Act of 1982 (NWPA, Pub. L. 97–425) formalized the current Federal program for the disposal of SNF and HLW by:

(1) Making DOE responsible for siting, building, and operating an underground geologic repository for the disposal of SNF and HLW;

(2) Directing us to set generally applicable environmental radiation protection standards based upon authority established under other laws; and

(3) Requiring NRC to implement our standards by incorporating them into its licensing requirements for SNF and HLW repositories.

Those responsibilities are generally maintained under the EnPA. Thus, NRC will implement the standards that we are proposing today, and DOE will submit a license application to NRC. The Commission will then determine whether DOE has met the standards and whether to issue an operating license for Yucca Mountain. We anticipate that NRC will require compliance with all of the applicable provisions of 40 CFR part 197 prior to allowing receipt of radioactive material onto the Yucca Mountain site.

In 1985, we established generic standards for the management, storage, and disposal of SNF, HLW, and transuranic radioactive waste. These standards are found in 40 CFR part 191 (50 FR 38066, September 19, 1985). The term "generic" meant that the standards applied to any applicable facilities in the United States, including Yucca Mountain, Nevada. In 1987, the U.S. Court of Appeals for the First Circuit invalidated the disposal standards and remanded them to us (*NRDC* v. *EPA*, 824 F.2d 1258 (1st Cir. 1987)). Also in 1987, the Nuclear Waste Policy Amendments Act (NWPAA, Pub. L. 100–203) amended the NWPA by, among other actions, selecting Yucca Mountain, Nevada as the only potential site to be characterized.

In October 1992, the Waste Isolation Pilot Plant Land Withdrawal Act (WIPP LWA, Pub. L. 102–579) and the EnPA became law. The statutes changed our obligations concerning certain radiation standards. The WIPP LWA:

(1) Reinstated the 40 CFR part 191 disposal standards except those that were the specific subject of the remand by the First Circuit;

(2) Required us to issue standards to replace those that were the subject of judicial remand; and

(3) Exempted the Yucca Mountain site from the 40 CFR part 191 disposal standards. We issued the final disposal standards in 40 CFR part 191 on December 20, 1993 (58 FR 66398) to address the judicial remand.

The EnPA gave us the responsibility to set public health and safety radiation standards for Yucca Mountain. Specifically, section 801(a)(1) of the EnPA directed us to "promulgate, by rule, public health and safety standards for the protection of the public from releases from radioactive materials stored or disposed of in the repository at the Yucca Mountain site." The EnPA also directed us to contract with NAS to give us findings and recommendations on reasonable standards for protection of public health and safety. Moreover, the statute provided that our standards shall be the only such standards applicable to the Yucca Mountain site and are to be based upon and consistent with NAS' findings and recommendations. On August 1, 1995, NAS released its report, "Technical Bases for Yucca Mountain Standards" (the NAS Report).

II. Background Information

II.A. What Are the Sources of Radioactive Waste?

Radioactive wastes are the result of using nuclear fuel and other radioactive material. Today's action proposes standards pertaining to SNF, HLW, and other radioactive waste (these are collectively referred to after this as ''radioactive material'' or ''waste'') which may be stored or disposed of in the Yucca Mountain repository. (When storage or disposal are discussed in this notice in reference to Yucca Mountain, it is to be understood that no decision has been made regarding the acceptability of Yucca Mountain for storage or disposal. To save space and excessive repetition, the description of Yucca Mountain as a ''potential'' repository will not be used but is intended.) These standards do not apply to facilities other than those related to Yucca Mountain.

Once enough uranium or other fissionable material in nuclear reactor fuel has been consumed through nuclear reactions, it is no longer useful. The product is known as ''spent'' nuclear fuel (SNF). Sources of SNF include:

(1) Commercial nuclear power plants;

(2) Government-sponsored research and development programs in universities and industry;

(3) Experimental reactors, such as, liquid metal fast breeder reactors and high-temperature gas-cooled reactors;

(4) Federal Government-controlled, nuclear-weapons production reactors;

(5) Naval and other Department of Defense reactors; and

(6) U.S.-owned, foreign SNF.

Spent nuclear fuel can be dissolved in a chemical process called ''reprocessing,'' which is used to recover desired radionuclides. Radionuclides which are not recovered become part of the acidic liquid wastes that DOE plans to convert into various types of solid materials. The highly radioactive liquid or solid wastes from reprocessing SNF are called HLW. If SNF is not reprocessed prior to disposal, it becomes the waste form without further modification. The only commercial reprocessing facility to operate in the United States, the Nuclear Fuel Services Plant in West Valley, New York, closed in 1972. Since that time, no commercial SNF has been reprocessed in the United States. In 1992, DOE decided to phase out reprocessing of its SNF which supported the defense nuclear weapons and propulsion programs.

Where are the wastes stored now? Today, most SNF is stored in water pools or above-ground in dry concrete or steel canisters at more than 70 commercial nuclear-power reactor sites across the Nation. High-level waste is stored underground in steel tanks at four Federal facilities in Idaho, Washington, South Carolina, and New York.

What types of wastes will be placed into Yucca Mountain? We anticipate that most of the waste in Yucca Mountain will be SNF and solidified HLW (in the rest of this notice, HLW will refer to solidified HLW unless otherwise noted). Under current NRC regulations (10 CFR 60.135), liquid HLW will have to be solidified, through processes such as vitrification (mixing the waste into glass), since non-solid waste forms would not be allowed to be stored or disposed of in Yucca Mountain. The Department estimates that by the year 2010, about 64,000 metric tons of SNF and 284,000 cubic meters (containing 450 million curies of radioactivity) of HLW in predisposal form and 2,600 cubic meters (containing 189 million curies) of the disposable form of HLW will be in storage (DOE/RW–0006, Rev. 12, December 1996).

We are aware that other radioactive materials might be stored or disposed of in the Yucca Mountain repository. These materials include highly radioactive low-level waste (LLW), known as greater-than-Class-C waste, and excess plutonium or other fissile materials resulting from the dismantlement of nuclear weapons. In the future, other types of radioactive materials could be identified for storage or disposal. Since the plans for the disposal of these materials have not been finalized, their impact upon the design and performance of the disposal system has not been analyzed by NRC or DOE. However, whatever types of radioactive materials are finally disposed of in Yucca Mountain, the disposal system must comply with these standards.

II.B. What Types of Health Effects Can Radiation Cause?

Ionizing radiation can cause a variety of health effects. These effects are classified as either ''non-stochastic'' or ''stochastic.'' Non-stochastic effects are those for which the damage increases with increasing exposure, such as destruction of cells or reddening of the skin. They are seen in cases of exposures to large amounts of radiation. Stochastic effects are associated with long-term exposure to low levels of radiation. Their type or severity does not depend upon the amount of exposure. Instead, the chance that an effect, for example, cancer, will occur is assumed to increase with increasing exposure.

The three categories of stochastic effects are cancer, mutations, and teratogenic effects. Cancers caused by radiation are indistinguishable from those occurring from other causes. Cancers caused by radiation have been observed in humans. However, the risk of cancer at the exposure levels normally encountered by members of the public must be estimated using indirect evidence, that is, extrapolation from higher doses.[1]

Mutations, the second category of stochastic effects, are created in the reproductive cells of exposed individuals and are transmitted to their descendants. The severity of hereditary effects can range from inconsequential to fatal. Although hereditary effects have been observed in animal studies at relatively high doses, hereditary effects in humans exposed to relatively small amounts of radiation have not been confirmed statistically in epidemiological studies. Finally, we assume that at low levels of exposure, the probability of incurring either cancer or hereditary effects increases as the dose increases and that there is no lower threshold, that is, a linear, non-threshold, dose-response relationship (this is discussed below in more detail).

Teratogenic effects, the third category of stochastic effects, can occur following exposure of fetuses. We believe that the fetus is more sensitive than adults to the induction of cancer by radiation. The fetus also is subject to various radiation-induced, physical malformations such as small brain size (microencephaly), small head size (microcephaly), eye malformations and slow growth prior to birth. Recent studies have focused upon the apparently increased risk of severe mental retardation as measured by the intelligence quotient. These studies indicate that the sensitivity of the fetus is greatest during 8 to 15 weeks following conception, and continues, at a lower level, between 16 and 25 weeks.[2] Although we do not know exactly how mental retardation is related to dose, it is prudent to assume that there is a linear, non-threshold, dose-response relationship between these effects and the dose delivered to the fetus during the 8- to 15-week period.

The NAS published its reviews of human health risks from exposure to low levels of ionizing radiation in a

[1] The general term ''dose'' is used to mean the dose equivalent, effective dose equivalent, or committed effective dose equivalent, depending upon the surrounding text. When precision is necessary, the exact term is used.

[2] *Health Effects of Exposure to Low Levels of Ionizing Radiation*, National Academy Press, Washington, D.C., 1990.

series of reports between 1972 and 1990. However, scientists still do not agree upon how best to estimate the probability of cancer occurring as a result of the doses encountered by members of the public [3] because these effects must be estimated based upon the effects observed at higher doses (such as effects seen in the survivors of the Hiroshima and Nagasaki atomic bombs). The linear model for estimating effects has been endorsed by many organizations, including NAS, the International Commission on Radiological Protection (ICRP), the United Nations Scientific Committee on the Effects of Atomic Radiation, and the National Radiological Protection Board of the United Kingdom.

Over the past decade, the scientific community has performed an extensive reevaluation of the doses and effects in the Hiroshima and Nagasaki survivors. These studies have resulted in increased estimates (roughly threefold between 1972 and 1990) of the extrapolated risk of cancer arising from exposure to environmental levels of radiation, that is, background levels of radiation. Nonetheless, the estimated number of health effects induced by small incremental doses of radiation above natural background levels remains small compared with the total number of fatal cancers that occur from other causes. In addition, because cancers are the same as those resulting from other causes, identifying them in human epidemiological studies may never be possible. This difficulty in identifying stochastic radiation effects does not mean that such effects do not occur. However, there is the possibility that effects do not occur as a result of these small doses, that is, there might be an exposure level below which there is no additional risk above the risk that is posed by natural background radiation. Sufficient data to prove either possibility scientifically is lacking. As a result, we believe that the best approach is to assume that the risk of cancer increases linearly starting at zero dose. That is, any increase in exposure to ionizing radiation results in a constant and proportionate increase in the potential for developing cancer.

The NAS Report stated that radiation causes about five cancers for every severe hereditary disorder. Also, NAS concluded that nonfatal cancers are more common than fatal cancers. Despite this, the NAS cited an ICRP study which judged that non-fatal cancers contribute less to overall health impact than fatal cancers "because of their lesser severity in the affected individuals." (NAS Report pp. 37–39). Our risk estimates for exposure of the population to low-dose-rate radiation is based upon fatal cancers rather than all cancers.

For radiation-protection purposes, we estimate (using a linear, non-threshold, dose-response model) an average risk for a member of the U.S. population of 5.75 in 100 (5.75×10^{-2}) fatal cancers per sievert (Sv) [4] (5.75×10^{-4} fatal cancers per rem) delivered at low dose rates.[5] (For example, if 100,000 people randomly chosen from the U.S. population were each given a uniform dose of 1 millisievert (mSv) (0.1 rem) to the entire body at a low rate, approximately five to six people are assumed to die of cancer during their remaining lifetimes because of that exposure. This is in addition to the roughly 20,000 fatal cancers that would occur in the same population from other causes.) The risk of fatal childhood cancer, resulting from exposure while in the fetal stage, is about 3 in 100 (3×10^{-2}) per Sv (that is, 3×10^{-4} effects per rem). The risk of severe hereditary effects in offspring is estimated to be about 1×10^{-2} per Sv (1×10^{-4} effects per rem).[6] The risk of severe mental retardation from doses to a fetus is estimated to be greater per unit dose than the risk of cancer in the general population.[7] However, the period of increased sensitivity is much shorter. Hence, at a constant exposure rate, fatal cancer risk in the general population remains the dominant factor.

We note that there is, of course, uncertainty in our risk estimates. A recent uncertainty analysis published by the National Council on Radiation Protection and Measurements (NCRP Report 126) estimated that the actual risk of cancer from whole-body exposure to low doses of radiation could be between 1.5 times higher and 4.8 times lower (at the 90-percent confidence level) than our basic estimate of 5.75×10^{-2} per Sv (5.75×10^{-4} per rem). Further, existing epidemiological data does not rule out the existence of a threshold. If there is a threshold, exposures below that level would pose no additional risk above the risk that is posed by natural background radiation. The risks of genetic abnormalities and mental retardation are less well known than those for cancer and, thus, may include a greater degree of uncertainty. However, in spite of uncertainties in the data and its analysis, estimates of the risks from exposure to low levels of ionizing radiation are more clearly known than those for virtually any other environmental carcinogen.

II.C. What Are the Major Features of the Geology of Yucca Mountain and the Disposal System?

The geology. The Yucca Mountain site is located in southwestern Nevada approximately 90 miles northwest of Las Vegas. The eastern part of the site is on the Nevada Test Site, the northwestern part of the site is on the Nellis Air Force Range, and the southwestern part of the site is on Bureau of Land Management land. The area has a desert climate with topography typical of the Basin and Range province. See the BID for more information.

Yucca Mountain is made of layers of ashfalls from volcanic eruptions which happened more than 10 million years ago. The ash consolidated into a rock type called "tuff" which has varying degrees of compaction and fracturing depending upon the degree of "welding" caused by temperature and pressure when the ash was deposited. Regional geologic forces have tilted the tuff layers and formed Yucca Mountain's crest (Yucca Mountain's shape is actually a ridge rather than a peak). Below the tuff is carbonate rock. The carbonate rock was formed from sediments laid down at the bottom of ancient seas which existed in the area.

There are two general hydrologic zones within and below Yucca Mountain. The upper zone is called the "unsaturated zone" because the pore

[3] The risk of interest is not at or near zero dose, but that due to small increments of dose above the pre-existing background level. Background in the U.S. is typically about 3 millisievert (mSv), that is, 300 millirem (mrem), effective dose equivalent per year, or 0.2 Sv (20 rem) in a lifetime. Approximately two-thirds of this dose is due to radon, and the balance comes from cosmic, terrestrial, and internal sources of exposure.

[4] The traditional unit for dose equivalent has been the rem. The unit "sievert" (Sv), a unit in the International System of Units which was adopted in 1979 by the General Conference on Weights and Measures, is now in general use throughout the world. One sievert is equal to 100 rem. The prefix "milli" (m) means one-thousandth. The individual-protection limit being proposed today may be expressed in either unit.

[5] "Low dose rates" here refer to dose rates on the order of or less than those from background radiation.

[6] The risk of severe hereditary effects in the first two generations, for exposure of the reproductive part of the population (with both parents exposed), is estimated to be 5×10^{-3} per Sv (5×10^{-5} per rem). For all generations, the risk is estimated to be 1.2×10^{-2} per Sv (1.2×10^{-4} per rem). For exposure of the entire population, which includes individuals past the age of normal child-bearing, each estimate is reduced to 40% of the cited value.

[7] Assuming a linear, non-threshold dose response, estimated risk for mental retardation due to exposure during the 8th through 15th week of gestation is 4×10^{-1} per Sv (4×10^{-3} per rem); under the same assumption, the estimated risk from the 16th to 25th week is 1×10^{-1} per Sv (1×10^{-3} per rem).

spaces and fractures within the rock are not filled entirely with water. Below the unsaturated zone, beginning at the water table, is the "saturated zone" in which the pores and fractures are filled completely with water. Fractures in both zones could act as pathways which allow for faster contaminant transport than would the pores. The Department plans to build the repository in the unsaturated zone about 300 meters below the surface and about 300 to 500 meters above the current water table.

There are two major aquifers in the saturated zone under Yucca Mountain. The upper one is in tuff, while the lower one is in carbonate rock. Regional ground water in the vicinity of Yucca Mountain is believed to flow generally in a south-southwesterly direction. The aquifers are more fully discussed in the BID.

The disposal system. The NAS Report described the current conception of the potential disposal system as a system of engineered barriers for the disposal of radioactive waste located in the geologic setting of Yucca Mountain (NAS Report pp. 23–27). Entry into the repository for waste emplacement would be on gradually downward sloping ramps which enter the side of Yucca Mountain. The NWPAA limits the capacity of the repository to 70,000 metric tons of SNF and HLW. Current DOE plans project that about 90 percent (by mass) would be commercial SNF and 10 percent defense HLW. Within 100 years after starting to put waste in place, the repository would be sealed by backfilling the tunnels, closing the opening to each of the tunnels, and sealing the entrance ramps and shafts.

We expect the engineered barrier system to consist of at least the waste form (that is, SNF assemblies or borosilicate glass containing the HLW), internal stabilizers for the SNF assemblies, the waste packages holding the waste, and backfill in the space between the waste packages and adjacent host rock. Spent nuclear fuel assemblies are comprised of uranium oxide, fission products, fuel cladding, and support hardware, all of which will be radioactive. (see the *What are the Sources of Radioactive Waste?* section above.)

II.D. Background on and Summary of the NAS Report

Section 801(a)(2) of the EnPA directed us to contract with NAS to conduct a study to provide findings and recommendations on reasonable standards for protection of public health and safety. Section 801(a)(2) of the EnPA specifically called for NAS to address the following three issues:

(A) whether a health-based standard based upon doses to individual members of the public from releases to the accessible environment (as that term is defined in the regulations contained in subpart B of part 191 of title 40, Code of Federal Regulations, as in effect on November 18, 1985) will provide a reasonable standard for protection of the health and safety of the general public;

(B) whether it is reasonable to assume that a system for post-closure oversight of the repository can be developed, based upon active institutional controls, that will prevent an unreasonable risk of breaching the repository's engineered or geologic barriers or increasing the exposure of individual members of the public to radiation beyond allowable limits; and

(C) whether it is possible to make scientifically supportable predictions of the probability that the repository's engineered or geologic barriers will be breached as a result of human intrusion over a period of 10,000 years.

On August 1, 1995, NAS submitted to us its report entitled "Technical Bases for Yucca Mountain Standards." The NAS Report is available for review in the dockets and information file described earlier. You can order the Report from the National Academy Press by calling 800–624–6242 or on the World Wide Web at http://www.nap.edu/bookstore/isbn/0309052890.html#title.

II.D.1. What Were the NAS Findings and Recommendations?

The NAS Report provided a number of conclusions and recommendations. (The EnPA used the term "findings," however, the NAS Report used the term "conclusions.")

Conclusions. The conclusions in the Executive Summary of the NAS Report (pp. 1–14) were:

(a) "that an individual-risk standard would protect public health, given the particular characteristics of the site, provided that policy makers and the public are prepared to accept that very low radiation doses pose a negligibly small risk" [later termed "negligible incremental risk"]. This is the response to the issue identified in section 801(a)(2)(A) of the EnPA;

(b) that the Yucca Mountain-related "physical and geologic processes are sufficiently quantifiable and the related uncertainties sufficiently boundable that the performance can be assessed over time frames during which the geologic system is relatively stable or varies in a boundable manner;"

(c) "that it is not possible to predict on the basis of scientific analyses the societal factors required for an exposure scenario. Specifying exposure scenarios therefore requires a policy decision that is appropriately made in a rulemaking process conducted by EPA;"

(d) "that it is not reasonable to assume that a system for post-closure oversight of the repository can be developed, based on active institutional controls, that will prevent an unreasonable risk of breaching the repository's engineered barriers or increasing the exposure of individual members of the public to radiation beyond allowable limits." This is the response to the issue identified in section 801(a)(2)(B) of the EnPA;

(e) "that it is not possible to make scientifically supportable predictions of the probability that a repository's engineered or geologic barriers will be breached as a result of human intrusion over a period of 10,000 years." This is the response to the issue identified in section 801(a)(2)(C) of the EnPA; and

(f) "that there is no scientific basis for incorporating the ALARA [as low as reasonably achievable] principle into the EPA standard or USNRC [U.S. Nuclear Regulatory Commission] regulations for the repository."

Recommendations. The recommendations in the Executive Summary of the NAS Report were:

(a) "the use of a standard that sets a limit on the risk to individuals of adverse health effects from releases from the repository;"

(b) "that the critical-group approach be used" (see the *Who Will Be Representative of the Exposed Population?* section later in this notice);

(c) "that compliance assessment be conducted for the time when the greatest risk occurs, within the limits imposed by long-term stability of the geologic environment;" and,

(d) "that the estimated risk calculated from the assumed intrusion scenario be no greater than the risk limit adopted for the undisturbed-repository case because a repository that is suitable for safe long-term disposal should be able to continue to provide acceptable waste isolation after some type of intrusion."

Other Conclusions and Recommendations. There were other conclusions and recommendations in addition to those summarized in the Executive Summary. Most were related to or supported those presented in the Executive Summary.

II.D.2. How Has the Public Participated in Our Review of the NAS Report?

We are committed to providing ample opportunity for public participation in our Yucca Mountain rulemaking activities. We announced the first opportunity for public participation on September 11, 1995 in the **Federal**

Register (60 FR 47172) where we requested comments upon the NAS Report and announced the times and locations of three public meetings. Along with the general request for public comments, we asked five questions:

(1) did the Report sufficiently answer the questions posed in the EnPA;

(2) was there sufficient rationale to support the NAS' findings and conclusions;

(3) do provisions other than those found in NAS' findings and conclusions need to be included in the EPA standards;

(4) are any of NAS' findings or conclusions inappropriate or inaccurate regarding Yucca Mountain; and

(5) would the cost of imposing the findings and recommendations be justifiable when compared with the benefits provided?

We held the public meetings to inform the public of our role, to outline the issues associated with setting standards for Yucca Mountain, and to seek comments upon the NAS Report. The meetings were held on September 20, 1995, in Amargosa Valley, Nevada; on September 21, 1995, in Las Vegas, Nevada; and on September 27, 1995, in Washington, DC. We also have established several other information sources and given directions, in the **ADDRESSES** and *Additional Docket and Electronic Information* sections earlier in this notice, on how to access them.

II.D.3. What Were the Public Comments on the NAS Report?

We received comments regarding the NAS Report both orally and in writing at the public meetings and in response to the September 11, 1995, **Federal Register** notice, respectively. All written comments are in the docket and information files. The oral comments were summarized in a separate document, copies of which are also in the docket and information files.

Some commenters believed that the NAS inadequately supported its conclusion that there is no scientific basis for including the "as low as reasonably achievable" (ALARA) principle and subsystem requirements in the standards and, therefore, that we should include them in the proposed standards. The ALARA principle is a radiation-protection concept which states that exposures to radiation should be kept as low as can be done taking into account the costs and benefits of exposure reduction methods. "Subsystem requirements" refers to regulation of individual components of the overall disposal system. Other comments indicated that there was inadequate rationale to support NAS' concept of negligible incremental risk (NIR). The NIR concept is based upon an NCRP concept known as "negligible incremental dose" (NID, discussed in more detail later in this notice) which was described by NAS "as a level of effective dose that can, for radiation protection purposes, be dismissed from consideration" (NAS Report pp. 59–60). Commenters also stated that they did not support the NAS" rejection of a collective-dose standard. Comments were divided upon requiring quantitative or qualitative assessment of human intrusion.

With regard to the three questions posed in the EnPA: (1) There were mixed responses upon whether a standard to protect individuals could adequately protect the general public; (2) there was nearly unanimous agreement that active institutional controls cannot prevent a breach of the repository; and (3) there was nearly unanimous agreement that it is impossible to predict the probability of future human intrusion into the repository.

Commenters also expressed views related to a number of other issues. The majority favored:

(1) A standard expressed in terms of dose;

(2) The highest level of protection possible;

(3) Measuring compliance at the time of peak risk of the maximally exposed individual;

(4) A reference biosphere to be specified by EPA;

(5) Including other local sources of man-made radiation in determining an acceptable level of protection;

(6) Protection equal to that specified for WIPP, that is, that in 40 CFR part 191 (WIPP is a geologic disposal system in New Mexico for defense-related transuranic waste but, unlike Yucca Mountain, WIPP is subject to our generic radioactive-waste standards codified at 40 CFR part 191; see also 61 FR 5224, February 9, 1996);

(7) Using a collective-dose limit to restrict exposure to the general population while ignoring the NIR concept;

(8) Including assurance requirements; and

(9) Including ground water protection requirements.

We have taken into consideration all comments received during preparation of these proposed standards. If you submitted comments in response to the September 11, 1995, **Federal Register** notice or at the September 1995 public hearings, you should submit additional comments in response to today's notice to convey any concerns or views about this proposal.

III. What Are We Proposing Today?

We are proposing, and requesting comment upon, public health and safety standards governing the storage and disposal of SNF, HLW, and other radioactive material in the repository at Yucca Mountain, Nevada. We are also announcing a public comment period and public hearings to gather comments upon the proposal.

As noted earlier, section 801(a)(1) of the EnPA gave us rulemaking authority to set "public health and safety standards for the protection of the public from releases from radioactive materials stored or disposed of in the repository at the Yucca Mountain site." The statute also directed us to develop standards "based upon and consistent with the findings and recommendations of the National Academy of Sciences." Section 801(a)(2) of the EnPA directed us to contract with NAS to conduct a study to provide findings and recommendations on reasonable standards for protection of the public health and safety. Because the EnPA called for us to act "based upon and consistent with" the NAS findings, a major issue in this rulemaking is whether we are bound to follow the NAS determinations without exception or whether we have discretionary decision-making authority.

As a practical matter, the difficulty of this issue is reduced because some of the findings and recommendations in the NAS Report are expressed in a non-binding manner. In other words, NAS stated its findings and recommendations as starting points for the rulemaking process or recognized those that involve public policy issues that are more properly addressed in this public rulemaking proceeding. However, the Report also contains some findings and recommendations stated in relatively definite terms. It is these issues that most squarely present the question of whether we are to treat the views of NAS as binding.

Whether the EnPA binds us to following exactly the NAS findings and recommendations is a question that warrants close attention at this stage of the rulemaking because it affects the scope of our rulemaking. If we are required to follow every view expressed in the NAS Report, any such issue would be treated as addressed conclusively by NAS. We would not need to entertain public comment upon the affected issues since the outcome would be predetermined.

We believe that the EnPA does not bind us absolutely to follow the NAS Report. Instead, we have used the NAS Report as the starting point for this rulemaking. Today's proposal is based upon and consistent with the findings and recommendations of NAS. We have developed this proposal guided by the findings and recommendations of NAS because of the special role given NAS by Congress and the scientific expertise of NAS. However, the entirety of our proposed standards for the Yucca Mountain disposal system is the subject of this rulemaking. We do not intend to treat the views expressed by NAS as necessarily dictating the outcome of this rulemaking, thereby foreclosing public scrutiny of important issues. For the reasons described below, we believe this proposed interpretation of the EnPA is consistent with the statute and prudent in that it avoids potential Constitutional issues. Further, this proposed interpretation supports an important EPA policy objective—ensuring an opportunity for public input upon all aspects of the issues presented in this rulemaking.

Section 801(a)(2) of the EnPA required a study by NAS that provides "findings and recommendations on reasonable standards for protection of the public health and safety." While this section of the EnPA calls for NAS to address three specific issues, Congress did not place any restrictions upon other issues NAS could address. The report of the Congressional conferees underscored that "the National Academy of Sciences would not be precluded from addressing additional questions or issues related to the appropriate standards for radiation protection at Yucca Mountain beyond those that are specified." (H.R. Rep. No. 1018, 102nd Cong., 2d Sess. 391 (1992)). Thus, given the potentially unlimited scope of the NAS inquiry under the statute, NAS could have provided findings and recommendations that would dictate literally all aspects of the public health and safety standards for Yucca Mountain, rendering our function a ministerial one.

Section 801(a)(1) of the EnPA plainly gave EPA the authority to issue, by rulemaking, public health and safety standards for Yucca Mountain. If at the same time that Congress gave NAS the authority to provide findings and recommendations on any issues related to the Yucca Mountain public health and safety standards, Congress also intended that NAS' findings and recommendations be binding upon us, then Congress would have effectively delegated to NAS a standard-setting authority that overrides our delegated rulemaking authority. Carried to its logical conclusion, under this view of the statute, NAS would have authority to establish the public health and safety standards, and to do so without a public rulemaking process. Then the direction for EPA to set standards "by rule" would be unnecessary or relatively meaningless. This tension in the statute can be reasonably resolved by interpreting the NAS' findings and recommendations as non-binding, but highly influential, expert guidance to inform our rulemaking.

Thus, we do not believe the statute forces our rulemaking to adopt mechanically the NAS' recommendations as standards. If it did, the statutory provisions would allow us to consider only those issues that NAS did not address. Further, the provisions calling for us to use standard rulemaking procedures in issuing the standards would be unnecessary to reach results that NAS already established.

The report of the conferees also indicates that Congress did not intend to limit our rulemaking discretion. The Conference Report provides that Congress intended NAS to provide "expert scientific guidance" on the issues involved in our rulemaking and that Congress did not intend for NAS to establish the specific standards:

> The Conferees do not intend for the National Academy of Sciences, in making its recommendations, to establish specific standards for protection of the public but rather to provide expert scientific guidance on the issues involved in establishing those standards. Under the provisions of section 801, the authority and responsibility to establish the standards, pursuant to rulemaking, would remain with the Administrator, as is the case under existing law. The provisions of section 801 are not intended to limit the Administrator's discretion in the exercise of his authority related to public health and safety issues. (H.R. Rep. No. 1018 at p. 391)

Our proposed interpretation of the EnPA as not limiting the issues for consideration in this rulemaking is consistent with the views we expressed to Congress during deliberations over the legislation. The Chairman of the Senate Subcommittee on Nuclear Regulation requested our views of the bill reported out of conference. The Deputy Administrator of EPA indicated that the NAS Report would provide helpful input. Moreover, EPA's Deputy Administrator pointed to the language, cited above, stating the intent of the conferees not to limit our rulemaking discretion and assured Congress that any standards for radioactive materials that we ultimately issue would be the subject of public comment and involvement and would fully protect human health and the environment. (138 Cong. Rec. S33,955 (daily ed. October 8, 1992)).

Our proposed interpretation also is consistent with the role that both NAS and Congress understood NAS would fulfill. During the Congressional deliberations over the legislation, NAS informed Congress that while it would conduct the study, it would not assume a standard-setting role because that is properly the responsibility of government officials. (138 Cong. Rec. S33,953 (October 8, 1992)).

Our proposed interpretation of the NAS Report also avoids implicating potentially significant Constitutional issues. Construing the EnPA as delegating to NAS the responsibility to determine the health and safety standards at Yucca Mountain may violate the Appointments Clause of the Constitution (Art. II, sec. 2, cl. 2), which imposes restrictions against giving Federal governmental authority to persons not appointed in compliance with that Clause. In addition, the Constitution places restrictions arising under the separation of powers doctrine upon the delegation of governmental authority to persons not part of the Federal government. We are not concluding, at this time, that an alternative interpretation would necessarily run afoul of Constitutional limits. However, we believe it is reasonable both to assume that Congress intended to avoid these issues when it adopted section 801 of the EnPA and to interpret the EnPA accordingly.

In summary, we do not believe we must, in this rulemaking, adopt all of the positions advanced by NAS. At the same time, the statute does give NAS a special role. As noted, the NAS' findings and recommendations have been the starting point for this rulemaking and our proposal is consonant with those findings and recommendations. In fact, the NAS Report influenced us heavily during the development of this proposed rule. We have included many of the findings and recommendations in whole in today's proposal, and we intend to continue to weigh the NAS Report heavily throughout the course of this rulemaking. We will tend to give greatest weight to the judgments of NAS about issues having a strong scientific component, the area where NAS has its greatest expertise. In addition, we will reach final determinations that are congruent with the NAS analysis whenever we can do so without departing from the Congressional delegation of authority to us to

promulgate, by rule, public health and safety standards for protection of the public, which we believe requires the consideration of public comment and our own expertise and discretion.

We request public comment upon how we should view and weigh the NAS' findings and recommendations in this rulemaking. Public commenters should also address this issue in the context of the specific issues presented in this rulemaking. Commenters should indicate whether we have given proper consideration to the NAS' findings and recommendations, whether we should give them more or less weight, and what the resulting outcome should be.

The following sections describe our proposed public health and safety standards for Yucca Mountain and the considerations which underlie the set of standards we are proposing today. The next section addresses the storage portion of the proposed standards. All of the other sections pertain to the disposal portion of the standards.

III.A. What Is the Proposed Standard for Storage of the Waste? (Proposed Subpart A)

Section 801(a)(1) of the EnPA calls for EPA's public health and safety standards to apply to radioactive materials "stored or disposed of in the repository at the Yucca Mountain site." (The repository is the mined portion of the facility constructed underground within the Yucca Mountain site. Hereafter, the term "repository" refers to the Yucca Mountain repository.) The EnPA differentiates between waste that is "stored" and waste that is "disposed," although it indicates that we must issue standards that apply to both types of activity. Congress was not clear regarding its intended use of the word "stored" in this context. Also, NAS did not address the issue of storage (see proposed §§ 197.2 and 197.12 for our proposed definitions of "storage" and "disposal"). The Yucca Mountain repository currently is conceived to be a disposal facility, not a storage facility, but that could change. Therefore, we propose to interpret this language as directing us to develop standards that apply to waste that DOE either stores or disposes of in the Yucca Mountain repository. The public health and safety standards we issue under section 801 of the EnPA would, therefore, apply to waste inside of the repository, whether it is there for storage or disposal.

The Department will also handle and might store radioactive material aboveground (that is, outside the repository). Those activities are covered by our previously promulgated standards for management and storage, codified at subpart A of 40 CFR part 191. The 40 CFR part 191 standards require that DOE manage and store SNF, HLW, and transuranic radioactive wastes at a site, such as Yucca Mountain, in a manner that provides a reasonable expectation that the annual dose equivalent to any member of the public in the general environment will not exceed 25 millirem (mrem) to the whole body. This is the standard which DOE must meet for WIPP and the greater confinement disposal (GCD) facility. (The GCD facility is a group of 120-feet deep boreholes located within the Nevada Test Site (NTS) which contains disposed transuranic wastes.)

The storage standards in 40 CFR 191.03(a) are stated in terms of an older dose-calculation method and are set at an annual whole-body-dose limit of 25 mrem/yr. The proposed storage standards for Yucca Mountain use a modern dose-calculation method known as "committed effective dose equivalent" (CEDE).[8] Even though today's proposal uses the modern method of dose calculation, we believe that the proposed dose level essentially maintains a similar risk level as in 40 CFR 191.03(a) at the time of its promulgation (see the discussion of the different dose-calculation methods in the *What Should the Level of Protection Be?* section later in this notice). The difference between these dose calculation procedures presents a problem in combining the doses for regulatory purposes. However, we have begun a rulemaking to amend both 40 CFR Parts 190 and 191. That rulemaking would update these limits to the CEDE methodology. We anticipate that we will finalize the amendments to parts 190 and 191 prior to the finalization of this rulemaking. If that does not occur, we would need to address the calculation of doses under the two methods in another fashion. For example, we could require that the doses occurring as a result of activities outside the repository be converted into annual CEDE for purposes of determining compliance with the storage standard. We request comments upon such an approach.

Section 801 of the EnPA specifically provides that the standards that we issue shall be the only "such standards" that apply at Yucca Mountain. Thus, the statute provides that the EnPA is the exclusive authority for "such standards" and, in turn, replaces our generally applicable standards for radiation protection to the extent that section 801 requires site-specific standards. Otherwise, our generic standards are not affected. As noted, we propose to interpret the scope of section 801 as applying to both storage and disposal of waste in the repository. Thus, waste inside the repository would be subject to the standards proposed in today's notice. Our generic standards in subpart A of 40 CFR part 191 will apply to waste outside of the repository.

Using this interpretation, we have considered the differences between the conditions covered by the storage standards in 40 CFR 191.03(a) and the conditions which could affect storage in the Yucca Mountain repository. The most significant difference is that the storage in Yucca Mountain would be underground whereas most storage covered under 40 CFR part 191 is aboveground. Otherwise, the technical situations we anticipate under both the existing generic standards and the proposed Yucca Mountain standards are essentially the same. Also, one of our goals in issuing 40 CFR parts 190 and 191 was to bring the entire uranium fuel cycle under consistent EPA standards. Therefore, we are proposing that the part 197 standards continue the coverage of the uranium fuel cycle because SNF, a large part of the waste planned for emplacement in Yucca Mountain, is part of that fuel cycle. Therefore, we are proposing to extend a similar level of protection as in the 1985 version of subpart A of 40 CFR part 191. In other words, under the part 197 storage standards, exposures of members of the public from waste storage inside the repository would be combined with exposures occurring as a result of storage outside the repository but within the Yucca Mountain site. The total dose could be no greater than 150 microsieverts (μSv) (15 mrem) CEDE per year (CEDE/yr).

Our application of subpart A of 40 CFR part 191 to storage activities outside of the repository at the Yucca Mountain site is supported by the WIPP LWA. Section 8 of the WIPP LWA excludes Yucca Mountain from our generic disposal standards but not from the generic management and storage standards found in subpart A of 40 CFR part 191. If we finalize the proposed interpretation of section 801 of the EnPA as applying to radioactive material stored or disposed of in the repository, we would apply subpart A of 40 CFR part 191 to the storage activities outside of the repository at the site without further public notice.

[8] The term "committed effective dose" in this rulemaking has the same meaning as the term "committed effective dose equivalent" which was used prior to the publication of ICRP Publication No. 60. It is used here since the term is less complicated and more compact. Also, the use of "committed effective dose" is consistent with subpart B of 40 CFR part 191 (58 FR 66398, 66402, December 20, 1993).

We request comment upon our proposed interpretation that section 801 of the EnPA directs us to develop new standards that apply only to radioactive materials stored in the repository. We also request public comment upon whether we should instead construe section 801 of the EnPA as providing for the establishment of new storage standards, rather than applying the existing storage standards in 40 CFR part 191 to storage, or handling, of radioactive materials at the Yucca Mountain site prior to their movement into the repository. If we decide, based upon the alternative interpretation of section 801, to promulgate new storage standards for the site, we anticipate that we would adopt standards essentially the same as those in 40 CFR 191.03(a). Thus, we request public comment upon whether we should develop and adopt in this rulemaking, under section 801 of the EnPA, new standards for management and storage activities at the site, and request comments upon the adoption of such standards based upon those in 40 CFR 191.03(a).

III.B. What Is the Standard for Protection of Individuals? (Proposed §§ 197.20 and 197.25)

III.B.1. Should the Limit Be on Dose or Risk?

Although a standard for limiting exposure of people to radiation can take many forms, NAS narrowed its final considerations to risk and dose, that is, a risk-based or dose—based standard. The numeric level of the proposed standard for protecting individual members of the public from radioactive materials disposed of in the Yucca Mountain disposal system is addressed in the *What Should the Level of Protection Be?* section later in this notice. The discussion here explains why we selected a dose-based standard rather than a risk-based standard, as recommended by NAS.

Two forms of radiation exposure can occur depending upon the location of the source relative to the body " internal and external. Internal exposures occur when a person inhales or ingests contaminated air, food, water, or soil. External exposures occur because a person is near a radionuclide which is emitting X-rays, gamma rays, beta particles, or neutrons. "Dose" is a measure of the amount of radiation received by individuals resulting from exposure to radionuclides. "Risk" is the probability of an individual incurring an adverse health effect from exposure to radiation. The NAS defined "risk" as the product of two parameters: (1) the probability of an individual receiving a dose, and (2) the probability of incurring a health effect because of that dose (NAS Report p. 42). This rulemaking takes both of these factors into account. (The probability of an individual receiving a dose is part of the performance assessment and is discussed in the *What Are the Requirements for Performance Assessments and Determinations of Compliance?* section later in this notice.) As mentioned in the previous section, these standards state radiation risk estimates as the probability of an individual developing a fatal cancer, since fatal cancers are the greatest harm to individuals from low-dose-rate radiation (NAS pp. 37–39).

Section 801(a)(1) of the EnPA directed that our standards for Yucca Mountain "shall prescribe the maximum annual effective dose equivalent to individual members of the public from releases to the accessible environment from radioactive materials stored or disposed of in the repository...." At the same time, the EnPA calls for us to issue our standards "based upon and consistent with" the findings and recommendations of NAS. The NAS recommended that we adopt a standard expressed as risk rather than the dose standard that Congress prescribed. The NAS offered two reasons for its recommendation. First, a risk-based standard is advantageous relative to a dose-based standard because it "would not have to be revised in subsequent rulemakings if advances in scientific knowledge reveal that the dose-response relationship is different from that envisaged today" (NAS Report p. 64). Second, a standard in the form of risk more readily enables the public to comprehend and compare the standard with human-health risks from other sources.

We have reviewed and evaluated the merits of a risk-based standard as recommended by NAS. However, we are proposing a dose-based standard for the following reasons. First, both national and international radiation protection guidelines developed by bodies of non-governmental radiation experts, such as ICRP and NCRP, generally have recommended that radiation standards be established in terms of dose. Also, national and international radiation standards, including the individual-protection requirements in 40 CFR part 191, are established almost solely in terms of dose or concentration, not risk. Therefore, a risk-based standard will not allow a convenient comparison with the numerous existing radiation guidelines and standards that are stated in terms of dose.

Second, we have an established methodology for calculating dose that is described in Federal Guidance Reports Nos. 11 and 12 (Federal Guidance). The development of this methodology was a combined effort of many Federal agencies involved in radiation protection and has become Federal policy. The guidance provides a consistent methodology for calculating doses for regulatory purposes. By contrast, there is currently no Federal Guidance Report, in final form, for calculating risk from radiation exposure.

Third, we have based the proposed dose-based standard upon the risk of developing a fatal cancer as a result of that level of exposure based upon a linear, non-threshold, dose-response relationship. We would establish a risk-based standard in the same manner. Thus, a risk-based standard, like a dose-based standard, depends upon current knowledge and assumptions about the chance of developing fatal cancer from a particular exposure level. Dose and risk are closely related; one can be converted to the other simply by using the appropriate factor. Therefore, both dose- and risk-based standards are based upon scientific assumptions that could change and no matter how it is expressed, the standard is based upon risk.

Finally, section 801(a)(1) of the EnPA specifically calls for a dose-based standard. Most commenters supported this by asking for a dose-based standard rather than a risk-based standard.

Accordingly, we are proposing a standard expressed as a limit on dose. We are requesting comments upon the proposed form of the standard, including whether the standard should be expressed as risk.

III.B.2. What Should the Level of Protection Be?

As noted previously, section 801(a)(1) of the EnPA calls for our Yucca Mountain standards to "prescribe the maximum annual effective dose equivalent to individual members of the public from releases of radioactive materials." Development of the individual-protection standard requires us to evaluate and specify several factors. These factors include the level of protection, who the standards should protect, and how long the standards should provide protection. Determining the appropriate dose level is ultimately a question of both science and public policy. The NAS stated in its Report: "The level of protection established by a standard is a statement of the level of the risk that is acceptable to society. Whether posed as "How safe is safe enough?" or as "What is an acceptable

level?'', the question is not solvable by science'' (NAS Report p. 49). We seek to find answers to these questions for the Yucca Mountain disposal system through this rulemaking.

We considered the NAS findings and recommendations in our determination of the CEDE level that would be adequately protective of human health. We also reviewed established EPA standards and guidance, other Federal agencies' actions for both radiation and non-radiation-related actions, and other countries' regulations. In addition, we evaluated guidance on dose limits provided by National and international, non-governmental, advisory groups of radiation experts.

The NAS recommended a range of risk levels that we could use as a reasonable starting point in this rulemaking (NAS Report p. 5). The range of annual risk of fatal cancer suggested by NAS was 1 chance in 100,000 (1×10^{-5}) to 1 chance in 1,000,000 (1×10^{-6}) (this corresponds to a range of 20 to 2 mrem CEDE/yr). The NAS based its recommendation upon its review and evaluation of our actions, other Federal actions, guidelines developed by National and international groups, and regulations of other countries. For these standards, we are proposing a limit of 150 µSv (15 mrem) CEDE/yr. This limit corresponds approximately to an annual risk of 7 chances in 1,000,000 (7×10^{-6})—within the range that NAS recommended as a starting point for consideration.

Table 1 below lists the dose limits of other current EPA and NRC regulations (adapted from NAS Report p. 50). Today's proposed standard of 150 µSv (15 mrem) CEDE/yr is within the range of these established standards. Further, it is consistent with the individual-protection standard at 40 CFR 191.15 in our generic disposal standards which limits the annual CEDE to 150 µSv (15 mrem)/yr.

TABLE 1.—CURRENT EPA AND NRC DOSE LIMITS ON VARIOUS ENVIRONMENTAL CONCERNS

Environmental concern	Limit*
Low-Level Waste (10 CFR part 61)	250 µSv (25 mrem)/yr
License Termination (10 CFR part 20)	25 mrem TEDE**/yr
Uranium Fuel Cycle (40 CFR part 190)	25 mrem/yr
Generic Standard for Management and Storage of SNF and HLW (40 CFR 191.03).	25 mrem/yr
Generic Individual-Dose Standard for Disposal of SNF and HLW (40 CFR 191.15).	150 µSv (15 mrem) CEDE/yr
National Emission Standards for Hazardous Air Pollutants (40 CFR part 61, subparts H and I).	10 mrem CEDE/yr
SNF and HLW Disposal Limit for Underground Sources of Drinking Water (40 CFR 191.24).	4 mrem/yr for man-made beta- and photon-emitting radionuclides

*Unless otherwise noted, only whole-body dose limits are listed; there may also be other requirements for any particular environmental concern. The 25-mrem/yr, whole-body-dose limit established in 1985 is essentially equivalent to the risk associated with today's dose rate of 150 µSv (15 mrem) CEDE/yr (58 FR 66402, December 20, 1993).

**TEDE (total effective dose equivalent) is NRC's term for CEDE. This regulation was not included in the NAS Report.

We note that, except for 40 CFR 191.15, 40 CFR part 61, and 10 CFR part 20, the dose limits in Table 1 are stated in terms of an old dose system. For example, the annual limits in 40 CFR 191.03(a) are 25 mrem for the whole body, 75 mrem for the thyroid, or 25 mrem for any other organ (only the whole-body limit is listed in Table 1). We established these dose levels in 1985 (50 FR 38085, September 19, 1985) under a different system for calculating doses than the more recent rulemakings that use the CEDE concept. We estimate that the 25-mrem/yr, whole-body-dose limit established in 1985 is essentially equivalent to the risk associated with today's proposed limit of 150 µSv (15 mrem) CEDE/yr (58 FR 66398, 66402, December 20, 1993).

In addition, the proposed 150-µSv (15 mrem)-CEDE/yr limit in today's proposal is consistent with other current standards. For example, our limits on radiation exposure through the air is part of the set of limits for pollutant releases known as the National Emission Standards for Hazardous Air Pollutants (NESHAPs, 40 CFR part 61). Since our NESHAPs limit of 10 mrem/yr covers radionuclide releases into only the air, the 150 µSv (15 mrem) CEDE/yr standard being proposed for 40 CFR part 197 is consistent with the NESHAPs limit because it applies to all potential pathways, that is, the dose limit is higher but includes other pathways in the analysis.

In summary, based upon our review of the guidance, regulations, and standards cited above, and the NAS Report, we are proposing a standard of 150 µSv (15 mrem) CEDE/yr for the Yucca Mountain disposal system. We request comment upon the reasonableness of this level of protection.

III.B.3. What Factors Can Lead to Radiation Exposure?

Protection of the public from exposure to radioactive pollutants requires knowledge and understanding of three factors: the source of the radiation, the pathways leading to exposure, and the recipients of the radiation. This section provides a discussion of the source of radiation and pathways of exposure. The following two sections discuss the recipients of the dose. The development of standards to protect public health and safety from radionuclides released from waste disposed of in the Yucca Mountain disposal system must include consideration of the sources of radiation and pathways which could lead to exposure of humans. The mechanisms of exposure are the basis of an analysis called the performance assessment. The performance assessment is the quantitative analysis of the projected behavior of the disposal system.

Source. The waste disposed of in Yucca Mountain will contain many different radionuclides including unconsumed uranium, fission products (for example, cesium-137 and strontium-90), and transuranic elements (for example, plutonium and americium).

The inventory of radionuclides over time will depend upon the type and amount of radionuclides originally disposed of in the disposal system, the half-lives of the radionuclides, and the amount of any radionuclides formed from the decay of parent radionuclides (see the BID). In the time frame of tens- to hundreds-of-thousands of years, most

radionuclides initially present in SNF and HLW will decay to essentially no radioactivity. Therefore, the waste will eventually have radiologic characteristics similar to a large uranium ore body (see the BID).

To delay the movement of radionuclides into the biosphere, DOE plans to use multiple barriers. These barriers would be man-made (engineered) and natural based upon the design of, and conditions in and around, the disposal system.

Engineered barriers must be designed to delay release of radionuclides from the repository. For example, an engineered barrier could be the waste form. The Department plans to convert liquid HLW derived from reprocessing of SNF into a solid by entraining the radionuclides into a matrix of borosilicate glass; NRC will likely consider this an engineered barrier. The molten glass then would be poured into and hardened in a second man-made barrier, a metal container (see the BID). In addition, it is possible to have other man-made barriers in the repository to serve as part of the disposal system (see the BID).

Natural barriers at Yucca Mountain also could slow the movement of radionuclides into the accessible environment. For instance, the Department plans to construct the repository in a layer of tuff located above the water table. The relative dryness of the tuff around the repository would limit the amount of water which comes into contact with the waste. It also would retard the future movement of radionuclides from the waste into the underlying aquifer. Any radioactive material that dissolved into infiltrating water, originating as surface precipitation, still would have to be moved to the saturated zone. Minerals, such as zeolites, contained within the tuff beneath the repository could act as molecular filters and ion-exchange agents for some of the released radionuclides, thereby slowing their movement. Such minerals also could limit the amount of water that contacts the waste and could help retard the movement of radionuclides from the waste to the water table. This mechanism would be most effective if flow was predominantly through the pores in the rock, also known as the matrix (see the BID).

Pathways. Once radionuclides have left the waste packages, they could be carried by water or air and reach the public. Upon release from the waste packages, most radionuclides will be carried by ground water away from the repository. However, those in a gaseous form, such as carbon-14 (^{14}C) in the form of carbon dioxide, will be carried by air moving through the mountain.

Movement via water. Radionuclides will not be moved into the water table instantaneously. The length of time it takes depends partly upon how much the water moves via fractures or through the matrix of the rock. Once radionuclides reach the saturated zone, they would move away from the disposal system in the direction of ground water flow.

There are currently no perennial rivers or lakes adjacent to Yucca Mountain to further transport contaminants. Therefore, based upon current knowledge and conditions, ground water and its usage will likely be the main pathway leading to exposure of humans. Current knowledge suggests that the two major ways that people would use the contaminated ground water are: (1) drinking and domestic uses; and (2) agricultural uses (see the BID). In other words, radionuclides that reach the public could deliver a dose if an individual: (1) Drinks contaminated ground water or uses it directly for other household uses; (2) drinks other liquids containing contaminated water; (3) eats food products processed using contaminated water; (4) eats vegetables or meat raised using contaminated water, or (5) is otherwise exposed as a result of immersion in contaminated water or air or inhalation of wind-driven particulates left following the evaporation of the water.

Movement via air. Some radionuclides could be carried by moving air. The largest known source of potential movement by air in Yucca Mountain is carbon dioxide containing ^{14}C. Airborne radionuclides might move through the tuff overlying the repository and exit into the atmosphere following release from the waste package. Once the radioactive gas enters the atmosphere, it would disperse. This dispersion would probably be global and, therefore, become greatly diluted. The major pathway for exposure of people by ^{14}C is the uptake of radioactive carbon dioxide by plants that humans subsequently eat (see the BID).

III.B.4. Who Will Be Representative of the Exposed Population?

To determine whether the Yucca Mountain disposal system complies with the standard, it will be necessary for DOE to calculate the dose to some individual or group of individuals exposed to releases from the repository and compare the calculated dose with the limit established in the standard. The standard must specify, therefore, the individual or group of individuals for whom the dose calculation is to be made.

The NAS definition of critical group. The NAS Report recommended that we base the standards for protection of individuals upon risk incurred by a critical group (CG). The CG would be the group of people which, based upon cautious, but reasonable, assumptions, has the highest risk of incurring health effects due to releases from the disposal system. The ICRP introduced the concept of a CG in order to account for the variation of dose which may occur in a population due to differences in age, size, metabolism, habits, and environment. In other words, the ICRP recommends the use of a group of people because individuals might have personal traits which make them much more or less vulnerable to releases of radiation than the average within a small group of the most highly exposed individuals. The ICRP defines the CG as a relatively homogeneous group of people whose location and habits are such that they represent those individuals expected to receive the highest doses as a result of the discharge of radionuclides. The NAS adapted the CG concept to a risk framework for the development of an individual-risk standard and recommended the following description of the CG (NAS Report p. 53):

> The critical group for risk should be representative of those individuals in the population who, based on cautious, but reasonable, assumptions, have the highest risk resulting from repository releases. The group should be small enough to be relatively homogeneous with respect to diet and other aspects of behavior that affect risks. The critical group includes the individuals at maximum risk and is homogeneous with respect to risk. A group can be considered homogeneous if the distribution of individual risk within the group lies within a total range of a factor of ten and the ratio of the mean of individual risks in the group to the standard is less than or equal to one-tenth. If the ratio of the mean group risk to the standard is greater than or equal to one, the range of risk within the group must be within a factor of 3 for the group to be considered homogeneous. For groups with ratios of mean group risk to the standard between one-tenth and one, homogeneity requires a range of risk interpolated between these limits.

The NAS also recommended that the CG risk calculated for purposes of comparison with the risk limit established in the standard is the average of the risks of all the members in the group. Using the average risk avoids the problem of the outcome being unduly influenced by unusual habits of individuals within the group.

The NAS indicated that in order to select a CG, the person or persons likely

to be at highest risk from among the larger, exposed population must be specified. To accomplish this, one must make assumptions about the nature of human activities, lifestyles, and pathways that affect the level of exposure. The set of circumstances that affects the dose received, such as where people live, what they eat and drink, and other lifestyle characteristics, is a very important part of the exposure scenario. Many human behavior factors important to assessing repository performance vary over periods that are short in comparison with the compliance period proposed for these standards. The past several centuries have seen radical changes in human technology and behavior, many of which were not reasonably predictable. Given this potential for rapid change, we believe that it is not possible to know what patterns of human activity and changes in human biology might occur thousands of years from now. For the purpose of compliance with the standard, therefore, we are proposing that it is appropriate to use many of the current characteristics of members of the public in the vicinity of Yucca Mountain in the compliance assessments required by these standards (see the *What Should Be Assumed About the Future Biosphere? section later in this notice).*

The NAS Report presented two illustrative approaches for formulating an exposure scenario for determining compliance. The NAS also clearly stated that there might be other methods to reach the same objective (NAS Report p. 100). One approach, described in Appendix C of the NAS Report, *A Probabilistic Critical Group,* used statistical methods and probabilities to characterize a CG. The second, *The Subsistence-Farmer Critical Group,* described in Appendix D, identified a subsistence farmer as a principal representative of the CG.

The NAS probabilistic critical group. Appendix C of the NAS Report described a "probabilistic critical group." This section describes the contents of Appendix C of the NAS Report.

The NAS probabilistic CG approach would require use of a theoretical population distribution which we would, or require DOE to, develop by using a mathematical method known as "Monte Carlo." The Monte Carlo method is a mechanism to randomly select values of parameters which have a range of possible values. The parameters would be present-day environmental parameters, including soil quality, land slope, growing season, depth to the aquifer, and population distribution and lifestyles. The individuals who comprise the CG may represent a variety of economic lifestyles and activities. The analysis would then use the variability of those parameters in the region around Yucca Mountain to arrive at the theoretical population for the calculation of radiation exposure. This theoretical population would then, according to NAS, be combined with Monte Carlo simulations of the distribution of contaminated ground water in time and space (NAS Report p. 148). According to NAS, each simulation would generate a plume path which could be overlain on a map of potential farm density or water use to determine a potential exposure area. Each of these potential plume paths is known as a "realization." Values for parameters, including well depths, rates of water use, food sources, and consumption rates, are determined by sampling from the parameter-value distributions. For each plume realization of the contamination in the aquifer, the results of the exposure simulations are combined to give a spatial distribution of maximum exposures for the locations likely to be inhabited. This approach would use a large number of simulations of plume realizations to identify critical subgroups with the highest risk. It would then be used to calculate the arithmetic average of the risk of all critical subgroups over all plume realizations to estimate the risk for the CG. In determining compliance, the Commission would compare this estimate with the risk limit in the standard.

We considered proposing the probabilistic CG approach but are not doing so for the following reasons. First, there is no relevant experience in applying the probabilistic CG approach. Second, the approach is very complex and difficult to implement in a manner that assures it would meet the requirements of defining a CG. Third, we are concerned that this approach does not appear to identify clearly who is being protected. Finally, a significant majority of the comments that we have received upon the NAS Report opposes the probabilistic CG approach.

The NAS subsistence-farmer critical group. The approach in Appendix D of the NAS Report specified one or more subsistence farmers as the CG. It made assumptions designed to define the farmer at maximum risk to be included in the CG. This section describes the contents of Appendix D of the NAS Report.

The subsistence-farmer CG is a definable, highly exposed segment of the larger, exposed population. The subsistence farmer would be assumed to: (1) be a person with eating habits and response to doses of radiation that would be average for present-day people and (2) obtain all potable water and grow all of his or her own food using water withdrawn from the aquifer contaminated with radionuclides from the disposal system. The water used by this CG would be withdrawn at a location downgradient from and outside the footprint of the repository at the point of maximum potential concentration of ground water contamination, provided that no natural geologic features preclude drilling for water at that location. (The footprint of the repository is the circumscription of the outermost, original emplacement locations of the waste.)

Concentrations of radionuclides in the extracted ground water may be smaller than in undisturbed ground water due to pumping; this possibility could be used when evaluating exposures (NAS Report p. 155). As a result of uncertainty, there will be probabilistic distributions of radionuclide concentrations, as they vary in time and space in the aquifer outside the repository footprint, which are the input variables needed to estimate the risk. The radionuclide distributions in the aquifers, in turn, depend upon the performance of the components of the natural and engineered barrier systems. Projections of their performance also contain uncertainty and likely will be subject to probabilistic assessment. Any assessment of the potential doses from the repository, therefore, must consider the probability of processes and events that influence eventual concentrations of radionuclides in aquifers supplying water to the CG.

Overall, the "expected" risk for the average member of this CG would be about one-half that of the most-exposed subsistence farmer (NAS Report p. 158). This average risk to the members of the CG would be compared with the standard selected for compliance.

We considered proposing that the protected individual(s) be the subsistence-farmer CG. The CG concept has been utilized within the U.S. in various ways. The NRC uses the CG concept in assessing compliance with NRC standards for radionuclide releases from nuclear facilities. For example, the Commission uses the CG concept in: (1) licensing actions involving dose calculations under 10 CFR part 40, appendix A; (2) its radiological criteria for license termination of all NRC-licensed facilities at 10 CFR part 20, subpart E; and (3) its draft guidance for LLW disposal under 10 CFR part 61. The State of Washington recently

implemented the CG concept in actions relating to U.S. Ecology's LLW site at Hanford, and the State of Texas endorses CG in its decommissioning standards. Also, a great deal of international guidance exists that discusses the use of CG. The ICRP endorses CG, and has recommended the CG concept in numerous documents, both recent and dating back as far as 1977. Canada, Sweden, Switzerland, and the United Kingdom are among those individual nations that have adopted the CG methodology for radioactive waste storage and disposal.

We prefer an approach to exposure assessment that is consistent with other Agency programs (*Guidance on Risk Characterization for Risk Managers and Risk Assessors,* Deputy Administrator F. Henry Habicht II, February 26, 1992) and which we believe provides a level of protection substantially equivalent to that which would be achieved by the CG concept.

Our proposal for the protection of individuals. Most of our programs use an approach for the development of exposure scenarios that involves determining the high-end range of doses or exposures. Conceptually, this range is that above the 90th percentile of the entire (either measured or estimated) distribution of potential doses within the exposed population. Conversely, the NESHAPs program for radionuclides and the individual-protection requirements in the generic SNF and HLW disposal standards at 40 CFR 191.15 require calculation of the individual dose for a person assumed to reside at a location where that person would receive the highest dose. However, other Agency programs use a different approach to protect individuals by using "reasonable, maximum exposure" (RME) conditions. The National Contingency Plan describes an approach to be used for the RME scenario to protect individuals as "a product of factors, such as concentration and exposure frequency and duration, that are an appropriate mix of values that reflect averages and 95th percentile distributions" (55 FR 8666, 8710, March 8, 1990). In the past, we have defined "reasonable maximum" to mean potential exposures that are likely to occur. The method for calculating the RME is to estimate the high-end range of possible exposures by identifying the factors which have the greatest effect upon the size of the dose, and using maximum or nearly maximum values for one or a few of these factors, leaving the others at their average values (57 FR 22888, 22922, May 29, 1992). In this approach, we select a hypothetical individual who would be representative of the most highly exposed individuals. We call this individual the reasonably maximally exposed individual (RMEI). To be effective, the RMEI approach must avoid incompatible combinations of parameter values, such as, low body weight used in combination with high intakes.

Thus, we intend for this procedure to project doses that are within a reasonably expected range rather than projecting the most extreme case. However, the procedure is also meant to identify an individual dose which is well above the average dose in the exposed population. The ultimate goal and purpose is to estimate a level of exposure that is protective of the vast majority of individuals at a site, but is still within a reasonable range of potential exposures.

For the preceding reasons, we are proposing the RMEI concept as our preferred approach instead of the CG approach. The United States and other countries have used the concept of a hypothetical individual to represent future populations in radioactive-waste management programs. This is consistent with widespread practice, current and historical, of estimating dose and risk to highly exposed individuals even when the exposure habits of future people cannot be specified or accurately calculated, as in this case where doses must be projected for very long periods. The approach is straightforward and relatively simple to understand. We believe that this approach provides protection similar to that afforded by the NAS recommendation to use a CG. The RMEI model uses a series of assumptions about the lifestyle of a hypothetical individual. The desired degree of conservatism can be built into the model through choices of assumed values of RME parameters. However, these values would be within certain limits since we are proposing to require the use of Yucca Mountain-specific characteristics in choosing those parameters and their values. In subpart B of 40 CFR part 197, we propose a framework of assumptions for NRC to incorporate into its implementing regulations.

Our proposed RMEI would be representative of a future population group termed "rural-residential." The CEDE received by this RMEI would be calculated by DOE using cautious, but reasonable, exposure parameters and parameter-value ranges. The projected CEDE would be used by NRC in the determination of compliance with the proposed standards. We believe that the results obtained by using this approach would be similar to those which would be obtained by using the subsistence-farmer CG approach put forth in Appendix D of the NAS Report. In both cases, the objective is to determine the magnitude of the potential exposure using reasonable, not extreme, assumptions. Under the proposed standards, the RMEI will have food and water intake rates, diet, and physiology like that of individuals currently living in the downgradient direction of flow of the ground water passing under Yucca Mountain. The Department will perform the dose calculation to estimate exposure resulting from releases from the waste into the accessible environment based upon the assumption of present-day conditions in the vicinity of Yucca Mountain. Presently, we expect the ground water pathway to be the most significant pathway for exposure from radionuclides that are transported from the repository. Our initial evaluation of potential exposure pathways from the disposal system to the RMEI suggests that the dominant fraction of the dose incurred by the RMEI likely will be from ingestion of food irrigated with contaminated water (see the BID). It is possible, however, that another exposure pathway will be determined by DOE and NRC to be more significant for radiation exposure. Consequently, DOE and NRC must consider and evaluate all potentially significant exposure pathways in the performance assessment. As a result of the performance assessment, there will be a distribution of the highest potential doses incurred by the RMEI. We are proposing that the mean or median value (whichever is higher) of that distribution be used by NRC to determine compliance with the individual-protection standard. We request comments upon this method of determining compliance with the individual-protection standard.

We are also requesting comments upon the alternative of adopting the CG approach rather than the RMEI. Comments supporting the CG approach should address the level of detail EPA's rule should include on the parameters of the CG.

Exposure scenario for the RMEI. A major part of the exposure scenario is the location of the RMEI. In preparing to propose a location for the RMEI, we collected and evaluated information on the natural geologic and hydrologic features, such as topography, geologic structure, aquifer depth, aquifer quality, and the quantity of ground water, that may preclude drilling for water at a specific location. Based upon these factors and the current understanding of ground water flow in the area of Yucca

Mountain, it appears that an individual could reside anywhere along the projected radionuclide flow path extending from Forty-Mile Wash, approximately five kilometers (km) from the proposed repository location, to the southwestern part of the Town of Amargosa Valley, Nevada, where the ground water is close to the land surface and where most of the farming in the area is done. However, an individual's ability to reside at any particular point along that path depends upon that individual's purpose and available resources. To explore these variations, we developed the four scenarios described below. We present our evaluation of factors associated with these scenarios more fully in the BID. We welcome comment upon the appropriateness of each of these scenarios and upon our preferred scenario. In developing scenarios, we assumed that the level of technology and economic considerations affecting population distributions and life styles in the future are the same as today (for more detail, see the *What Should Be Assumed about the Future Biosphere?* section below).

The RMEI in the first scenario is a subsistence (low technology) farmer. Such an individual would have continuous exposure to radionuclides in water, air, and soil which are arriving through all exposure pathways. The RMEI's location and habits would be generally consistent with historical locations of Native Americans and early settlements in Amargosa Valley and influenced heavily by easy access to water, that is, where the water table is near the surface (approximately 30–40 km away from the disposal system). In addition, all of the RMEI's water and food would come from contaminated sources. We did not choose this option because we believe that such a scenario is overly conservative given the site-specific characteristics of the area and reasonable consideration of the lifestyles of individuals in that area.

In the second scenario, we considered using a commercial farmer as the RMEI. We evaluated economic factors and current and potential future technologies which could be economically viable. There are areas in the vicinity of Yucca Mountain which are currently being farmed commercially or could be economically farmed based upon reasonable assumptions, current technology, and experience in other arid parts of the western United States. The exposure pathways in this scenario would be the same as those used for the subsistence-farmer scenario. We did not choose this as our preferred scenario since we believe that commercial farming would not be representative of the general population and would not be likely in areas other than where there is currently such farming, approximately 30 kilometers from the disposal system.

The third scenario, selected as our preferred approach, involves a rural-residential RMEI. We assume that the rural-residential RMEI is exposed through the same general pathways as the subsistence farmer. However, this RMEI would not be a full-time farmer but would do personal gardening and earn income from other sources of work in the area. We assume further that all of the drinking water (two liters per day) and some of the food consumed by the RMEI is from the local area. The consumption of two liters per day of drinking water is a high value since people consume water from outside sources, such as commercial products. Similarly, we assume that local food production will use radioactively contaminated water coming from the disposal system. We believe this lifestyle is similar to that of most people living in Amargosa Valley today.

The fourth scenario which we considered is domestic use of an underground source of drinking water (USDW) by a community living near the repository site. A USDW is essentially an aquifer which is large enough to supply or could supply a public water system (the full definition is in 40 CFR 144.3). Based upon current water usage in the arid western United States, a public water supply inside of the current NTS could exist since a community would have greater resources to access and recover water than would most individuals. Such a community water supply would have characteristics similar to DOE's water wells J–12 and J–13. These wells have supplied water needs (including human consumption) since the early 1960s for the Federal government. While we consider such a scenario possible, it could be less protective than the rural-residential scenario because it would not protect individuals from the ingestion of contaminated home-grown food. Also, we consider this scenario less representative of current conditions for most people in the vicinity of Yucca Mountain.

Location of the RMEI. The location of the RMEI is a basic part of the exposure scenario. We considered locations within a region occupying an area bordering Forty-Mile Wash, within a few kilometers of the repository site, to the southwestern border of the Town of Amargosa Valley. This region, which we believe is hydrologically downgradient from Yucca Mountain, can be considered as three general subareas.

The first subarea occupies the land south from near Yucca Mountain to the vicinity of U.S. Route 95. This subarea has deep ground water (up to about 300 meters) which is accessed by Federally owned wells used for DOE activities associated with Yucca Mountain and the NTS. This land is currently under government control and ownership. In addition, the likelihood of small or economically viable agricultural activities in this area is questionable when the depth to the water table is taken into consideration.

The next subarea borders the first and extends several kilometers south of U.S. Route 95. The northern portion of the Town of Amargosa Valley, including the businesses at the intersection of U.S. Route 95 and Nevada State Route 373 (Lathrop Wells), is included in this subarea. This subarea currently includes about 15 residents and no agricultural activities, although abandoned irrigation wells exist (see the BID). The depth to water in this area ranges from slightly more than 100 to about 60 meters. The U.S. Natural Resource Conservation Service has designated the types of soils in this area as suitable for rangeland and wildlife habitat.

The third subarea borders the second and covers the remainder of the Town of Amargosa Valley. This subarea is the closest downgradient location to Yucca Mountain with perennial agricultural activity. The depth to ground water is relatively shallow—approximately 50 to 15 meters. The agriculture consists of both personal gardens and commercial activities. The commercial agriculture is a mainstay of the local economy. Commercial farms produce crops, livestock, and dairy products for either local consumption or for transport out of the region. Most of the residents of the Town of Amargosa Valley are within this subarea, as are the community center, school, clinic, library, post office, and sheriff's office. The population consists of all age groups.

Based upon these considerations of the subareas, we propose that the intersection of U.S. Route 95 and Nevada State Route 373, known as Lathrop Wells, is a likely location for the RMEI. In this example, we do not consider it probable that the rural-residential RMEI would occupy locations significantly north of U.S. Route 95. We make this assumption mainly because the rough terrain and increasing depth to ground water nearer to Yucca Mountain would likely discourage settlement by individuals because access to water is more difficult than it would be a few kilometers

farther south. Also, there are currently several residents and businesses near this location whose source of water is the underlying aquifer (which we understand flows from under Yucca Mountain). Therefore, we believe that it is reasonable to assume that individuals could reside near this intersection in the future.

Farming occurs today farther south, in the southwestern portion of the Town of Amargosa Valley in an area near the California border and west of Nevada State Route 373. However, soil conditions in the vicinity of Lathrop Wells are similar to those in southwestern Amargosa Valley. Therefore, it should be feasible for the RMEI to grow some of his or her own food, including a grazing cow, using a fraction of the water recovered but not used for household purposes. Larger-scale food production at Lathrop Wells is unlikely because of the cost of recovering sufficient water. To supplement the gardening and grazing, we propose that it is also reasonable to assume that the RMEI would obtain much of his or her food from the local area.

Finally, we believe that a rural-residential RMEI near Lathrop Wells would be among the most highly exposed individuals in the downgradient direction from Yucca Mountain. We believe that this is true even though individuals residing closer to the repository (where the ground water is at a greater depth) could be consuming higher concentrations of radionuclides in their drinking water. Because of the significant cost of finding and withdrawing the ground water, we further believe that individuals living nearer the repository are unlikely to withdraw water from the significantly greater depth and in the much larger quantities needed for farming activities. Based upon our analyses of potential pathways of exposure, discussed above, we believe that irrigation would be the most likely pathway for most of the dose from the most soluble, least retarded radionuclides (such as technetium-99 and iodine-129). The percentage of the dose that results from irrigation would depend upon the assumptions about the fraction of all food assumed to be consumed by the RMEI from gardening or other crops grown using contaminated water. We also are proposing that protection of a rural-residential RMEI would be protective of the general population (see the *How Will the General Population Be Protected?* section below).

Our identification of Lathrop Wells as a potential location of the RMEI is based upon a review of available, site-specific information. Of course, DOE and NRC must consider other, more appropriate locations based upon additional data which DOE or others may develop later, but the selection of that other location must be based upon the same considerations used for this example. For example, if DOE subsequently determines that the direction of ground water flow is different than we have assumed, DOE and NRC must choose the location, at the same distance from the center of the repository footprint as the original point of compliance, where the highest radionuclide concentrations occur.

As stated earlier, the method of calculating the RME is to select average values for most parameters except one or a few which are set at their maximum, that is, high-end, values. We believe that the Lathrop Wells location and a consumption rate of two liters per day of drinking water from the plume of contamination represent high-end values for two of these factors. The Commission may identify additional parameters for which to assign high-end values in projecting the dose to the RMEI. To the extent possible, NRC should use site-specific information for any remaining factors. For example, NRC should use the most accurate projections of the amount of contaminated food that would be ingested in the future. Projections might be based upon surveys which indicate the percentage of the total diet of Amargosa Valley residents which is from food grown in the Amargosa Valley area.

We particularly request comment upon whether:

(1) Based upon the above criteria, there is now sufficient information for us to adequately support a choice for the RMEI location in the final rule or should we leave that determination to NRC in their licensing process based upon our criteria;

(2) Another location in one of the three subareas identified previously should be the location of the RMEI; and

(3) Lathrop Wells and an ingestion rate of two liters per day of drinking water are appropriate high-end values for parameters to be used to project the RME. We also request comment upon the potential approaches and assumptions for the exposure scenario to be used for calculating the dose incurred by the RMEI.

III.B.5. How Will the General Population be Protected?

In section 801(a)(2)(A) of the EnPA, Congress asked whether an individual-protection standard could also protect the general population. In response, the NAS concluded that an individual-protection standard could provide such protection for the case of the proposed Yucca Mountain repository. The NAS premised this conclusion upon the condition that the public and policymakers would accept the idea that extremely small individual radiation doses spread out over large populations pose a risk that is negligible (NAS Report p. 57). The NAS refers to this concept as "negligible incremental risk" (NAS Report p. 59). Earlier, we described our proposed individual-protection standard for the RMEI which would establish the highest allowable radiation dose. This section of the notice raises another question—should we also adopt a standard to limit the possible widespread exposure of whole populations to extremely small individual doses?

In discussing the feasibility of protecting the general population from releases of radionuclides from Yucca Mountain, NAS considered the potential for the release of gaseous radionuclides. The NAS Report explained how the release of carbon dioxide gas containing ^{14}C from the Yucca Mountain disposal system might expose a large population:

> Global populations might be affected because radionuclide releases from a repository can in theory be diffused throughout a very large and dispersed population. In the case of Yucca Mountain, the likely pathway leading to widely dispersed radionuclides is via the atmosphere beginning with release of carbon dioxide gas containing the carbon-14 (^{14}C) radioactive isotope which might escape from the waste canisters. (NAS Report p. 7)

On page 61 of its Report, NAS estimated that the average dose to members of the global population, based upon this scenario, to be 0.003 μSv/year (0.0003 mrem/yr) and equated that to an annual risk of fatal cancer of 1.5 in 10 billion (1.5×10^{-10}).

The NAS relied upon the recommendations of the NCRP in its report titled "Limitation of Exposure to Ionizing Radiation" (NCRP Report No. 116) to support their claim that such doses are negligibly small. In this report, the NCRP stated that a radiation dose of less than 10 μSv (1 mrem)/yr for any source or practice would represent a "negligible incremental dose." The NCRP endorsed the assumption that there is some radiation risk for every radiation exposure. Further, they explained that there are great uncertainties in trying to understand the meaning of radiation effects upon populations, especially when these effects are calculated by summing extremely small individual doses among huge populations. Agreeing with this

concept, the NAS preferred to use risk instead of dose. The NAS then estimated the risk level associated with the NCRP's NID level of 10 μSv/yr and adopted the term "negligible incremental risk." The NAS then proposed this NIR level as the starting point for a process to establish a risk level for individuals that would be "negligible."

For different reasons, we provisionally agree with the NAS that an individual-risk standard can adequately protect the general population near Yucca Mountain. Our agreement is based upon the particular characteristics of the Yucca Mountain site. We emphasize that our view relates to the specific circumstances associated only with Yucca Mountain. We are not proposing to adopt either an NID or NIR level. We are concerned that such an approach is not appropriate in all circumstances. Again, our proposed determination that an individual-risk standard is adequate to protect both the local and general population is based upon considerations unique to the Yucca Mountain site—it is not a general policy judgment by us upon other uses of the concept of NID or NIR.

We considered the NAS suggestion to adopt a general NIR level but have not done so because of reservations regarding the reasoning and analysis employed by NAS. As noted above, NAS referred to the NID level of 10 μSv (1 mrem)/yr per source or practice recommended by the NCRP. The International Atomic Energy Agency (IAEA) has made similar recommendations regarding exemptions in its Safety Series No. 89, "Principles for the Exemption of Radiation Sources and Practices from Regulatory Control." The IAEA has recommended that individual doses not exceed 10 μSv (1 mrem)/yr from each exempt practice. The IAEA's recommendations relate to criteria for exempting whole sources or practices, such as waste disposal or recycling generally, not whether radiation doses from a portion of a given practice, such as the release of gases from a specific geologic repository, may be considered negligible. Finally, the IAEA's recommendations intend their exemption to be for sources and practices "which are inherently safe." It is not clear that the low individual doses or risks projected from gaseous releases from the Yucca Mountain repository should be considered on their own as a "source" or "practice" or that such a source or practice should be considered inherently safe. Also, we believe it to be inappropriate to not calculate a radiation dose merely because the dose rate from a particular source is small.

Further, we are not sure it is appropriate to apply the NIR concept to consideration of population dose. A recent NCRP report questions the application of the negligible incremental dose (NID) concept to consideration of population doses. According to NCRP Report No. 121: "A concept such as the NID (Negligible Incremental Dose) provides a legitimate lower limit below which action to further reduce individual dose is unwarranted, but it is not necessarily a legitimate cut-off dose level for the calculation of collective dose. Collective dose addresses societal risk while the NID and related concepts address individual risk." Based upon this, we think it would be inappropriate to use the negligible incremental dose or risk concept to evaluate whether an individual-protection standard adequately protects the general population.

Although we do not advocate use of the NID concept, we acknowledge that the extremely low levels of individual risk and dose cited by NAS as being associated with the release of ^{14}C from Yucca Mountain are many orders of magnitude below the levels at which we have regulated in other circumstances. For example, we used the following policies under the pre-1990 Clean Air Act (CAA) hazardous air pollution control program: (1) provide public health protection for the greatest number of persons possible based upon a lifetime (70 years) risk level no higher than approximately 1 x 10^{-6} for an individual, and (2) limit the maximum, individual-lifetime, estimated risk to no higher than 1 in 10,000 (1 x 10^{-4}) (54 FR 51654, 51655, December 15, 1989). Even though we adopted this approach in a different policy context, it provides insight into how we have dealt with similar risk-management issues in a regulatory context. In 1990, Congress amended the CAA to require us to develop technology-based standards to reduce emissions. At the same time, Congress authorized us to delete categories of sources from regulation if no source in that category could cause a lifetime risk of cancer exceeding 1 x 10^{-6} for the most-exposed individual in the population. The risk over an individual's lifetime from exposure to gaseous ^{14}C released from the Yucca Mountain repository, as estimated by NAS, would be about 100 times lower than 10^{-6}. This particular risk level is extremely low and well below the risk level that we generally regulate.

The disposal standards in 40 CFR part 191 include release limits (or containment requirements) to protect populations and an individual-protection standard. We rejected adopting only an individual-protection standard in those standards because of a concern that an individual-dose limitation alone might encourage selection of disposal sites that relied upon dilution of radionuclides at the expense of increased overall population exposures. Specifically, we were concerned that, in the absence of release limits, "disposal sites near bodies of surface water or large sources of ground water might be preferred—which the Agency believes is an inappropriate policy that would usually increase overall population exposures" (50 FR 38066, 38078, September 19, 1985). For example, it is possible to have a site that could meet the 150 μSv (15 mrem)−CEDE/yr individual-protection standard while still having large numbers of people being exposed to radiation levels just below the standard. This scenario could result in significant numbers of calculated health effects for each generation exposed and very large numbers of calculated health effects over the regulatory period. We believe that the policy embodied in the generic 40 CFR part 191 disposal standards is sound. The provisions in 40 CFR part 191, which could apply to a variety of potential disposal sites, should discourage reliance upon dilution of radionuclides in the general environment as a disposal method.

However, the potential for large-scale dilution of radionuclides, through ground water and into surface water, as modeled in the supporting analyses for 40 CFR part 191, does not exist at Yucca Mountain, thereby minimizing the need for the kind of population-protection requirements found in 40 CFR part 191. Rather, DOE plans to locate the Yucca Mountain repository in an unsaturated rock formation with limited amounts of infiltrating water passing through it and into the underlying tuff aquifer. ("Unsaturated" means that the rock could absorb more water than it is holding.) That aquifer is, in turn, within a ground water system which discharges into arid areas having high evaporation rates and very little surface water. In other words, we believe that the characteristics of the saturated zone under Yucca Mountain are such that dilution from other sources will be limited and the aquifer does not discharge into any large bodies of surface water. Therefore, our basis for inclusion of a population-protection requirement in 40 CFR part 191 does not appear to apply to the development of site-specific standards for Yucca Mountain.

In addition, we based the release limits in 40 CFR part 191 partly upon technology and partly upon risk levels which we believed to be acceptably small. The technology basis for the release limits was based upon assessments of repository performance of several generic disposal systems, including one located in tuff. In finalizing 40 CFR part 191, we stated:

[T]he rule cannot be interpreted as setting precedents for ''acceptable risk'' levels to future generations that should not be exceeded regardless of the circumstances. Instead, because of a number of unique circumstances, the Agency has been able to develop standards for the management and disposal of these wastes that are both reasonably achievable . . . and that limit risks to levels that the Agency believes are clearly acceptably small. (50 FR 38066, 38070, September 19, 1985)

We developed these standards during the siting process mandated by the NWPA in the 1980s. The inclusion of release limits pointed to the importance of considering population doses during site selection. We established the standards at a level that appeared to be reasonably achievable for several types of rocks or geologic media and which would keep risks to future populations acceptably small. The assessments we performed in support of these generally applicable standards, however, did not include a gaseous-release pathway similar to that described by NAS for ^{14}C because no one foresaw the potential importance of that pathway at that time. In fact, according to the generic analyses we performed in support of 40 CFR part 191, the unsaturated site in tuff was generally more protective, in terms of limiting total releases, than the other geologic media we evaluated.

For these reasons, we do not believe that these generic analyses and conclusions supporting the development of release limits in 40 CFR part 191 are appropriate for judging the need for population-risk limits or the acceptability of population risks from releases from wastes in the Yucca Mountain disposal system. We are proposing to find that the individual-protection standard is sufficient to protect public health based upon the unique characteristics of the area around the Yucca Mountain site.

In summary, we are proposing to adopt an individual-protection standard for Yucca Mountain that will limit the annual radiation dose incurred by the RMEI to 150 μSv (15 mrem) CEDE. At the same time, we are not proposing to adopt a separate limit on radiation releases for the purpose of protecting the general population, but we are recommending that collective dose be estimated and considered (see the following paragraph). We based this decision upon several factors. The first factor is the NAS projection of extremely small doses to individuals resulting from air releases from Yucca Mountain. That dose level is well below the risk corresponding to our proposed individual-protection standard for Yucca Mountain. It is also well below the level that we have regulated in the past through other regulations. Further, while we decline to establish a general NIR level, we do agree with NAS that estimating the number of health effects resulting from a 0.0003 mrem/yr dose rate, in addition to the dose rate from background radiation, in the general population is uncertain and controversial. The second major factor is that, based upon current and site-specific conditions near Yucca Mountain, there is not likely to be great dilution resulting in exposure of a large population. In addition, we are proposing additional ground water protection standards that would establish specific limits to protect users of ground water and ground water as a resource. Finally, we are still proposing to require that all of the pathways, including air and ground water, would be analyzed by DOE and considered by NRC under the individual-protection standard. We request comment upon this approach. Commenters who disagree with this approach should specifically address why it is inappropriate for the Yucca Mountain disposal system and make suggestions about how we might reasonably address this issue.

While we are not proposing to adopt additional regulatory requirements for collective exposures of the general population from releases from the Yucca Mountain disposal system, we urge DOE to examine design alternatives for the disposal system, for the purpose of reducing potential risk to the general population, in the National Environmental Policy Act (NEPA) process for Yucca Mountain. We received public comments, in response to our request for comments regarding the NAS Report, noting that DOE had already proposed, in its Notice of Intent to prepare a NEPA-prescribed environmental impact statement (EIS) for Yucca Mountain, to evaluate technical alternatives (60 FR 40167, August 7, 1995). In other words, DOE has previously proposed to evaluate technical alternatives as part of its waste containment and isolation strategy for Yucca Mountain (DOE, ''Strategy for Waste Containment and Isolation for the Yucca Mountain Site,'' Preliminary Review Draft, October 9, 1995). Thus, we recommend that DOE incorporate these or similar considerations into its NEPA process to assess the effectiveness of design alternatives to mitigate population exposures.

The following language provides context to the approach we consider appropriate for calculating population exposure in the NEPA process. We recommend that DOE calculate the collective dose without truncation and with full consideration of the appropriate factors. This recommendation is supported by a recent NCRP report upon the principles and application of a collective dose in radiation protection (NCRP Report No. 121). The NCRP advocated the use of collective dose for optimization of protection and provided guidance on future exposures from long-lived radionuclides, the situation that will likely exist at Yucca Mountain:

The most reasonable risk assessment that can be made for such situations is to calculate potential individual doses for a range of scenarios in order to: (1) evaluate protective measures and (2) to try to place some boundaries on estimates of future individual risks. For the few very long-lived radionuclides that are metabolically regulated in the body and more or less uniformly distributed within the biosphere (e.g., ^{14}C and ^{129}I), future average individual doses may be estimated from total quantities in the environment. . . . (NCRP Report No. 121, pp. 57–58)

III.B.6. What Should Be Assumed About the Future Biosphere?

We propose to require DOE and NRC to use the biosphere assumptions described in this section in all analyses of repository performance, including the performance assessment for determining compliance with the individual-protection standard, the assessment for determining compliance with the ground water standards, and the human-intrusion analysis. Projecting biosphere conditions necessitates making assumptions, many of which are very uncertain and may not be boundable. The NAS stated:

In view of the almost unlimited possible future states of society and of the significance of these states to future risk and dose, . . . we have recommended that a particular set of assumptions be used about the biosphere (including, for example, how and where people get their food and water) for compliance calculations . . . we recommend the use of assumptions that reflect current technologies and living patterns. (NAS Report p. 122)

The NAS also stated:

. . . unlike our conclusion about the earth science and geologic . . . factors described [earlier], we believe that it is not possible to

predict on the basis of scientific analyses the societal factors that must be specified in a far-future exposure scenario. . . . Any particular scenario about the future of human society near Yucca Mountain . . . should not be interpreted as reflecting conditions that eventually will occur. Although we recognize the burden on regulators to avoid regulations that are arbitrary, we know of no scientific method for identifying these [exposure] scenarios. (NAS Report p. 96)

We agree with the NAS on this point and propose that speculation concerning some characteristics of the future should not be the focus of the compliance determination process. Instead, we believe that it would be more appropriate to assume that those characteristics will be the same as they are today. No one should interpret this assumption so literally that only current residences and lifestyles of individuals living in the area on the day of promulgation of this part can be considered. Rather, we intend that, based upon current knowledge, DOE and NRC may use those characteristics in combinations in a cautious, but reasonable, manner as input into the Yucca Mountain performance projections. Future characteristics which NRC and DOE may assume to be the same as they are today include the level of human knowledge and technical capability (including medical), human physiology and nutritional needs, general lifestyles of the population, and potential pathways through the biosphere leading to radiation exposure of humans. Also, we propose that it is inappropriate to speculate upon extreme changes in the number of residents, but that consideration should be given to changes in population near the location of the RMEI.

In concert with the NAS Report, we also propose not to allow the assumption that conditions in the future will be the same as present conditions for geologic, hydrologic, and climatic conditions. We are proposing this because we believe the parameter values in the performance assessment which relate to these conditions can be reasonably bounded. We propose to require that these conditions be varied within reasonable bounds over the compliance period and request comment upon this proposed approach.

III.B.7. How Far Into the Future Is It Reasonable To Project Disposal System Performance?

The NAS recommended that the time over which compliance should be assessed, that is, the compliance period, should be "the time when the greatest risk occurs, within the limits imposed by long-term stability of the geologic environment" (NAS Report p. 7). The NAS stated that it based this recommendation upon technical, not policy, considerations. However, we believe the selection of the compliance period necessarily involves both technical and policy considerations. For example, NAS stated that we might choose to establish similar policies for managing risks "from disposal of both long-lived hazardous nonradioactive materials and radioactive materials" (NAS Report p. 56). As NAS recognized, we must consider, in this rulemaking, both the technical and policy issues associated with establishing the appropriate compliance period for the performance assessment of the Yucca Mountain disposal system.

We request public comment upon two alternatives for the compliance period for the individual-protection standard. One alternative is to adopt a compliance period that is the time to peak dose within the period of geologic stability. The second alternative is to adopt a time period during which the repository must meet the disposal standards. For the reasons described below, we believe that the second alternative is preferable. Therefore, we are proposing that the peak dose within 10,000 years after disposal must comply with the individual-protection standard. Also, the EPA-preferred approach would require calculation of the peak dose within the period of geologic stability. It does not, however, apply a quantitative limit after 10,000 years. The intent of examining disposal system performance after 10,000 years is to estimate the long-term performance of the disposal system to see if dramatic changes in the performance of the disposal system could be anticipated. We would require DOE to include the results and bases of the additional analysis in the EIS for Yucca Mountain as an indicator of the future performance of the disposal system. This analysis also would serve as another source of information for decisionmakers in making both design and licensing decisions. However, NRC is not to use the additional analysis in determining compliance with proposed § 197.20.

The principal tool used to assess compliance with the individual-protection standard is a quantitative performance assessment. This method relies upon modeling of the potential processes and events leading to releases of radionuclides from the disposal system, subsequent radionuclide transport, and consequences upon health. To consider compliance for any length of time, several facets of knowledge and technical capability are necessary. First, the scientific understanding of the relevant, potential processes and events leading to releases must be sufficient to allow a quantitative estimate of projected repository performance. Second, adequate analytical methods and numerical tools must exist to incorporate this understanding into a quantitative assessment of compliance. Third, scientific understanding, data, and analytical methods must be adequately developed to allow evaluation of performance with sufficient robustness to judge compliance with reasonable expectation over the regulatory period. Finally, the analyses must be able to produce estimated results in a form capable of comparison with the standards.

The NAS evaluated these requirements for Yucca Mountain and concluded that those aspects of disposal system and waste behavior that depend upon physical and geologic properties can be estimated within reasonable limits of uncertainty. Also, NAS believed that these properties and processes are sufficiently understood and boundable over the long periods at issue to make such calculations possible and meaningful. The NAS acknowledged that these factors cannot be calculated precisely, but concluded that there is a substantial scientific basis for making such calculations. The NAS concluded that by taking uncertainties and natural variabilities into account, it would be possible to estimate, for example, the concentration of radionuclides in ground water at different locations and the times of gaseous releases. Second, NAS concluded that the mathematical and numerical tools necessary to evaluate repository performance are available or could be developed as part of the standard-setting or compliance-determination processes. Third, NAS concluded that: "So long as the geologic regime remains relatively stable, it should be possible to assess the maximum risks with reasonable assurance" (NAS Report p. 69). The NAS used the term "geologic stability" to describe the situation where geologic processes, such as earthquakes and erosion, that could affect the performance assessment of the Yucca Mountain site are active (not static) and are expected to occur. Based upon the use of the terms "stable" and "boundable" throughout the NAS Report, one can infer that NAS applied the term "geologic stability" or "stable" to the situation where the rate of processes and numeric range of individual physical properties could be bounded with reasonable certainty. The

subsequent use of the term ''stable'' will not imply static conditions or processes. Rather, it will describe the properties and processes that can be bounded. Finally, NAS found that the established procedures of risk analysis should enable the results of each performance simulation of the disposal system to be combined into a single estimate for comparison with the standard.

Time to peak dose within the period of geologic stability. The NAS recommended that the compliance period for the Yucca Mountain disposal system be the time to peak risk within the long-term stability of the geologic environment. Since the time to peak risk is generally the time to peak dose, subsequent discussion of the NAS findings will refer to the time to peak dose. The ''peak dose'' is the mean value of the range of the highest potential annual doses, as determined by the performance assessment, incurred by the RMEI within the compliance period. The NAS based its recommendation to use the time to peak dose upon its review of:

(1) The technical analyses supporting 40 CFR part 191;

(2) Information derived from current performance assessments of the Yucca Mountain disposal system; and (3) The geologic and physical processes that could affect the release and transport of radionuclides to the biosphere.

The 40 CFR part 191 standards contain a compliance period of 10,000 years. There were three reasons that we set this time frame:

(1) After that time, there is concern that the uncertainties in compliance assessment become unacceptably large (50 FR 38066, 38076, September 19, 1985);

(2) There are likely to be no exceptionally large geologic changes during that time (47 FR 58196, 58199, December 29, 1982); and

(3) Using time frames of less than 10,000 years does not allow for valid comparisons among potential sites. For example, for 1,000 years, all of the generic sites analyzed appeared to contain the waste approximately equally because of long ground water travel times at well-selected sites (47 FR 58196, 58199, December 29, 1982).

One purpose of geologic disposal is to provide long-term barriers to the movement of radionuclides into the biosphere (NAS Report p. 19). As described earlier, the Department plans to locate the Yucca Mountain repository in tuff about 300 meters above the local water table. When nongaseous radionuclides are released from the waste packages, they most likely will be transported by rain water that moves from the surface both horizontally within individual tuff layers and vertically downward, through fractures in the tuff layers, toward the underlying aquifer. Once the radionuclides reach the aquifer, they will be carried away from the repository in the direction of ground water flow. The most probable route for exposing humans to radiation resulting from releases from the Yucca Mountain disposal system is via withdrawal of contaminated water for local use. In the case of Yucca Mountain, DOE estimates that most radionuclides would not reach currently populated areas within 10,000 years (see the BID).

While this finding alone seems to indicate that the compliance period for Yucca Mountain should be longer than 10,000 years to be protective, NAS concluded that the need to consider the exposures when they are calculated to occur must be weighed against the problem of cumulative uncertainty. As noted above, exposures could occur over tens-to hundreds-of-thousands of years. However, as the compliance period is extended to such lengths, uncertainty increases and the resulting projected doses are increasingly meaningless from a policy perspective. The NAS stated that there are significant uncertainties in a performance assessment and that the overall uncertainty increases with time. Even so, NAS found that, ''. . . there is no scientific basis for limiting the time period of the individual-risk standard to 10,000 years or any other value'' (NAS Report p. 55). Estimates by NRC and DOE related to the Yucca Mountain disposal system have indicated wide differences in estimates of the time that radionuclides may take to reach the biosphere and cause the peak dose to occur (see the BID). However, while the results have indicated that the time to peak dose may vary anywhere from a few tens-of-thousands to hundreds-of-thousands of years, the estimated values of the peak doses, while separated in time, are similar in magnitude (see the BID). These estimates differ because the analysts used different assumptions and conceptual models for flow and transport of radionuclides through the Yucca Mountain unsaturated zone. We believe that this situation will exist independently of the compliance-period issue. The NAS also stated that data and analyses of some of the factors that are uncertain at one time might be more certain at a later time. For example, there is uncertainty as to how many waste packages might fail in the near term. However, at some later time in the distant future, the uncertainty is very small because when enough time has passed, all of the packages will fail (NAS Report p. 72). Also, NAS stated that many of the uncertainties in parameter values describing the geologic system are not due to the length of time but rather to the difficulty in estimating values of site characteristics which vary across the site. We believe that these difficulties are always present and that analysts must consider them in the compliance assessment for any period chosen (NAS Report p.72).

As NAS noted, evaluating compliance with the 40 CFR part 197 standards depends upon being able to:

(1) Understand and model radionuclide-transport processes and the processes and events that might lead to transport;

(2) Use appropriate analytical methods to determine the levels of human exposure;

(3) Quantify or bound the probabilities of the processes and events, including the related uncertainties; and

(4) State the results in a form capable of being compared with the standards.

The NAS reviewed how radionuclides might enter the biosphere in order to determine the feasibility of evaluating them in a compliance assessment. In addition, to determine whether the modifying processes should also be evaluated in a compliance assessment, NAS analyzed the geologic and physical processes that could modify the properties of the contaminant-containing media and processes by which radionuclides are moved.

The radionuclide-transport processes evaluated by NAS included:

(1) Release from the waste form;

(2) Transport from canisters into the near-field (near the waste canisters) unsaturated zone;

(3) Gas-phase transport from the unsaturated zone into the atmosphere around Yucca Mountain;

(4) Atmospheric circulation leading to dispersal of gaseous radionuclides in the global atmosphere;

(5) Aqueous-phase transport from the unsaturated zone to the water table; and

(6) Transport of radionuclides through the saturated zone beneath the repository to other locations from which water may be extracted by humans or ultimately reach the surface at a discharge area (NAS Report pp. 85–90).

The NAS concluded that these processes are ''sufficiently quantifiable and the uncertainties are sufficiently boundable that they can be included in performance assessments that extend over time frames corresponding to those over which the geologic system is relatively stable or varies in a boundable

manner'' (NAS Report p. 85). The NAS concluded that the ''geologic record suggests that this time frame is on the order of about one million years'' (NAS Report pp. 9 and 85). Likewise, NAS concluded that the probabilities and consequences of these processes and events that could modify the way in which radionuclides are moved in the vicinity of Yucca Mountain, including climate change, seismic activity, and volcanic eruptions, ''are sufficiently boundable so that these factors can be included in performance assessments that extend over periods on the order of about one million years'' (NAS Report p. 91).

Thus, NAS recommended, on a technical basis, that the compliance period for the protection of the individual should extend to the time of the peak dose during the period in which geologic processes are stable or boundable. This would require determining compliance and licensing the disposal system on the basis of projections of performance over tens- to hundreds-of-thousands of years into the future. We believe that such an approach is not practical for Yucca Mountain.

As noted earlier, NAS concluded that ''there is no scientific basis for limiting the time period of the individual-risk standard to 10,000 years or any other value.'' Nevertheless, there is still considerable uncertainty as to whether current modeling capability allows development and validation of computer models that will provide sufficiently meaningful projections over a time frame up to tens-of-thousands to hundreds-of-thousands of years. Simply because such models can provide projections for those time periods does not mean those projections are either meaningful for decisionmakers or accurate. Furthermore, we are not aware of a policy basis that we could use to determine the level of proof or confidence necessary to determine compliance based upon projections of hundreds-of-thousands of years into the future. While NAS indicated that analyses of the performance of the Yucca Mountain disposal system dealing with the far future can be bounded, a large and cumulative amount of uncertainty is associated with those numerical projections. Setting a strict numerical standard at a level of risk acceptable today for the period of geologic stability would tend to ignore this cumulative uncertainty. For example, if the performance assessment indicates that the peak dose occurs 600,000 years in the future at an annual CEDE that has an uncertainty range of 0.1 mrem to 10,000 mrem, does that indicate that the disposal system is safe or unsafe and should NRC license it or not? In light of the cumulative uncertainty for calculations over an extremely long time, it may be more appropriate to consider, in a regulatory decisionmaking, assessments of disposal system performance over such time in a qualitative manner. We request comments upon the reasonableness of adopting the NAS-recommended compliance period or some other approach in lieu of the 10,000-year compliance period which we favor and describe below. We also seek comment upon whether the NAS-recommended compliance period can be implemented in a reasonable manner and how that could be done.

A 10,000-year compliance period (proposed § 197.20). As noted earlier, the selection of the compliance period for the individual-protection standard involves both technical and policy considerations. It is our responsibility to weigh both during this rulemaking. In addition to the technical guidance provided in the NAS Report, we have considered several policy and technical factors that NAS did not fully address.

First, as suggested by NAS, we evaluated the policies for managing risks from the disposal of both long-lived, hazardous, nonradioactive materials and radioactive materials. Second, we evaluated consistency with both 40 CFR part 191 and the issue of consistent time periods for the protection of ground water resources and public health. Third, we considered the issue of uncertainty in predicting dose over the very long periods contemplated in the alternative of peak dose within the period of geologic stability. Finally, we reviewed the feasibility of implementing the alternative of peak risk within the period of geologic stability, as recommended by NAS. As a result of these considerations, we are proposing a 10,000-year compliance period with a quantitative limit and a requirement to calculate the peak dose, using performance assessments, if the peak dose occurs after 10,000 years. Under our proposal, the performance assessment results for the post-10,000-year period must be made part of the public record by DOE including it in the EIS for Yucca Mountain.

In its discussion of the policy issues associated with the selection of the time period for compliance, NAS suggested that we might choose to establish consistent risk-management policies for long-lived, hazardous, nonradioactive materials and radioactive materials. We previously addressed the 10,000-year compliance period in the regulation of hazardous waste subject to land-disposal restrictions. Land disposal, as defined in 40 CFR 268.2(c), includes, but is not limited to, any placement of hazardous waste in land-based units such as landfills, surface impoundments, and injection wells. Facilities may seek an exemption by demonstrating that there will be no migration of hazardous constituents from the disposal unit for as long as the waste remains hazardous (40 CFR 268.6). We have interpreted the phrase ''for as long as the waste remains hazardous'' to mean that the no-migration demonstration shows that hazardous constituents will not exceed acceptable concentration levels for as long as the constituents retain the potential to harm human health and the environment. This period may include not only the operating phase of the facility, but also what may be an extensive period after facility closure. With respect to injection wells, we have specifically required a demonstration that the injected fluid will not migrate within 10,000 years (40 CFR 148.20(a)). We chose the 10,000-year performance period referenced in our guidance upon no-migration petitions, in part, to be equal to time periods cited in draft or final DOE, NRC, and EPA regulations (10 CFR 960, 10 CFR 60, or 40 CFR 191, respectively) governing siting, licensing, and releases from HLW disposal systems. With respect to other land-based units regulated under the Resource Conservation and Recovery Act (RCRA) hazardous-waste regulations, we concluded that the compliance period is specific to the waste and site under consideration. For example, for the WIPP no-migration petition, we found that ''it is not particularly useful to extend this model beyond 10,000 years into the future.* * * [However, t]he agency does believe * * * that modeling over a 10,000-year period provides a useful tool in assessing the long-term stability of the repository and the potential for migration of hazardous constituents'' (55 FR 13068, 13073, April 6, 1990).

Second, the individual-protection requirements in 40 CFR part 191 (58 FR 66398, 66414, December 20, 1993) have a compliance period of 10,000 years. The part 191 standards apply to the same types of waste and type of disposal system as proposed for Yucca Mountain. However, as we explained in the *What Led up to Today's Action?* section earlier in this notice, by statute the part 191 requirements do not apply to Yucca Mountain. If we finally adopt the 10,000-year compliance period, it would require the same compliance period for

the Yucca Mountain disposal system as for other disposal systems subject to 40 CFR part 191. Such a requirement would be consistent with 40 CFR part 191, which we deem appropriate since both sets of standards apply to the same types of waste.

Third, we are concerned that there might be large uncertainty in projecting human exposure due to releases from the repository over extremely long periods. We agree with the NAS conclusion that it is possible to evaluate the performance of the Yucca Mountain disposal system and the lithosphere within certain bounds for relatively long periods. However, we believe that NAS might not have fully addressed two aspects of uncertainty.

One of the aspects of uncertainty relates to the impact of long-term natural changes in climate and its effect upon choosing an appropriate RMEI. For extremely long periods, major changes in the global climate, for example, a transition to a glacial climate, could occur (see the BID). However, over the next 10,000 years, the biosphere in the Yucca Mountain area will probably remain, in general, similar to present-day conditions due to the rain-shadow effect of the Sierra Nevada Mountains, which lie to the west of Yucca Mountain (see the BID). For the longer periods contemplated for the alternative of time to peak dose, the global climate regime is virtually certain to pass through several glacial-interglacial cycles, with the majority of time spent in the glacial state (NAS Report p. 91). These longer periods would require the specification of exposure scenarios that would not be based upon current knowledge or cautious, but reasonable, assumptions, but rather upon potentially arbitrary assumptions. The NAS indicated that it knew of no scientific basis for identifying such scenarios (NAS Report p. 96). It is for these reasons that such extremely long-term calculations are useful only as indicators, rather than accurate predictors, of the long-term performance of the Yucca Mountain disposal system (IAEA TECDOC–767, 1994).

The other aspect of uncertainty concerns the range of possible biosphere conditions and human behavior. It is necessary to make certain assumptions regarding the biosphere, even for the 10,000-year alternative, because the period of 10,000 years represents a very long compliance period for current-day assessments to project performance. For example, it is twice as long as recorded human history (see the *What Should Be Assumed About the Future Biosphere?* section earlier in this notice). For periods approaching the 1,000,000 years that NAS contemplated under the peak-dose alternative, even human evolutionary changes become possible. Thus, reliable modeling of human exposure may be untenable and regulation to the time of peak dose within the period of geologic stability could become arbitrary.

Fourth, many international geologic disposal programs use a 10,000-year regulatory compliance period as a requirement.

Finally, an additional complication associated with the time to peak dose within the period of geologic stability is that it could lead to a period of regulation that has never been implemented in a national or international radiation regulatory program. Focusing upon a 10,000-year compliance period forces more emphasis upon those features over which man can exert some control, such as repository design and engineered barriers. It is unlikely that over much longer time frames that any engineered barrier will be effective. Those features, the geologic barriers, and their interactions define the waste isolation capability of the disposal system. By focusing upon an analysis of the features that man can influence or dictate at the site, it may be possible to influence the timing and magnitude of the peak dose, even over times longer than 10,000 years.

Thus, we request comment upon our proposal of a 10,000-year compliance period to judge compliance with proposed § 197.20 and our proposal to require consideration of the peak dose, using performance assessments, if it occurs after 10,000 years. Again, after 10,000 years, we would not require the calculated level to comply with a specific numerical standard but we would require its consideration as an indicator of longer-term performance and be included in the EIS for Yucca Mountain.

We also request comment upon the appropriateness of a 10,000-year compliance period for the individual-protection standard. Commenters should address the issues that we should consider in determining the appropriate compliance period. We also specifically request comments upon whether the NAS' recommendation of the time to peak dose within the period of geologic stability can be implemented reasonably and, if so, how that could be done.

III.C. What Are the Requirements for Performance Assessments and Determinations of Compliance? (Proposed §§ 197.20, 197.25, and 197.35)

III.C.1. What Limits Are there on Factors Included in the Performance Assessments?

The Commission is responsible for deciding whether or not to license the Yucca Mountain disposal system. It must make that decision based largely upon whether DOE has demonstrated compliance with our standards in 40 CFR part 197. Under the proposed 40 CFR part 197, the quantitative analysis underlying that decision will be a performance assessment (the proposed definition of "performance assessment" is in § 197.12). We are proposing that performance assessments be a requirement of licensing. The EnPA requires that the Commission modify its technical requirements for licensing the disposal system to be consistent with our final 40 CFR part 197 standards. Therefore, our standards would require DOE to complete a performance assessment prior to applying for a license and would require NRC to determine, taking into consideration that performance assessment, whether the disposal system's projected performance complies with § 197.20.

We also are proposing, consistent with the performance assessment requirements in 40 CFR part 191:

(1) To exclude from performance assessments those natural processes and events whose likelihood of occurrence is so small that they are very unlikely;

(2) That such performance assessments need not include categories of processes or events that DOE and NRC estimate to have less than a 1 in 10,000 (1×10^{-4}) chance of occurring during the 10,000 years after disposal. Probabilities below this level are associated with events such as the appearance of new volcanoes outside of known areas of volcanic activity or a cataclysmic meteor impact in the area of the repository. We believe there is little or no benefit to public health or the environment from trying to regulate the effects of such very unlikely events; and

(3) That the performance assessment need not evaluate, in detail, the releases from processes, events, and sequences of processes and events estimated to have a likelihood of occurrence greater than 1×10^{-4} of occurring during the 10,000 years following disposal, if there is a reasonable expectation that the time to, or the magnitude of, the peak dose would not be changed significantly by such omissions. As necessary, the Commission may provide specific

guidance upon scenario selection and characterization to assure that processes or events are not excluded inappropriately.

A related issue upon which we request comment is if there is a period of the geologic record which we should require DOE and NRC to use to calculate the probability of processes and events occurring. The probability of a geologic event, such as an earthquake, occurring in the future typically comes from evidence of previous events which is preserved in, and can be dated by using, the geologic record. We believe that the geologic record is best preserved in the relatively recent past.

We are also proposing to require that DOE and NRC use quantitative assessments to determine compliance with the human-intrusion and ground water protection standards (see the *What Is the Standard for Human Intrusion?* and *How Will Ground Water Be Protected?* Sections later in this notice). The human-intrusion analysis would require a separate assessment of the effects of human intrusion upon the resilience of the Yucca Mountain disposal system. Following the recommendation of NAS, we intend the analysis to be an assessment of the disposal system's isolation capability following a single, stylized, human intrusion. The analysis required to determine compliance with the ground water protection standards applies only to undisturbed performance.

We are proposing to allow the exclusion of unlikely natural events from both the ground water and human-intrusion assessments. The approach for the ground water protection requirements is consistent with subpart C of 40 CFR part 191, "Environmental Standards for Ground-Water Protection" while the approach for the human-intrusion assessment is consistent with the NAS recommendation (see the *What Is the Standard for Human Intrusion?* section later in this notice). We request public comment upon whether this approach is appropriate for Yucca Mountain.

III.C.2. Is Expert Opinion Allowed?

The quantitative requirements in proposed subpart B of part 197 require:

(1) Evaluation of processes, events, and sequences of processes and events leading to radionuclide releases from the disposal system;

(2) Estimation of the resulting doses or radionuclide concentrations; and

(3) Estimation of the likelihood of the resulting doses or radionuclide concentrations.

The likelihood of the processes, events, and sequences of processes and events occurring should be estimated by DOE and NRC based upon current scientific knowledge of previous occurrences. However, it is likely that there will be processes, events, and sequences of processes and events which have not occurred or occurred too infrequently to be statistically significant. This situation will require the use of expert opinion, for example, scientific and engineering expertise, to arrive at cautious, but reasonable, estimates of the probability of future occurrence. Also, there likely will be many other areas where DOE could use expert opinion, for example, when there are multiple models applicable to the performance assessment or human-intrusion analysis, or significant uncertainties in the variation of parameter values.

There are two commonly used methods for the gathering of expert opinion, namely, expert judgment and expert elicitation. Expert judgment is typically obtained informally from one or more individuals and is noted by the person(s) seeking the judgment in documentation used to support the activity. In contrast, expert elicitation is a formal, structured, and thoroughly documented process. Whether it is appropriate to conduct an expert elicitation depends upon the issue under consideration.

We have considered setting guidelines for the use of expert elicitation. The type of guidelines we considered could include one or all of the following requirements when expert elicitation is used: (1) the Commission needs to consider the source and use of the information so gathered; (2) we would expect the Commission to assure that, to the extent possible, experts with both expertise appropriate for the subject matter and independence from DOE will be on the expert elicitation panel consulted to judge the validity and adequacy of the model(s) or value(s) for use in a compliance assessment; and (3) when DOE presents information to the expert elicitation panel, it should do so in a public meeting, and qualified experts, such as representatives of the State, should be given an opportunity to present information.

If we were to set any requirement, we would have to consider whether NRC may allow DOE to use expert elicitations, which did not follow these rules but were completed prior to the effective date of part 197, for the purpose of determining compliance with the provisions of part 197. We believe that it would probably be an unnecessary use of time and resources to require such work to be repeated or not be used if the Commission judges them to be acceptable.

We request comment upon whether it is appropriate for us to set guidelines for the use of expert opinion in this standard and, if so, what those guidelines should be.

III.C.3. What Level of Expectation Is Required for NRC To Determine Compliance?

While the provisions in this rule establish minimum requirements for implementation of the disposal standards, NRC may establish requirements that are more stringent. As mentioned in the previous section, we are proposing the concept of "reasonable expectation" to reflect our intent regarding the level of "proof" necessary for NRC to determine whether the projected performance of the Yucca Mountain disposal system complies with the standards (see proposed §§ 197.20, 197.25, and 197.35). We intend for this term to convey our position and intent that unequivocal numerical proof of compliance is neither necessary nor likely to be obtainable. The NRC has used a similar qualitative test, "reasonable assurance," for many years in its regulations. However, the NRC regulations are focused upon engineered systems with relatively short lifetimes, for example, nuclear power reactors. We believe that for very long-term projections, involving the interaction of natural systems with the engineered system and the uncertainties associated with the long time periods involved, a different approach may be more appropriate.

Therefore, we are proposing to require that the test of disposal system compliance be a "reasonable expectation" that the standards will be met. In carrying out performance assessments under a "reasonable expectation" approach, all parameters that significantly affect performance would be identified and included in the assessments. The distribution of values for these parameters would be made to the limits of confidence possible for the expected conditions in the natural and engineered barriers and the inherent uncertainties involved in estimating those values. Selecting parameter values for quantitative performance assessments would focus upon the full range of defensible and reasonable parameter distributions rather than focusing only upon the tails of the distributions as is more commonly done under the "reasonable assurance" approach. The "reasonable expectation" approach also would not exclude important parameters from the assessments because they are difficult to

quantify to a high degree of confidence. Some parameters, such as corrosion rates for metal container components, may be quantified with a high degree of accuracy and precision. Others, such as the amount of water entering a waste emplacement drift and dripping onto a waste package, cannot be quantified with a high degree of accuracy and precision, but are very important to a realistic assessment of performance. Overestimating or underestimating the values of parameters, or ignoring the positive effects upon performance for other processes and parameters because they cannot be precisely estimated, would essentially result in the performance assessments actually being analyses of extreme performance scenarios. These extreme assessments have a high probability of being unrealistic or of such low probability that they would not represent the range of likely performance for the disposal system.

We note that if the compliance period for the individual-protection standard extended to the time of peak dose within the period of geologic stability (which NAS estimated to be one million years for the Yucca Mountain site), this test would allow for decreasing confidence in the numerical results of the performance assessments as the compliance period increases beyond 10,000 years. For example, this means that the weight of evidence necessary, based upon reasonable expectation, for a compliance period of 10,000 years would be greater than that required for a compliance period of hundreds of thousands of years.

III.D. Are There Qualitative Requirements To Help assure Protection?

In addition to the quantitative limits in the standards, we considered several qualitative principles called "assurance requirements." We considered including such requirements because of the uncertainties that exist in projecting the effects of releases from radioactive waste over long periods. The intent for such assurance requirements would be to add confidence that the Yucca Mountain disposal system will achieve the level of protection proposed in the quantitative standards. This is the same approach that we require in 40 CFR part 191 and would provide similar protection regarding Yucca Mountain. The NAS also recognized the need for protection beyond that provided by the disposal system when it addressed institutional controls in its Report (NAS Report p. 11).

The assurance requirements we considered included the use of passive and active institutional controls, monitoring, the use of multiple barriers to isolate waste, and the ability to locate and remove the waste after disposal. In 40 CFR part 191, there is a sixth assurance requirement, 40 CFR 191.14(e), which we consider to be inappropriate for the Yucca site. The purpose of that requirement is to avoid sites where there are resources that might increase the likelihood of human intrusion. Congress specifically designated the Yucca Mountain site for characterization, so avoiding sites close to resources is not relevant in this instance. Further, the EnPA specifically dictates that we establish standards for the Yucca Mountain site so the intent of influencing site selection does not apply here.

We recognize that no one can accurately project the increase of protection brought by these assurance requirements. Under 40 CFR part 191, which we promulgated under the authority of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2022), NRC is exempted from the assurance requirements because it included equivalent provisions in 10 CFR part 60, the NRC regulations which implement 40 CFR part 191. The EnPA requires NRC to modify its technical requirements and criteria to be consistent with our standards for Yucca Mountain. We request comment upon whether it is appropriate for us to establish assurance requirements in 40 CFR part 197, and if so, what those requirements should be.

III.E. What Is the Standard for Human Intrusion? (Proposed § 197.25)

Previous standards and regulations for radioactive waste disposal, for example, 40 CFR part 191 for SNF and HLW and 10 CFR part 61 for LLW, included consideration of inadvertent human intrusion which could affect the release rate from, and the resultant quantity of radionuclides leaving, a disposal system.

In section 801(a)(2)(B) of the EnPA, Congress inquired about whether active institutional controls could effectively stop human intrusion into the Yucca Mountain disposal system (see Background on and Summary of the NAS Report section earlier in this notice). In its Report, NAS concluded that the answer to this question was "no" (NAS Report p. 11). The NAS reasoned that an answer of "yes" would require assumptions that active institutional controls will endure and that future generations are willing to dedicate resources for this purpose for a period longer than recorded human history. In support of its opinion, NAS stated, "that there is no scientific basis for making projections over the long term of either the social [or] institutional...status of future societies' (NAS Report p. 106).

It was NAS' opinion that human intrusion is plausible at Yucca Mountain and that the standards should, therefore, include consideration of the effects of human intrusion. In order to assess the effects of human intrusion, one must determine the probability of its occurrence sometime in the future and the consequences of that intrusion. Whether it is possible to predict the probability or frequency of human intrusion in a scientifically supportable manner was the third and final question posed by Congress in the EnPA (section 801(a)(2)(C)). The NAS concluded "that there is no technical basis for predicting either the nature or the frequency of occurrence of intrusions' and that although accurate prediction of the frequency of human intrusion is not possible, calculations can project potential consequences of assumed human-intrusion events (NAS Report p. 106). The NAS thus recommended that we assume that an intrusion will occur and that we specify an intrusion scenario for DOE and NRC to use to evaluate the "resilience" of the repository. The NAS stated: "The key performance issue is whether repository performance would be substantially degraded as a consequence of an inadvertent intrusion...." (NAS Report p. 121).

In following that recommendation, we are proposing a single-borehole intrusion scenario based upon Yucca Mountain-specific conditions. The intended purpose of analyzing this scenario "...is to examine the site-and design-related aspects of repository performance under an assumed intrusion scenario to inform a qualitative judgment" (NAS Report p. 111). The assessment would result in a calculated RMEI dose arriving through the pathway created by the assumed borehole (with no other releases included). Consistent with the NAS Report, we also are proposing "that the conditional risk as a result of the assumed intrusion scenario should be no greater than the risk levels that would be acceptable for the undisturbed-repository case" (NAS Report p. 113). We are proposing to interpret the NAS" term "undisturbed" to mean that the Yucca Mountain disposal system is not disturbed by human intrusion but could be disturbed by other processes or events which are likely to occur.

We also are proposing that the human-intrusion analysis of repository

performance use the same methods and RME characteristics for the performance assessment as those required for the individual-protection standard, with two exceptions. Those exceptions are that the human-intrusion analysis would exclude unlikely natural events and that the analysis would only address the releases occurring through the borehole (see the *What Are the Requirements for Performance Assessments and Determinations of Compliance?* section earlier in this notice).

Concerning intentional intrusion, NAS concluded that: "We also considered intentional intrusion...but concluded that it makes no sense...to try to protect against the risks arising from the conscious activities of future human societies" (NAS Report p. 114). We agree with this conclusion and propose to find it acceptable to exclude long-term or deliberate, as opposed to acute and inadvertent, human disturbance of the disposal system from the human-intrusion analysis on the theory that society could retain at least some general knowledge of the disposal system and, therefore, would know that such actions could be dangerous. The proposed human-intrusion scenario, therefore, includes only an acute, inadvertent intrusion.

Description of the proposed human-intrusion scenario. To develop an appropriate scenario, we reviewed information about known resources and geologic characteristics of the Yucca Mountain site associated with past and current drilling for resources in the area surrounding Yucca Mountain that could have an effect upon the type of proposed human-intrusion scenario (see the BID). Based upon this examination, we are proposing to adopt the NAS-suggested starting point for a human-intrusion scenario. That scenario is a single, stylized intrusion through the repository to the underlying aquifer based upon current drilling practices. The proposed scenario presumes that the intrusion occurs because of exploratory drilling for water. There are a number of reasons why people in the future could be drilling within the repository area, e.g., archeological pursuits, mineral exploration, or geological investigations. However, we believe that drilling for water is, for regulatory purposes, the best example of an intrusion scenario. The choice of exploratory drilling for water is not a prediction that this type of intrusion will occur or that it will occur on the surface slopes overlying the repository but it is necessary to fulfill the NAS' consideration that a borehole "of specified diameter [is] drilled from the surface through a canister of waste to the underlying aquifer" (NAS Report p. 111). Exploratory drilling for water, using current technology, essentially fixes the diameter of the borehole and drilling from the surface necessarily places the drill rig somewhere above the repository, but not necessarily on the crest of Yucca Mountain. For purposes of determining compliance with the human-intrusion standard, DOE must calculate the CEDE incurred by the RMEI using only releases through the pathway created by the assumed borehole (with no other releases included).

Under our proposal, NRC would specify when the intrusion would occur based upon the earliest time that current technology and practices could lead to waste package penetration. However, it must not occur sooner than the cessation of active institutional controls (see the *Are There Qualitative Requirements To Help Assure Protection?* section earlier in this notice). In general, we believe that the time frame for the drilling intrusion should be within the period that a small percentage of the waste packages have failed but before significant migration of radionuclides from the engineered barrier system has occurred since, based upon our understanding of drilling practices, this would be about the earliest time that impact with a waste package would not be recognized by a driller. Our review of information about drilling and experiences of drillers indicates that special efforts, for example, changing to a specialized drill bit, would likely be necessary to penetrate intact, nondegraded waste packages of the type DOE plans to use. As stated earlier, NRC would determine the timing as part of the licensing process. The Department's waste-package performance estimates indicate that a waste package would be recognizable to a driller for at least thousands of years (see the BID).

This is consistent with NAS' example scenario (NAS Report pp. 111–112). It requires evaluation of a single, nearly vertical borehole from the surface that breaches the repository, passes through a degraded waste package, and reaches the water table. We also are proposing that careful sealing of the borehole does not occur, but that natural processes gradually modify the transport characteristics within the borehole. In determining compliance, we are proposing that it is appropriate to assume that the result is no more severe than the creation of a ground water flow path from the crest of Yucca Mountain through the repository and into the ground water table. By proposing this single-borehole, single-waste-package scenario, we are not suggesting that other forms or types of human intrusion, or that intrusion as a result of a resource other than water, will not occur. For example, we know of different drilling techniques such as slanted, horizontal, and robotic which, in theory, could result in more penetrated waste packages. However, we do not believe that more complex scenarios would provide more information about the resilience of the repository than would the proposed scenario.

We also considered use of a human-intrusion scenario consistent with that required in EPA's criteria for certifying WIPP (40 CFR part 194). These criteria required DOE to identify the rate of resource drilling in the area surrounding the WIPP for the past 100 years (approximately the period of recorded history for drilling events in the area). DOE was required to then use this drilling rate in its performance assessment to determine the number of intrusions into the repository over the 10,000-year regulatory period. We considered this approach appropriate for the WIPP facility given the considerable amount of drilling in the vicinity of the site. We chose not to propose this approach for the Yucca Mountain facility given the recommendation in the NAS Report. We request comment upon the reasonableness of the proposed human-intrusion scenario, and whether an approach similar to that used for WIPP is more appropriate.

As noted earlier, we are proposing to use the same RME descriptors for this analysis and scenario as in the assessment for compliance with the individual-protection standard. While one could postulate that an individual occupies a location above the repository footprint in the future and is impacted by radioactive material brought to the surface during an intrusion event, the level of exposure of such an individual would be independent of whether the repository performs acceptably when breached by human intrusion in the manner prescribed in the proposed scenario. Movement of waste to the surface as a result of human intrusion is an acute action with the resulting exposure being a direct consequence of that action. Thus, we propose to interpret the NAS-recommended test of "resilience" to be a longer-term test as measured by exposures caused by releases which occur gradually through the borehole, not suddenly as with direct removal. In addition, the effects of direct removal depend upon the specific parameters involved with the drilling and not upon the containment

characteristics of the disposal system. We also are proposing that the test of the resilience of the repository system be the dose incurred by the same RMEI as determined for the individual-protection standard. This is consistent with the NAS' recommendation.

We request comment upon how much the human-intrusion analysis will add to protection of public health. Also, given current drilling practice in the vicinity of Yucca Mountain, we seek comment upon whether our proposed, stylized, human-intrusion scenario is reasonable.

Time frame for the analysis. We are considering two approaches to determine how far into the future that the human-intrusion analyses will be required to project doses. In the first approach, which is proposed in §§ 197.25 and 197.26, we would require the peak dose during the first 10,000 years, as a result of human intrusion, to be less than 150 μSv/yr (15 mrem/yr). In the second approach, DOE would calculate the earliest time that the engineered barrier system would degrade sufficiently that current drilling techniques could lead to complete waste package penetration without recognition by the drillers. If that intrusion can happen within 10,000 years, then DOE must do an analysis which projects the peak dose that would occur as a result of the intrusion within 10,000 years. That dose would have to be less than 150 μSv/yr (15 mrem/yr) for the site to be licensed, considering reasonable expectation. If the undetected intrusion could not occur until after 10,000 years, then DOE would still do the analysis, however the results would not be part of the licensing process but would be included in the Yucca Mountain EIS. This approach mirrors the way that the 10,000-year and post-10,000-year analyses are proposed in the individual-protection standard. This approach has the advantage of encouraging DOE to use a robust engineered design. We request comment upon the appropriateness of using either of these alternatives.

III.F. How Will Ground Water Be Protected? (Proposed § 197.35)

Ground water is a valuable resource with many potential uses. Our proposed ground water protection standards would protect ground water that is being used or might be used as drinking water by restricting potential future contamination. Water from the aquifer which flows beneath Yucca Mountain is currently being used as a source of drinking water 20 to 30 km south of Yucca Mountain in the communities directly protected by the individual-protection standard. It is also a potential source of drinking water for more distant communities and, theoretically, could supply drinking water for several hundred thousand people. For these reasons, we believe it is a resource that needs to be protected. Therefore, we are proposing to protect the ground water to the same level as the maximum contaminant levels (MCLs) for radionuclides which we have established under the authority of the Safe Drinking Water Act (SDWA). This is also consistent with our policy for ground water protection as stated in "Protecting the Nation's Ground Water: EPA's Strategy for the 1990s" ("the Strategy," EPA 21Z–1020, July 1991). In addition to drinking water, ground water may be a source of radiation exposure when used for irrigation, stock watering, food preparation, showering, or when incorporated into various industrial processes. Ground water contamination is also of concern to us because of potential adverse impacts upon ecosystems, particularly sensitive or endangered ecosystems.

Today's proposal utilizes the current MCLs, but the MCLs might change in the final rule. The Agency recognizes that the current MCLs are based upon the best scientific knowledge regarding the relationship between radiation exposure and risk that existed in 1975 when the MCLs were developed. Scientific understanding has evolved since 1975 and we are working to update the existing MCLs based upon a number of factors, including: the current understanding of the risk of developing a fatal cancer from exposure to radiation; pertinent risk management factors, e.g., information about treatment technologies and analytical methods; and applicable statutory requirements. Particularly relevant statutory requirements, in this context, are the requirements that MCLs be set as closely as feasible to the Maximum Contaminant Level Goal (MCLG) (SDWA section 1412(b)(4)(B)) and that revised drinking water regulations provide for equivalent or greater human health protection than the regulations they replace (SDWA section 1412(b)(9)). The Agency's preliminary efforts indicate that, for the radionuclides of concern at Yucca Mountain, the concentration values for those MCLs are probably not likely to change significantly. However, if those revisions to the MCLs are finalized prior to finalization of the part 197 standards, we plan to adopt those MCLs into the final part 197 standards. If part 197 is finalized first, the MCLs being proposed today would be maintained. We believe that this approach is necessary to provide stability for NRC and DOE in the licensing process. The uncertainty involved in not knowing when a change would occur and what form that change would take could delay the licensing proceeding. We request public comment upon this approach. If you do not consider the proposed approach appropriate, please provide an alternative and rationale.

In July 1991, we issued the Strategy cited above in order to guide future EPA and State activities in ground water protection and cleanup. The Strategy presents an effective approach for protecting the Nation's ground water resources. Our policies, programs, and resource allocations reflect this approach. It guides EPA, State and local governments, and other parties in carrying out ground water protection programs. In addition, our "Final Comprehensive State Ground-Water Protection Program Guidance" provides guidance to States for establishing a coordinated approach to their ground water protection.

The key element of our ground water protection strategy is the overall goal of preventing adverse effects upon human health and the environment by protecting the environmental integrity of the Nation's ground water resources. We believe that it is important to protect ground water to ensure that the Nation's currently used and potential USDWs are preserved for present and future generations. Also, we believe that it is important to protect ground water to ensure that where it interacts with surface water it does not interfere with the attainment of surface-water-quality standards. These standards are necessary to protect human health and the integrity of ecosystems.

Our Strategy also recognizes, however, that our efforts to protect ground water must take into consideration the use, value, and vulnerability of the resource, as well as social and economic values. In carrying out our programs, we use MCLs, established under the SDWA, as reference points for water-resource protection efforts when the ground water in question is a potential source of drinking water. Pursuant to section 1412 of the SDWA, we issued the National Primary Drinking Water Regulations for contaminants in drinking water which may cause an adverse effect upon the health of persons and which are known or anticipated to occur in public water systems (see 40 CFR parts 141 and 142). These regulations specify either MCLs or treatment techniques and contain "criteria and procedures to assure a

supply of drinking water which dependably complies'' with such MCLs (see SDWA § 1401). The relevant MCLs, for water containing less than 10,000 milligrams per liter (mg/L) of total dissolved solids (TDS) and assuming an ingestion rate of 2 L of water per day, are:

(1) 5 picocuries per liter (pCi/L) for combined radium-226 and radium-228;

(2) 15 pCi/L for gross alpha; and

(3) 4 mrem/yr for combined beta particle and photon radiation from man-made radionuclides.

We employ MCLs to protect ground water in numerous regulatory programs. This approach is reflected in our regulations pertaining to hazardous-waste disposal (40 CFR part 264), municipal-waste disposal (40 CFR parts 257 and 258), underground injection control (UIC) (40 CFR parts 144, 146, and 148), generic SNF, HLW, and transuranic radioactive waste disposal (40 CFR part 191), and uranium mill tailings disposal (40 CFR part 192). These Agency programs have demonstrated that such protection is scientifically and technically achievable, within the constraints applied in each of these regulations (''Progress In Ground Water Protection and Restoration,'' EPA 440/6–90–001).

Most ground water in the United States moves slowly, in the range of five to 50 feet per year. This means that a large amount of a contaminant can enter an aquifer and remain undetected until it affects a water well or surface-water body. Contaminants in ground water, unlike those in other environmental media like air or surface water, can move with relatively little mixing or dispersion, so concentrations can remain relatively high. Moreover, because ground water is below the Earth's surface and ''out of sight,'' its contamination is far more difficult to monitor or remove than is contamination in air, surface water, or soil. These plumes of contaminants move slowly through aquifers and may be present for many years, sometimes for decades or longer, potentially making the resource unusable for extended periods of time. Because an individual plume may underlie only a small part of the land surface, it can be difficult to detect by aquiferwide or regional monitoring. In addition, for periods spanning thousands of years, monitoring is unlikely to continue, avoidance of the contamination may be difficult, and the area affected may become large. These factors are part of the reason that our policy emphasizes prevention of ground water pollution.

Regarding this rulemaking, NAS clearly identified the ground water pathway as one of the significant pathways of exposure in the vicinity of the Yucca Mountain site (NAS Report pp. 52 and 81). The NAS also recognized that ground water modeling for the Yucca Mountain site is complex, involving both fracture and matrix flow and, as a result, that there is uncertainty regarding which model or models to use in the analysis:

> Because of the fractured nature of the tuff aquifer below Yucca Mountain, some uncertainty exists regarding the appropriate mathematical and numerical models required to simulate advective transport....[E]ven with residual uncertainties, it should be possible to generate quantitative (possibly bounding) estimates of radionuclide travel times and spatial distributions and concentrations of plumes accessible to a potential critical group. (NAS Report p. 90)

The basis of NRC's determination of compliance with the ground-water protection standards will be DOE projections in the license application of potential future contaminant concentrations that will inevitably contain uncertainty. An important cause of uncertainty, as recognized above by NAS, is the choice of conceptual site models. To illustrate, the conceptual models used for Yucca Mountain can differ fundamentally, that is, water can be presumed to flow through either pores in the rock or conduits through the rock, such as discrete fractures or a network of fractures that may act as preferential pathways for faster ground water flow, or a combination of the two. To further complicate the situation, any of these flow scenarios, with the possible exception of flow through conduits, can occur at Yucca Mountain whether the rock is completely saturated with water or not.

We believe that adequate data and the choice of models will be critical to any compliance calculation or determination. The NAS has examined the use of ground-water flow and contaminant-transport models in regulatory applications (''Ground Water Models: Scientific and Regulatory Applications,'' 1990). In that report, NAS concluded that data inadequacy is an impediment to the use of unsaturated fracture flow models for Yucca Mountain. However, NAS noted that data inadequacy was also an impediment to using models that assume the pores in the rock are either saturated or unsaturated or that assume flow through fractures that are completely filled with water. However, despite the recognition of the importance of the choice of the site conceptual model, the Agency believes that the need for sufficient quantity, types, and quality of data to adequately analyze the site, because of its hydrogeologic complexity, is even more important. In other words, the complexity of the ground water flow system requires adequate site characterization to justify the choice of the conceptual flow model.

The choice of modeling approaches to address the ground water system in the area of Yucca Mountain, based upon the conceptual model of the site developed from site characterization activities, is important to characterize contaminant migration, particularly the mixing of water, contaminated with radionuclides from breached waste packages, with uncontaminated water. The extent of the dilution afforded by mixing contaminated water with other ground water moving through the rocks below the repository but above the water table and the dispersion of the plume of contamination within the saturated zone as the ground water system carries radionuclides downgradient are critical elements of the dose assessments.

At one end of a spectrum of approaches to modeling the site ground water system is the assumption that the system can be modeled based upon flow through pores over the area of total system assessments (tens of square kilometers). At the other extreme is the assumption that radionuclides are carried through fast-flow, fracture pathways in the unsaturated zone separately from uncontaminated ground water also passing through the repository footprint. Those radionuclides then are assumed to be carried through the saturated zone in fractures that allow little or no dispersion within, or mixing with, uncontaminated water in the saturated zone. This is essentially ''pipe flow'' from the repository to the receptor. Although the flow of ground water at the site is influenced strongly by fractures, which should be reflected in the models, we believe that it is unreasonable to assume that no mixing with uncontaminated ground water would occur along the radionuclide travel paths. We request comment upon this approach, including consideration of the practical limitations on characterizing the flow system over several or tens of square kilometers.

Our intention is to develop ground water protection standards that are implementable by NRC. In this regard, NAS indicated that quantitative estimates of ground water contamination should be possible (NAS Report p. 90). We are proposing to require DOE to project the level of radioactive contamination it expects to be in the representative volume of ground water. The representative

volume could be calculated to be in any aquifer which contains less than 10,000 mg/L of TDS and is downgradient from Yucca Mountain. By proposing this method, we intend to avoid requiring DOE and NRC to project the contamination in a small, possibly unrepresentative amount of water since we believe that this is not practical (see the discussion of "representative volume of ground water" immediately below). For example, we do not intend that NRC must consider whether a few gallons of water in a single fracture would exceed the standards. Thus, we are proposing to allow use of a larger volume of water which must, on average, meet the standards. This larger volume, the "representative volume," is discussed below.

Since the intended purpose of the engineered and natural barriers of the geologic repository is to contain radionuclides and minimize their movement into the general environment, we anticipate that radionuclide releases from the repository will not occur for long periods of time. With this in mind, we believe that ground water protection for the Yucca Mountain site should focus upon the protection of the ground water as a resource for future human use. It is the general premise of this proposal that the individual-protection standard would adequately protect those few current residents closest to the repository. The proposed ground water standards are directed to protecting the aquifer as a resource for current users, and a potential resource for larger numbers of future users either near the repository or for communities farther away comprised of as many as several hundred thousand people. To implement this conceptual approach and develop an approach for compliance determinations, we believe that the ground water standards currently used, the MCLs, should apply to public water supplies downgradient from the repository in aquifers at risk of contamination from repository releases. Applying the MCLs assures that the level of protection currently required for public water supplies elsewhere in the Nation is also maintained for future communities using the water supply downgradient from the Yucca Mountain repository.

To implement the standards in § 197.35, we are proposing that DOE use the concept of a "representative volume" of ground water in which DOE and NRC would project the concentration of radionuclides released from the Yucca Mountain disposal system for comparison against the MCLs. The representative volume will be the volume of water that would supply the annual water demands of a defined hypothetical community that could exist in the future at the point of compliance for the ground water protection standards. We believe that community size and water demand estimates should reflect the current, general lifestyles and demographics of the area, but not be rigidly constrained by current activities since any potential contamination would occur far into the future. In the area south of Yucca Mountain, the ground water is currently used for domestic purposes, commercial agriculture (for example, dairy cattle, feed crops, other crops, and fish farming), residential gardening, commercial, and municipal uses. The water resources, as reflected by estimates of current usage and aquifer yields, indicate that there is theoretically enough water to support communities of hundreds to thousands of people at the four alternative proposed locations for the point of compliance. This sets an upper bound on the size of the hypothetical community and its water demand. On the other hand, the SDWA defines the minimum size for a public water system as a system with 15 service connections or, regularly supplying at least 25 people.

For the four alternative proposed downgradient distances for the point of compliance (approximately 5, 18, 20, and 30 km from the repository), current populations vary from hundreds of persons around 30 km, to about 10 people residing at 18–20 km, to no residents at 5 km. Current projections of population growth in the area indicate increases at both the 20– and 30–km locations. Based upon current water usage, lifestyles, projections of population increases, and the potential number of people that could be supported by available ground water, there is a range of annual ground water volumes that could correspond to possible future public water system uses. While we believe that, ideally, the representative volume should be fully consistent with the protection objectives of the ground water protection strategy, we also recognize the unique features of this proposal. The extraordinary 10,000-year compliance period introduces unresolvable uncertainties that make this situation fundamentally different from the situations of clean-up or foreseeable, near-term potential contamination to which the strategy ordinarily applies. We therefore request comment upon a proposed representative ground water volume and upon possible alternatives for the size of the representative volume of ground water. These alternatives are based upon variations in possible lifestyles for residents downgradient from the repository and upon current and near-term projections of population growth and land use in the area.

The proposed representative volume is based upon a small farming community of 25 people and 255 acres of alfalfa cultivation, the current economic base in the Amargosa Valley. This approach assumes a community whose water needs include an agricultural component comparable to present water usage in the vicinity of the repository. The size of the average area of alfalfa cultivation, 255 acres, is based upon site-specific information for the nine alfalfa-growing operations which range in size from about 65 acres to about 800 acres. Using a water demand for alfalfa farming in Amargosa Valley of 5 acre-feet per acre per year, we estimate the water demand for the average operation to be 1275 acre-feet per year. As discussed below, it is appropriate to add 10 acre-feet per year for domestic uses resulting in 1285 acre-feet per year.

We request comment upon whether this approach is the most appropriate representative volume of ground water, or whether other values within the ranges discussed below are more appropriate. We believe that there may be significant technical, policy, or practical obstacles with the use of either very small or very large water volumes.

We considered using volumes of 10 and 120 acre-feet per year. Although the character of ground water movement in the saturated zone makes it progressively more difficult to model smaller volume flow, we are interested in comment upon the use of and whether, or how, it would be practical and feasible, using scientifically defensible methods, for the Commission to determine compliance with an alternative which specifies smaller representative volumes, such as 10 acre-feet and 120 acre-feet per year. A volume of 10 acre-feet would be representative of the annual water use of a non-farming family of four with average domestic water usage, including a garden. This is also the lower bound for the amount of water that would be used through 15 connections serving at least 25 persons in a public water supply, as defined in the SDWA. As mentioned in earlier discussions regarding the nature of ground water flow in fractured rocks, modeling the flow of ground water and the movement of contaminants involves significant uncertainties in the exact quantitative relationship between ground water

movement in fractures versus its movement in the rock pore spaces. Modeling these processes, of necessity, requires simplifying assumptions and approximations that lower the level of confidence that can be attached to estimating contaminant concentrations in progressively smaller volumes of ground water. From our understanding of the complexity of the flow system at Yucca Mountain and the surrounding area, and the uncertainties involved in modeling it, a small representative volume such as 10 acre-feet would be difficult to model with a sufficient degree of certainty for regulatory confidence. The Agency, of course, wants the size of the representative volume used in compliance calculations to be scientifically defensible in order to provide the public a reasonable certainty of their accuracy.

An annual water demand of 120 acre-feet assumes a community of 150 persons and is based upon current water use data for the area. This population estimate is based upon recent population increases in the area and 20-year projections of land use at the 20-km location, as described in county planning documents. In such a scenario, it would be important for commenters to look at whether it is appropriate to assume this community would have an agriculture component, or whether a primarily residential community is more appropriate.

We also considered using a volume of 4,000 acre-feet which would be representative of the estimated perennial yield of the Jackass Flats hydrographic sub-basin in which the proposed Yucca Mountain repository is located. This volume represents the annual sustainable quantity of water which could be removed from this sub-basin without significantly decreasing the subsequent water yield and quality in the future. This volume is not directly linked to any specific use, but rather is included as representative of the volume of the water resource for potential future, large-scale, sustainable ground water use.

As already stated, we believe that there may be significant technical, policy, or practical obstacles that preclude the use of such a large volume. Releases from the repository will migrate downward and into the saturated zone where the contaminated ground water will move generally southward. The Jackass Flats sub-basin covers a large area, most of which is east of the repository site and not in the path of ground water flow from the repository. The Agency did not include this alternative in the rule since the use of 4,000 acre-feet would result in a contaminant estimate based upon dilution by a large volume of unaffected water. We are requesting comment upon the use of 4,000 acre-feet as the basis for the Commission to determine compliance with an alternative which specifies this volume as representative of the ground water resource.

To implement these options, the Department would project the radionuclide concentration in the representative volume or the resultant doses, for the option selected, and compare them against the appropriate MCLs. For these calculations, the movement of radionuclides released from the repository must be calculated as they move downgradient toward the compliance point. For the purpose of demonstrating compliance with the ground water protection standards, we intend for DOE and NRC to use the performance assessments to determine compliance with the individual-protection standard to calculate the concentration of radionuclides in the ground water.

There are two basic approaches between which DOE must choose for calculating the concentrations of radionuclides at the point of compliance. The Department may perform this analysis by determining how much contamination is in: (1) a ''well-capture zone''; or (2) a ''slice of the plume.'' (These approaches are explained immediately below.) For either approach, the volume of water used in the calculations is equal to the representative volume, i.e., the annual water demand for the proposed future group using the ground water.

The ''well-capture zone'' is the volume from which a water supply well, pumping at a defined rate, is withdrawing water from an aquifer. The dimensions of the well-capture zone are determined by the pumping rate in combination with aquifer characteristics assumed for calculations, such as hydraulic conductivity, gradient, and the screened interval. If this approach is used, DOE must assume that the:

(1) Well has characteristics consistent with public water supply wells in Amargosa Valley, for example, well bore size and length of the screened interval;

(2) Screened interval is centered at the highest concentration in the plume of contamination at the point of compliance; and

(3) Pumping rate is set to produce an annual withdrawal equal to the representative volume.

To include an appropriate measure of conservatism in the compliance calculations for the well withdrawal approach, we are proposing that, for the purpose of the analysis, DOE should assume that the community water demand would be supplied from one pumping well located in the center of any projected plume of contamination originating in the repository. Conservatism is achieved by requiring that the entire water demand is withdrawn from one well intercepting the center of the plume of contamination so that the highest radionuclide concentrations in the plume are included in the volume used for the compliance calculations.

The ''slice of the plume'' is a cross-section of the plume of contamination centered at the point of compliance with sufficient thickness parallel to the prevalent flow of the plume such that it contains the representative volume. If DOE uses this approach, it must:

(1) Propose to NRC, for its approval, where the edge of the plume of contamination occurs, for example, where the concentration of radionuclides reaches 0.1% of the level of the highest concentration at the point of compliance;

(2) Assume that the slice of the plume is perpendicular to the prevalent direction of flow of the aquifer; and

(3) Set the volume of ground water contained within the slice of the plume equal to the representative volume.

In both alternatives, we are proposing that DOE must determine the physical dimensions and orientation of the representative volume during the licensing process, subject to approval by the Commission. Factors that would go into determining the orientation of the representative volume would include hydrologic characteristics of the aquifer and the well.

Under our proposal, the Department must demonstrate compliance with the proposed ground water protection standards (§ 197.35) assuming undisturbed performance of the disposal system. The term ''undisturbed performance'' means that human intrusion or the occurrence of unlikely, disruptive, natural processes and events do not disturb the disposal system. This approach recognizes that human behavior is difficult to predict and, if human intrusion occurs, that individuals may be exposed to radiation doses that would be more attributable to human actions than to the quality of repository siting and design (NAS Report p. 11). The requirement that DOE project performance for comparison with the ground water protection standards based upon undisturbed-performance scenarios is consistent with our generally applicable standards for SNF, HLW, and transuranic waste in 40 CFR part 191 (58 FR 66402,

December 20, 1993; 50 FR 38073 and 38078, September 19, 1985).

We also are proposing to require that DOE combine certain estimated releases from the Yucca Mountain disposal system with the pre-existing naturally occurring or man-made radionuclides to determine the concentration in the representative volume (see Table 1 in the *What Should the Level of Protection Be?* section earlier in this notice for particular cases). This means that the releases of radionuclides from radioactive material in the Yucca Mountain disposal system must not be allowed to cause the projected level of radioactivity at the point of compliance to exceed the limits in § 197.35 with reasonable expectation.

We request public comment upon these approaches. Comments also are requested upon whether it is desirable and appropriate for us to provide more quantitative requirements for the proposed representative volume in the final standards. If so, please provide specifics.

III.F.1. Is the Storage or Disposal of Radioactive Material in the Yucca Mountain Repository Underground Injection?

We first addressed the issue of whether the disposal of radioactive waste in geologic repositories might be considered a form of underground injection in a rulemaking to amend 40 CFR part 191. In the preamble to the final amendments (58 FR 66398), we stated that it was unnecessary to address whether the disposal of radioactive waste in a geologic repository covered under 40 CFR part 191 constitutes underground injection under the SDWA since the ground water protection requirements in 40 CFR part 191 conformed with the MCLs. We also noted that in *NRDC* v. *EPA*, 824 F.2d at 1270–71, the First Circuit Court of Appeals itself did not resolve the underground injection issue. The Court stated only that disposal in geologic repositories would "likely" constitute underground injection. Also, in the preamble to the 40 CFR part 191 amendments, we reviewed the SDWA, its legislative history, and the regulations governing the UIC program. We concluded that the underground disposal of containerized radioactive waste in geologic repositories subject to 40 CFR part 191 does not constitute underground injection within the meaning of the SDWA or our regulations governing the UIC program (58 FR 66398, 66408–66411, December 20, 1993). Similarly, in the present rulemaking, we propose to find that the storage or disposal of containerized radioactive waste in Yucca Mountain does not constitute underground injection.

Section 1421 of the SDWA defines "underground injection" as "the subsurface emplacement of fluids by well injection." 42 U.S.C. 300h(d)(1). The statute defines neither "fluids" nor "well injection." Moreover, neither the statute nor the legislative history directly addresses whether the underground storage or disposal of containerized radioactive waste constitutes the "subsurface emplacement of fluids by well injection." Even though the legislative history states, "[t]he definition of 'underground injection' is intended to be broad enough to cover any contaminant which may be put below ground level and which flows or moves, whether the contaminant is in semi-solid, liquid, sludge, or any other form or state," (H.R. Rep. No. 1185, 93d Cong., 2d Sess. 31 (1974)), it does not specifically address whether the underground storage or disposal of containerized radioactive waste in a geologic repository, such as Yucca Mountain, constitutes the "subsurface emplacement of fluids by well injection."

In this rulemaking, we are proposing to conclude that the underground storage or disposal of containerized radioactive waste in the Yucca Mountain repository does not constitute underground injection both because the materials to be emplaced are not "fluids" and because the mode of emplacement of these materials is not "well injection." We do not consider the type of containerized radioactive wastes covered under today's proposal to be "fluids." Instead, DOE plans for the wastes to consist entirely of solid materials and to be enclosed in thick metal waste packages. We do not believe that the SDWA's reference to "subsurface emplacement of fluids" was intended to address the subsurface storage or disposal of solid, containerized materials. As noted above, neither the statute nor the legislative history specifically address the subsurface emplacement of containerized materials or solids. On the other hand, the legislative history does address the injection of liquid materials that flow or move at the time they are emplaced into the ground. For example, in floor debate, Sen. Domenici stated that "the [UIC] regulations would cover all types of injection wells from industrial and nuclear disposal wells, oil and gas injection wells, solution mining wells or any hole in the ground designed for the purpose of injecting water or other fluids below the surface" (see 126 Cong. Rec. 30189, November 19, 1980, remarks of Sen. Domenici). Indeed, in amending the SDWA in 1985, Congress stated "underground injection is the process of forcing liquids underground through a well." H.R. Rep. No. 168, 99th Cong., 1st Sess. 30 (1985). Moreover, it is clear from the legislative history of the SDWA that Congress intended to ratify EPA's policy regarding deep-well injection contained in Administrator's Decision Statement #5, entitled "Subsurface Emplacement of Fluids," (39 FR 12922, April 2, 1974, H.R. Rep. No. 1185, 93rd Cong., 2d Sess. 31–32 (1974)). Administrator's Decision Statement #5 contains parameters for well injection including, among other things, data requirements for volume, rate, and injection pressure of the fluid; degree of fluid saturation; and formation and fluid pressure (39 FR 12923, April 9, 1974). Like the legislative history itself, the policy does not mention the subsurface emplacement of containerized radioactive wastes, but it does address the injection of noncontainerized liquids as an object of regulatory concern.

The legislative history of the SDWA indicates that Congress was concerned about contamination of ground water from a variety of sources of noncontainerized liquids and sludges. Quoting from a U.S. Department of Health, Education and Welfare report entitled "Human Health and the Environment—Some Research Needs," Representative Rogers noted in floor debate that ground water pollution was rapidly increasing from sources including ". . . waste water sludges and effluents . . . mine drainage, subsurface disposal of oil-field brines, seepage from septic tanks and storage transmission facilities, and individual on-site waste-water disposal systems." (123 Cong. Rec. 22460 (July 12, 1977)). Later in 1985, Congress made clear its intent that there would be early detection of fluid migration into or in the direction of a USDW (H.R. Rep. No. 168, 99th Cong., 1st Sess. 30 (1985)). Again, there is no mention that Congress intended that the SDWA cover the subsurface emplacement of containerized radioactive wastes.

Reflecting this statutory approach, our UIC regulations similarly do not treat containerized radioactive wastes as fluids or liquids for the purpose of control under the UIC program. Our regulations at 40 CFR 146.3 define "fluid" as "material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state." In adopting this regulatory definition of fluid, we did not consider the emplacement of containerized

radioactive wastes into geologic repositories to be fluids subject to the UIC regulations. There is no mention of this activity in the preambles to the proposed or final UIC regulations. On the contrary, the fluids regulated by our UIC program include: (1) Brines from oil and gas production; (2) hazardous and industrial waste waters; (3) liquid hydrocarbons (gasoline, crude petroleum, and others); (4) solution mining fluids from uranium, sulfur, and salt solution mining; and (5) sewage and treated effluent (40 CFR 144.6). All of these materials can flow or move at the time they are emplaced into the ground. There is no indication of any intention to cover containerized materials as fluids under the UIC regulations.

Finally, we have never interpreted our UIC regulations to include the subsurface emplacement of containerized wastes or solid materials that do not flow or move. As explained in greater detail below, we have stated instead that placement of containerized hazardous waste in geologic repositories such as underground salt formations, mines, or caves, is regulated under Subtitle C of the RCRA hazardous waste program. Subtitle D of RCRA regulates the disposal of containerized, nonhazardous wastes pursuant to the regulatory provisions at 40 CFR 257.1. Today's proposed standards for Yucca Mountain regulate the emplacement and disposal of containerized radioactive wastes including SNF and HLW.

In *NRDC* v. *EPA*, 824 F.2d 1258, the First Circuit was concerned that radiation itself might be considered a fluid within the meaning of the SDWA and EPA's UIC regulations (40 CFR 146.3). We believe that radiation itself does not meet the UIC regulatory or statutory definition of "fluid." Radioactivity is a specific characteristic of the radionuclides in the waste but does not define the form of the waste. Also, radioactivity results in the emission of ionizing radiation in the form of electromagnetic energy or subatomic particles. Electromagnetic radiation is a form of energy, not a "material or substance." Hence, it is not a "fluid." Subatomic particles, such as alpha and beta particles, will be absorbed in either the waste or the container and, therefore, not travel beyond the container, or will travel very short distances, perhaps a few inches. In any event, as set forth above, we believe that since the activity at the Yucca Mountain repository will consist of the emplacement of containers of radioactive wastes underground, this activity is emplacement of solid materials, not "fluids." Even though these materials might eventually disintegrate or dissolve and release some radiation, liquids, or gases, the activity in question still consists of emplacement of containers and solid materials that will not flow or move at the time of emplacement underground.

Moreover, we do not consider the emplacement into the Yucca Mountain repository of containerized and solid wastes that do not flow or move to be subsurface emplacement "by well injection." At the Yucca Mountain repository as currently conceived, a rail car will be used to carry the containerized waste into the repository. The waste containers then will be emplaced in drifts mined into the geologic formation. Once enough containers are accumulated, each drift will be closed. Closure of the disposal system will occur when all of the openings into the repository have been backfilled and all entrance ramps sealed.

Our UIC regulations define "well injection" as "subsurface emplacement of fluids through a bored, drilled or driven well; or through a dug well, where the depth of the dug well is greater than the largest surface dimension" (40 CFR 146.3). The regulations define a "well" as "a bored, drilled or driven shaft, or a dug hole, whose depth is greater than the largest surface dimension" (Id.). Although movement of the materials underground in the Yucca Mountain repository will involve waste handling, it will be drifts, that is, tunnels, through which containerized solid materials are transported and emplaced, not "wells" into which fluids are being "injected" within the meaning and intent of the SDWA or our UIC regulations. In addition, the overall configuration of the repository is far different from that of a "drilled," "driven," or "dug" injection well.

We noted in the preamble to the proposed UIC rules setting forth the definitions of "well" and "well injection" that the definitions cover not only "conventional" deep wells, but also drilled, bored, and driven wells. Dug wells and non-residential septic tanks also fall under the term. We further stated, however, that "although the definition is broad, it is not without limitation." (44 FR 23738, 23740, April 20, 1979) For example, we stated that the term does not cover simple depressions in the land or single-family domestic cesspools or septic systems, nor does it cover surface impoundments (Id.). Although we had been concerned initially about whether the UIC regulations should impose conditions upon surface impoundments, generally referred to as "pits, ponds, and lagoons," since they pose a threat to ground water, we noted that standards to control such contamination are under the RCRA hazardous-waste management program (44 FR 23740, April 20, 1979). Thus, we recognized that there are some disposal practices that might contaminate ground water that would not be covered under the UIC program.

Similarly, we do not believe that the UIC program should cover emplacement of containerized waste by way of a drift. Such emplacement is in no way similar to the pressurized or gravity-driven flow of fluids, liquids, or sludges injected into a well that has been the traditional focus of the UIC program (for example, 41 FR 36726, 36732, August 31, 1976). Even Class-V wells, a general category of injection wells, are not used for the disposal of containerized waste. Class V covers the subsurface emplacement of fluids, usually by gravity-driven flow, into the injection well. Although Class-V wells include some types of wells that traditionally might not be thought of as injection wells, for example, septic systems, all of the well types involve the emplacement of noncontainerized fluids into drilled, bored, dug, or driven wells, typically through gravity-driven flow rather than pressurized flow.

We specifically addressed the status of containerized waste under RCRA and SDWA in the preamble to the final rule promulgating standards for miscellaneous units used for the disposal of hazardous wastes under subpart X of the RCRA regulations (40 CFR part 264). In the preamble to the final rule, we stated: "Placement of containerized hazardous waste or bulk non-liquid hazardous waste in geologic repositories such as underground salt formations, mines, or caves, either for the purpose of disposal or long-term retrievable storage, is included under subpart X" (52 FR 46946, 46952, December 10, 1987).

We promulgated the subpart X regulations to address hazardous-waste management technologies not covered under 40 CFR part 264 (RCRA regulations for the disposal of hazardous waste) or 40 CFR part 146 (UIC program technical criteria and standards). As we indicated in the preamble to the subpart X regulations, the 40 CFR part 146 technical standards do not address practices other than the injection of noncontainerized liquids, slurries, and sludges, and do not fully address some potential disposal or storage practices that may fall under our regulatory definition of well injection (52 FR 46946, 46953, December 10, 1987). In the subpart X rule, we provided that, to the extent that miscellaneous disposal practices subject to subpart X might be

underground injection, a subpart X permit would constitute a UIC permit for well injection of hazardous waste for which current 40 CFR part 146 technical standards are not generally appropriate. We stated, however, that we were not ''specifying that these miscellaneous management practices constitute underground injection'' (Id.).

Thus, we have never expressed an intent that the disposal of containerized waste, including containerized radioactive waste, in geologic repositories is an activity covered by the UIC program. Instead, injection wells have been described as ''facilities [within] which wastes, in a fluid (usually liquid) state, are injected into the land under a pressure head greater than the pressure head of the ground water into or above which they are injected for the purpose of disposal. Discharge to the ground water is either direct or by direct seepage of leachate from the well outlet (46 FR 11126, 11137–38, February 5, 1981).

Moreover, we have never intended for the regulatory criteria and standards applicable to underground injection, contained in 40 CFR parts 144 and 146, to apply to a geologic repository such as Yucca Mountain. The concepts of area of review, pressure buildup and pressure monitoring, restrictions upon injection pressure, other operating requirements, and mechanical-integrity testing of injection wells, that are included in the 40 CFR part 146 regulations, are meaningless as applied to Yucca Mountain. Further, as noted above, the Yucca Mountain disposal system will have mined containment areas in which humans operate mechanical equipment to emplace waste packaged in containers surrounded by both engineered and natural barriers designed to isolate such waste from the environment. The UIC regulations are directed at injection of fluids by pressure or gravity flow where they are then in direct contact with the natural, underground media; this activity is far different, from an engineering perspective, than the subsurface emplacement of containerized wastes planned for Yucca Mountain.

Finally, as explained below, we are proposing specific ground water protection standards, in addition to other public health and safety standards, to protect ground water resources in the vicinity of Yucca Mountain. We believe these standards are adequate to protect public health and the environment from the radiation exposure resulting from releases following the emplacement of these containerized radioactive wastes into the Yucca Mountain disposal system. Thus, it is not necessary to expand the scope of the UIC program to cover this activity.

III.F.2. Does the Class-IV Well Ban Apply?

Today's action provides protection, with one possible exception, substantively similar to the SDWA through the proposed adoption of the MCLs to protect ground water resources in the vicinity of Yucca Mountain (proposed § 197.35). The possible exception relates to the provision of 40 CFR 144.13 banning ''Class IV'' injection wells. As defined in 40 CFR 144.6(d), such wells include those which dispose of radioactive waste into or above a formation which contains a USDW within one-quarter (1/4) mile of the well. In the preamble to the amendments to 40 CFR part 191 (58 FR 66398, 66410, December 20, 1993), we said we would further consider the Class-IV well-ban issue in the context of the Yucca Mountain rulemaking. We have done so and are proposing in this rulemaking not to apply the Class-IV injection-well ban to the Yucca Mountain repository. Our position is that this is appropriate in light of the statutory and regulatory provisions, discussed above, relating to ''underground injection'' and the differences in the purposes of the UIC program and the authority delegated to us under the EnPA to establish public health and safety standards for Yucca Mountain.

The UIC regulations mandate minimum requirements for State programs to prevent underground injection which endangers USDWs, while the 40 CFR part 197 standards proposed for Yucca Mountain are directed toward protecting ground water in the accessible environment in the vicinity of the Yucca Mountain site and establish requirements for performance of the Yucca Mountain disposal system. As discussed below, we believe that the proposed standards for the Yucca Mountain disposal system achieve public health and environmental protections comparable to those of the UIC program. Moreover, as discussed above, we do not believe that the emplacement of radioactive waste in the Yucca Mountain disposal system is a form of underground injection. Therefore, we are proposing to find that the Class-IV well ban does not apply to, and is not needed, in the case of the Yucca Mountain disposal system.

It is important to emphasize that our proposed decision not to apply the Class-IV well ban to Yucca Mountain does not affect other disposal systems that dispose of hazardous or radioactive waste into or above a formation which, within one-quarter (1/4) mile of the disposal system, contains a USDW. We are basing today's proposal upon site- and facility-specific characteristics of the Yucca Mountain repository, and today's proposal is limited to the Yucca Mountain repository.

The Class-IV well ban is part of the UIC program and is recognized in section 3020 of RCRA. As explained previously, the UIC program addresses ''well injection'' in the common-sense meaning of that term. In contrast, the proposed 40 CFR part 197 regulations address emplacement of radioactive wastes into a uniquely designed and utilized facility. The Yucca Mountain disposal system is planned to be subjected to extremely sophisticated site characterization, design, engineering, containerization, and operational requirements. Given such intense scrutiny, applying a blunt instrument akin to the Class-IV well ban as a siting prohibition appears to be both unnecessarily restrictive and a poor substitute for more sophisticated site characterization studies that may preclude siting of a disposal facility for reasons other than those embodied in the Class-IV restriction. Further, if Congress intended that the Yucca Mountain disposal system be subject to and summarily precluded by the Class-IV well ban, we seriously question whether Congress would have specifically directed us, under the EnPA, to establish public health and safety standards for Yucca Mountain.

Previously, we explained our proposed conclusion that emplacement of radioactive material into the Yucca Mountain disposal system is not underground injection. The materials to be disposed are solid, containerized radioactive wastes emplaced in a mined containment system in which humans operate heavy mechanical equipment. Such emplacement and such materials do not fall under the intent or meaning of the UIC concepts or programs, or more specifically, the Class-IV well ban at 40 CFR 144.13, but are judged more appropriately by the standards mandated by Congress under the EnPA specifically for Yucca Mountain. Further, the ground water protection alternatives presented in today's proposal provide protections very comparable to those under the UIC program.

Taken together, we believe these distinctions are sufficient to justify nonapplicability of the Class-IV well ban under the SDWA. We request comment upon our position that application of the UIC Class-IV well ban is neither legally required nor

appropriate for the Yucca Mountain disposal system. Further, we will not address in this rulemaking the relevance of the Class-IV well ban to underground repositories generally.

III.F.3. Which Ground Water Should Be Protected?

Although we propose to find that the Yucca Mountain disposal system is not a form of underground injection in the context of the SDWA, we nevertheless consider the ground water protection principles embodied in the SDWA to be important. Therefore, while not applying all aspects of the SDWA, we are proposing ground water protection standards consistent with the levels of the radionuclide MCLs.

We request public comment upon the proposal and the other approaches, described below, that are designed to protect ground water resources in the vicinity of the repository. We are concerned that ground water resources in the vicinity of Yucca Mountain receive adequate protection from radioactive contamination. The primary purpose of our proposed standards is to prevent contamination of drinking-water resources. (Since the proposed compliance period is 10,000 years after disposal, references to levels of contamination mean those levels projected to exist at specific future times, unless otherwise noted. However, these projections will be made at the time of licensing.) This prevents placing the burden upon future generations to decontaminate that water by implementing expensive clean-up or treatment procedures. We believe it is prudent to protect drinking water from contamination through prevention rather than to rely upon clean-up afterwards. The cost to remediate the effects of radionuclides released from a geologic disposal system, such as Yucca Mountain, could far exceed the costs typically associated with near-surface Superfund sites. Moreover, absent this protection through prevention, the disposal system itself could become subject to clean-up by future generations. Thus, our proposed ground water protection standards stress pollution prevention and provide protection from contamination of sources of drinking water containing up to 10,000 mg/L of TDS. We emphasize that all ground water pathways, including drinking water, are also covered under the proposed individual-protection standard (§ 197.20).

The definition of USDW received extensive discussion in the legislative history of the SDWA as reflected in the report of the House Committee on Interstate and Foreign Commerce. To guide the Agency, the Committee Report suggested inclusion of aquifers with fewer than 10,000 mg/L of TDS (H.R. Rep. No. 1185, 93d Cong., 2d Sess. 32, 1974). We have reviewed the current information on the use of aquifers for drinking water which contain high levels of TDS. This review found that ground water containing up to 3,000 mg/L of TDS that is treated is in widespread use in the U.S. In the Yucca Mountain vicinity, with few exceptions (one being the Franklin Playa area), ground water contains less than 1,000 mg/L of TDS. Our review also found that ground water elsewhere in the Nation, containing as much as 9,000 mg/L of TDS, currently supplies public water systems. Based upon this review and the legislative history of the SDWA, we are proposing that it is reasonable to protect the aquifers potentially affected by releases from the Yucca Mountain disposal system. Therefore, the provisions found in proposed § 197.35 would apply to all aquifers, or their portions, containing less than 10,000 mg/L of TDS. The proposed definitions associated with § 197.35 are taken directly from our UIC regulations found in 40 CFR parts 144–146.

III.F.4. How Far Into the Future Should Compliance Be Projected?

We are proposing a 10,000-year compliance period for ground water protection. This is consistent with the 10,000-year compliance period we are proposing for the individual-protection standard and, therefore, provides internal consistency within the proposed standards. This time period would also make the ground water protection compliance period consistent with 40 CFR part 191. Consistency also is achieved with regulations covering long-lived chemically hazardous wastes which present potential health risks similar to those from radioactive waste.

In addition to trying to achieve consistency with our other hazardous and radioactive-waste programs, we are concerned about the uncertainty associated with projecting radiation doses over periods longer than 10,000 years. The NAS indicated that beyond 10,000 years uncertainty will likely continue to increase (NAS Report p. 72). As a result, it will become increasingly difficult to discern a difference between the radiation dose from drinking water containing radionuclides (limited by the MCLs) and the total dose arriving through all pathways (which is limited by the individual-protection standard).

In fact, we considered incorporating a compliance period of time-to-peak concentration within the geologic stability of the site. However, this approach may be unworkable and duplicative of the requirements already promulgated in the MCLs. The current MCLs for radionuclides are expressed both in terms of radiation dose and concentration. For man-made beta and photon emitters, the MCL is a dose limit of 4 mrem/yr, with specific instructions for determining radionuclide-specific concentrations corresponding to that dose (40 CFR part 141.16(b)). For radium-226 (^{226}Ra) and ^{228}Ra combined, the MCL is a concentration level of 5 pCi/L of water, while for gross-alpha activity (including ^{226}Ra but excluding radon and uranium), the MCL is a concentration level of 15 pCi/L (40 CFR 141.15(a) and 141.15(b), respectively).

The Yucca Mountain disposal system will contain all of these types of radionuclides. To express a regulatory limit for ground water protection in terms of a single limit on peak concentration may be impractical because of the separate, multiple, and distinct MCLs established by regulation. Although the gross-alpha limit is set at 15 pCi/L to limit lifetime cancer risk to about 1 x 10^{-4}, the concentrations of specific alpha-emitting radionuclides corresponding to this risk level may vary widely. For various thorium isotopes, concentrations of 50 to 125 pCi/L are equivalent to this risk, while for either neptunium-237 or plutonium-238, a concentration of 7 pCi/L corresponds to a lifetime cancer risk of 1×10^{-4} (56 FR 33050, 33121, July 18, 1991). To develop a limit on the peak concentration for each radionuclide would be unwieldy, because of the large number of radionuclides involved. To establish a single, overall, limiting peak concentration applicable to all radionuclides would be, at best, an approximation of the public-health protection already embodied in the MCLs. For these reasons, we are concerned that expressing ground water protection requirements in terms of a single, peak concentration or numerous radionuclide-specific limits is not appropriate.

We request comment upon our proposal to impose the ground water protection standards during the first 10,000 years following disposal and whether we should, instead, adopt a compliance period of time-to-peak concentration (see the *How Far Into the Future Should Compliance Be Projected?* section earlier in this notice for a discussion of time-to-peak-dose compliance period which is the basis of this concept). Commenters recommending the time-to-peak-concentration approach should address our concerns, particularly those related to implementability, as expressed above.

III.F.5. How Will the Point of Compliance Be Identified?

To provide a basis for determining projected compliance with § 197.35, it is necessary to establish a geographic location where DOE must project the concentrations of radionuclides in the ground water over the compliance period. We refer to this location as the "point of compliance."

In this section, we will discuss two alternative approaches for determining the location of the point of compliance. In the final rule, we will specify the location to be used by NRC and DOE as the point of compliance. One approach (used in Alternatives 1 and 4) would establish the maximum size for an area around the repository (that is, a "controlled area") which would be exempt from the ground water protection standards. In demonstrating compliance, the Department would choose the point on the area's boundary located above the primary ground water flow pathway and where the highest concentrations of radionuclides are expected to be found. Under the second approach (used in Alternatives 2 and 3), we would specify a specific geographic location where we believe the primary ground water flow pathway and the highest concentrations of radionuclides will be. If the Department's improved knowledge of ground water flow direction changes the expected location of the highest concentrations of radionuclides, DOE must propose that location to NRC as an alternative point of compliance. This new point of compliance, however, must be at the same distance from the repository as the originally promulgated point of compliance. As discussed below, DOE must obtain the approval of the Commission prior to using the alternative point for demonstrating compliance.

Under the "controlled area" approach of Alternatives 1 and 4, the standards would designate an area within which DOE would not have to demonstrate compliance with the ground water protection standards. These standards would apply outside of that area. Under this approach, we are proposing that the Department would have to determine the point on the boundary of the controlled area where the highest projected concentrations of radionuclides will occur. That location would become the point of compliance. In effect, a certain volume of the geologic medium would be dedicated to delaying or keeping releases from the waste within the controlled area and away from the accessible environment. We adopted a generic definition of controlled area in 40 CFR part 191. The definition of controlled area for this rulemaking could take into account unique features in the vicinity of the Yucca Mountain site or we could adopt the definition from part 191. An alternative for each definition is presented and discussed below.

Not applying the ground water protection standards inside a controlled area is consistent with the approach in 40 CFR Part 191 in which the natural geologic barriers surrounding radioactive-waste repositories are a part of the disposal system and may be dedicated for this purpose (50 FR 38066, 38077, September 19, 1985). We implemented this concept in 40 CFR part 191 by requiring compliance with ground water standards outside of the controlled area. This concept was upheld by the First Circuit in *NRDC* v. *EPA*, 824 F.2d at 1272–73 & 1277–79. The court reasoned that allowing for contamination of some area surrounding a geologic repository was consistent with the site-selection provisions of the NWPA and that Congress expected DOE to rely upon geologic barriers and, therefore, "knew of the inevitability of some contamination of ground water in the immediate area of the stored waste." *NRDC* v. *EPA*, 824 F.2d at 1278.

For Yucca Mountain, the EnPA also generally follows the approach of dedicating some portion of the surrounding geology for containment and requiring compliance in the accessible environment outside of such an area. For example, section 801(a)(1) of the EnPA specifically uses the term "accessible environment" (that is, outside of the controlled area) when calling for us to prescribe standards for "releases to the accessible environment from radioactive materials stored or disposed of in the repository." The EnPA also specifically incorporates the definition from 40 CFR part 191 in its direction to NAS to address whether a health-based standard based upon doses to individual members of the public "from releases to the accessible environment (as that term is defined in the regulations in subpart B of part 191 of title 40, Code of Federal Regulations, as in effect on November 18, 1985)" will provide a reasonable standard for protection of the general public.

The second approach (Alternatives 2 and 3) for establishing a point of compliance is the identification of a specific location where DOE must project the concentration of radionuclides. Rather than designating a "controlled area," under this approach we would specify a specific point as the point of compliance. This approach relies upon current knowledge of the ground water flow system in the region around Yucca Mountain with a realization that more information may be available to DOE and NRC at the time of licensing. Therefore, if this approach is the one we adopt in the final standard, it is important to explain our current understanding of ground water flow in the area and to establish a mechanism which allows flexibility for selecting an alternative point of compliance during licensing if the current conceptual model proves no longer valid at the time of licensing. Despite the fact that a particular point would be designated, please note that this approach would allow radioactive contamination in the path of the plume of contamination between the repository footprint and the point of compliance. In fact, the intervening area could contain ground water which is contaminated above the ground water protection standards. However, with this approach, those standards could not be exceeded at or beyond the point of compliance during the proposed 10,000-year compliance period.

Our understanding, based upon current knowledge, of the flow of ground water passing under Yucca Mountain is as follows. The general direction of ground water movement in the aquifers under Yucca Mountain is south and southwest. The major aquifers along the flow path are in tuff, alluvium, and, underlying both of these, much deeper carbonate rocks. At the edge of the repository, even the tuff aquifer is relatively (several hundred meters) deep. It gets closer to the surface as it moves toward its natural discharge points. Potential releases of radionuclides from the engineered barrier system into the surrounding rocks would be highly directional and would reflect the orientation of fractures, rock unit contacts, and ground water flow in the area downgradient from Yucca Mountain. Directly under the repository, we anticipate that any waterborne releases of radionuclides will move through the unsaturated zone and downward into the tuff aquifer, in an easterly direction, between layers of rocks which slant to the east, and then horizontally. The layer of tuff gradually thins proceeding south (downgradient) from Yucca Mountain. As the tuff thins, the overlying alluvium becomes thicker until the tuff disappears and the water in the aquifer moves into the alluvium to become the "alluvial aquifer." Along the flow path, there might be movement of water between the carbonate aquifer and either the tuff or alluvial aquifers. If there is significant upward flow from the carbonate aquifer, contamination in

overlying aquifers could be diluted. It is generally believed, however, that any such flow would not significantly affect the concentration of radionuclides in the overlying aquifers. Conversely, downward movement of ground water from the tuff aquifer could contaminate the carbonate aquifer. Today, most of the water for human use is withdrawn between 20 and 30 km away from the repository footprint (that is, at Lathrop Wells and farther south through the Town of Amargosa Valley) where it is more easily and economically accessed for agricultural use and human consumption. It is likely that water within the alluvial aquifer is the source of this water.

Another basis of our understanding is the historical record of water use in the region. That record indicates that significant, long-term human habitation has not occurred in the southwestern area of the NTS, or for that matter anywhere in the vicinity of Yucca Mountain, except where ground water is very easily accessible, for example, in Ash Meadows. This observation coincides with current practice whereby the number of wells generally decreases relative to the greater depth to ground water. The difficulty in accessing ground water in the tuff aquifer in the near vicinity of Yucca Mountain is made more difficult by the rough terrain, the relative hardness of the tuff formations containing the aquifer, and the great depth to ground water there. As described earlier, the ground water flow from under Yucca Mountain is thought to be generally south and southwest. In those directions, the ground water gets progressively closer to the Earth's surface the farther away it gets from Yucca Mountain until it is thought to discharge to surface areas 30–40 km away (the southern boundary of NTS is about 18 km from Yucca Mountain). This means that access into the upper aquifer is easier at increasing distance from Yucca Mountain. It should also be pointed out, the Yucca Mountain site is on several Federally controlled areas of land, i.e., the Nellis Test Range, NTS, and Bureau of Land Management land. In these areas, the U.S. government is the senior appropriator and holds water rights, i.e., water is appropriated for beneficial use by and for the U.S. government.

Because of DOE's ongoing site characterization studies, it is possible that, at the time of licensing, data not now available will reveal important inaccuracies in the preceding conception of ground water flow. In proposing Alternatives 2 and 3 (see discussion below), we intend that the location of the point of compliance will be where the highest concentrations of radionuclides within the plume are projected by DOE and NRC to be. We believe, based upon current information, that the locations specified for the proposed alternative points of compliance in Alternatives 2 and 3 are likely to include such concentrations.

However, if DOE and NRC determine that the direction of ground water flow or location of the highest concentration is different than now believed because new knowledge is available at the time of licensing, we propose to require the Department to propose to the Commission the location where the highest concentration is projected to be. Any such new point of compliance would replace the one we specify in the final rule only if it is at the same distance from the repository as the original point of compliance and is approved by the Commission. It may be moved only to account for new information regarding flow-direction or the location of the highest concentration. We believe such flexibility will enhance the quality of NRC's licensing decision and will provide greater protection of public health and the environment by taking into account the latest available information. We request comment upon this approach.

III.F.6. Where Will the Point of Compliance Be Located?

Introduction to the alternatives. We are presenting four alternatives for comment prior to determining the location of the point of compliance. They are presented in the proposed regulatory text (see proposed § 197.37) and are discussed here in no particular order of preference. For convenience, we refer to them as Alternatives 1, 2, 3, and 4, respectively.

We note that Alternatives 2 and 3 rely upon our current knowledge of ground water flow and use in the region. As discussed above, we are also proposing a method for proceeding under Alternatives 2 and 3, if further knowledge changes the understanding of the flow of the region's ground water or the location of the highest concentrations of radionuclides.

Alternatives in proposed § 197.37. Alternative 1 would establish a "controlled area." In this case, we would define the extent of the controlled area (in proposed § 197.12) as it is in 40 CFR part 191 (with the substitution of the term "repository footprint" for the original wording, "outer boundary of the original location of the radioactive wastes in a disposal system"):

(1) A surface area, identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than five kilometers in any direction from the repository footprint; and (2) the subsurface underlying the surface area.

The Department would determine where on the controlled area's boundary to place the point of compliance based upon the projected direction of ground water flow and the expected locations of the highest concentrations of radionuclides.

As mentioned earlier, this approach would be consistent with 40 CFR part 191 and would, therefore, maintain consistency with the generic standards which apply to WIPP, GCD, and any future disposal system for SNF, HLW, and transuranic radioactive waste which is subject to 40 CFR part 191. (As described earlier, the GCD facility is a complex of 120-foot deep boreholes, located within NTS, which contains disposed transuranic radioactive waste and WIPP is a geologic disposal system, in New Mexico, for defense-related transuranic radioactive waste.) While this alternative would not provide explicitly for consideration of site-specific factors in determining the size of the controlled area, it would ensure that the boundary of the controlled area would not extend substantially beyond Yucca Mountain itself. This alternative would have the effect of providing natural topographic constraints on access to ground water within the controlled area. Therefore, it would provide a safeguard against use of ground water within the controlled area during the compliance period.

In Alternative 2, we would specify the location of the point of compliance. In this case, the point of compliance would be located near the intersection of U.S. Route 95 and Nevada State Route 373, commonly referred to as Lathrop Wells (Lathrop Wells is actually an area within the Town of Amargosa Valley and is the location closest to Yucca Mountain where the general population currently consumes water). We have found that the depth to the water currently withdrawn for domestic use within the Town of Amargosa Valley ranges from a few meters in the southern parts of the town to 110 meters near Lathrop Wells (see the BID). This alternative would put the point of compliance near the currently assumed location of the RMEI.

In Alternative 3, we would establish an area located about 30 km south of Yucca Mountain within which DOE and NRC would identify a specific point as the point of compliance. The area would be bounded by Frontier Street on the

north, Nevada State Route 373 on the east, the Nevada-California border on the south/southwest, and Casada Way on the west. About 75% of the current population and about 60% of the current water-supply wells in what we understand to be the downgradient direction from Yucca Mountain are within this area. This is an area where it is relatively easy to access ground water (see the BID). This option would, therefore, provide direct protection for most of the population currently using drinking water from the alluvial aquifer.

In Alternative 4, the Department, with the consent of NRC, would establish a controlled area outside of which the ground water standards would apply. Its size would be determined by DOE (without exceeding the limits set by us). This controlled area would be a combination of Alternative 1 and site-specific considerations for Yucca Mountain. The site-specific consideration is the proximity of the repository footprint and NTS. The boundary of the controlled area could be no more than five kilometers from the footprint (the same limit applied in Alternative 1), except in those cases where the five kilometers is located within the NTS. In that case, DOE may extend the controlled area to include all or part of the NTS.

We base this alternative, in part, upon the fact that NTS has existed under the control of DOE for about 50 years. Another basis is that we believe that future generations will be aware of the extensive, well-publicized nuclear activities that occurred there. This will likely increase the effectiveness of the passive institutional controls, as discussed below. The NTS is well-known around the world for many reasons but most notably for the approximately 900 tests of nuclear weapons conducted there. This makes NTS unique in the Western Hemisphere because of the resultant presence of hundreds of millions of curies of radionuclides (see the BID). This will presumably lead the Federal government to document the extent of radionuclide contamination and the activities which occurred there, including the Yucca Mountain disposal system, more thoroughly and retain records for longer periods than might occur elsewhere.

To repeat for clarification, the conceptual difference between Alternatives 1 and 4 and Alternatives 2 and 3 is that in Alternatives 1 and 4, we will define an area surrounding the repository outside of which the ground water standards would apply, whereas for Alternatives 2 and 3, we will specify limited areas downgradient from the repository within which DOE and NRC must place the point of compliance.

We request comment upon all of the alternatives discussed above. Commenters should address the effectiveness of these or other alternatives for protecting ground water, including consideration of site-specific characteristics and reasonable methods of implementing the alternatives.

IV. Specific Questions for Comment

In addition to requesting comment upon all aspects of this rulemaking, many of which we have highlighted in the preceding sections of this notice, we also request comment based upon the following specific questions. To be most useful to us, please provide your reasoning in your answers.

1. The NAS recommended that we base the individual-protection standard upon risk. Consistent with this recommendation and the statutory language of the EnPA, we are proposing a standard in terms of annual CEDE incurred by individuals. Is our rationale for this aspect of our proposal reasonable?

2. We are proposing an annual limit of 150 μSv (15 mrem) CEDE to protect the RMEI and the general public from releases from waste disposed of in the Yucca Mountain disposal system. Is our proposed standard reasonable to protect both individuals and the general public?

3. To define who should be protected by the proposed individual-protection standard, we are proposing to use an RMEI as the representative of the rural-residential CG. Is our approach reasonable? Would it be more useful to have DOE calculate the average dose occurring within the rural-residential CG rather than the RMEI dose?

4. Is it reasonable to use RME parameter values based upon characteristics of the population currently located in proximity to Yucca Mountain? Should we promulgate specific parameter values in addition to specifying the exposure scenarios?

5. Is it reasonable to consider, select, and hold constant today's known and assumed attributes of the biosphere for use in projecting radiation-related effects upon the public of releases from the Yucca Mountain disposal system?

6. In determining the location of the RMEI, we considered three geographic subareas and their associated characteristics. Are there other reasonable methods or factors which we could use to change the conclusion we reached regarding the location of the RMEI? For example, should we require an assumption that for thousands of years into the future people will live only in the same locations that people do today? Please include your rationale for your suggestions.

7. The NAS suggested using an NIR level to dismiss from consideration extremely low, incremental levels of dose to individuals when considering protection of the general public. For somewhat different reasons, we are proposing to rely upon the individual-protection standard to address protection of the general population. Is this approach reasonable in the case of Yucca Mountain? If not, what is an alternative, implementable method to address collective dose and the protection of the general population?

8. Is our rationale for the period of compliance reasonable in light of the NAS recommendations?

9. Does our requirement that DOE and NRC determine compliance with § 197.20 based upon the mean of the distribution of the highest doses resulting from the performance assessment adequately address uncertainties associated with performance assessments?

10. Is the single-borehole scenario a reasonable approach to judge the resilience of the Yucca Mountain disposal system following human intrusion? Are there other reasonable scenarios which we should consider, for example, using the probability of drilling through a waste package based upon the area of the package versus the area of the repository footprint or drilling through an emplacement drift but not through a waste package? Why would your suggested scenario(s) be a better measure of the resilience of the Yucca Mountain disposal system than the proposed scenario?

11. Is it reasonable to expect that the risks to future generations be no greater than the risks judged acceptable today?

12. What approach is appropriate for modeling the ground water flow system downgradient from Yucca Mountain at the scale (many kilometers to tens of kilometers) necessary for dose assessments given the inherent limitations of characterizing the area? Is it reasonable to assume that there will be some degree of mixing with uncontaminated ground water along the radionuclide travel paths from the repository?

13. Which approach for protecting ground water in the vicinity of Yucca Mountain is the most reasonable? Is there another approach which would be preferable and reasonably implementable? If so, please explain the approach, why it is preferable, and how it could be implemented.

14. Is the 10,000-year compliance period for protecting the RMEI and ground water reasonable or should we

extend the period to the time of peak dose? If we extend it, how could NRC reasonably implement the standards while recognizing the nature of the uncertainties involved in projecting the performance of the disposal system over potentially extremely long periods?

15. As noted by NAS, some countries have individual-protection limits higher than we have proposed. In addition, other Federal authorities have suggested higher individual-dose limits with no separate protection of ground water. Therefore, we request comment upon the use of an annual CEDE of 250 μSv (25 mrem) with no separate ground water protection, including the consistency of such a limit with our ground water protection policy.

16. We are proposing to require, in the individual-protection standard, that DOE must project the disposal system's performance after 10,000 years. Are the specified uses of the projections appropriate and adequate?

V. Regulatory Analyses

V.A. Executive Order 12866

Section 3(f) of Executive Order 12866 (E.O. 12866) defines "significant regulatory action" for purposes of centralized regulatory review by the Office of Management and Budget (OMB) to mean any regulatory action that is likely to result in a rule that may:

(1) Have an annual effect upon the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

We are classifying this proposed action as significant under the fourth clause. These standards have been mandated by the EnPA which gave us, for the first time, the authority to set site-specific environmental radiation protection standards. Also, the subject of this rulemaking, Yucca Mountain, Nevada, is a unique facility since it is the first and only one of its kind in the United States being studied for the potential disposal of SNF and HLW.

The OMB has reviewed the text of the draft of this rulemaking and associated materials. In accordance with § 6(a)(3)(E) of E.O. 12866, we have placed interagency review materials into the docket and other locations listed at the beginning of this notice. The interagency materials include: (1) the draft document(s) provided to OMB; and (2) document(s) identifying the substantive changes made between the draft submitted to OMB and the proposed rulemaking, and identifying those changes that we made at the suggestion or recommendation of OMB.

V.B. Executive Orders on Federalism

Under Executive Order 12875 (E.O. 12875), "Enhancing Intergovernmental Partnerships," we may not issue a regulation that is not required by statute and that creates a mandate upon a State, local, or tribal government, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by those governments, or unless we consult with those governments. If we comply by consulting, E.O. 12875 requires us to provide to OMB a description of the extent of our prior consultation with representatives of affected State, local, and tribal governments; the nature of their concerns; any written communications from the governments; and a statement supporting the need to issue the regulation. In addition, E.O. 12875 requires us to develop an effective process permitting elected officials and other representatives of State, local, and tribal governments "to provide meaningful and timely input in the development of regulatory proposals containing significant unfunded mandates."

Today's rule does not create a mandate upon State, local, or tribal governments. The rule does not impose any enforceable duties upon those entities. Accordingly, the requirements of section 1(a) of E.O. 12875 do not apply to this rule. Despite this fact, we nonetheless held public meetings in Nevada and Washington, D.C. in September 1995 (see the *How Has the Public Participated in Our Review of the NAS Report?* section earlier in this notice) during which we received comments from and had discussions with representatives of the State of Nevada and county officials. There were also informal meetings with State and local officials in which those personnel were apprised of the status of the rulemaking.

Finally, while there is a new executive order on federalism, it will not go into effect for 90 days. In the interim, under the current Executive Order 12612 on Federalism, this rule does not have a substantial direct effect upon States, upon the relationship between the national government and the States, or upon the distribution of power and responsibilities among the various levels of government, because the rule only prescribes standards appropriate for one facility in one State.

V. C. Executive Order 12898

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations And Low-income Populations (Environmental Justice)," directs us to incorporate environmental justice as part of our overall mission by identifying and addressing disproportionately high and adverse human health and environmental effects of programs, policies, and activities upon minority populations and low-income populations.

We find no disproportionate impact in the outcome of this rulemaking. No plan has thus been devised to address a disproportionate impact.

V. D. Executive Order 13045

Executive Order 13045 (E.O. 13045), "Protection of Children from Environmental Health Risks and Safety Risks," (62 FR 19885, April 23, 1997) applies to any rule that (1) is determined to be "economically significant" as defined under E.O. 12866, and (2) concerns an environmental health or safety risk that we have reason to believe may have a disproportionate effect upon children. If the regulatory action meets both criteria, we must evaluate the environmental health or safety effects of the planned rule upon children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives that we considered.

This proposed rule is not subject to E.O. 13045 because we do not have reason to believe the environmental health risks or safety risks addressed by this action present a disproportionate risk to children. The public is invited to submit or identify peer-reviewed studies and data, of which we may not be aware, that assessed results of early life exposure to radiation.

V. E. Executive Order 13084

Under Executive Order 13084 (E.O. 13084), "Consultation and Coordination with Indian Tribal Governments," we may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs upon those communities, unless the Federal government provides the funds necessary to pay the direct

compliance costs incurred by the tribal governments, or we consult with those governments. If we comply by consulting, Executive Order 13084 requires us to provide to OMB, in a separately identified section of the preamble to the rule, a description of the extent of our prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, E.O. 13084 requires us to develop an effective process permitting elected officials and other representatives of Indian tribal governments "to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

Today's rule implements requirements specifically set forth by the Congress in the EnPA without the exercise of any discretion by us. Accordingly, the requirements of section 3(b) of E.O. 13084 do not apply to this rule.

V. F. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Pub. L. No. 104–113, section 12(d) (15 U.S.C. 272 note) directs us to use voluntary consensus standards in our regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs us to provide Congress, through OMB, explanations when we decide not to use available and applicable voluntary consensus standards. This proposed rulemaking does not involve technical standards. Therefore, we are not considering the use of any voluntary consensus standards.

We request public comment upon this aspect of the proposed rulemaking and, specifically, ask you to identify potentially applicable voluntary consensus standards and to explain why such standards could be used in this regulation.

V. G. Paperwork Reduction Act

We have determined that this proposed rule contains no information requirements within the scope of the Paperwork Reduction Act, 42 U.S.C. 3501–20.

V. H. Regulatory Flexibility Act/Small Business Regulatory Enforcement Fairness Act of 1996

Under the Regulatory Flexibility Act, 5 U.S.C. 601 *et seq*., agencies must prepare and make available for public comment an initial regulatory flexibility analysis assessing the impact of a proposed rule upon "small entities" (5 U.S.C. 603). "Small entities" include small businesses, small not-for-profit enterprises, and government entities with jurisdiction over populations of less than 50,000 (5 U.S.C. 601). However, the requirement to prepare a regulatory flexibility analysis does not apply if the Administrator certifies that the rule will not, if promulgated, have a significant economic impact upon a substantial number of small entities (5 U.S.C. 605(b)). The rule proposed today would establish requirements that apply only to DOE. Therefore, it does not apply to small entities. Accordingly, I hereby certify that the rule, when promulgated, will not have a significant economic impact upon a substantial number of small entities.

V.I. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA, Pub. L. 104–4) establishes requirements for Federal agencies to assess the effects of their regulatory actions upon State, local, and tribal governments and the private sector. Under section 202 of UMRA, we generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures by State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before we promulgate a rule for which a written statement is needed, section 205 of UMRA generally requires us to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows us to adopt an alternative other than the least costly, most cost-effective, or least burdensome if the Administrator publishes with the final rule an explanation as to why that alternative was not adopted. Before we establish any regulatory requirements that significantly or uniquely affect small governments, including tribal governments, we must develop, under section 203 of UMRA, a small-government-agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input into the development of regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

Today's proposed rule is not subject to the requirements of sections 202 and 205 of UMRA because it implements requirements specifically set forth by the Congress in section 801 of the EnPA. We are proposing rules which, when final, would establish requirements that DOE and NRC must follow in connection with licensing the Yucca Mountain disposal system. The EnPA directs the Administrator of EPA to promulgate standards for the protection of the public from releases from radioactive materials stored or disposed of in the repository at Yucca Mountain, Nevada.

Also, today's proposed rule does not impose new, enforceable duties upon State, local, or tribal governments, or the private sector. Thus, we have determined that this rule contains no regulatory requirements that might significantly or uniquely affect small governments as contemplated in section 203 of UMRA.

List of Subjects in 40 CFR Part 197

Environmental protection, Nuclear energy, Radiation protection, Radionuclides, Uranium, Waste treatment and disposal, Spent nuclear fuel, High-level radioactive waste.

Dated: August 18, 1999.

Carol M. Browner,

Administrator.

The Environmental Protection Agency is proposing to add a new part 197 to Subchapter F of Chapter I, title 40 of the Code of Federal Regulations, as follows:

SUBCHAPTER F—RADIATION PROTECTION PROGRAMS

PART 197—ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR YUCCA MOUNTAIN, NEVADA

Subpart A—Environmental Standards for Storage

Sec.

Subpart B—Environmental Standards for Disposal

Introduction

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197.35 What standards must DOE meet?
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197.40 Are there limits on what must be considered in the performance assessments?
197.41 Can the EPA amend this rule?

Authority: Sec. 801, Pub. L. 102–486, 106 Stat. 2921, 42 U.S.C. 10141 n.

Subpart A—Environmental Standards for Storage

§ 197.1 What does subpart A cover?

This subpart covers the storage of radioactive materials by DOE in the Yucca Mountain repository and on the Yucca Mountain site.

§ 197.2 What definitions apply in subpart A?

Annual committed effective dose equivalent means the committed effective dose equivalent plus the effective dose equivalent received by an individual in one year from radiation sources external to the individual.

Committed effective dose equivalent means the total effective dose equivalent received by an individual from radionuclides internal to the individual following a one-year intake of those radionuclides.

DOE means the Department of Energy.

Effective dose equivalent means the sum over specified tissues of the products of the dose equivalent received following an exposure of, or an intake of radionuclides into, specified tissues of the body, multiplied by appropriate weighting factors.

EPA means the Environmental Protection Agency.

General environment means everywhere outside the Yucca Mountain site, the Nellis Air Force Range, and the Nevada Test Site.

High-level radioactive waste means high-level radioactive waste as defined in the Nuclear Waste Policy Act of 1982 (Public Law 97–425).

Member of the public means anyone who is not a radiation worker for purposes of worker protection.

NRC means the Nuclear Regulatory Commission.

Radioactive material means matter composed of or containing radionuclides subject to the Atomic Energy Act of 1954, as amended. Radioactive material includes, but is not limited to, high-level radioactive waste and spent nuclear fuel.

Spent nuclear fuel means spent nuclear fuel as defined in the Nuclear Waste Policy Act of 1982 (Public Law 97–425).

Storage means retention (and any associated activity, operation, or process necessary to carry out successful retention) of radioactive material with the intent or capability to readily access or retrieve such material.

Yucca Mountain repository means the mined portion of the facility constructed underground within the Yucca Mountain site.

Yucca Mountain site means the site recommended by the Secretary of DOE to the President under section 112(b)(1)(B) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10132(b)(1)(B)) on May 27, 1986.

§ 197.3 How is subpart A implemented?

The NRC implements this subpart A. The DOE must demonstrate to NRC that operations on the Yucca Mountain site will occur in compliance with this subpart before NRC may grant to DOE a license to receive and possess radioactive material on the Yucca Mountain site.

§ 197.4 What is DOE required to do relative to stored radioactive material?

(a) The DOE must ensure that no member of the public in the general environment receives more than an annual committed effective dose equivalent of 150 microsieverts (15 millirems) from the combination of:

(1) Management and storage (as defined in 40 CFR 191.02) of radioactive material which:

(i) Is subject to 40 CFR 191.03(a); and

(ii) Occurs outside of the Yucca Mountain repository but within the Yucca Mountain site; and

(2) Storage (as defined in § 197.02) of radioactive material inside the Yucca Mountain repository.

§ 197.5 When will this part take effect?

The standards in this part take effect on [sixty days after publication of the final standards in the **Federal Register**].

Subpart B—Environmental Standards for Disposal

Introduction

§ 197.11 What does subpart B cover?

This subpart covers the disposal of waste in Yucca Mountain by DOE.

§ 197.12 What definitions apply in subpart B?

All definitions in subpart A of this part and the following:

Active institutional control means controlling access and/or performing work on the Yucca Mountain site by any means other than passive institutional controls.

Aquifer means an underground geological formation, group of formations, or part of a formation that can yield a significant amount of water to a well or spring.

Barrier means any material, structure, or feature that, for a period to be determined by NRC, prevents or substantially reduces the rate of movement of water or radionuclides from the Yucca Mountain repository, or prevents the release or substantially reduces the release rate of radionuclides from the waste. For example, a barrier may be a geologic feature, an engineered structure, a canister, a waste form with physical and chemical characteristics that significantly decrease the mobility of radionuclides, or a material placed over and around the waste, provided that the material substantially delays movement of water or radionuclides.

Alternative 1 for § 197.12, Definition of Controlled Area:

Controlled area means:

(1) A surface area, identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than five kilometers in any direction from the repository footprint; and

(2) The subsurface underlying the surface area. [This definition would be included only if Alternative 1 for § 197.37 were chosen.]

Alternative 2 for § 197.12, Definition of Controlled Area:

Controlled area means:

(1) A surface area, identified by passive institutional controls, that extends horizontally no more than five kilometers in any direction from the repository footprint except that DOE may include in the controlled area any

contiguous area within the boundary of the Nevada Test Site (as established as of the date of promulgation of this part); and

(2) The subsurface underlying the surface area. [This definition would be included only if Alternative 4 for § 197.37 were chosen.]

Disposal means emplacement of radioactive material into the Yucca Mountain disposal system with the intent of isolating it for as long as reasonably possible and with no intent of recovery, whether or not the design of the disposal system permits the ready recovery of the material. Disposal of radioactive material in the Yucca Mountain disposal system begins when all of the ramps and other openings into the Yucca Mountain repository are backfilled and sealed.

Ground water means water below the land surface and in a saturated zone.

Human intrusion means breaching of any portion of the Yucca Mountain disposal system by human activity.

Passive institutional controls means:

(1) Markers, as permanent as practicable, placed on the Earth's surface;

(2) Public records and archives;

(3) Government ownership and regulations regarding land or resource use; and

(4) Other reasonable methods of preserving knowledge about the location, design, and contents of the Yucca Mountain disposal system.

Peak dose means the highest annual committed effective dose equivalent projected to be received by the reasonably maximally exposed individual.

Performance assessment means an analysis that:

(1) Identifies the processes, events, and sequences of processes and events (except human intrusion), and their probabilities of occurring over 10,000 years after disposal, that might affect the Yucca Mountain disposal system;

(2) Examines the effects of those processes, events, and sequences of processes and events upon the performance of the disposal system; and

(3) Estimates the annual committed effective dose equivalent received by the reasonably maximally exposed individual, including the associated uncertainties, as a result of releases caused by all significant processes, events, and sequences of processes and events.

Period of geologic stability means the time during which the variability of geologic characteristics and their future behavior in and around the Yucca Mountain site can be bounded, that is, they can be projected within a reasonable range of possibilities.

Plume of contamination means that volume of ground water that contains radioactive contamination from releases from the Yucca Mountain disposal system. It does not include releases from any other potential sources on or near the Nevada Test Site.

Point of compliance is the place where DOE must project the amount of radionuclides in the ground water for purposes of § 197.35. The point of compliance is located above the highest concentration in the plume of contamination as specified in § 197.37.

Repository footprint means the outline of the outermost locations of where the waste is emplaced in the Yucca Mountain repository.

Slice of the plume means a cross-section of the plume of contamination with sufficient thickness parallel to the prevalent flow of the plume that it contains the representative volume.

Total dissolved solids means the total dissolved (filterable) solids in water as determined by use of the method specified in 40 CFR part 136.

Undisturbed performance means that human intrusion or the occurrence of unlikely, disruptive, natural processes and events do not disturb the disposal system.

Waste means any radioactive material emplaced for disposal into the Yucca Mountain disposal system.

Well-capture zone means the volume from which a well pumping at a defined rate is withdrawing water from an aquifer. The dimensions of the well-capture zone are determined by the pumping rate in combination with aquifer characteristics assumed for calculations, such as hydraulic conductivity, gradient, and the screened interval.

Yucca Mountain disposal system means the combination of underground engineered and natural barriers at the Yucca Mountain site which prevents or substantially reduces releases from the disposed radioactive material.

§ 197.13 How is subpart B implemented?

The NRC implements subpart B. In the case of the specific numerical requirements in this subpart, NRC will determine compliance based upon the mean or median (whichever is higher) of the highest results of DOE's performance assessments projecting the performance of the Yucca Mountain repository for 10,000 years after disposal. The DOE must demonstrate to NRC that there is a reasonable expectation of compliance with this subpart before NRC can issue a license.

§ 197.14 What is reasonable expectation?

Reasonable expectation means that the Commission is satisfied that compliance will be achieved based upon the full record before it. Reasonable expectation:

(a) Requires less than absolute proof because absolute proof is impossible to attain for disposal due to the uncertainty of projecting long-term performance;

(b) Is less stringent than the reasonable assurance concept that NRC uses to license nuclear power plants;

(c) Takes into account the inherently greater uncertainties in making long-term projections of the performance of the Yucca Mountain disposal system;

(d) Does not exclude important parameters from assessments and analyses simply because they are difficult to precisely quantify to a high degree of confidence; and

(e) Focuses performance assessments and analyses upon the full range of defensible and reasonable parameter distributions rather than only upon extreme physical situations and parameter values.

§ 197.15 How must DOE take into account the changes that will occur during the next 10,000 years?

The DOE should not attempt to project changes to society, human biology, or increases or decreases to human knowledge. In all analyses done to demonstrate compliance with this part, DOE must assume that all of those factors remain constant as they are at the time of license submission to NRC. However, DOE must vary factors related to the geology, hydrology and climate based on environmentally protective but reasonable scientific predictions of the changes that could affect the Yucca Mountain disposal system over the next 10,000 years.

Individual-Protection Standard

§ 197.20 What standard must DOE meet?

The DOE must demonstrate, using performance assessment, that there is a reasonable expectation that for 10,000 years following disposal the reasonably maximally exposed individual receives no more than an annual committed effective dose equivalent of 150 microsieverts (15 mrem) from releases from the undisturbed Yucca Mountain disposal system. The DOE's analysis must include all potential pathways of radionuclide transport and exposure.

§ 197.21 Who is the reasonably maximally exposed individual (RMEI)?

The RMEI is a hypothetical person who could meet the following criteria:

(a) Based upon current understanding, lives within one-half kilometer of the junction of U.S. Route 95 and Nevada State Route 373, unless NRC determines that the RMEI would receive a higher dose living in another location at the same distance from the Yucca Mountain repository;

(b) Has a diet and living style representative of the people who are now residing in the Town of Amargosa Valley, Nevada. The DOE must use the most accurate projections which might be based upon surveys of the people residing in the Town of Amargosa Valley, Nevada, to determine their current diets and living styles and use the mean values in the assessments conducted for §§ 197.20 and 197.25; and

(c) Drinks 2 liters of water per day from wells drilled into the ground water at the location where the RMEI lives.

Human-Intrusion Standard

§ 197.25 What standard must DOE meet?

Alternative 1 for § 197.25:

The DOE must demonstrate that there is a reasonable expectation that for 10,000 years following disposal the reasonably maximally exposed individual receives no more than an annual committed effective dose equivalent of 150 microsieverts (15 mrem) as a result of a human intrusion. The DOE's analysis of human intrusion must include all potential environmental pathways of radionuclide transport and exposure.

Alternative 2 for § 197.25:

The DOE must determine the earliest time after disposal that the waste package would degrade sufficiently that a human intrusion (see § 197.26) could occur without recognition by the drillers. The DOE must:

(a) Demonstrate that there is a reasonable expectation that the reasonably maximally exposed individual receives no more than an annual committed effective dose equivalent of 150 microsieverts (15 mrem) as a result of a human intrusion, if complete waste package penetration can occur at or before 10,000 years after disposal. The analysis must include all potential environmental pathways of radionuclide transport and exposure; and

(b) Include the results of the analysis and its bases in the environmental impact statement for Yucca Mountain as an indicator of long-term disposal system performance, if the intrusion cannot occur before 10,000 years after disposal.

§ 197.26 What are the circumstances of the human intrusion?

For the purposes of the analysis of human intrusion, DOE must make the following assumptions:

(a) There is a single human intrusion as a result of exploratory drilling for ground water;

(b) The intruders drill a borehole directly through a degraded waste container into the uppermost aquifer underlying the Yucca Mountain repository;

(c) The drillers use the common techniques and practices that are currently employed in the region surrounding Yucca Mountain;

(d) Careful sealing of the borehole does not occur, instead natural degradation processes gradually modify the borehole;

(e) Only releases of radionuclides that occur as a result of the intrusion and that are transported through the resulting borehole to the saturated zone are projected;

(f) No releases are included which are caused by unlikely natural processes and events; and

(g) The intrusion occurs at a time or within a range of time determined by NRC. The NRC must make that determination based upon the following factors

[Paragraph (g) would be included only if Alternative 1 for § 197.25 is chosen]:

(1) The earliest time that current drilling techniques could lead to waste package penetration without recognition by the drillers;

(2) The time it would take for a small percentage of waste packages to fail but before significant migration of radionuclides has occurred; and

(3) Intrusion would not occur during the period of active institutional control.

Other Considerations

§ 197.30 What other projections must be made by DOE?

To complement the results of § 197.20, DOE must calculate the peak dose of the reasonably maximally exposed individual that would occur after 10,000 years following disposal but within the period of geologic stability. While no regulatory standard applies to the results of this analysis, DOE must include the results and their bases in the environmental impact statement for Yucca Mountain as an indicator of long-term disposal system performance.

Ground Water Protection Standards

§ 197.35 What standards must DOE meet?

In its license application to NRC, DOE must provide a reasonable expectation that, for 10,000 years of undisturbed performance after disposal, releases of radionuclides from radioactive material in the Yucca Mountain disposal system will not cause the level of radioactivity in the representative volume of ground water at the point of compliance to exceed the limits in Table 1 as follows:

TABLE 1.—LIMITS ON RADIONUCLIDES IN THE REPRESENTATIVE VOLUME.

Radionuclide or type of radiation emitted	Limit	Is natural background included?
Combined radium-226 and radium-228	5 picocuries per liter	Yes
Gross alpha activity (including radium-226 but excluding radon and uranium).	15 picocuries per liter	Yes
Combined beta and photon emitting radionuclides	40 microsieverts (4 millirem) per year to the whole body or any organ.	No

§ 197.36 What is a representative volume?

(a) It is the volume of ground water that would be withdrawn annually from an aquifer containing less than 10,000 milligrams of total dissolved solids per liter of water to supply a given water demand. The DOE must project the concentration of radionuclides from the Yucca Mountain repository that will be in the representative volume. The DOE must then use the projected concentrations to demonstrate to NRC compliance with § 197.35. The DOE must make the following assumptions concerning the representative volume:

(1) It is centered on the highest concentration level in the plume of contamination at the point of compliance;

(2) Its position and dimensions in the aquifer are determined using average hydrologic characteristics for the aquifers along the radionuclide migration path from the Yucca Mountain repository to the compliance point as determined by site characterization; and

(3) It contains 1285 acre-feet of water (about 1,591,023,000 liters or 418,690,000 gallons).

(b) The DOE must use one of two alternative methods for determining the dimensions of the representative volume. The DOE must propose the method, and any underlying assumptions, to NRC for approval.

(1) The dimensions may be calculated as a well-capture zone. If this approach is used, DOE must assume that the:

(i) Water supply well has characteristics consistent with public water supply wells in Amargosa Valley, Nevada, for example, well bore size and length of the screened intervals;

(ii) Screened interval is centered in the highest concentration in the plume of contamination at the point of compliance; and

(iii) Pumping rate is set to produce an annual withdrawal equal to the representative volume.

(2) The dimensions may be calculated as a slice of the plume. If this approach is used, DOE must:

(i) Propose to NRC, for its approval, where the location of the edge of the plume of contamination occurs. For example, the place where the concentration of radionuclides reaches 0.1% of the level of the highest concentration at the point of compliance;

(ii) Assume that the slice of the plume is perpendicular to the prevalent direction of flow of the aquifer; and

(iii) Assume that the volume of ground water contained within the slice of the plume is equal to the representative volume.

§ 197.37 Where is the point of compliance?

Alternative 1 for § 197.37:

The point of compliance is any point on the boundary of the controlled area.

Alternative 2 for § 197.37:

The point of compliance is any point within a one-half kilometer radius of the intersection of U.S. Route 95 and Nevada State Route 373. However, if NRC determines that there is another location, at the same distance (approximately 20 kilometers) from the center of the repository footprint, where the representative volume would have a higher concentration of radionuclides which were released from the Yucca Mountain disposal system, NRC must specify that location the point of compliance.

Alternative 3 for § 197.37:

The point of compliance is any point within the Town of Amargosa Valley, Nevada, and within the area bounded by Frontier Street on the north, Nevada State Route 373 on the east, the Nevada-California border on the south/southwest, and Casada Way on the west (as they are located at the time of promulgation of this part). However, if NRC determines that there is another location, at approximately 30 kilometers, from the center of the repository footprint where the representative volume would have a higher concentration of radionuclides which were released from the Yucca Mountain disposal system, NRC must specify that location as the point of compliance.

Alternative 4 for § 197.37:

The point of compliance is any point on the boundary of the controlled area.

Additional Provisions

§ 197.40 Are there limits on what must be considered in the performance assessments?

Yes. The DOE's performance assessments should not include consideration of processes or events that are estimated to have less than one chance in 10,000 of occurring within 10,000 years of disposal. The NRC may change this limit to exclude slightly higher probability events. In addition, with the NRC's approval, DOE's performance assessments need not evaluate, in detail, the impacts resulting from any processes and events or sequences of processes and events with a higher chance of occurrence if the results of the performance assessments would not be changed significantly.

§ 197.41 Can EPA amend this rule?

Yes. We can amend this rule by another notice-and-comment rulemaking. However, if we amend this rule, there must be a public comment period of at least 90 days and we must, at a minimum, hold hearings in Washington, D.C. and the Nevada Counties of Nye and Clark.

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The Proposed Ward Valley Radioactive Waste Facility: Papers Submitted to the National Academy of Sciences

October 12, 1994

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Panel on Ward Valley
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Dear Member of the NAS/NRC Panel on Ward Valley:

I believe that the enclosed material should prove useful in the deliberations of your committee. It merits your careful scrutiny.

Sincerely,

Robert Cornog

Robert Cornog, Ph.D.
[co-discoverer of tritium, 1939]

EMPIRICAL MEASUREMENT OF RADIONUCLIDE MIGRATION AT LLRW DISPOSAL SITES IN ARID LOCATIONS

Abstract: Comprehensive radiation monitoring data for the US Ecology LLRW site at Beatty, Nevada, published in the last few days, provide a unique opportunity to evaluate the validity of optimistic transport models that have been used to predict travel times to groundwater in the tens of millennia. The newly available data show gross alpha readings in groundwater in excess of action levels in eight different years, gross beta in violation of action levels seven years, and tritium in excess of action levels four years, with significantly elevated tritium (>1,000 pCi/L) but below action levels an additional four years. The data provide clear evidence that radioactive materials have migrated from the disposal trenches to groundwater, 300 feet beneath the surface, in a few decades. The presence of elevated gross alpha, gross beta, and Cobalt-60 in the groundwater, in addition to substantial tritium, rule out vapor-phase migration. These empirical observations of rapid radionuclide migration contrast sharply with predictions by Prudic (1994) for Beatty and Ward Valley using Chloride Mass Balance calculations.

Introduction

Proponents of the Ward Valley LLRW project have attempted through various theoretical models and assumption-driven calculations to demonstrate that radioactivity buried in an arid location such as the existing US Ecology facility at Beatty, Nevada, or the proposed site at Ward Valley will assertedly take tens of thousands of years to migrate through the vadose zone. These models and calculations are dependent upon a long list of controversial assumptions: that there is an upward gradient at the sites, that matric potential and other soil parameters needed as inputs for the calculations have been accurately measured, that heterogeneities in the soil profiles can be effectively ignored, that all water movement in the unsaturated zones in question can be accurately described with a simple piston-flow displacement model and that there aren't potential bypass modes such as preferred pathways or mobile/immobile phases of soil water, that (in the case of the chloride mass balance approach) chloride deposition rates over the last 50,000 years are well known and can be estimated from measurements taken in the current period far from the location in question, and so on.

The problem, of course, is that models may or may not accurately represent what occurs in the field. Furthermore, they are only as good as the input assumptions upon which they are based, and the input assumptions at work here are untested and heavily disputed. Leaving aside for the moment the question of the serious problems with the measurements (e.g., thermocouple psychrometer readings) upon which US Ecology attempts to rely, at base what exists is an almost theological dispute. By that we mean that advocates of the proposition that there is essentially no deep percolation in arid zones and that what does infiltrate migrates only over tens of millennia

are being strongly challenged by skeptics, but the former belief is based to a significant degree on faith (i.e., theory). True, there are serious arguments that can be advanced to support the theory, as there are to challenge it, but theory it remains. The evolution of science, however, makes clear that theories change or are abandoned over time as more data are obtained, or as intellectual fashions in a particular field shift.

Hazardous/Radioactive Waste Disposal History One of Optimistic Initial Models Subsequently Abandoned After Facilities Fail

Indeed, this pattern of the promulgation of optimistic theory and the necessity subsequently to abandon the theory when events in the real world tragically disproved it, has been at the root of the troubled history of toxic low-level radioactive waste disposal in this country. The State of California approved the Stringfellow Acid Pits based on the fact that annual evaporation exceeded annual precipitation; 15 years later groundwater contamination was extensive and spreading, and now a court has saddled the state with a cleanup bill approaching $800 million due to inadequate review when it first approved the project (Environment Week, 1992). During much of the 1950s and 1960s, radioactive waste was dumped in 55 gallon oil drums off the east and west coasts of the United States, on the assumption that the drums would contain the radioactive materials until they had decayed and that should any be released, it would be dispersed. In the mid-1970s, however, subsequent studies found that many of the barrels were already corroding and breached, releasing radioactivity; and that the radioactivity adsorbed onto bottom sediments where they were ingested by bottom-dwelling organisms which in turn were subsequently consumed by higher species, concentrating radionuclides up the food chain (cf. Davis, 1982). Monitoring was so inefficient that responsible agencies lost track of even the locations of something on the order of half of the ocean dump sites (Hirsch, 1981).

Initial predictions for US Ecology's LLRW facility at Sheffield, Illinois, were that it would safely contain the radioactive waste for millennia; within 15 years of opening, the facility had failed and had to be closed after extensive radionuclide migration and contamination resulting from the failure to adequately characterize the site beforehand (failure to identify sand lenses and their capability of acting as fast-track migration pathways) and reliance on models that eventually were found to have substantially underestimated travel times (U.S. Congress, 1976). US Ecology's LLRW facility at Maxey Flats similarly failed, when radionuclides such as tritium and plutonium were found to have migrated offsite in as little as a decade despite initial predictions such migration would take many thousands of years (Shrader-Frechette, 1992); the failure to consider the effects of complexing agents on increased mobility and decreased soil

retention were among the causes identified (Cleveland and Rees, 1981; Weiss and Czyscinski, 1981; Fowler and Polzer, 1988).

The history of the heavily contaminated Department of Energy nuclear complex strongly reinforces this same theme – initial optimistic models predicting extremely slow travel times proved by experience to be tragically wrong, as radioactive wastes have contaminated vast areas, with cleanup costs estimated on the order of $155 billion (U.S. Congress, 1991; U.S. Department of Energy, 1991). As the National Research Council (1989, p. 37) noted in its evaluation, "Virtually every facility in the weapons complex has some amount of environmental contamination within its boundaries while many also have some contamination outside the boundaries."

Models are transient, changing, readily abandoned. Radioactive contamination is, in human terms at least, permanent, and abandonment of aquifers or land are considerably more costly than subsequent abandonment of a model that turned out to be a mistake. Mistaken models can thus be extremely costly to the human enterprise and the environment in general.

Best Evidence: Has Radioactivity Migrated at Arid Sites?

It should be remembered that in the case at hand, the models and theory-based calculations are all designed to answer only one question: Can the radioactive materials proposed to be buried in unlined trenches at Ward Valley reach groundwater or the surface prior to having decayed away? The best evidence to answer that question is not the theoretical models advanced by facility proponents. Theories are, after all, merely hypothesis. Science is not the promulgation of theory – that is merely the first step. The core of science is the testing of hypothesis against hard evidence obtained from controlled experimentation.

The best evidence is thus, by definition, not theoretical models but actual data. The best data for the question at hand are those that indicate whether there has been, at arid LLRW sites, radioactive migration faster than predicted by the optimistic models of the Ward Valley project proponents. US Ecology (1990) has conceded that it has had troubles at its now-closed eastern LLRW sites involving radioactive contamination but asserts its facilities located in arid western sites (Richland, Washington, and Beatty, Nevada) have been free of such difficulties. The problems its facilities have experienced, US Ecology asserts, are due neither to its reliance on a design involving no containment (i.e., unlined trenches) nor its own track record, but rather location in humid climates (Kentucky and Illinois).

Furthermore, US Ecology has said that its Beatty site can be relied upon as an analog for Ward Valley; indeed, the company has used infiltration estimates from Beatty for its computer model for Ward Valley (License Application, Appendix, p. A-11 - A-12). Prudic (1994) has based his conclusion that it would take more than 50,000 years for radioactive material to migrate to a depth of 30 meters beneath the Ward Valley site on chloride mass balance calculations he has applied identically to both the Beatty and Ward Valley sites. The best evidence of whether he may be right would be to examine whether and how far radioactive material from the Beatty waste trenches has indeed migrated and compare that to his assertion, based on his chloride mass balance (CMB) calculations, that no movement of moisture has occurred beneath 10 meters for 15,000 years and that before that time the migration rate was only 0.2 centimeter per year (Prudic, 1994, p. 18). Evaluating actual radioactive migration at Beatty would be a good test of his even more dramatic assertions regarding the Ward Valley site, of migration rates of a mere 2-3 centimeters (cm) per 1,000 years (Prudic, 1994, p. 18).

The chloride mass balance technique utilized by Prudic is handicapped by the fundamental fact of chemistry that stable chloride is by definition *stable* (i.e., it does not decay, so its age cannot be determined by measuring how many half-lives have elapsed). A radioactive isotope, in contrast, in essence carries with it a clock by which its age can be directly measured.

Techniques based on stable chloride are further handicapped, because stable chlorine has been in existence since the earliest history of the earth, as opposed to artificial radionuclides whose existence or abundance is due to recent human activity, for example, nuclear weapons testing or wastes from nuclear reactors. Such artificial tracers carry an additional "clock" with them, as their time of origin is more or less known (e.g., 1945 or thereafter for A-bomb fallout, 1952 or thereafter for H-bomb fallout, 1962 or thereafter for wastes migrating from commercial LLRW sites). Reliance on such artificially-produced tracers makes direct estimates of travel times possible without resort to theoretical calculations highly dependent on input assumptions and the unproven validity of the model itself.[1]

[1] It is for this reason that the tritium found beneath Ward Valley is of such significance. That tritium carries with it its own clock. Given the 12.3 year half-life of tritium, and pre-bomb tritium concentrations in precipitation that should be less than the 7 TUs currently measured there in atmosphere moisture, it must have taken something on the order of three half-lives, or ~35 years, to travel that distance. If the tritium is from bomb fallout, the same time period is at work, as the first thermonuclear bombs were detonated in the early 1950s, about 35 years before the tritium measurements were made at Ward Valley.

The simplest, and most important test of the assertions of project proponents thus would be to examine US Ecology's other arid sites as to whether there is any evidence of radionuclide migration at those facilities . Of course, those sites have been operating for only a relatively short time (~30 years) and the migration times of concern are far longer, given the longevity of many of the radionuclides buried. Thus, the absence of evidence of migration might not be determinative of the larger question, but its presence would be.

Evidence of Radionuclide Migration at Beatty

Depth to groundwater at US Ecology's Beatty site is 85 to 115 meters and mean annual precipitation is approximately the same at Beatty as at Ward Valley, 12.8 cm for the former and 11.7 cm for the latter (Prudic, 1994, p. 2). Prudic estimates that there has been no movement of water beneath 9 meters of the surface in 20,000 years and a downward percolation rate of 0.2 centimeters per year below that depth, although he asserts that that rate was probably only applicable about 20,000 years ago and current percolation rates would be even lower. Taking that rate as the current rate, however, it would take 35,000 years to travel 70 meters, the minimum depth to groundwater from the deepest Beatty waste trench, 15 meters deep [Conference of Radiation Control Program Directors (CRCPD), 1994, p. 4-8]. Clearly, if Prudic's CMB assumptions and calculations are correct, there should be absolutely no radioactive material from the Beatty waste trenches in groundwater at the site, at least not for another 35,000 years.

During his presentation before the NAS-NRC Ward Valley panel in July 1994, Prudic did not volunteer that there were groundwater contamination data from Beatty that called into question the model and calculations he was presenting. Upon repeated questioning by the panel, he eventually conceded that samples taken from a well drilled by USGS downgradient of the LLRW site were positive for tritium.

Well MR-3 was drilled in 1987 and sampled for the first and only time in August 1989, showing levels of 12.2 ± 1.9 and 6.4 ± 1.9 pCi/L (Prudic, 1993a; 1993b). This was part of a United States Geological Survey (USGS) program collecting data on groundwater quality near the Beatty LLRW site; six wells were sampled in 1989 (including the one that tested positive for tritium, well MR-3) and four separate wells were sampled in 1992 (Prudic, 1993b, p. [illegible]).

Prudic speculated (1993a, Table 4 - 1989) that the positive finding for tritium, which was confirmed by replicate analysis, might have been caused by remnant drilling fluid. This is

unlikely, as he himself noted that more than 2,000 gallons of water had been pumped from the well immediately prior to sampling, and the sampling itself occurred two years after drilling. In addition, it is unclear why this problem would assertedly manifest itself only in this well, when there were other wells also monitored within 2 years of drilling (wells 600, 604, and W001).

The more reasonable interpretation that the tritium finding is valid is supported both by the fact that it was confirmed by replicate analysis and by noting the location of the well in which the tritium was found compared to those in which it was not found. Of the wells monitored by Prudic in his review, *only MR-3, the one in which tritium was found, was directly downgradient of the radioactive waste facility*. Eight were upgradient of the LLRW facility, and one (W001) was off to the side. Only MR-3 was downgradient of the LLRW site. (See map from Prudic, 1993a, on p. 7 of this report.)[2] If one were going to find radioactive contamination, it would be in MR-3, which is indeed precisely where it was found. The other wells, upgradient, serve as controls, demonstrating that the tritium found in MR-3 appears tied to the waste facility.

Upon repeated prodding by the NAS-NRC panel, Prudic conceded there was other evidence of radioactive contamination having reached groundwater at Beatty, in addition to his own measurements discussed above. After many years in which there were no monitoring wells, either on the LLRW site or downgradient from it, in 1982 US Ecology drilled two wells on the LLRW site itself, one (301) just inside the upgradient boundary and one (302) just inside the downgradient boundary (see map on p.7). From the time of the opening of the LLRW facility in 1962 until wells 301 and 302 were added, only the site supply well was monitored[3] (CRCPD, 1994, p. 4-15). The site well is in the buffer zone outside the LLRW facility boundary and upgradient of it (see map).

The very first sample taken from the new downgradient well (302) found extremely elevated tritium levels – 410,000 ± 10,000 pCi/L (Administrative Record, 1993, p. 123-00190 - 123-00191). This is more than 20 times the U.S. Environmental Protection Agency (EPA) Safe Drinking Water standard for tritium[4] (EPA, 1976, p. 155) and 200 times the Beatty facility's

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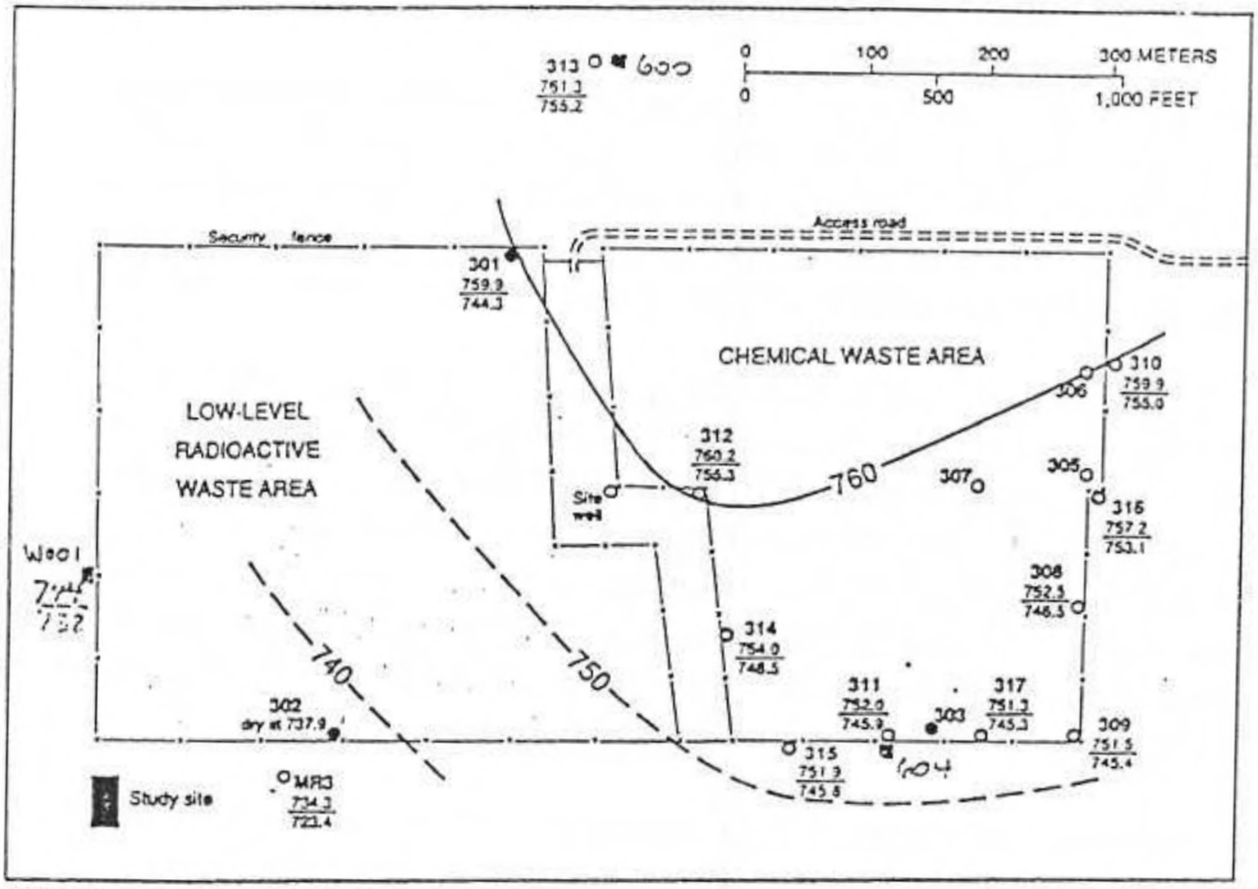
[2] Prudic monitored the site well, and wells MW 313, 314, 315, 316, 600, 604, 311, W001, as well as MR-3. (Prudic, 1993a). It is difficult to understand the purpose of sampling wells almost all of which are upgradient of the facility one is attempt to monitor.

[3] Again, it is difficult to comprehend how a LLRW facility could be effectively monitored for such a long period via only well, one that was not even on the LLRW site and which was upgradient of it.

[4] A higher standard employed by the U.S. Nuclear Regulatory Commission for tritium in effluents from nuclear facilities (10 CF 20 Appendix B) is sometimes cited for comparison purposes, but the more restrictive EPA standard is controlling for concentrations in water supplies.



Base from US Ecology, Inc., 1990.

EXPLANATION

——750 — — GROUND-WATER LEVEL CONTOUR — Shows altitude of water levels as determined from monitoring wells. Contour interval is 10 meters. Dashed where approximately located. Datum is sea level

313 O 751.3/755.2 GROUND-WATER MONITORING WELL — Three-digit numbers and "MR3" are well identifications. Number above line is water-surface altitude, in meters, for December 1988. Number below line is well-bottom altitude, in meters. Datum is sea level. Water level at well MR3 measured by U.S. Geological Survey; all other wells measured by US Ecology, Inc.

FIGURE 3.--Waste-desposal areas showing location of monitoring wells and approximate altitude of ground-water levels in December 1988. Solid circles indicate wells for which geophysical logs are available.

New wells drilled during 1990, and water samples collected in December 1992.

Source: Prudic, 1993a
(handwritten note is from Prudic)

action level (CRCPD, 1994, p. 4-10). Tritium was also found in upgradient well 301, but in levels generally considerably lower than those found in the downgradient well. The discovery of tritium contamination via the opening of the new wells led to increased frequency of monitoring. Tritium continued to be found in the wells, at significant levels, month after month, although the concentration appeared to decline over the next two years. The data are reproduced in **Table 1**.

Prudic (1993b, p. 2) says that well 302 "reportedly" went dry in August 1983 and has been dry since that time, however it is clear from the data that measurements of groundwater continued through the end of January 1985, so if the well went dry, it would appear to have occurred after January 1985. Fischer (1992, p. 7) reports well 302 as dry in December 1988. In any case, the available data indicate elevated tritium in the downgradient well (302) for virtually all of the more than 2-year period, 1982 through 1985, for which data are available, as well as lower but still significant tritium levels in upgradient well 301 on half a dozen occasions during the 1 1/2 years for which measurements are available for it.

The California Department of Health Services (DHS) has dismissed the tritium findings, claiming they were "greater up-gradient than down-gradient," that the readings allegedly occurred only in 1983, and that "there was no recurrence" (DHS, 1993, p. 27). In particular, DHS has stated, "There has been no tritium detected in Beatty wells in 1991 or the recent past." As we have shown above, and will show in more detail below, each of these assertions is incorrect. The tritium findings were repeated samples, essentially monthly, from 1982 into the end of 1984. There is no evidence of subsequent measurements showing no tritium from 1985 on; in fact, Prudic and Fischer claim the downgradient well went dry, and when USGS put in a new well downgradient, quite near well 302, the only measurements from it, in 1989, were also positive for tritium. Furthermore, as shall be shown below, in addition to Prudic's measurement in well MR3 in 1989, other measurements at Beatty found elevated readings 100 times higher than Prudic's in 1989 and, in 1991 as well. Lastly, the well (302) with the very high tritium readings from 1982 through 1984 was downgradient, not upgradient as DHS asserted (see map, above), precisely where one would most expect elevated levels. The well downgradient from the LLRW trenches was an order of magnitude higher than the well on the upgradient portion of the facility, a clear indication that the contamination was indeed coming from the trenches. DHS does say that investigations by US Ecology and the State of Nevada were "not able to ascertain the specific cause" of the contamination (DHS, 1993, p. 27).

Table 1. Beatty, Nevada, Well Water Sampling Results

Well	Date Sampled	Tritium, pCi/L	Analyzer
301	* 6-28-82	0.0 ± 1,000	Eberline
	* 9-09-82	24,000 ± 1,000	Eberline
	* 10-26-82	< 1,000	Teledyne
	* 2-03-83	200 ± 70	Teledyne
	* 3-03-83	< 2,000	Teledyne
	3-30-83	< 200	EAL
	3-30-83	< 200	USGS
	4-07-83	< 200	USGS
	7-11-83	< 200	USGS
	7-11-83	< 220	EPA
	7-11-83	< 200	EAL
	8-02-83	0 ± 200	EAL
	8-22-83	500	CEP
	9-02-83	500	CEP
	9-30-83	500	CEP
	10-27-83	300 ± 200	EAL
	11-30-83	< 200	EAL
	12-21-83	0 ± 200	EAL
	1-26-84	0 ± 200	EAL
302	* 10-26-82	410,000 ± 10,000	Eberline
	* 2-03-83	48,900 ± 3,000	Teledyne
	* 3-03-83	65,200 ± 6,520	Teledyne
	3-11-83	50,100	EPA
	3-30-83	30,700	USGS
	3-30-83	31,000	USGS
	4-07-83	30,000	USGS
	5-03-83	46,700	EPA
	5-03-83	47,000 ± 2,000	EAL
	6-03-83	13,000 ± 600	EAL
	6-29-83	11,000 ± 600	EAL
	7-11-83	10,000	EAL
	7-11-83	18,200 ± 900	EAL
	8-02-83	13,200 ± 700	EAL
	8-22-83	< 500	CEP
	9-30-83	2,800 ± 750	CEP
	10-27-83	5,800 ± 300	EAL
	11-30-83	4,200 ± 200	EAL
	12-21-83	3,000 ± 300	EAL
	1-26-84	3,600 ± 200	EAL
	3-02-84	2,900 ± 100	EAL
	4-14-84	2,100 ± 200	EAL
	5-31-84	1,600 ± 200	EAL
	6-29-84	1,000 ± 200	EAL
	7-31-84	1,000 ± 200	EAL
	8-30-84	1,400 ± 200	EAL
	9-27-84	800 ± 200	EAL
	10-30-84	500 ± 200	EAL
	11-30-84	300 ± 200	EAL
	12-28-84	500 ± 200	EAL
	1-31-85	0 ± 200	EAL

* Samples collected and analyzed by US Ecology contractor. Rest of samples collected by State and analyzed by different agencies or contractors.

Source: Ward Valley Administrative Record, 123-00190 to 123-00191.

There have been suggestions that the contamination found in the groundwater during the 1982-1984 period may have been due to sabotage by a disgruntled employee. While this is not a particularly comforting an explanation – as sabotage is a mechanism for radionuclide transfer to and contamination of groundwater not considered in any environmental impact or safety review for either the Beatty or Ward Valley projects – the evidence makes such an explanation highly unlikely. First of all, as will be shown below, similar contamination was found in other wells before (in 1979 and 1980) and after (1985, 1989, and 1991) (CRCPD, 1994, p. 4-16; Prudic 1993a). Second, contamination was found in both the upgradient and downgradient wells, and far greater in the downgradient one. Third, the suggestion that well 302 was a dry hole and water strangely appeared in it for a time (Prudic, 1993b, p. 2), water that turned out to be contaminated, before becoming dry again, cannot explain the dropping *concentrations* of tritium in the well. The amount of water in the well could perhaps drop, if it was originally a dry hole and someone had poured contaminated water in it, but the *concentration* of tritium in that water should remain essentially constant over the two years of measurements. Prudic (1993b, p. 2-3) agrees that the drop in concentration eliminates the sabotage possibility as a reasonable explanation.

The 12.3 year half-life of tritium cannot explain the drop in concentration in Well 302 from 410,000 pCi/L on October 26, 1982, to 47,000 pCi/L in May 1983, not to 1,400 pCi/L in August 1984. Tritium leaking from particular degrading waste packages from the waste trenches, migrating down to groundwater, and then traveling downgradient in the aquifer *can* readily explain the data, and is in fact the only reasonable explanation. The data present a picture of a contamination front passing the monitoring well, with tailing concentrations traveling behind. Subsequent releases from the trenches can have the same effect, and the measurements of elevated tritium before and after the 1982-1984 findings paint the same picture – a leaking facility, with leachate reaching and contaminating the groundwater beneath it.

Indeed, despite US Ecology's efforts at the NAS-NRC Ward Valley panel meeting in June to explain the tritium findings away as potential sabotage, its monitoring reports for Beatty conclude that *the most probable cause for the presence of tritium in ground water is migration down to the ground water from the disposed waste* (CRCPD, p. 4-15 and 4-34, citing US Ecology's annual monitoring reports).

It may be argued by Ward Valley/Beatty defenders that the tritium somehow reached the groundwater 300 feet below the surface via gas phase migration and is not indicative of potential solute travel. It is essentially impossible to show a mechanism for gas phase migration that would result in tritium concentrations in groundwater 300 feet below, 20 years after the facility

opened, resulting in levels of over 400,000 pCi/L. Furthermore, as will be discussed below, elevated gross alpha, gross beta, and cobalt-60 levels in groundwater demonstrate that the contamination is not just by tritium but by other radionuclides that cannot travel as a gas and must travel as a solute.

On November 21, 1984, the Nevada Department of Human Resources (State of Nevada, 1984) cited US Ecology for violating its license, in particular the requirement "that when the concentrations of radioactive material in water samples are found to be above action levels (30 picocuries per liter for alpha and 90 picocuries per liter for beta) the Division will be notified." The citation stated:

> Contrary to the above requirement, during this inspection it was learned that the company had been notified on October 18, 1984 of analyses of two water samples that had radioactive materials in concentrations above the action levels and the Division had not been notified.

A 1987 inspection report by the State of Nevada noted that wells 301 and 302 "have shown elevated levels of gross alpha and beta, and tritium in the past" (State of Nevada, 1987). The gross alpha and beta contamination indicate solute contamination. Tritium alone could be arguably vapor phase, but not elevated gross alpha and gross beta.[5]

Additional Monitoring Data, Showing Repeated Contamination at Beatty – Alpha, Beta, Cobalt-60 – in Groundwater, Unsaturated Zone Soil, and Offsite Vegetation

It is our understanding that the NAS-NRC Ward Valley panel, interested in learning whether there is any further evidence of migration of wastes from the US Ecology facility at Beatty, as a test of whether proffered models asserting no such migration could occur in arid zones, has requested from US Ecology and various regulatory bodies all such monitoring data. We understand little if any such data have as yet been received. Indeed, US Ecology asserted at the August meetings of the panel that all other monitoring data have shown no indication of any radioactivity and that they would provide all the data.

We have just received new data, dated October of this year, summarizing 30 years of monitoring at Beatty (CRCPD, 1994). The data compilation was issued by the Conference of

[5] Because of the very weak beta given off by tritium, and the analytic methods employed for gross beta scans, tritium is not included in gross beta readings and is measured and reported separately.

Radiation Control Program Directors, Inc., and prepared for it by the EG&G contractors at Idaho Falls, Idaho, who run the National Low Level Radioactive Waste Management Program for the Department of Energy.[6] CRCPD is the national organization of chiefs of state radiation protection programs. The new data demonstrate far more clearly than previous information presented to the NAS panel that radioactivity has migrated from the waste trenches at Beatty – into groundwater beneath the site (vertical migration), soil in dry wells downgradient from the site (lateral migration), and in vegetation (upward migration). The contaminants include tritium, cobalt-60, and gross alpha and gross beta contamination, demonstrating that liquid-phase solute transport is involved. The new data present a long and consistent pattern – not an isolated allegedly anomalous reading or two, as asserted by Prudic and US Ecology at the meetings of the NAS panel.

Table 2, summarizing groundwater monitoring data for gross alpha, gross beta, and tritium since Beatty opened, is taken from the CRCPD report, p. 4-16. For *eight* separate years, beginning as early as eight years after the facility first opened and continuing into the 1990s, gross alpha activity in groundwater beneath the site exceeded the Action Levels set by US Ecology and the State of Nevada, at times by more than a factor of 20. For *seven* separate years, gross beta in groundwater exceeded Action Levels, at times by an order of magnitude. Measurable tritium (in excess of 500 pCi/L) was found *8 out of the 13 years* for which there are data, ranging from 1,000 to 49,000 pCi/L.[7] By contrast, current tritium levels in rainfall are about 20-60 pCi/L. With tritium's 12.3 year half-life, no measurable tritium whatsoever should be showing up in groundwater, let alone at these high concentrations, whether from rainfall or leachate, if the Ward Valley proponents' were right that migration rates are on the order of thousands or tens of thousands of years. Whereas US Ecology and Prudic at the NAS meetings appeared to suggest there were just a couple of anomalous readings, the elevated tritium is showing up most years for which there are data. Despite suggestions of sabotage being the cause for the 1982-1984 readings, this report (p. 4-15 and 4-34), says US Ecology's own monitoring reports have attributed the tritium in groundwater to "migration from the disposed waste."

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[6] The report was prepared by the "E-5 Committee" of the Conference of Radiation Control Program Directors, Inc. The "E-5 Committee" is the Waste Management Oversight Committee.

[7] The authors of the CRCPD study (p. 4-15) reported the high tritium level found in 1982, 410,000 pCi/L ±10,000 pCi./L, in the text of their report but did not include it in their table on p. 4-16. Similarly, the highest 1983 reading reported in the Administrative Record table on p. 123-00190 is 65,200 ± 6520, higher than the value reported in the CRCPD report and with a far smaller error bar. The error margin given in the CRCPD report for the figure 49,000 ± 29,000 appears to be an error; the Administrative Record table gives the value as 48,999 ± 3,000. Likewise, the error margins reported in the Administrative Record table for 1984 are much smaller, e.g., 3,600 ± 300.

Table 2. Gross alpha, gross beta, and tritium activity in groundwater, Beatty LLRW facility, 1962-1992.

Year	Gross alpha[a] pCi/L	Gross beta[a] pCi/L	Tritium pCi/L
1962	3 ± 2	54 ± 4	no data
1963	no data	no data	no data
1964	8 ± 3	50 ± 26	no data
1965	20 ± 5	60 ± 31	no data
1966	10 ± 5	60 ± 34	no data
1967	10 ± 4	40 ± 28	no data
1968	14 ± 5	52 ± 3	no data
1969	6 ± 3	41 ± 41	no data
1970	→ **39 ± 7**	→ **94 ± 30**	no data
1971	no data	no data	no data
1972	10 ± 4	9 ± 4	no data
1973	→ **46 ± 7**	→ **549 ± 47**	no data
1974	16 ± 10	→ **132 ± 77**	no data
1975	→ **47 ± 9**	→ **173 ± 55**	no data
1976	12 ± 5	40 ± 32	no data
1977	< 3	<30	no data
1978	3 ± 2	<20	no data
1979	10 ± 5	<20	→ **$3,800 \pm 1,100$**
1980	< 5	10 ± 4	•• **$1,700 \pm 900$**
1981	21 ± 7	31 ± 4	0
1982	→ **710 ± 183**	→ **340 ± 49**	→ **$24,000 \pm 1,000$**
1983	→ **140 ± 98**	→ **930 ± 150**	→ **$49,000 \pm 29,000$**
1984	→ **63 ± 29**	→ **140 ± 24**	→ **$5,000 \pm 4,000$**
1985	25 ± 18	26 ± 10	•• **$1,100 \pm 600$**
1986	15 ± 9	14 ± 5	< 500
1987	no data	no data	no data
1988	→ **31 ± 11**	10 ± 3	< 500
1989	20 ± 14	30 ± 23	•• **$1,548 \pm 508$**
1990	→ **78 ± 24**	63 ± 11	< 500
1991	10 ± 6	11 ± 5	•• **$1,079 \pm 551$**
1992	7 ± 3	13 ± 3	< 500

Action Levels: gross alpha = 30.0 pCi/L; gross beta = 90.0 pCi/L; tritium = 2,000 pCi/L

a. Indicates highest value for each year.
→ Indicates Action Level exceeded. •• Indicates < Action Level but >1000 pCi/L H-3

Source: Conference of Radiation Control Program Directors, Inc., 1994, Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites: Frankfort, KY, Conference of Radiation Control Program Directors, Inc., p. 4-16.

Vapor-phase migration is contradicted, both by the very high concentrations of tritium found in groundwater and by the evidence of migration of soluble radionuclides as shown by the repeated elevation of gross alpha and gross beta above action levels in groundwater. In addition, cobalt-60 was found in sediment in groundwater taken from one of the monitoring wells .[8] Cobalt-60 is an artificial isotope with a five-year half-life (in 50 to 100 years it decays to non-radioactive levels) and found in large amounts in low level radioactive waste, its presence is likewise indicative of migration of leachate to groundwater since the facility opened in 1962. Cobalt-60 has been found to migrate rapidly at other radioactive sites, particularly when in chelated form (Means and others, 1978, Killey and others, 1984).

In **Table 3**, we have reprinted the soil sample data, which, until 1984, were taken primarily from dry wells dug downgradient to monitor for possible lateral migration from the trenches (CRCPD, 1994, p. 4-21 - 3). These dry wells were normally located downgradient of the completed trenches and extended at least 10 feet below the established bottom of the trench. Two additional dry wells were located downgradient of the site itself. Note that for four years, gross alpha in the soil samples exceeded action levels. For six years, gross beta was in excess of action levels. This suggests lateral subsurface flow in the unsaturated zone, a matter raised by the Wilshire group regarding Ward Valley (Wilshire and others, 1993, p. 3-7).

In September 1984, the State of Nevada eliminated the requirement for soil sampling of the dry wells, in part because most of the soil had been removed from the dry wells during the years of sampling, leaving behind mainly rocks (CRCPD, 1994, p. 4-22). The fact that subsequent to that time, action levels for soil have not been violated would appear to be resulting primarily from the elimination of the requirement to continue sampling the dry wells where the previous violations of action levels had been detected.

In **Table 4**, the table for vegetation sampling is reproduced (CRCPD, 1994, p. 4-27). Gross beta limits were exceeded in vegetation in six different years.

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[8] The CRCPD report indicates that during some time after the very elevated tritium readings were found, at least during part of 1985 and perhaps parts of 1983 and/or 1984 (it is not clear from the text), gamma spectroscopy and fluoroscopy were performed on the suspended fraction (as opposed to dissolved fraction) taken from the water samples to attempt to ascertain contribution to gross alpha and gross beta levels resulting from naturally occurring radionuclides. Action levels were not exceeded in 1985. Furthermore, it is not clear that the artificial radionuclides of concern would be in the suspended fraction rather than the dissolved fraction. If rapid migration were resulting from chelation, the complexed radionuclides would be primarily in the dissolved fraction and thus missed. Additionally, gross alpha or gross beta levels would not fluctuate, year to year, from 10% of the Action Level to 10 times the Action Level, if the sole source of activity were naturally occurring radionuclides.

Table 3. Soil sample analysis – Beatty LLW Site.

Year	Gross alpha[a] pCi/gm	Gross beta[a] pCi/gm
1962	no data	no data
1963	no data	no data
1964	no data	no data
1965	1.9 ± 0.63	72 ± 4.4
1966	2.7 ± 1.2	73 ± 5.3
1967	1.7 ± 0.64	3.5 ± 0.34
1968	2.94 ± 0.41	5.03 ± 0.57
1969	9.5 ± 3.7	37 ± 4.1
1970	no data	no data
1971	8.9 ± 3.8	80 ± 4.9
1972	13 ± 5	→ **108 ± 32**
1973	6 ± 3	→ **110 ± 40**
1974	18.2 ± 8.2	→ **253.6 ± 111**
1975	→ **64 ± 15**	→ **614 ± 60**
1976	→ **42 ± 7.7**	→ **257 ± 28**
1977	20 ± 6.1	60 ± 24
1978	18 ± 6	60 ± 24
1979	→ **31 ± 13**	80 ± 3.1
1980	23 ± 6.1	→ **90 ± 16**
1981	→ **32 ± 9.8**	60 ± 15
1982	25 ± 6	66 ± 18
1983	24 ± 7	79 ± 4
1984	25 ± 7	52 ± 1.5
1985	16 ± 3	40 ± 17
1986	10.2 ± 1.6	9.6 ± 1.0
1987	1.3 ± 0.3	7.0 ± 0.8
1988	5.7 ± 1.1	6.6 ± 0.9
1989	9.3 ± 2.5 (wet)	21.5 ± 1.3 (wet)
1990	12.8 ± 3 (dry)	51.5 ± 7 (dry)
1991	3.5 ± 1.0 (dry)	22.0 ± 1.3 (dry)
1992	5.4 ± 2.7 (dry)	28.4 ± 2.3 (dry)

Action Levels: gross alpha = 30.0 pCi/gm; gross beta = 90.0 pCi/gm

a. Indicates highest value for each year. → Indicates Action Level exceeded.

Source: CRCPD, 1994, p. 4-23

Table 4. Vegetation sample analysis – Beatty LLW Site.

Year	Gross alpha[a] pCi/gm	Gross beta[a] pCi/gm
1962	0.73 ± 0.32	→ **126 ± 3.1**
1963	no data	no data
1964	no data	no data
1965	0.13 ± 0.04	21 ± 0.5
1966	0.9 ± 0.45	→ **110 ± 5.4**
1967	0.39 ± 0.22	8.0 ± 0.4
1968	0.16 ± 0.04	13.3 ± 0.2
1969	0.17 ± 0.12	31.3 ± 0.27
1970	no data	no data
1971	0.19 ± 0.16	2.8 ± 0.3
1972	1.4 ± 1.0	→ **722 ± 35**
1973	0.36 ± 0.32	27.2 ± 3
1974	3.8 ± 4.1	→ **420 ± 110**
1975	3.49 ± 2.2	→ **146 ± 30**
1976	9 ± 3	→ **220 ± 20**
1977	0.3 ± 0.006	39.6 ± 14.5
1978	0.7 ± 0.03	36.9 ± 9
1979	0.7 ± 0.6	29.3 ± 4.2
1980	2.4 ± 1	50 ± 5.1
1981	9 ± 4	17.6 ± 1.4
1982	2.4 ± 2	30 ± 4.9
1983	6 ± 3	55.7 ± 4.9
1984	6.3 ± 1.8	15.5 ± 2.3
1985	7.2 ± 1.3	16 ± 1
1986	0.8 ± 0.2	5.8 ± 0.2
1987	5.3 ± 2.7	77.6 ± 2.5
1988	3.2 ± 0.4	10 ± 0.3
1989	0.6 ± 0.2 (dry)	65.5 ± 8.1 (dry)
1990	3.1 ± 2.4 (dry)	16.3 ± 3.6 (dry)
1991	0.5 ± 0.2 (dry)	5.9 ± 0.3 (dry)
1992	11.4 ± 2.3 (dry)	48.9 ± 2.8 (dry)

Action Levels: gross alpha = 30.0 pCi/gm; gross beta = 90.0 pCi/gm

a. Indicates highest value for each year. → Indicates Action Level exceeded.

Source: Conference of Radiation Control Program Directors, Inc., 1994, Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites: Frankfort, KY: Conference of Radiation Control Program Directors, Inc., p. 4-27

Table 5 reproduces tritium readings for vegetation for one time period, March 1982, taken from outside the facility boundary (CRCPD, 1994, page 4-30). The readings are extraordinary – up to 1000 pCi/ml. (These readings are questioned in the report as "not readily explained." Split samples with the State of Nevada resulted in widely divergent readings, with US Ecology saying they may possibly be related to chemiluminescence.)

Table 5. Tritium and gamma spectroscopy analysis of vegetation samples (March 1982).[a]

Location	Analysis	Concentration
200 ft. southeast of south fence in dry wash	H-3	34 ± 2 pCi/ml
	Cs-137	1 ± 0.4 pCi/gm
240 ft. southeast of south fence in dry wash	H-3	1,000 ± 100 pCi/ml
	Cs-137	1.5 ± 0.6 pCi/gm
300 ft. southeast of south fence in dry wash	H-3	630 ± 10 pCi/ml
	Cs-137	1.4 ± 0.5 pCi/gm
400 ft. southeast of south fence in dry wash	H-3	340 ± 10 pCi/ml
	Cs-137	0.9 ± 0.5 pCi/gm
320 ft. south of south fence, NE	H-3	60 pCi/ml
	Cs-137	0.8 ± 0.3 pCi/gm
320 ft. south of south fence, SE	H-3	170 ± 10 pCi/ml
	Cs-137	1.5 ± 0.4 pCi/gm
320 ft. south of south fence, SW	H-3	15 ± 1 pCi/ml
	Cs-137	0.5 ± 0.3 pCi/gm
320 ft. south of south fence, NW	H-3	11 ± 1 pCi/ml
	Cs-137	1.3 ± 0.4 pCi/gm

a. Data for other years are not available.

Source: Conference of Radiation Control Program Directors, Inc., 1994, Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites: Frankfort, KY: Conference of Radiation Control Program Directors, Inc.

Lastly, even the direct gamma exposures measured by thermoluminescent dosimeters (TLDs) above the surface at the site fenceline are remarkable, measuring up to 1,140 mrem per quarter, or about forty times background (CRCPD, 1994, p. 4-31).

Discussion

When Prudic gave his presentation to the NAS-NRC Ward Valley panel about Beatty and his models supposedly demonstrating that no migration of radionuclides was possible at the site – and by implication, any similarly arid site – it was unfortunate that he did not volunteer the best possible data for assessing his assertions, actual measurements of leachate reaching groundwater. Similarly, it is unfortunate that his recent paper on the subject (Prudic, 1994) is likewise silent on the subject and that he hasn't published his own findings of tritium in groundwater at Beatty. Even when the NAS-NRC panel tried diplomatically to extract from him information about such data, he was reluctant to disclose it. Unfortunately, these data now appear to be but the tip of the iceberg.

It now appears that there is ample evidence of radionuclide migration from the US Ecology trenches at Beatty to groundwater 300 feet below, migration that must be in the liquid phase. This contradicts the claims of Ward Valley proponents, including Prudic, that water basically does not move in the vadose zone in arid locations, and raises very serious questions about his theoretical chloride mass balance calculations, based on idealized model assumptions (e.g., pure piston flow, uniform and well-known chloride deposition rates over long times). Prudic's chloride paper (1994) asserts moisture movement at Beatty of only a millimeter per year and even less than that at Ward Valley, purportedly taking tens of thousands of years to travel 10 meters – yet radioactive waste has reached groundwater at Beatty, 100 meters below the surface, within ten years of the facility opening.

Theoretical models have their place, but it is data that matters. Models are merely to help us assess whether radioactive material can migrate at appreciable rates in conditions of arid climates. The best possible answer to that question would be not models, but actual measurements of whether radioactive materials *have* reached groundwater. The Beatty radiological monitoring data make clear not only that it *can* happen, but that it already *has* happened.[9] In science, Theory must defer to Fact.

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[9] A discussion of new evidence about contamination at US Ecology's Richland LLRW site is found in Appendix A.

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APPENDIX A

NEW EVIDENCE OF CONTAMINATION OF THE VADOSE ZONE AT THE US ECOLOGY LLRW SITE IN RICHLAND, WASHINGTON

We have recently obtained data showing elevated tritium levels (~400,000 pCi/L) in soil pore water from the vadose zone beneath US Ecology's Richland LLRW facility, strongly suggesting rapid migration in that arid site as well. Claims have repeatedly been made about Richland, similar to the claims regarding Beatty and Ward Valley, that because average annual pan evaporation potential so exceeds average annual precipitation (~6 inches at Richland), there is essentially no infiltration and recharge at the site. Those claims are in similar jeopardy as a result of vadose zone monitoring just completed.

In November 1991, US Ecology installed three wells into the unsaturated zone at its LLRW facility at Richland, located in the semi-arid region of eastern Washington State, as part of a two-year research project conducted at the request of the Washington State Department of Health. Vadose Well (VW) #101 was installed in the vicinity of waste trenches 4 and 5, and VW-102 was placed near trenches 10 and 11A. A background well (VW-100) was placed away from the disposal areas in the northwest corner of the site. A map identifying the locations of the two monitoring vadose wells and of the background control vadose well follows, as well as a completion log for VW-100 (US Ecology, 1994a). The wells extended approximately 85 feet below the surface. Silica gel packs were placed in a perforated cylinder into the bottom of the well to absorb water vapor present in the vadose zone; the vadose well was then sealed off at about the 45 foot depth (US Ecology, 1994a, p. 3; US Ecology 1994b, p. 5-141). (Potential contamination from atmospheric moisture would not be a concern, as the monitored tritium levels in the vadose wells were on the order of 400,000 pCi/L, about four orders of magnitude higher than tritium in atmospheric moisture.) Silica gel packs were replaced quarterly and the accumulated soil moisture was then monitored for tritium. Results for 1993 are reproduced in **Table A-1** from US Ecology (1994b).

The reader will readily see that tritium concentrations in the vadose zone beneath the waste trenches range as high as 4.5×10^{-4} µCi/cc (450,000 pCi/L), over 20 times the U.S. Environmental Protection Agency (EPA) Safe Drinking Water Level. The concentrations found in the vadose zone near the burial locations average three orders of magnitude higher than at the control/background location (see **Figures A-1** and **A-2**). The control location, located about

600 feet farther from the burial trenches than the locations where the elevated tritium was found, is nonetheless still in the middle of the U.S. Department of Energy (DOE) Hanford Reservation. Therefore, the contamination found in the vadose zone near the US Ecology burial locations cannot be coming from other operations at Hanford but must be coming from the US Ecology waste trenches.

The vadose zone monitoring program was initiated at the request of the Washington Department of Health in part to verify markedly elevated tritium readings in vegetation at the US Ecology site, in particular in vegetation growing on the trench caps. The State of Washington concluded, after reviewing the vadose zone data and the vegetation data, that "there was a correlation between the two" (Washington, 1993, p. 46). Thus, there is strong evidence that tritium is migrating in substantial quantities both upwards to the surface and downward in the vadose zone fairly deep below the waste trenches.

TABLE A-1. **1993 Vadose Zone Monitoring Results From US Ecology Richland, Washington, LLRW Site.**

Vadose Zone Tritium Measurements
(Units of μCi/cc)

Location	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average
VW#100	1.44 ± 0.13 E-6	-2.23 ± 9.51 E-8	9.19 ± 9.39 E-8	3.77 ± 9.58 E-8	3.87 ± 2.10 E-7
VW#101	2.03 ± 0.01 E-4	2.14 ± 0.01 E-4	2.16 ± 0.01 E-4	2.39 ± 0.01 E-4	2.18 ± 0.01 E-4
VW#102	4.50 ± 0.02 E-4	4.22 ± 0.02 E-4	4.22 ± 0.01 E-4	4.05 ± 0.01 E-4	4.25 ± 0.02 E-4

Source: Palmer, A.J., and Ledoux, M.R., 1994, Annual Environmental Monitoring Report for Calendar Year 1993: US Ecology Richland, Washington Low-Level Radioactive Waste Disposal Facility: Richland, WA, US Ecology.

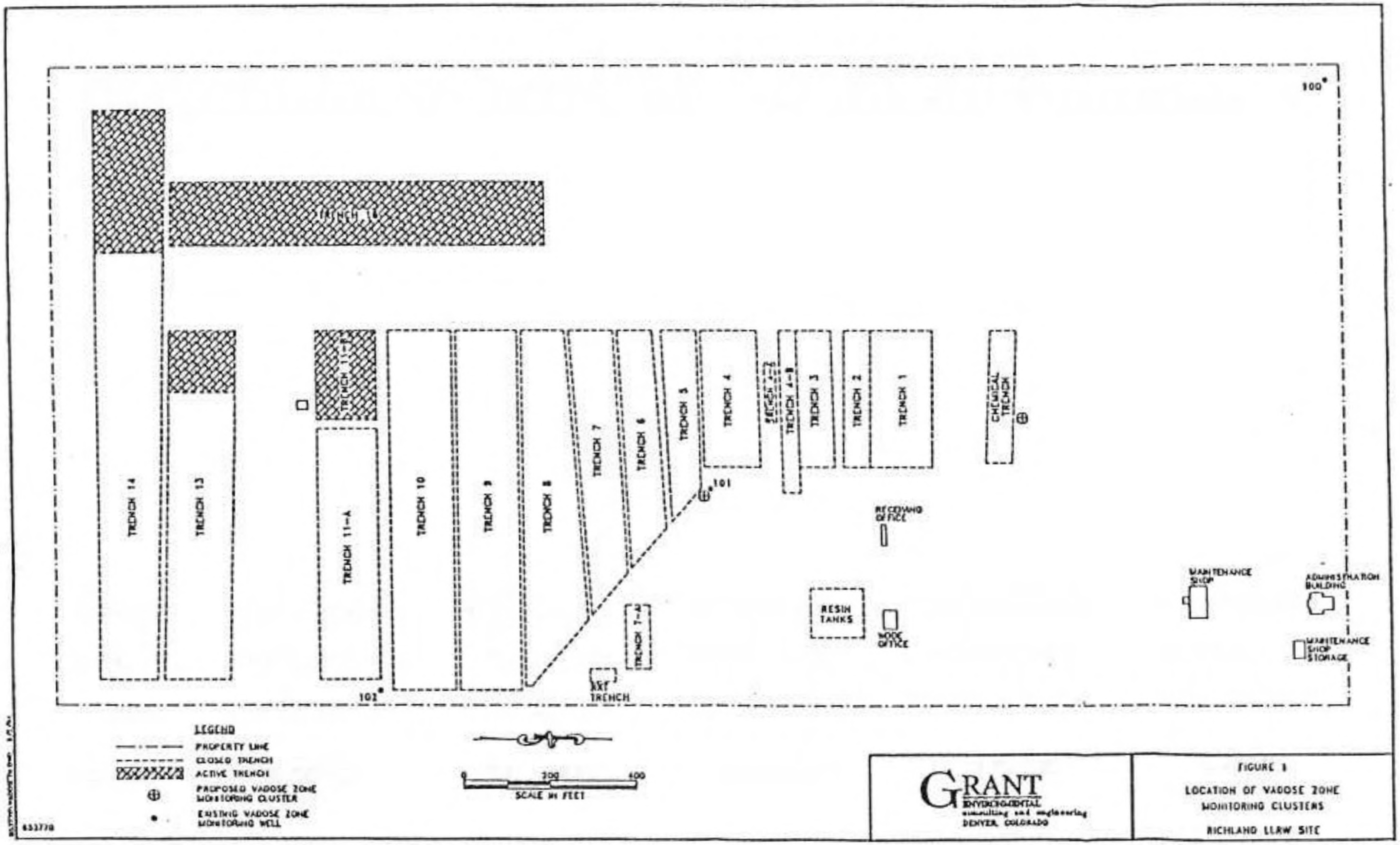

Figure A-1. Map of US Ecology Richland, Washington, LLRW facility.

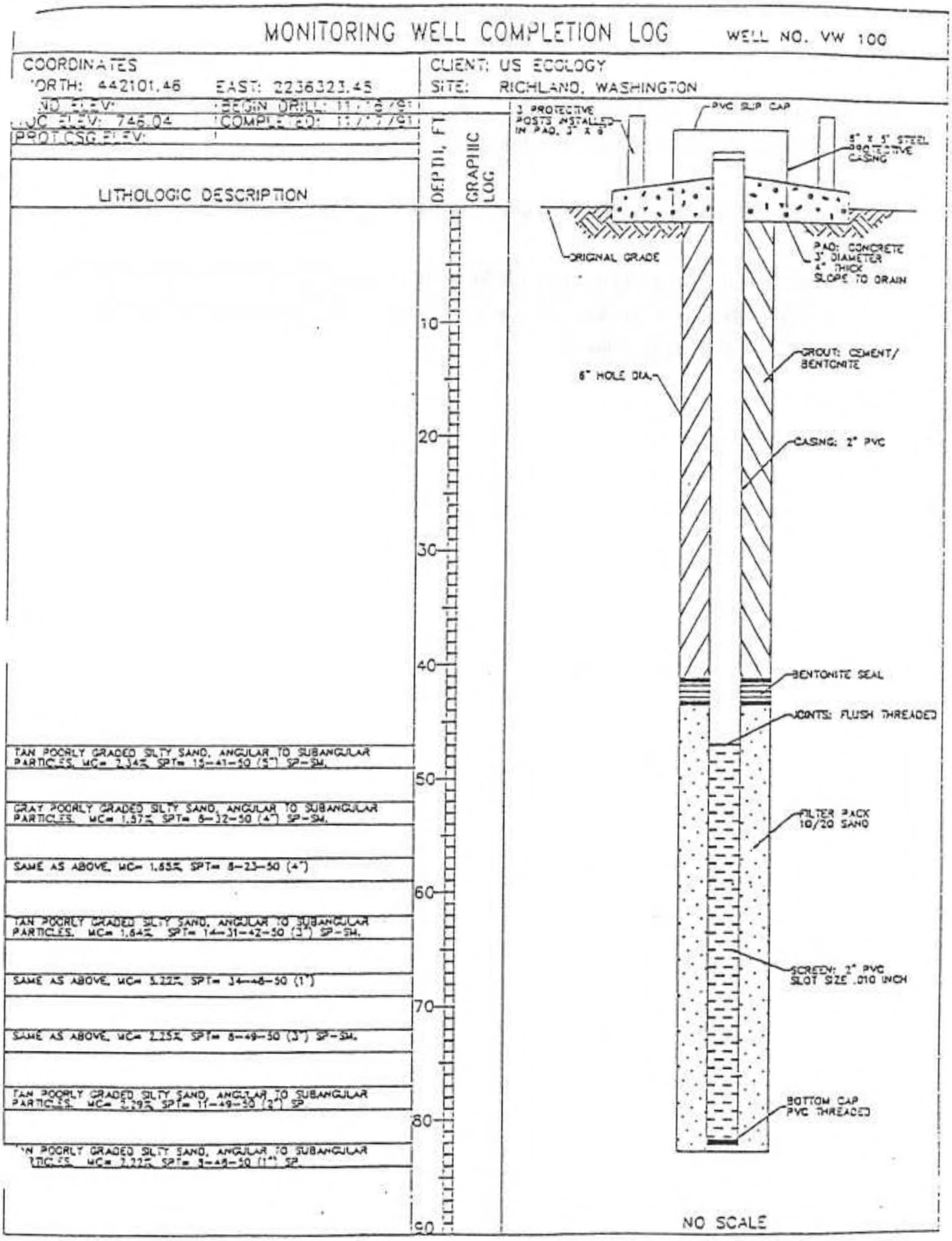

Figure A-2. Vadose zone monitoring well log.

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DOE/LLW-241

Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites (1960's through 1990's)

Conference of Radiation Control
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DOE/LLW-241

Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites (1960's through early 1990's)

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ABSTRACT

During the time period covered in this report (1960's through early 1990's), six commercial low-level radioactive waste (LLRW) disposal facilities have been operated in the United States. This report provides environmental monitoring data collected at each site. The report summarizes: (1) each site's general design, (2) each site's inventory, (3) the environmental monitoring program for each site and the data obtained as the program has evolved, and (4) what the program has indicated about releases to off-site areas, if any, including a statement of the actual health and safety significance of any release. A summary with conclusions is provided at the end of each site's chapter.

The six commercial LLRW disposal sites discussed are located near:

- Sheffield, Illinois
- Maxey Flats, Kentucky
- Beatty, Nevada
- West Valley, New York
- Barnwell, South Carolina
- Richland, Washington

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ACRONYMS, INITIALISMS, AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ARMS	Aerial Radiological Measuring Surveys
ASDA	New York State Atomic and Space Development Authority
BLM	Bureau of Land Management
Bq	Becquerel
CFR	Code of Federal Regulations
Ci	curie
CNSI	Chem-Nuclear Systems, Inc.
CRCPD	Conference of Radiation Control Program Directors
DEC	Department of Environmental Conservation
DHEC	Department of Health and Environmental Control
DOE	U.S. Department of Energy
DOH	Department of Health
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAR	Facility Assessment Report
HDPE	high density polyethylene
HIC	high integrity container
HMS	Hanford Meteorological Station
HTO	tritiated water
HWMF	hazardous waste management facility
KAR	Kentucky Administrative Regulations
LLDs	lower limits of detection
LLW	low-level radioactive waste
LLRW	low-level radioactive waste
LSA	low specific activity
MDC	minimum detectable concentration
NDA	NRC-licensed disposal area
NECO	Nuclear Engineering Company
NFS	Nuclear Fuel Services, Inc.
NRC	U.S. Nuclear Regulatory Commission
NYCR	New York Code of Regulations
NYSERDA	New York State Energy Research and Development Authority
NYSGS	New York State Geological Survey

PCBs	polychlorinated biphenyls
PL	public law
ppb	parts per billion
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDA	State-licensed disposal area
TDS	total dissolved solids
TLDs	thermoluminescent dosimeters
TOC	total organic carbon
USGS	U.S. Geological Survey
WAC	Washington State Administrative Code
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services, Inc.

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Committee E-5 membership since 1985 has included:

Virgil Autry (SC)
Darice Bailey (CA)
Harold Borchert (NE)
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Special thanks are thus due to the directors of the state radiation control programs who either encouraged the participation of their staff in Committee E-5 efforts or, being from a state hosting a site, provided much of the information on which this summary report is based.

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This compilation and presentation of environmental monitoring information for commercial low-level radioactive waste disposal sites in the United States is the collective volunteer effort of state staff, federal resource persons and affiliate advisors serving with CRCPD's Committee on Radioactive Waste Management. It has no individual author or authors. This report was completed in the spirit of cooperation and partnership which represents CRCPD at its best and most uniquely productive activity.

Kenneth L. K. Weaver
E-5 Chair, 1989-1993

Paul Merges
E-5 Chair, 1993-1995

CHAPTER 1

Environmental Monitoring Report for Commercial Low-Level Radioactive Waste Disposal Sites

ENVIRONMENTAL MONITORING PERSPECTIVES

Environmental monitoring results have always been the most significant quantitative measure of low-level radioactive waste (LLW) disposal facilities' compliance with regulatory standards. In this report, the E-5 Committee on Radioactive Waste Management of the Conference of Radiation Control Program Directors (CRCPD) has assembled environmental monitoring results from the six commercial LLW disposal facilities which have operated within the United States.

The environmental results included in this report are not new. Except for the more recent measurements reported herein, results presented in this report have been available for many years and were used as evidence of regulatory compliance for the facilities they represent based upon the standards and regulations existing during applicable eras. Historically, many of these data were used by regulatory professionals to determine compliance status. The perspective that forms the conclusions in this report about site performance is one which looks back at the data from the 1960's through the early 1990's.

The data for air, water, soil, and vegetation summarized in this report vary from site to site in both the time period covered and the level of detail. While comparisons between and among some data sets are appropriate, this must be done with care and caution. Differences in the time periods represented, the media sampled, and the types and level of analyses limit the ability to make meaningful comparisons. In this report, comparative analyses are limited to sets of data representing specific media for a specific site. Because of the data available, different statistical parameters (e.g., means, extremes, variances) were used for different subsets of data.

Environmental monitoring programs have significantly evolved and improved since the 1960's. Changes have occurred in the nature and frequency of sampling, sampling and analysis protocols, media sampled, quality assurance/quality control (QA/QC), and perhaps most importantly, the regulatory framework within which environmental monitoring occurs.

In the early days of environmental monitoring, samples were collected almost on an ad hoc basis, often with limited sampling procedures. Few, if any, protocols were employed for sample handling, packaging, shipping, or receipt inspection. Analytical laboratories made few quality control checks during sample preparation or analytical procedures. Counting equipment was less sophisticated than today's equipment. The lower limits of detection (LLDs) for results were several orders of magnitude greater than those available and used today. Required analyses were often limited to gross indicator parameters such as alpha, beta, and sometimes tritium. Trend analyses of results were often limited to

very basic statistical parameters. In contrast, sophisticated computer software codes now rapidly produce results which used to involve many weeks' worth of time.

Still, results were used as they are today for comparison with a regulatory standard or fraction thereof. If the standard was exceeded, action was mandated. In this regard, all references to compliance with regulatory standards in this report are made relative to regulatory standards in effect at such time as measurements were made or environmental samples were collected and analyzed.

The scope of environmental monitoring programs has changed significantly for the next generation of LLW sites.

Current regulations call for extensive pre-operational baseline environmental monitoring to establish a basis against which to measure future monitoring results. Naturally occurring radioactive material is often present in the soil, air, vegetation, and water under pristine conditions in concentrations at or near levels of significance for today's LLW sites. When no baseline monitoring is performed, little basis exists for back-comparison of sampling results.

Today's sampling protocols are sophisticated compared to the days of extracting samples by the best of a limited number of methods available. Today there are rigorous procedures for sample collection and preservation as well as procedures to eliminate cross contamination from one sample to another.

Currently, a multi-tiered system is used to look at environmental results:

- An investigating level, typically tied statistically to the baseline mean or multiple of an LLD, may trigger an increased awareness and watchfulness regarding a specific radionuclide. Data at this level may also lead to more investigation, explanation, and more frequent or detailed analyses.

- An action level, typically some fraction of a regulatory limit, implies proactive response on the part of a licensee to mitigate the circumstances, usually involving administrative controls, impact analysis, and sometimes, increased regulatory oversight.

- Regulatory limits, if exceeded, call for immediate regulatory action, such as mitigation, enforcement actions, or cessation of operations.

Because of the complexity of all phases of environmental monitoring, sampling, packaging, shipping, analysis, recording, and reporting, many opportunities exist for data errors on individual results. This increases the need for rigorous validation and verification. Such validation and verification were not always part of the process, so some individual data results must be viewed with caution.

Often, the only recourse to sample anomalies was to re-sample the same media at the same location and analyze the sample. If the facility program called for replicate sampling, the other recourse was to run a duplicate analysis on the backup sample.

All data must be reviewed in context. There is often a temptation, particularly in a highly politicized and controversial arena, to take one result as representative of the actual situation. A properly designed monitoring program will emphasize the relationship between samples for different time periods and even for results from different media. Sampling results should be scrutinized within the context of known physical relationships. For example, certain nuclides are known to exist in expected ratios with one another in specific media. If data suggest deviation from these ratios, the results are suspect.

Often, older data do not allow deeper analysis because only gross indicator parameters were collected. Therefore, some of the tools for data validation were absent.

Gross alpha and beta:

Early radiological reporting relied heavily on using screening techniques such as gross alpha and beta levels as indicators that radionuclides were present above some predetermined level. These parameters were reported rather than specific radionuclides, because, at that time, there were few facilities that maintained the more costly equipment necessary to perform gamma or alpha spectroscopy. If increases in gross alpha and beta levels were observed, samples could be sent to off-site laboratories for more specific analyses.

Gross alpha and beta measurements are still frequently made and occasionally still used as screening criteria. However, even small laboratories can now afford spectral analysis and, as a result, specific radionclides are reported instead of just the gross alpha and beta results.

Tritium:

Tritium is an isotope of hydrogen, which has an atomic mass of three, two neutrons and one proton. Tritium is worthy of note because, in the form of its oxide, it is one of the most mobile of the radionuclides likely to be found in radioactive waste, will probably be present as a significant fraction of the total activity of the radioactive waste, and has a half-life of 12.3 years. Therefore, tritium would be the most likely radionuclide to be detected first should waste be transported by ground water out of the disposal area at a shallow land disposal facility.

Studies at the Hanford site and other locations have demonstrated that tritium in ground water will move in the same direction and at the same rate as the ground water (with some slight retardation in clay).[a]

Certain behavioral trends within certain media for migration of certain radionuclides are known and expected. Significantly different behavior patterns are subject to question. For instance, tritium concentrations associated with a "chronic" site release are expected to gradually increase with time to a steady state condition (known as "buildup") then gradually dissipate as radioactive decay takes place.

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a. *National Low-Level Waste Management Program Radionuclide Report Series, Volume 5: Tritium*, Idaho National Engineering Laboratory, Idaho Falls, Idaho, 1994.

The E-5 Committee decided to keep tables of data in the units originally reported. Most of the discussion in the narrative text follows CRCPD's policy of listing values using the International System of Units (with conventional units in parentheses), but in some sections the historical units were kept for clarity. Conversion units are provided in Table 1-1 for convenience in converting units for comparison of results appearing throughout the report.

Table 1-1. Conversion units.

Activity[a]

pCi = µCi × 1.0E-06
pCi = nCi × 1.0E-03
pCi = fCi × 1.0E+03

37 GBq (37E+09 Bq) = 1 Ci
37 mBq = 1 pCi
1 Bq = 27 pCi
37 kBq = 1 µCi

1 µCi/L = 37 kBq/L
10 µCi/L = 370 kBq/L
100 µCi/L = 1000 kBq/L

Dose

100 rem = 1 sievert (Sv)
1 rem = 10 mSv
1 mrem = 10 µSv
100 rads = 1 gray (Gy)
1 rad = 10 mGy
1 mrad = 10 µGy

Temperature

°F = (°C × 9/5) + 32 = (°C × 1.8) +32
°C = (°F - 32)5/9 = (°F - 32) 0.556

Activity Concentration

Ci/mL = (E+15) pCi/L
Ci/mL = (E+18) pCi/m^3

Mass

pounds = 0.4536 kilogram (kg)
pounds (lb) = 453.6 grams (gm)
kilograms (kg) - 2.21 pounds

Length

inches = 2.54 centimeters (cm)
centimeters (cm) = 0.394 inch
millimeters = 0.001 meter
feet = 0.305 meters (m)
meters (m) = 3.281 feet (ft)
miles = 1.609 kilometers (km)
kilometers (km) = 0.6214 mile
1 hectare = square kilometer ÷ 100

Area

acre = 43,560 square feet (ft^2)
hectares = 2.471 acres
square feet (ft^2) = 0.0929 square meter (m^2)
square meter (m^2) = 10.76 square feet (ft^2)
square inches (in^2) = 0.00065 square meter (m^2)
square inches (in^2) = 6.45 square centimeter (cm^2)

Volume

cubic feet (ft^3) = 0.0283 cubic meter (m^3)
cubic meter (m^3) = 35.31 cubic feet (ft^3)
liters (L) = 1000 cubic centimeters (cc)
cubic centimeter (cc) = 0.001 liter (L)
liters (L) = 100 centiliters (cL)
gallons = 3.785 liters (L) = 0.1337 ft^3
cubic centimeter (cc) = 1 milliliter (mL)

Time

days = 1440 minutes = 86,400 seconds
years = 3.15 E+07 seconds

Velocity

miles per hour (mph) = 44.70 cm/sec
cm/sec = 0.0360 km/hr
ft/min = 0.508 cm/sec

Table 1-1. (continued).

a	atto	E-18	k	kilo	E+03
f	femto	E-15	M	mega	E+06
p	pico	E-12	G	giga	E+09
n	nano	E-09	T	tera	E+12
μ	micro	E-06	P	peta	E+15
m	milli	E-03	E	exa	E+18

a. For powers of ten, the notation 10^6 or 10^{-6} is the same as E+06 or E-06.

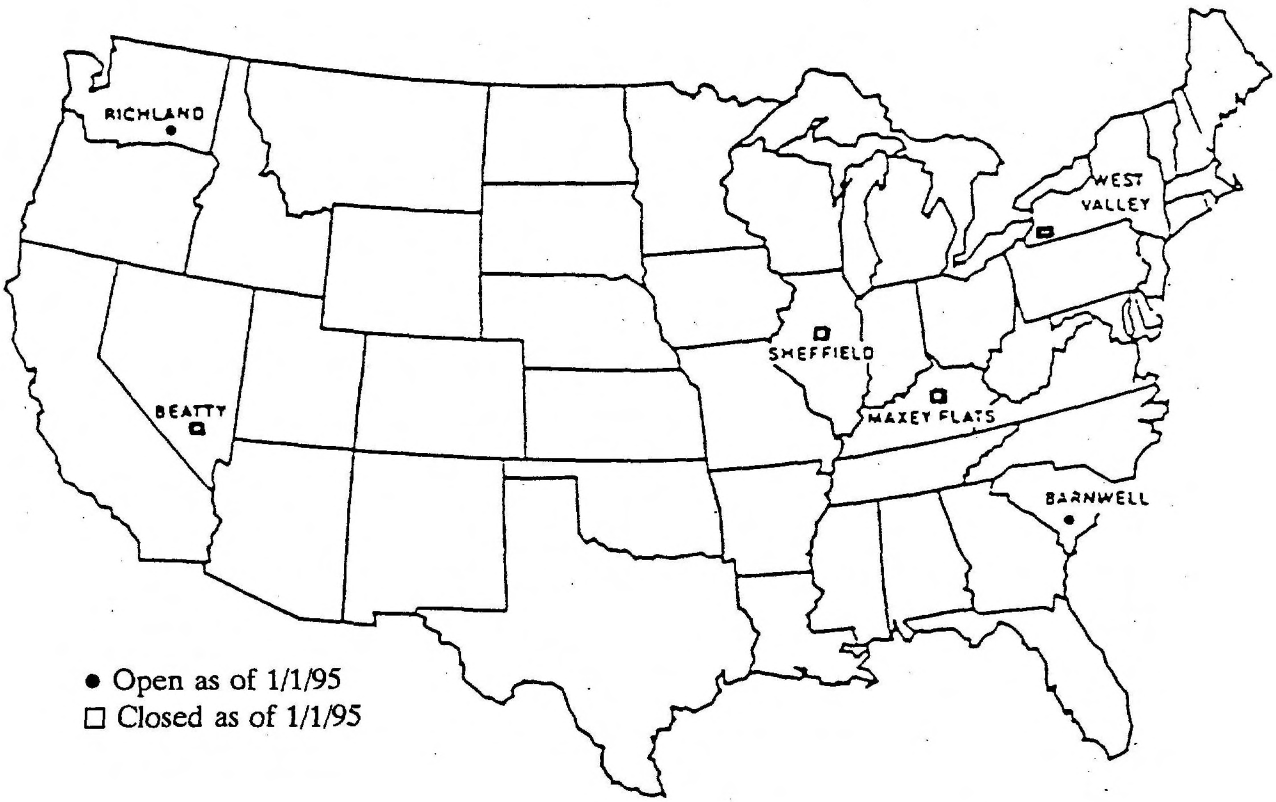


Figure 1-1. Location of the six commercial LLW disposal facilities discussed in this report.

Purpose and Organization of Report

Six commercial LLW disposal facilities have been operated in the United States (see Figure 1-1). All are now regulated by states under agreements with the U.S. Nuclear Regulatory Commission

(NRC). Such states are referred to as Agreement States. The NRC still licenses special nuclear material at the Barnwell and Richland sites in coordination with the host state.

This report summarizes each site's (1) general design, (2) environmental monitoring program and the data obtained as the program has evolved, and (3) what the program has indicated about releases to off-site areas, if any, including an estimate of the actual health and safety significance of any releases.

Three sites have been closed since the mid-1970's: West Valley, New York (1975), Maxey Flats, Kentucky (1977), and Sheffield, Illinois (1978). The Beatty, Nevada site closed at the end of 1992. The Barnwell, South Carolina site has plans to remain open to nationwide LLW generators for the next several years. The Richland, Washington site receives LLW from only generators in the Northwest and Rocky Mountain compact regions.

The sites are discussed Chapter-by-Chapter in alphabetical order by host state.

Chapter 2 Sheffield, Illinois
Chapter 3 Maxey Flats, Kentucky
Chapter 4 Beatty, Nevada
Chapter 5 West Valley, New York
Chapter 6 Barnwell, South Carolina
Chapter 7 Richland, Washington

CHAPTER 2

Environmental Summary of the Sheffield, Illinois Low-Level Radioactive Waste Disposal Site

INTRODUCTION

Background

The Sheffield low-level radioactive waste (LLW) disposal site operated by NECo, and its successor, US Ecology, from 1966 to 1978.[2-1] During that time, about 3.2 million cubic feet of low-level radioactive waste were buried in 21 earthen trenches.

Disposal operations were regulated under the provisions of a license issued by the U.S. Atomic Energy Commission which later became the U.S. Nuclear Regulatory Commission. The State of Illinois regulated the site under the provisions of a license and lease issued by the Illinois Department of Public Health. The lease was necessary because federal law required that low-level radioactive waste be disposed on government-owned land and, accordingly, the 20-acre LLW site was (and is) owned by the state. In 1980, the state's regulatory functions dealing with the LLW site were transferred to the newly created Department of Nuclear Safety. Regulation of the adjoining hazardous chemical sites is the responsibility of the Illinois Environmental Protection Agency.

In 1979, the site operator attempted to unilaterally terminate its state and federal licenses and the state lease. Both state and federal regulators objected to the unilateral terminations, arguing that the site operator must first safely close the site before terminating either of the licenses. The state further argued that the term of its lease with the site operator was 99 years (expiring in 2065) and that the lease could not be unilaterally terminated until then.

All of this resulted in both federal and state litigation. The federal litigation was administratively argued before the Atomic Safety and Licensing Board which eventually ruled against the operator on all counts. The state's complaint was argued before the Bureau County Circuit Court. After ten years of negotiation, the state and the site operator came to agreement about how the site was to be safely closed and the litigation was resolved in the form of an Agreed Order, signed May 25, 1988. Illinois became an Agreement State on June 1, 1987. At that time, the Atomic Energy Act licensing authority for the Sheffield site was transferred to the Illinois Department of Nuclear Safety.

Location

The Sheffield commercial low-level radioactive waste disposal facility is located in Bureau County, Illinois. The Sheffield LLW site is south of Interstate Highway 80 about 200 km (120 mi) west of Chicago, about 65 km (40 mi) northwest of Peoria, and 60 km (35 mi) east of Rock Island/Moline (Figure 2-1).

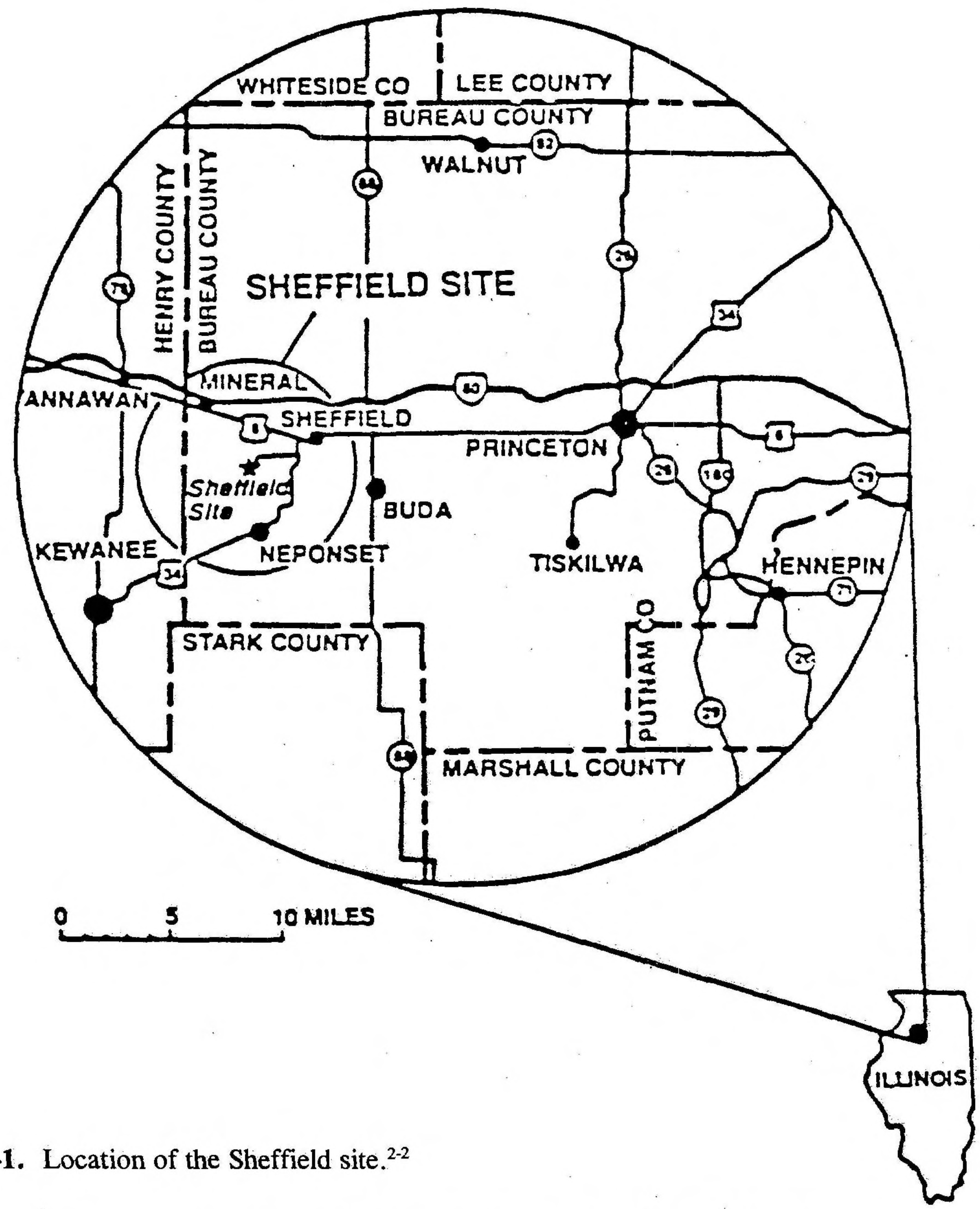


Figure 2-1. Location of the Sheffield site.[2-2]

Two hazardous chemical waste disposal areas are to the north and northwest of the radioactive waste disposal site (Figure 2-2), separated from the radioactive waste site by approximately 45 m (150 ft). The first area accepted hazardous chemical waste from 1968 to 1974 and the second area from 1974 to 1983.

Facility

The Sheffield LLW site first received wastes in 1967 and operated until the 21 trenches were full in 1976. The disposal trenches were generally in parallel with a buffer approximately 3 m (10 ft) wide between trenches, constructed in a cut-and-cover operation, and were 60 to 150 m (200–500 ft) long, 12 to 25 m (40–80 ft) wide, and 6 to 12 m (20–40 ft) deep (Figure 2-2). The wastes were mainly packaged in steel drums, fiberboard boxes, fiberboard drums, and steel liners.

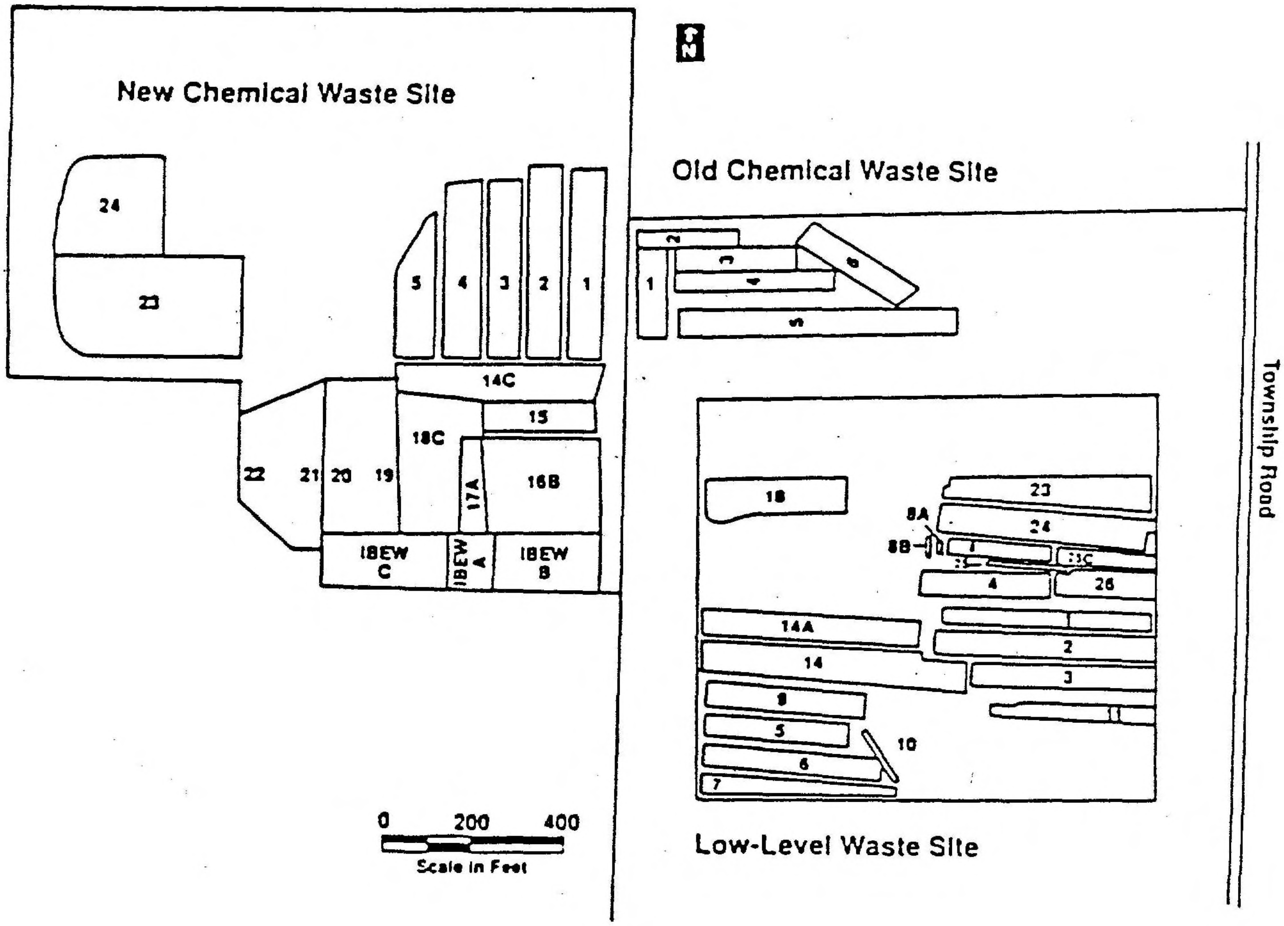


Figure 2-2. Plan view of Sheffield low-level radioactive waste and chemical disposal areas.[2-2]

Volume

The estimated 88,000 m^3 (3,100,000 ft^3) total inventory is listed in Table 2-1. Three separate studies[2-3,2-4,2-5] have estimated the isotopic inventory since the site operator was not required to keep a precise inventory of radioactive waste buried in each trench. The more than 61,000 curies of radioactive waste consisted primarily of tritium, strontium-90, cesium-137, and cobalt-60, with lesser amounts of carbon-14, iodine-129, plutonium, and americium.

Stabilization and Closure

The 1988 Agreed Order between US Ecology (NECo's successor) and the Illinois Department of Nuclear Safety specifies what the site operator must do to safely close the site and assure its continuing safety into the future. The closure plan requires the operator to:

1. Construct a new low-permeability (less than 10^{-7} cm/s)[a] clay cap over all the trenches. Cap construction began and was completed in 1989.

2. Purchase a 170+ acre buffer zone around the site.

3. Monitor and maintain the site and buffer zone until June 1998, when responsibility will transfer to the state. To compensate the state for its future obligations at the site, the operator must pay $2.5 million in quarterly installments of $62,500.00 over a ten year period (1988–1998). These monies, plus accrued interest, remain on deposit in a special fund of the state treasury reserved exclusively for Sheffield-related expenses.[2-6]

4. Take remedial action as needed to prevent discharge beyond the buffer zone of radioactive materials in excess of Illinois Department of Nuclear Safety limits. The operator has established financial assurance in the form of an irrevocable letter of credit for $1.9 million for remedial action.[2-6]

Table 2-1. Estimated key radionuclides (half-lives greater than five years) at the Sheffield site.

Radionuclide	Activity (Ci) at time of emplacement	Half-life[b] (y)
H-3	5,990.	12.3
C-14	450.	5,730.
I-129	0.01	15,700,000.
Sr-90	3,690.	29.1
Cs-137	15,500.	30.17
Co-60	20,000.	5.27
Pu-238	7.5	87.7
Pu-239	4,870.	24,100.
Pu-240	—	6,560.
Pu-241	—	14.4
Am-241	137.5	432.7

a. Permeability is expressed as hydraulic conductivity measured in units of centimeters per second (cm/sec). 10^{-7} cm/sec is equivalent to one-tenth of one-millionth of a centimeter per second. A centimeter is a measure of length equal to about 0.4 inch. Converting units, 10^{-7} cm/sec equates to about 1.25 inches per year.

b. Chart of the Nuclides, 14th ed., updated through April 1988.

SITE

Topography

The Sheffield site is located on rolling terrain (the Galesburg Rolling Plain) in north-central Illinois approximately 5 km (3 mi) southwest of the town of Sheffield. The landforms in this region of hilly terrain are primarily of glacial origin. Surface mining operations during the 1950s produced some areas of pronounced ridges and valleys.

Climate

The regional climate in Bureau County, Illinois, is continental with summer highs around 32°C (100°F) and winter lows of -26°C (-13°F). January is usually the coldest month of the year with July and August usually being the warmest.

Annual precipitation at surrounding weather stations ranges from a minimum of 65 cm (25 in.) to a maximum of 130 cm (52 in.), with a long-term average of 89 cm (35 in.).[2-7] Convective thunderstorms dominate the summer months, May through September, when most of the precipitation falls. The wettest month is June, averaging 11.6 cm (4.5 in.), and the driest month is February, averaging 3.3 cm (1.3 in.). The average annual snowfall is 850 cm (33.5 in.). The relative humidity for the area averages about 70.6 percent.

Land Use

The approximately 70 hectare (170 acre) buffer area owned by US Ecology, which surrounds the 8.3 hectare (20.5 acre) radioactive waste disposal facility (Figure 2-2), is used for industrial waste disposal (16 hectare) and farm leases (48.8 hectare); it includes a small abandoned coal mine pit, called Trout Lake, and a small stream to the south and southeast of the site. The areas south of the site are used primarily for agriculture (crops and pasture).

The Sheffield site is bordered to the north by abandoned strip mines and the industrial waste disposal site, which is separated from the radioactive waste disposal site by a 60 m (200 ft) buffer zone. Approximately 400 m (1,300 ft) east-northeast of the site is a strip mine lake which resulted from the surface mining operations. To the north and to the northeast and northwest are abandoned coal pits that are filled with water. These manmade lakes are restricted and not used for fishing, swimming, or boating.

Seventeen residences are within a 3 km (2 mi) radius of the Sheffield site. Sheffield, population 1,052, is 5 km (3 mi) to the northeast. The unincorporated town of Mineral, population 286, is 8 km (5 mi) to the northwest. The town of Neponset, population 509, is 5 km (3 mi) south.

Geology

The Sheffield LLW disposal site is located in the glaciated till plain section of the Central Lowlands Physiographic Province. Test drilling has indicated that the Sheffield site is underlain by a

complex series of interbedded and interfingering glacial sediments. The disposal trenches cut through a complex series of quaternary deposits (Figures 2-3 through 2-5), which are composed primarily of silts, clays, and sands ranging in thickness from 3 to 20 m (10-65 ft).

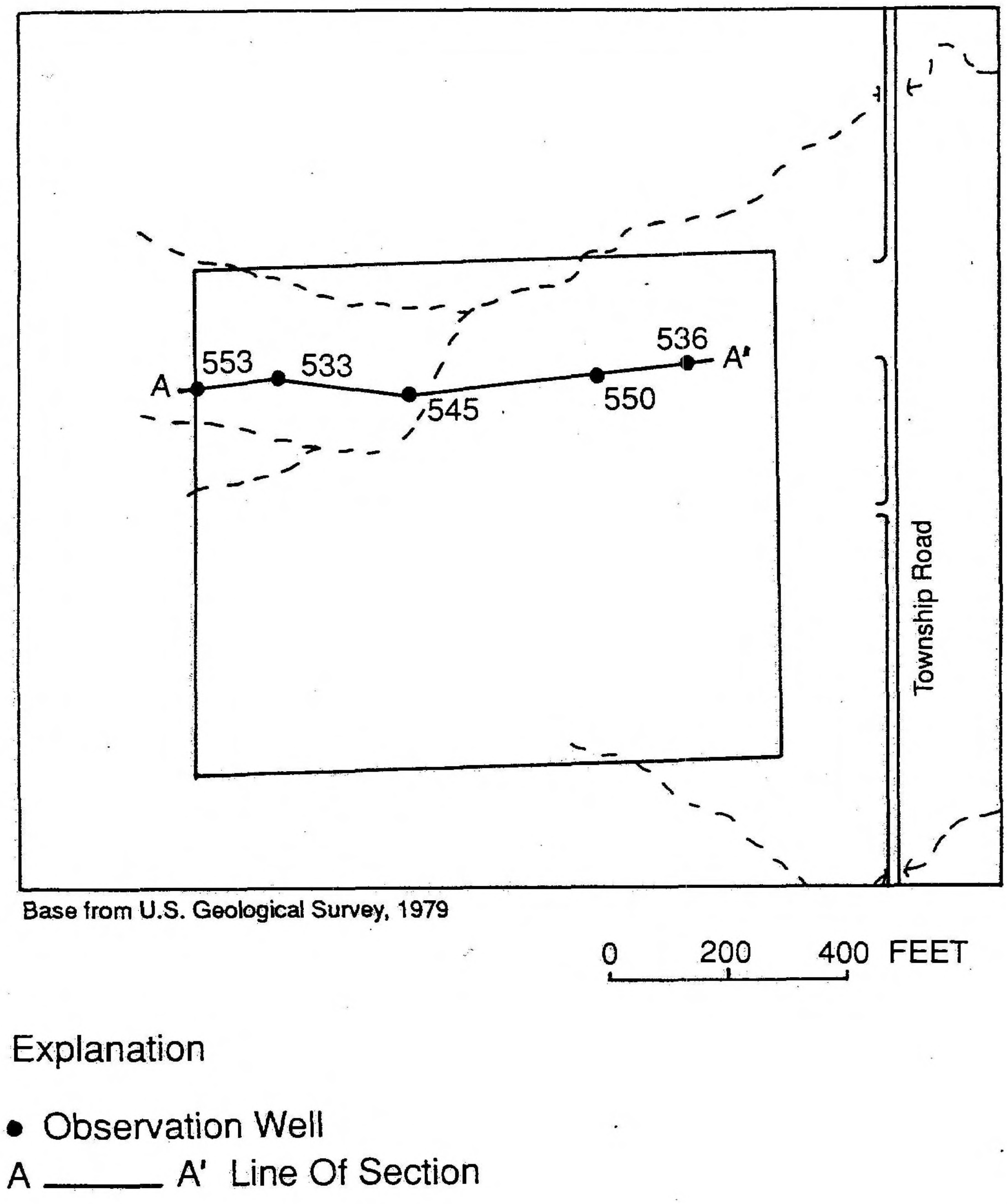


Figure 2-3. Location of geologic cross section for the Sheffield site.[2-8]

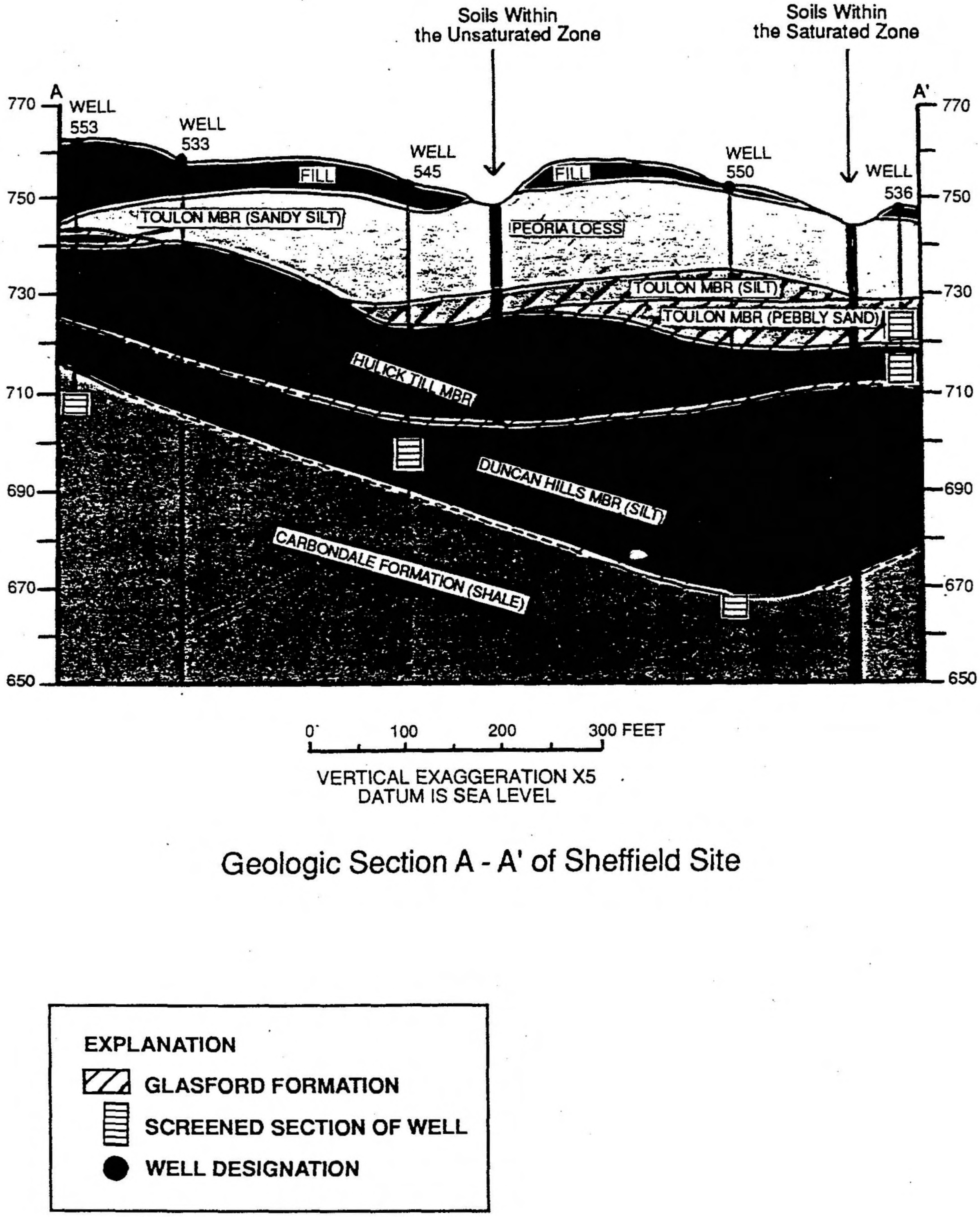


Figure 2-4. Geologic cross section for the Sheffield site.[2-8]

	Time/Rock Stratigraphy	Thickness (m)
	PLEISTOCENE: Unconsolidated glacial deposits, loess and alluvium	0-150
	PENNSYLVANIAN: Carbondale Formation, shale with thin sandstone, limestone and coal beds	0-150
	MISSISSIPPIAN: Shale, grey, green	0-8
	DEVONIAN: Limestone	15-30
	SILURIAN: Dolomite, lower part cherty	90-150
ORDOVICIAN	MAQUOKETA: Shale with limestone and dolomite beds	30-60
ORDOVICIAN	GALENA-PLATTEVILLE: Largely dolomite with shale and limestone zones	90-105
ORDOVICIAN	GLENWOOD-ST. PETER: Sandstone, some dolomite and shale beds, some clay at base	15-120
ORDOVICIAN	PRAIRIE DuCHIEN: Dolomite with some sandstone beds	0-120
CAMBRIAN	TREMPEALEAU: Dolomite, thin sandstone beds may occur	0-60
CAMBRIAN	FRANCONIA: Green sandstone, shale and dolomite	25-35
CAMBRIAN	IRONTON-GALESVILLE: Sandstone	40-75
CAMBRIAN	EAU CLAIRE: Predominantly shale and dolomite in upper portion grading to sandstone	120-140
CAMBRIAN	MT. SIMON: Sandstone, thin shale beds	305-610
	PRE-CAMBRIAN: Granite	

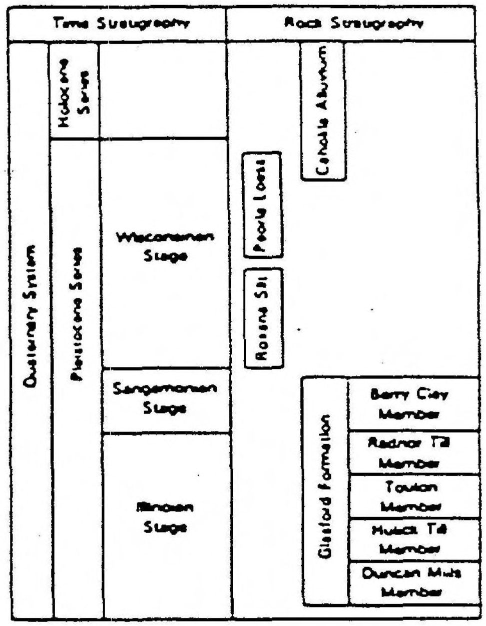


Figure 2-5. Stratigraphy of northern Illinois and the Sheffield site.[2-2]

In ascending order and beginning with the bedrock, the stratigraphy of the site includes the weathered shale of the Carbondale Formation, the Duncan Hills Member, the Hulick Till Member, the Toulon Member, the Radnor Till Member, and the Berry Clay Member of the Glasford Formation (all bedrock); the Roxana Silt; the Peoria Loess; and the Cahokia Alluvium. More recent units on the site include a modern soil and coal mine spoils.

Surface Water

The two major drainage features of western Illinois are the Mississippi and Illinois Rivers. The Sheffield site is located within the Mississippi River Basin near the drainage divide between two creeks, Lawson Creek and King Creek. The divide separating the Illinois and Mississippi drainage basins runs in a northeasterly direction about 1.5 km (1 mi) south of the site and passes through the town of Kewanee about 11 km (7 mi) southwest of the site.

The small, intermittent (ephemeral) streams draining the site formerly discharged to the abandoned coal mine pit 400 m (1,250 ft) east-northeast, but now discharge downstream of this strip mine lake (Figure 2-6). Lawson Creek eventually discharges to the Green River, about 15 km (10 mi) north of the site. The Green River flows westerly to the confluence with the Rock River near Moline, Illinois, where the Rock River joins the Mississippi River.

Ground Water

Two aquifer systems lie beneath the Sheffield site each with a different direction of flow (Figure 2-7). A regional confined aquifer system is contained in deep sandstone and carbonate bedrock. The local aquifer system contains ground water mainly under water table conditions. This shallow, unconfined aquifer, which is in unconsolidated deposits comprised of weathered shale, till, and alluvium and ranging from 1.5 to 14 m (5–46 ft) thick, is generally of low permeability. The shallow aquifer overlies a 140 m (450 ft) thick sequence of Pennsylvanian bedrock shale of low porosity and permeability.

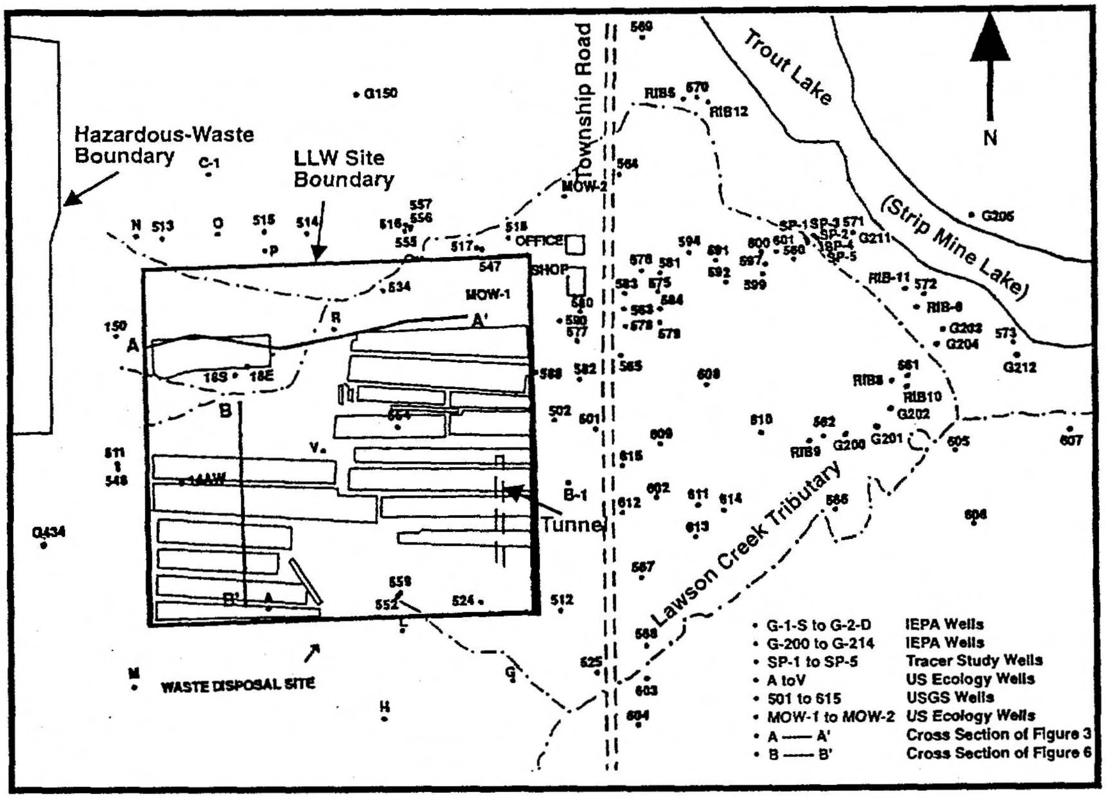


Figure 2-6. Map of well locations, trenches and tunnels at the Sheffield site.[2-2]

The groundwater is recharged in the topographically high areas in southeast and southwest portions of the site. It flows toward discharge areas along the unnamed tributary to Lawson Creek and the strip mine area. The site aquifer is recharged locally from the direct precipitation falling on and immediately west of the site, infiltration in areas where loess is thin or absent, and downward percolation through the loess.

The depth to water beneath the site ranges from 1.8 to 6 m (6–20 ft). Flow in the shallow aquifer is within three ground water basins. The aquifer's configuration is similar to surface topography. Ground water movement is generally in two predominant directions (Figure 2-7); (1) northeast to east toward Trout Lake, a strip mine lake, and (2) south to southeast toward small tributary channels belonging to Lawson Creek, which formerly drained into Trout Lake. Ground water flow divides are

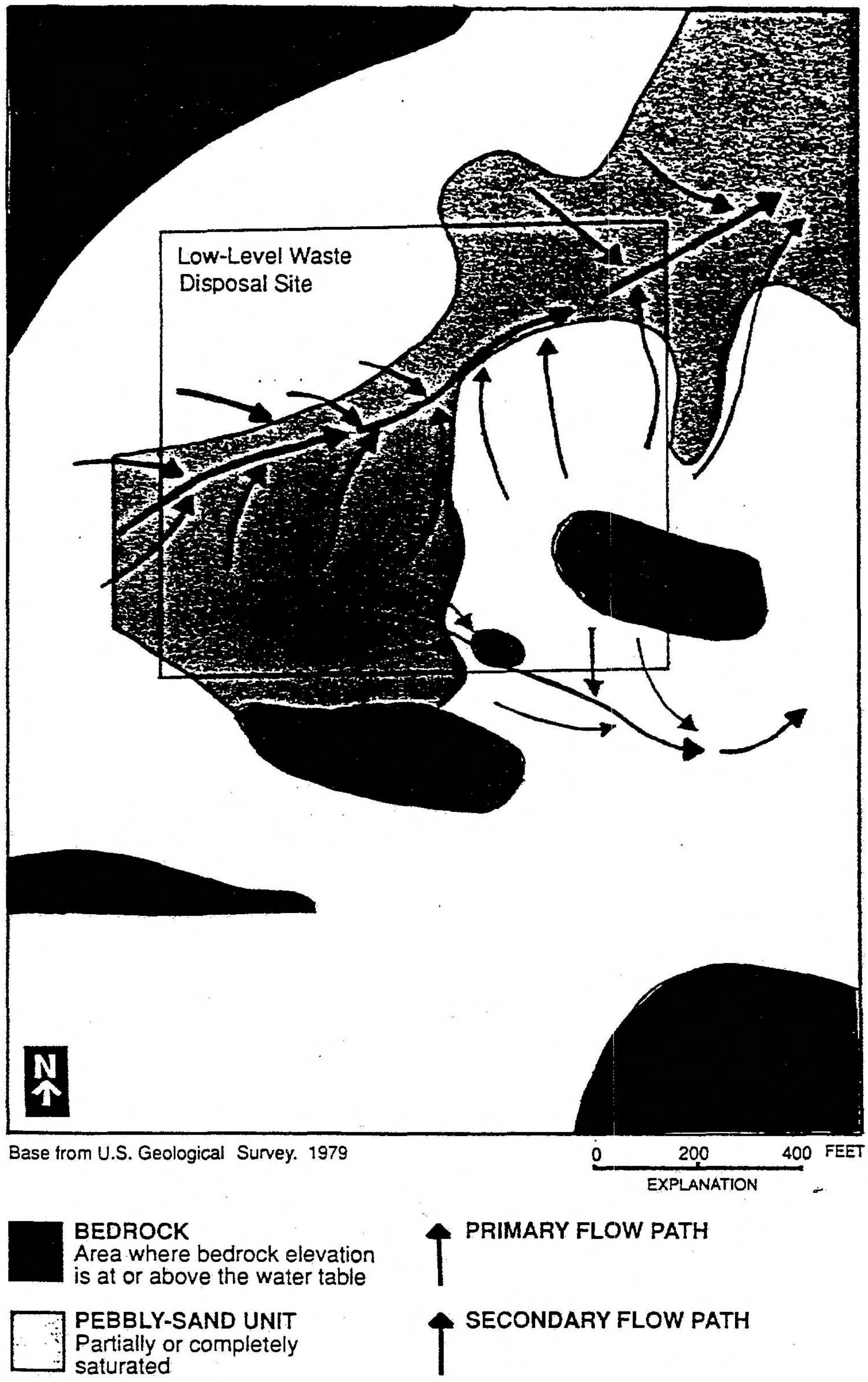


Figure 2-7. Ground water flow boundaries, direction of flow and principal flow paths for the Sheffield site.[2-8]

found west of the disposal facility, north of the facility in strip mine spoil materials, and on a topographic high found in the southeast corner of the site.

Ground water moves from the hill areas toward the valleys to the north and south. As it approaches the axis of the valley, flow direction changes to the east. Moisture infiltrating the surficial sediments and underflow from the area adjacent to the western disposal site boundary provides all the water moving through the shallow ground water system. The ground water gradients are relatively flat over much of the site. The maximum ground water fluctuations in the disposal area are generally less than 3 m (10 ft). Larger fluctuations may occur in recharge areas where the depth to ground water is greatest. The depth to ground water was found to be usually less than 3 m (10 ft) in the areas of the unnamed tributary to Lawson Creek and the strip mine area.

Precipitation, which annually averages just under 90 cm (35 in.), is the source of recharge for the shallow hydrogeologic system and yields approximately 5 cm (2 in.) of recharge per year. Over the 8 hectare (20.5 acre) disposal site, this translates to roughly one million gallons of moisture penetrating the soil of the shallow hydrogeologic system. Runoff is estimated to be 23 cm (9 in.) per year and evapotranspiration accounts for 60 cm (24 in.) per year. Trench covers installed prior to 1988 to prevent the infiltration of moisture from precipitation were only partially effective. Indications are that water movement into the trenches occurs primarily along the periphery of the cover and secondarily through the center of the cover.

The primary path of the shallow aquifer originates west of the disposal site and extends beneath the upper southwest quadrant through the central northeast quadrant. It is joined by flow from the upper northwest quadrant of the disposal site and migrates in a northeast direction toward Trout Lake where surface discharge is observable as small springs emptying into the lake. This pathway is through a section of the pebbly sand of the Toulon Member which is significant because it connects hydraulically to most saturated and unsaturated sediments on site. The Toulon Member unit underlies 67 percent of the disposal site and is recognized as controlling the flow of ground water through the disposal site. The pathway extending eastward from the northeast corner of the disposal site is through a narrow, channel-like depression in the Hulick Till Member which is filled with course gravelly sand from the Toulon Member. As mentioned previously this channel connects the Sheffield site hydraulically to the lake. The ground water speed through this narrow, short channel has been estimated to be about 750 m/y (2400 ft/y). Due to the connection with the disposal site, tritium was detected in the ground water along the entire channel-like depression, as well as in seeps along the bank of Trout Lake.

The secondary path originates beneath the lower southwest quadrant of the disposal site and flows into the valley to the south through the Peoria Loess silt, but because of smaller flow volume and lower velocities this pathway represents a less significant migration path. This secondary pathway is also controlled by a buried bedrock channel partially filled with pebbly sand. However, the sand in this channel was found to have no relation to the Toulon Member previously identified as a conduit for ground water exiting the disposal site. This sand was found to belong to the Henry Formation, a younger deposit having a lesser potential for significant exit migration along this pathway.

Ecology

The area contains woody vegetation, natural grasses, and revegetated grasses. Approximately 20 percent of the site is forested.

A wide diversity of terrestrial vertebrates is found in central Illinois. The habitats available to terrestrial animals on the site include intermittent stream-forest, forest-edge, and disturbed prairie. These systems support various animal and bird species.

Table 2-2 lists some of the vegetation, mammals, and birds found near the Sheffield site in Bureau County.

ENVIRONMENTAL MONITORING

Overview

Environmental samples were collected at the Sheffield site and analyzed by the site operator and the Illinois Department of Public Health between 1967 and 1980. An ongoing monitoring and surveillance program has been conducted by the Illinois Department of Nuclear Safety since 1980.

The environmental monitoring program is designed to evaluate the site performance by monitoring any movement, or lack of movement, of tritium and other radionuclides, to evaluate the general environment, and to evaluate any potential or actual exposure to radionuclides. The major part of the environmental monitoring program involved the sampling and analysis of ground water and surface water at or near the site. According to the provisions of the Agreed Order, the limits for discharge beyond the buffer zone were (and will continue to be) those that were in force as of the date the Agreed Order was signed (May 25, 1988).

The following components comprise the Illinois Department of Nuclear Safety monitoring program:

1. Surface water, drinking water, and ground water are sampled at monthly to quarterly intervals, depending on how significant the sampling location is and how frequently it contains sufficient water for sampling. All samples are analyzed for gross alpha, gross beta, and tritium levels. Analysis for specific gamma-emitting radionuclides is performed on those samples found to have elevated alpha or beta levels. Strontium-90 analysis is conducted on those samples with elevated beta levels.

2. Air samples are collected continuously by a low-volume sampler and are analyzed weekly for airborne particulates.

Table 2-2. Examples of biota found near the Sheffield site.

Common name	Scientific name
<u>Vegetation</u>	
Bur oak	*Quercus macrocarpa*
Hickories	*Carya spp.*
Sumac	*Rhus sp.*
Blackberry	*Rubus sp.*
Snoberry	*Symphoricorpos sp.*
Little bluestem	*Andropogon scoparius*
Sideoats grama	*Bouteloua curtipendula*
Kentucky bluegrass	*Poa pratensis*
Orchard grass	*Dactylis glomerata*
Brome	*Bromus sp.*
Sweet clover	*Trifoluim sp.*
<u>Mammals</u>	
Opossum	*Didelphis marsupialis*
Raccoon	*Procyon lator*
Badger	*Taxidea toxus*
Coyote	*Canis latrans*
Red fox	*Vulpes fulva*
Gray fox	*Urocyon cinerecargentaus*
Woodchuck	*Marmata monax*
Eastern gray squirrel	*Sciurus carolinensis*
Eastern cottontail	*Sylvilagus floridanus*
White tailed deer	*Odocoileus virginianus*
<u>Birds</u>	
Common loon	*Gavia immer*
Whistling swan	*Olor columbianus*
Canada goose	*Brunta canadensis*
Mallard	*Anas olatyshynchos*
Blue-winged teal	*Anas discors*
Wood duck	*Aix sponsa*
Turkey vulture	*Cathartas aura*
Bobwhite	*Colinus virginianus*
Ring-necked pheasant	*Phasianus colchicus*
Killdeer	*Charodrius vociferus*
Mourning dove	*Zenaida macroura*
Screech owl	*Otus asio*
Downy woodpecker	*Dendrocopos pubescans*
Common crow	*Corvus brachyrhonchos*
American robin	*Turdus migratorius*

3. Direct radiation is measured by thermoluminescent dosimeters (TLDs). The TLDs are collected and analyzed quarterly.

4. Soil samples are collected intermittently and analyzed for radionuclides which may have leached out of the radioactive waste into soil.

5. Vegetation samples are collected intermittently and analyzed for radionuclides that may have been absorbed from the environment and incorporated into plant tissue.

6. Samples of fish and ground squirrels are collected intermittently and analyzed for radionuclides which may have been consumed and accumulated in tissue.

All environmental samples are analyzed for total alpha and beta radioactivity, a method of screening for radionuclides in the disposal trenches which emit either alpha or beta particles. Since tritium emits a very low energy beta particle, tritium cannot be detected by ordinary procedures for evaluating gross beta activity. To measure the concentration of tritium, all of the water samples are distilled and analyzed using a liquid scintillation detector, an instrument that measures radioactive emissions with very low energies and in very low concentrations.

Some samples are analyzed for strontium-90 (a beta-emitter) and gamma-emitting radionuclides such as cesium-137. Strontium-90 is easily masked by other radionuclides, including those which are naturally-occurring. Selected samples which may contain strontium undergo preliminary chemical separation so that the strontium can be isolated for analysis. Gamma-emitting radionuclides are analyzed in a process called gamma spectroscopy using a high purity germanium detector which enables the identification of radionuclides individually.

The Illinois Department of Nuclear Safety laboratory developed a procedure for analysis of environmental carbon-14. Since carbon-14 occurs naturally in the environment along with the carbon present in vegetation and water, the laboratory performs an analysis for total organic carbon as well as the analysis for carbon-14.

The standard unit of measurement for radioactivity has been the curie (Ci). Multiples or fractions of a curie follow standard metric system prefixes. The Illinois Department of Nuclear Safety expresses results of the radioactivity monitoring in terms of picocuries per liter (pCi/L) for water; femtocuries per cubic meter (fCi/m^3) for air; picocuries per gram (pCi/g) for soil; picocuries per kilogram (pCi/kg) for animals and fish; and nanocuries per liter (nCi/L)[c] for tritium in water distilled from vegetation samples. The direct radiation measurements are expressed in milliroentgens per year (mR/y).

In 1976, tritium (a radioactive form of hydrogen) was discovered in shallow groundwater beneath the 20-acre site. This was the first evidence of radioactivity leaking from the burial trenches. In 1981, tritium was discovered in groundwater to the east of the site. This was the first evidence of radioactive material moving off the 20-acre site. Since then, tritium movement has been traced to the east where it

c. A nanocurie (nCi) is a measure of radioactivity equivalent to 37 nuclear transitions per second. A liter (L) is a measure of volume equal to 1.05 quarts.

discharges into a small lake (Trout Lake) located about 1000 feet from the site (Figures 2-8 and 2-9). The groundwater carrying the tritium away from the site and Trout Lake are both located within the 170-acre buffer zone that surrounds the site. Trout Lake serves to both dilute and impound the vast majority of tritium moving from the site.

The new, low permeability cap was completed in late summer 1989. The graph of tritium in the Northeast Pathway Wells (Figure 2-10) illustrates the tritium concentrations prior to the completion of the cap and subsequent to it. Prior to installation of the cap, the tritium concentrations averaged about 400 nanocuries per liter (nCi/L) around the rising trend line. After installation of the cap, the concentrations continued to increase at an average rate of approximately 107 nCi/L and peaked at 890 nCi/L in well No. 575 about the third quarter of 1990. Subsequently, the concentrations have decreased at a rate of 86 nCi/L per year. These data suggest that the decrease in concentrations may be due to the effectiveness of the low permeability cap.

Recently, levels of tritium in Trout Lake have averaged between 3 and 5 nanocuries per liter (Table 2-3). This is less than 0.2% of the Department's limit (3,000 nCi/L) for discharge beyond the buffer zone. Since February 1989, tritium concentrations in Trout Lake have been decreasing at an average rate of about 0.4 nCi/L per year; in August 1994 the concentration in Trout Lake was 3.2 nCi/L. Again, this decreasing trend is likely due to the new cap. Trace amounts of tritium may exit the buffer zone by seeping from Trout Lake into adjacent groundwater, flowing over the dam spillway during periods of heavy precipitation, or evaporating into the atmosphere. In each case, the tritium is rapidly dispersed and diluted to levels indistinguishable from natural background. The highest levels of tritium observed beyond the buffer zone have been 2.4 nCi/L and 0.8 nCi/L in groundwater and surface water, respectively.

Ground Water

From 1967 to 1976, most of the ground water monitoring was conducted on samples from wells installed by the site operator. Figure 2-8 indicates sample locations at the Sheffield site. Only gross alpha and beta analyses were conducted during most of this period. Tritium counting capability was developed in 1974. Generally during this period, only background levels of naturally-occurring radionuclides were measured in the monitoring wells. Several anomalous readings were recorded, but additional analyses were unable to repeat them, possibly due to high levels of naturally occurring dissolved solids in the samples. This problem still exists but is now routinely resolved using gamma spectroscopy. Table 2-3 summarizes tritium concentrations in Trout Lake during the period 1981 to 1994.

The U.S. Geological Survey (USGS) began a hydrogeological study of the Sheffield site in 1976 and installed the wells designated 501 to 524, as indicated in Figure 2-9. Tritium was detected in USGS Well 523 in October of 1976. The presence of tritium was verified upon resampling of the well. Tritium was also detected in USGS Well 507 at about the same time. This was the first evidence of radionuclide migration at Sheffield and indicated a slow migration to the southeast.

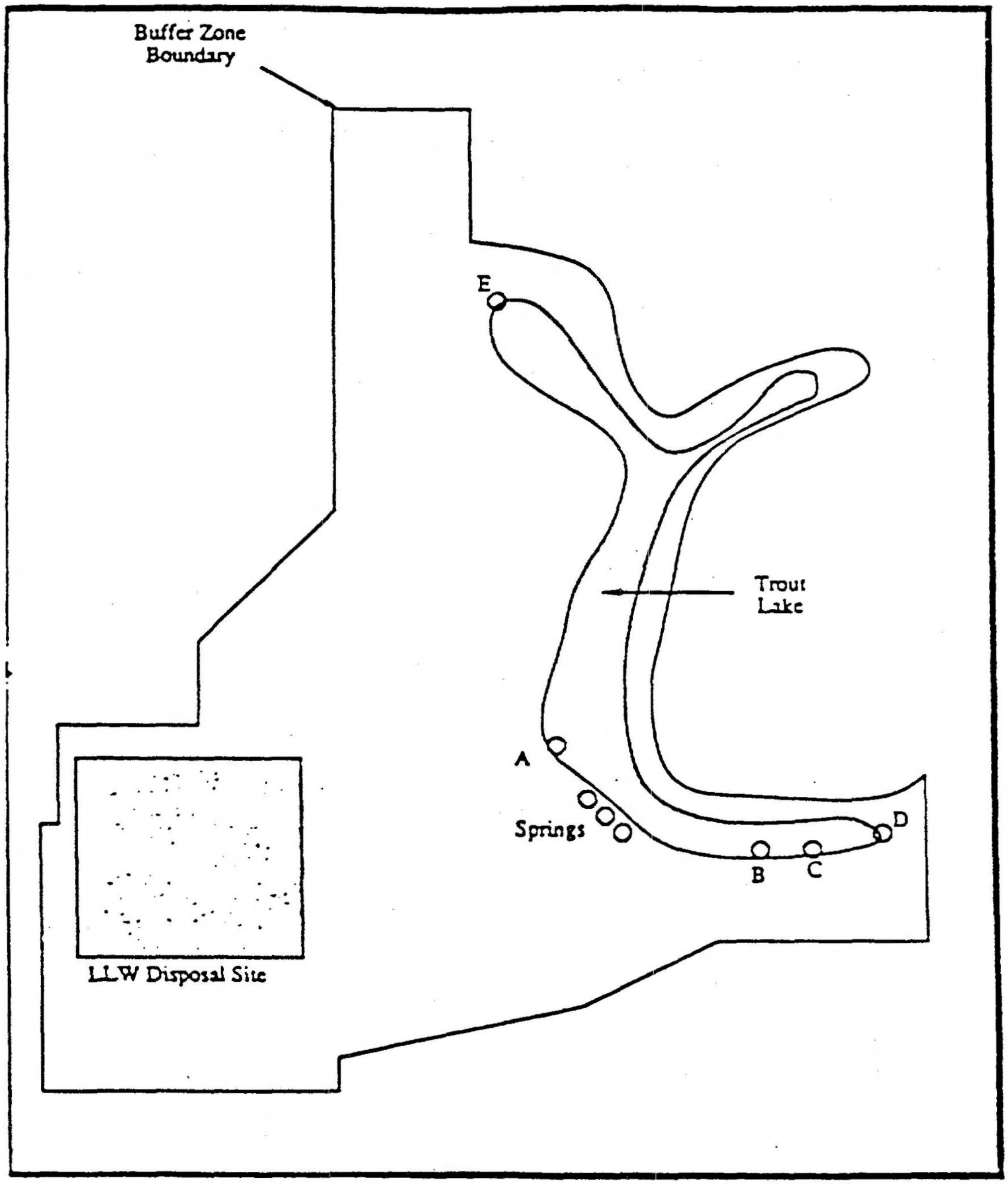


Figure 2-8. Trout Lake sampling locations at the Sheffield site.[2-2]

Table 2-3. Tritium concentrations in Trout Lake in nCi/L 1981–1994 at the Sheffield site.

		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994*
Trout Lake A	Number	2	7	4	4	3	8	6	18	16	15	13	12	11	6
	Maximum	0.5	1.0	0.6	0.9	1.3	1.8	2.0	6.5	6.5	5.6	4.9	4.8	3.5	3.4
	Minimum	<MDC	<MDC	<MDC	<MDC	0.6	0.8	1.6	1.7	4.4	2.2	1.2	4.1	1.0	2.7
	Average	0.3	0.4	0.4	0.4	0.6	1.2	1.8	2.7	5.4	4.5	4.1	4.4	2.9	3.1
Trout Lake B	Number	0	0	0	0	3	4	1	10	13	15	10	11	3	2
	Maximum					1.0	1.9	1.6	4.4	9.0	5.6	5.7	5.1	4.7	3.3
	Minimum					0.6	0.9	1.6	1.4	5.0	3.8	3.8	4.2	3.1	3.3
	Average					0.8	1.3	1.6	3.0	5.9	4.8	4.4	4.6	3.7	3.3
Trout Lake C	Number	0	0	0	0	2	0	0	7	12	14	11	11	4	3
	Maximum					0.9			4.5	7.6	5.4	4.9	4.8	4.8	3.6
	Minimum					<MDC			0.9	4.8	4.0	3.2	4.1	3.0	3.1
	Average					0.5			3.3	5.6	4.8	4.1	4.4	3.7	3.3
Trout Lake D	Number	0	0	0	0	0	0	0	0	13	21	11	12	11	6
	Maximum									5.9	5.7	7.6	5.4	5.7	3.5
	Minimum									4.7	4.1	3.8	4.1	3.1	3.2
	Average									5.2	4.9	4.7	4.5	3.9	3.3
Trout Lake E	Number	0	0	0	0	0	0	0	0	13	14	11	9	3	1
	Maximum									5.5	5.4	4.6	4.6	3.0	3.0
	Minimum									4.4	3.6	3.1	3.9	2.8	3.0
	Average									5.0	4.6	3.9	4.2	2.9	3.0

* - Data thru August 1994

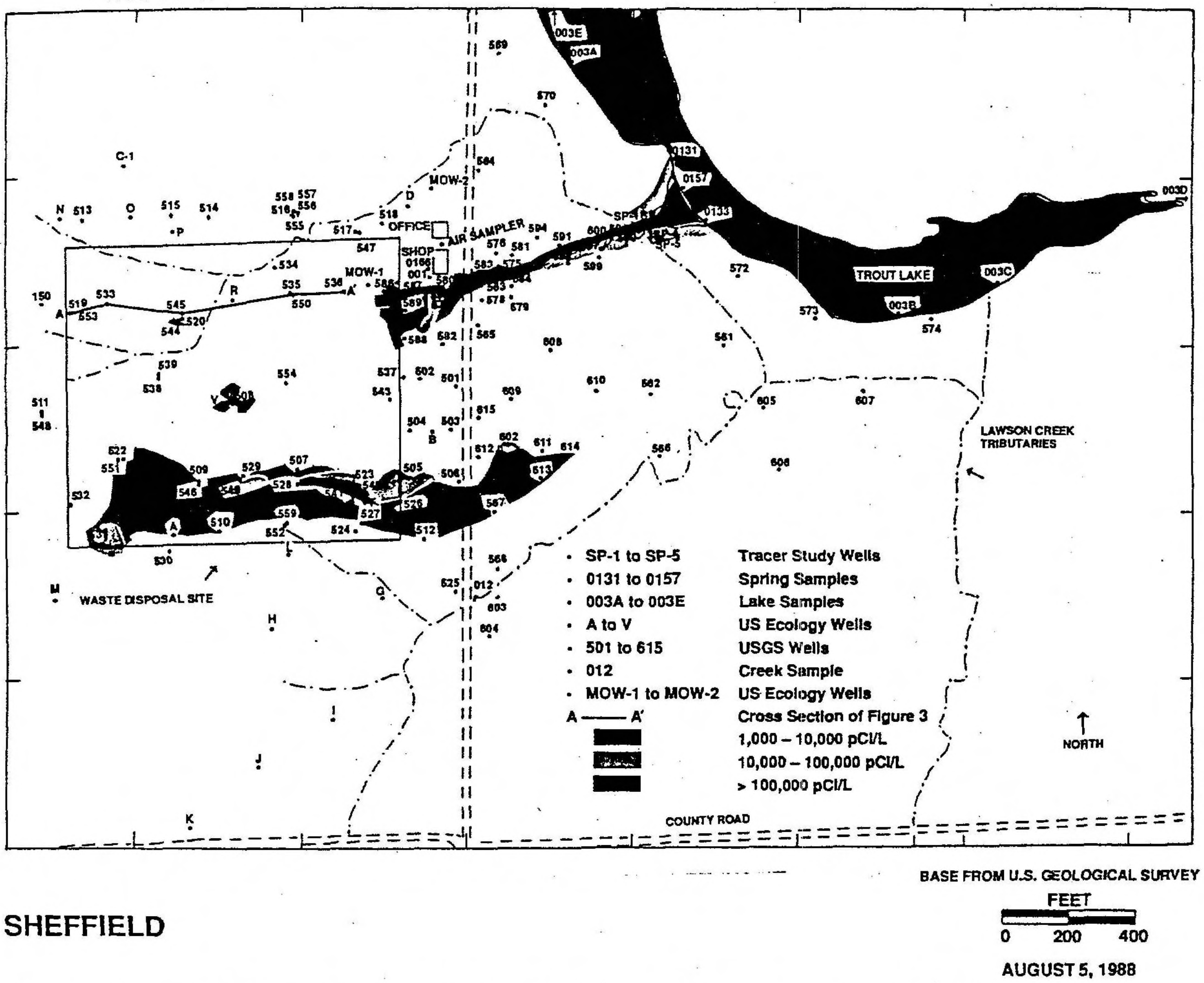


Figure 2-9. Well locations and tritium concentrations (shaded) in water at the Sheffield site.[2-2]

From the summer of 1977 to the fall of 1981, the objective of the environmental monitoring was to continue to investigate the movement of ground water in the southeast quadrant of the site and to perform general hydrogeologic studies. The USGS installed additional monitoring wells in the series 525 to 559 and the Illinois Department of Nuclear Safety continued to conduct sampling and analysis. In 1977, tritium was found in USGS wells 527 and 528, providing further evidence of tritium movement in the southeasterly direction. On-site Well 523 continued to exhibit the highest concentration of tritium in this area through the end of 1981. In 1981, a single measurement of 133,000 pCi/L was obtained. For comparison, the maximum permissible concentration of tritium in water released into unrestricted areas was 3,000,000 pCi/L.

Since the general hydrogeologic studies indicated ground water movement to the north and east, the USGS installed wells 560 to 576 in this area in the summer of 1981. Tritium was found in USGS well 563 in November 1981, which was the first time that tritium had been detected beyond the original site boundary. Based on this finding, USGS Wells 577 to 596 were installed northeast of the property in the summer of 1982 to determine the source, velocity, and extent of the tritium movement. A narrow northeast pathway was found to be about 6 to 12 m (20 to 40 ft) wide through the sampling and analysis of the new wells. This plume is bounded on the southwest by the original 8 hectare (20 acre) site and by Trout Lake on the northeast. About 250 m (800 ft) separate the site from Trout Lake.

Since 1982, the focus of the ground water monitoring program has been to monitor tritium concentrations in both the southeast and the northeast pathways, in order to determine whether a potential exists for exposure to the general public. The monitoring of wells 501 to 559 has continued at a lower frequency, because the efforts have been shifted further to the northeast.

In preparation for trench recapping, several of the wells on or near the original site were sealed in 1987. This included on-site well 523, which had exhibited exceptionally high tritium concentrations until it was closed. One of the last 1987 measurements was found to be greater than 1,300,000 pCi/L.

Monitoring of Springs

The three springs which empty into Trout Lake from the west (Figure 2-9) were found to contain tritium in October 1982. These springs are the end of the northeast pathway. The USGS conducted a tracer dye study in 1984 to determine ground water velocities along the northeast pathway. This study found that the ground water velocity was about 800 m (2,500 ft) per year downgradient of USGS well 601. This measurement represents the highest ground water velocity in that area; due to the variability in hydrogeologic characteristics, inferences regarding other ground water velocities are difficult to make.

Northeast Pathway Tritium

The Illinois Department of Nuclear Safety has expended considerable effort toward describing the tritium concentrations in the wells and springs of the northeast pathway (Figures 2-7 through 2-11). Factors which appear to have an interdependent influence on concentrations at a given time in a given well are:

1. Precipitation on the disposal site

2. The condition of the trench caps during precipitation

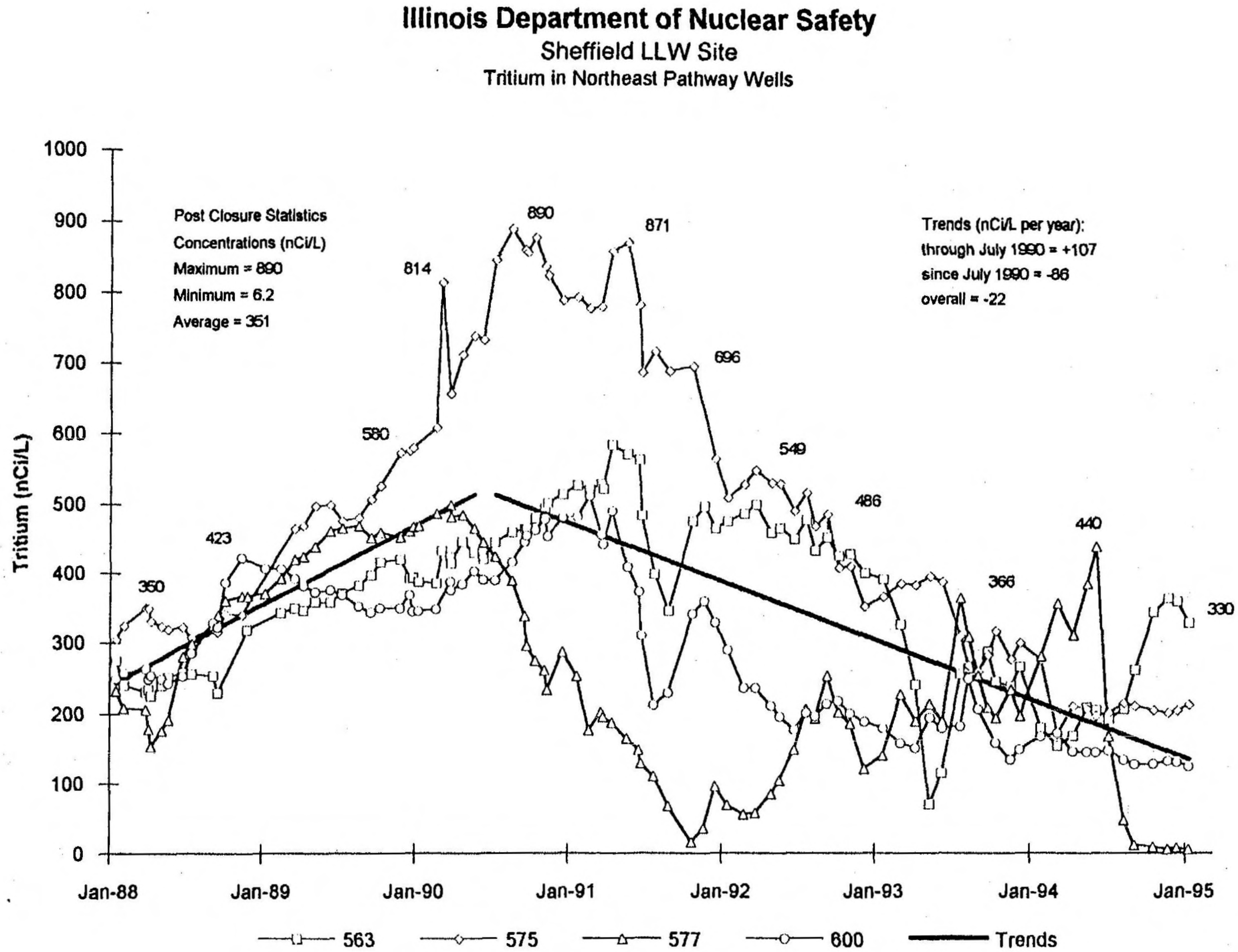
3. Precipitation in the areas which recharge the pathway wells.

Precipitation variations on the disposal site result in variable amounts of tritium available for transport. A cyclical pattern of tritium concentrations occurs in many of the northeast pathway wells due to a combination of the variables.

USGS wells 577, 580, 583, 563, 575, 592, 597, 600, and 601 (Figure 2-9) are placed along the northeast pathway. Tritium concentrations increased in these wells until reaching peak concentrations above 100,000 pCi/L. Tritium concentration has tended to change over longer periods of time in contrast to the on-site wells. USGS well 528 (near the trenches) exhibits sharp spikes in concentration which are related to single or closely-grouped rainfall events.

Southeast Pathway Tritium

The USGS installed wells 608 to 615 (Figure 2-9) in May 1983. The purpose of these wells was to determine the path of ground water to the southeast after it crosses the boundary of the disposal site.



According to the provisions of the Agreed Order of May 1988, the limits for discharge beyond the buffer zone are 3000 nCi/l.

Figure 2-10. Tritium concentrations in northeast pathway wells at the Sheffield site.[2-2]

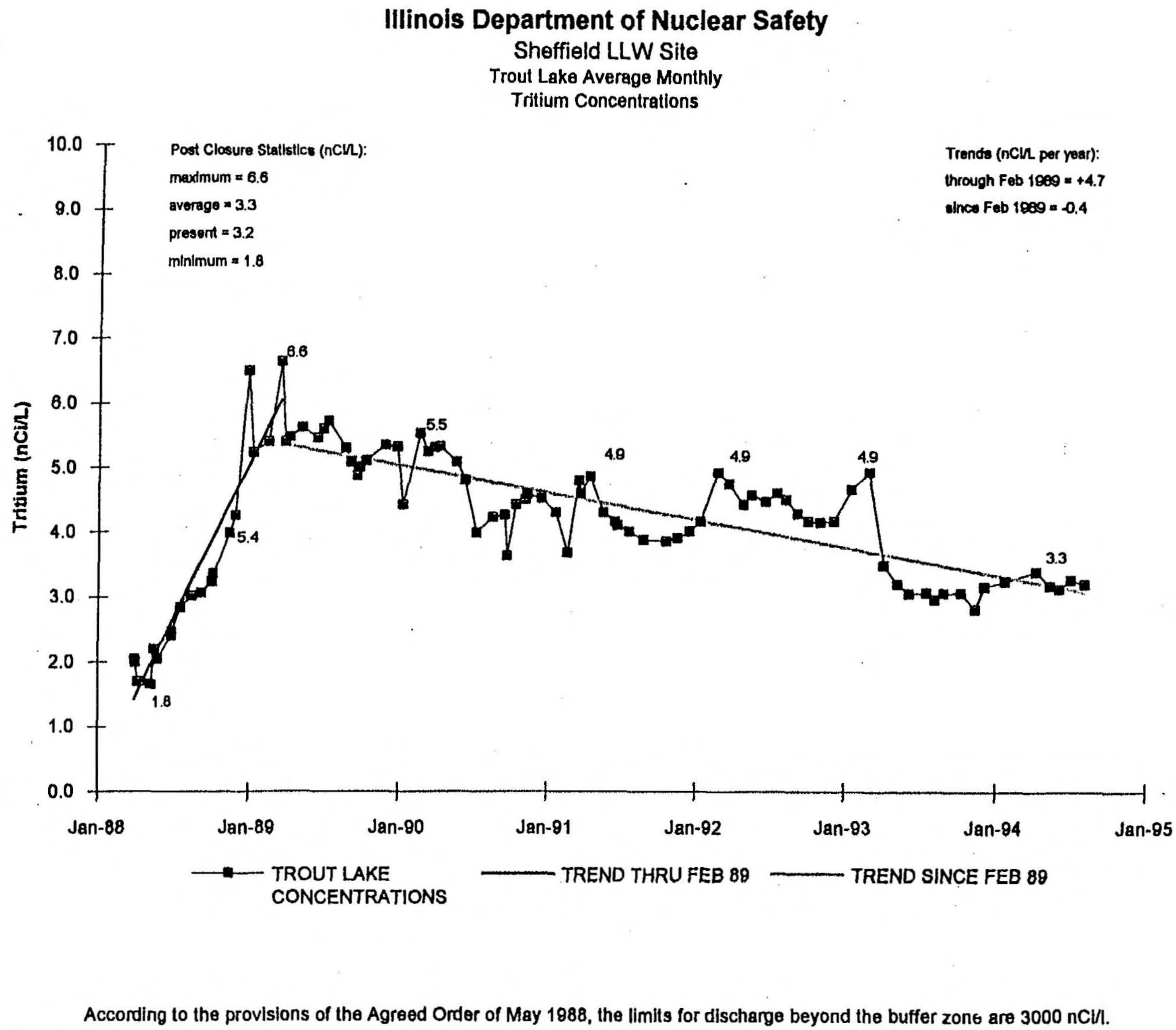


Figure 2-11. Tritium concentrations in Trout Lake near the Sheffield site.[2-1]

The samples obtained from these wells indicated that the tritium does not continue to move to the southeast but turns toward the northeast. Although the migration rate along this pathway has not been measured directly, it appears to be slower than along the northeast pathway. Data from the wells numbered 603 and 604 indicated little or no tritium. However, samples from wells numbered 602, 611, and 613 indicate up to 6,400 pCi/L. Information from these wells generally corroborated the ground water flow information from earlier studies.

Surface Water

Surface water monitoring consisted of periodic sampling of the intermittent streams around the site, Lawson Creek, and a single location at Trout Lake (Figure 2-9 and 2-12) during the early years of operation. The springs that discharge into Trout Lake have been sampled regularly since October 1982. Samples from as many as five different locations in Trout Lake have been taken on a regular basis. The tritium concentrations at the different sampling locations in Trout Lake appear to depend on the following variables:

1. The flow of water from the springs

2. The runoff from surrounding areas

3. The discharge to the Lawson Creek tributary, if any

4. The presence of ice on the lake.

Evidence of uneven mixing has been observed under some exceptional conditions. The sampling location E on Trout Lake has been lower than the overall mean concentration when ice is on the lake and when discharge occurs from the opposite end. A summary of the tritium results from the Trout Lake sampling is contained in Table 2-3 and shown in Figure 2-11. A summary of the tritium results from the stream and creek sampling is contained in Table 2-4.

Drinking water samples have been taken from off-site locations (Figure 2-12) in the Sheffield area to assure that there has been no impact on local water supplies since the site opened in 1967. Only naturally occurring radionuclides have been found in samples of these water supplies. No radionuclides attributable to activities from the radioactive waste disposal site were found in any of these water suppllies. Figure 2-12 indicates the locations of the sampling sites.

Air

Figure 2-9 indicates an air monitoring station located near the northeast quadrant of the site, near Trenches 23 and 24. This sampler has been used to continuously collect particulate samples since February 1977. The filters have been analyzed weekly for gross alpha and beta activity. For the majority of the monitoring periods, the air monitoring results did not indicate any statistically significant increases over natural background. Nuclear weapons testing in 1977 and 1980 and the Chernobyl accident in 1986 were the exceptions when the airborne concentrations of radionuclides were elevated over most of the northern hemisphere due to the release of fission products. The

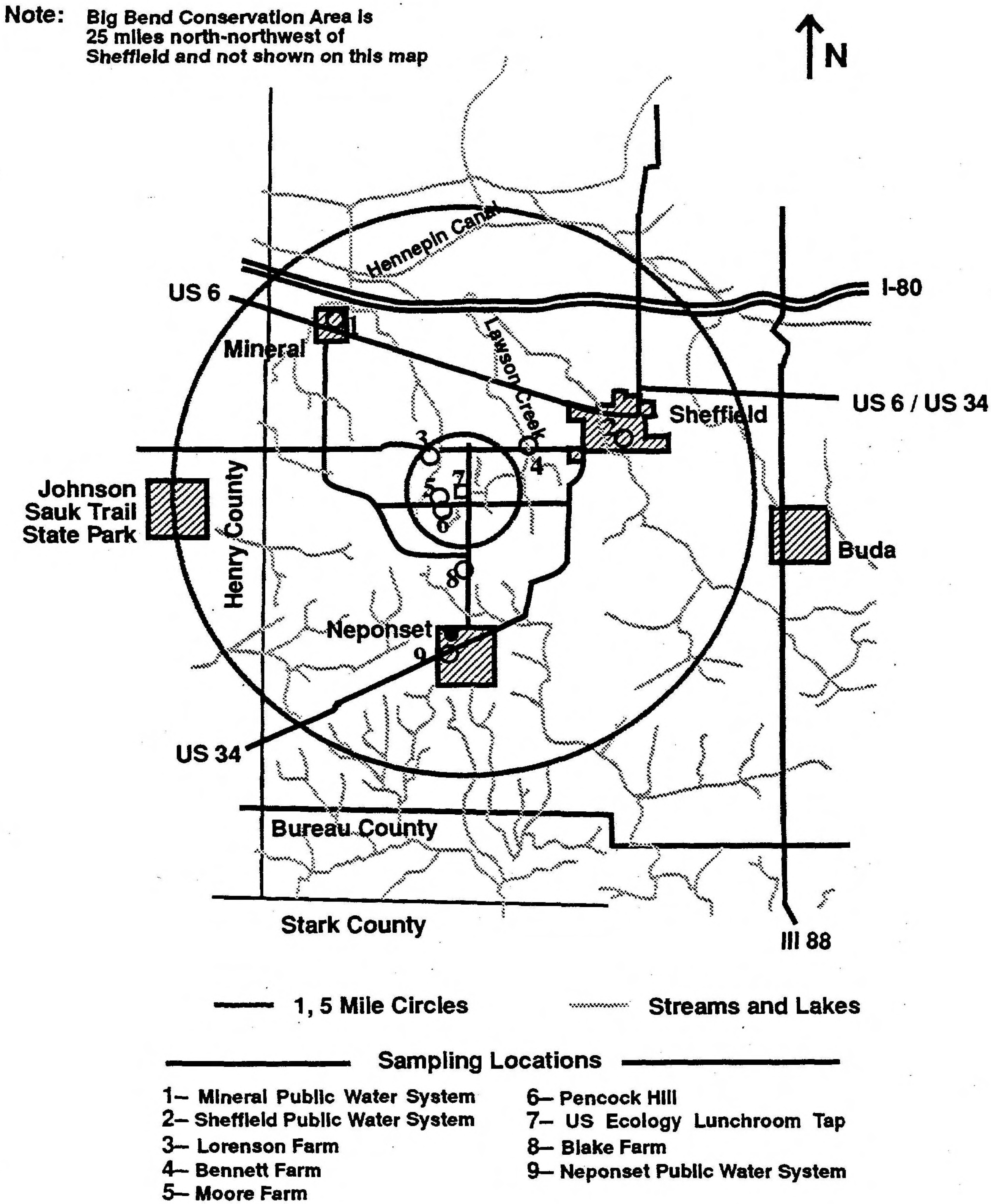


Figure 2-12. Environmental sampling around the Sheffield site.[2-2]

Table 2-4. Tritium concentrations in streams and creeks in nCi/L 1981–1994 at the Sheffield site.

		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994*
Coal Creek	Number	0	0	2	0	0	3	3	4	5	4	7	12	8	1
	Maximum			<MDC			0.5	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC
	Minimum			<MDC			<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC
	Average			<MDC			<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC
Lawson Creek	Number	0	0	3	2	3	4	3	5	14	18	11	12	11	7
	Maximum			<MDC	<MDC	<MDC	0.5	0.3	1.2	<MDC	0.5	0.7	0.4	0.5	0.4
	Minimum			<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	0.2	<MDC
	Average			<MDC	<MDC	<MDC	<MDC	<MDC	0.4	<MDC	0.2	0.3	0.2	0.3	<MDC
Stream Northwest of Site	Number	3	4	5	3	3	4	3	3	5	4	9	12	8	1
	Maximum	0.4	0.6	<MDC	<MDC	<MDC	0.4	<MDC	<MDC	<MDC	<MDC	<MDC	0.2	<MDC	<MDC
	Minimum	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC
	Average	0.3	0.3	<MDC	<MDC	<MDC	0.2	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC
Stream South of Site	Number	3	7	7	3	1	4	3	3	5	5	9	11	4	6
	Maximum	0.4	0.7	<MDC	<MDC	<MDC	0.6	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	0.3
	Minimum	<MDC	0.3	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC
	Average	0.2	0.5	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC	<MDC

* - Data thru August 1994

sampling results do not indicate any airborne releases from the Sheffield site. Air sampling results are summarized in Table 2-5.

Direct Radiation

Thermoluminescent dosimeters (TLDs) were used for direct radiation measurements. The number of monitoring sites has varied over the years as a result of occasional badge losses, malfunctioning of equipment, and changes in the scope of the program. The dosimeters that were closest to the site entrance were exposed to the incoming shipments of radioactive wastes. Elevated TLD readings resulted from this placement. During 1976, the highest on-site levels of direct radiation were 234 mRem/y. According to the waste receipt and burial records, 1976 was a peak period for volume and curie quantity of radioactive waste in storage above ground. Since the cessation of waste burial at the site, all readings have been typical of natural background in northern Illinois, about 65 mRem/y. A summary of the cumulative total exposures measured since 1971 is contained in Table 2-6.

Soil

Soil samples have been taken to determine whether surface contamination exists from the unloading of shipments and from burial operations. A sample taken and analyzed in 1976 indicated no contamination was present. Only potassium-40 and radium-226, naturally occurring radionuclides, were reported in the sample. Cesium-137 was found in two samples taken near USGS wells 507 and 512 in 1977. Duplication of samples did not verify the results, which thus remain anomalies. Wells 507 and 512 are located in the southeast quadrant and just east of the southeast quadrant, respectively.

Biota

Vegetation samples have been taken periodically since the site opened. These samples were taken to determine whether any bioaccumulation of radionuclides from the Sheffield site has occurred. The results demonstrate that no detectable release from the Sheffield site has occurred. Only radionuclides contributed from radioactive fallout (cesium-137, niobium-95, zirconium-95, ruthenium-103, strontium-89, strontium-90) and naturally occurring radioactive materials were identified.

Tritium concentrations found in vegetation appear to relect the concentrations of tritium in the ground water near a plant's root system. When the origin of the tritium is ground water, the concentrations found in the deeper rooted plants (such as alfalfa) are usually higher than those detected in more shallow rooted grasses. Tritium conentrations have ranged from 1,300 to 16,000 pCi/L in grass samples, from 200 to 35,800 pCi/L in clover, and from 6,300 to 89,000 pCi/L in alfalfa. Tritium levels have been measured at 31,900 pCi/L in brome grass and at 10,400 pCi/L in tree leaves. The higher concentrations were found on the tops of the trench caps.

Fish samples have been taken to determine whether any bioaccumulation of radioactive material has occurred in aquatic life in Trout Lake. The results of samples collected in 1977 and 1982 indicated that only naturally occurring radionuclides were found at levels greater than the minimum detectable concentration (MDC). Improvements in laboratory analytical techniques resulted in a more sensitive MDC in 1988. Strontium-90 concentrations from 10-17 pCi/kg were found in samples collected in 1988. The strontium levels in fish will generally be 20 times higher than the strontium level in the

Table 2-5. Air sampling results in fCi/m^3 1977–1994 at the Sheffield site.

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Gross Alpha	Number	37	36	35	19	11	8	3	18	46	51	48	53	55
	Maximum	12	3	12	200[1]	6	7	4	11	18	16	10	21	21
	Minimum	<MDC	<MDC	<MDC	0	1	0	0	2	1	1	1	<MDC	<MDC
	Average	4	0	1	12	2	2	2	7	5	6	3	5	5
Gross Beta	Number	37	36	35	19	11	8	3	18	46	51	47	53	55
	Maximum	455[1]	110	20	2800[1]	335[1]	100	43	31	73	420[1]	41	44	110
	Minimum	21	10	2	3	6	7	2	12	10	13	9	12	12
	Average	100	38	10	180	108	31	19	18	22	49	24	22	28

		1990	1991	1992	1993	1994[2]
Gross Alpha	Number	50	45	50	49	34
	Maximum	12	4	3	4	2
	Minimum	<MDC	<MDC	<MDC	<MDC	<MDC
	Average	3	1	1	0	0
Gross Beta	Number	51	47	50	49	34
	Maximum	71	34	36	42	42
	Minimum	12	7	4	6	5
	Average	27	18	14	17	15

1 - Elevated concentrations coincide with general northern hemisphere conditions due to atmospheric releases of fission products, including nuclear weapons testing in 1977 and 1980 and the Chernobyl accident in 1986.

2 - Data thru August 1994.

Table 2-6. Direct radiation (TLD) results in mR/y 1977–1994 at the Sheffield site.

ID	Location	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1983	1984	1987	1988	1989[1]
1	Air Sampler Housing	124	86	114	99	100	115	128	117	80	50	62	95	121	53	43
2	Above Change Romm Door		335	194	134	469	470	161	186	69	41	58	44		42	30
3	South Fence Near West End		198	138	106	188	163	93	102	47	62	69	44		54	49
4	Near White Fence by Office		239	140	99	121	186	112	124			62	43	54	56	47
6	Northeast Corner of Fence							200	146		58	66	47	65	51	42
7	Northwest Corner of Fence							189	179		75	80	77	53	57	48
8	Southwest Corner of Fence							216	153		57	73	75	51	51	42
9	Southeast Corner of Fence							190	179		38	73	62	44	46	28
	On-Site Average	124	215	147	110	220	234	161	148	65	54	68	61	65	51	41
5	In Sheffield							64	72	48	50	51	43		54	45
10	1 Mile North of Site							68	84		61	69	64			
11	1.5 Miles East of Site							60	58		57	47	68			
12	1 Mile South of Site							75	84		68	69	46			
13	1.5 Miles West of Site							79	95			66	60			
14	Big Bend Conservation Area											100				
	Off-Site Average							69	79	48	59	67	56		54	45

ID	Location	1989[2]	1990	1991	1992	1993	1994[3]
1	Nothwest Corner of Fence	61	61	57	55	51	49
2	Southeast Corner of Fence	54	50	47	47	45	43
3	Middle Of Fence South Side	62	58	54	52	50	51
4	Southwest Corner of Fence	58	61	59	59	56	54
5	Middle of Fence West Side	66	57	59	58	53	57
6	On Fence at Well C-150	66	64	62	61	58	56
7	Middle of Fence North Side	63	60	59	55	50	51
8	Middle of Fence East Side	60	56	55	49	46	46
9	Air Sampler Housing	40	40	43	42	40	39
10	Adjacent to Well C-434	57	62	61	58	53	55
11	Southwest Corner of Buffer Zone Fence	64	57	54	52	47	48
12	Buffer Zone Fence at End of Lake Road	62	54	54	54	50	51
13	Buffer Zone Fence at NW Corner of Lake	60	58	55	54	51	54
	Site Average	59	56	55	53	49	50

1-Data Prior to August 1989   2 - Data Since August 1989   3-Data Thru October 1994

body of water from which the fish was obtained, especially in a freshwater aquatic environment. For this reason, strontium in fish is a sensitive indicator and strontium is seldom routinely measured in water. Strontium that has been detected in bottom sediment samples in many control areas of Illinois is attributed to global fallout from nuclear weapons testing.

Burrowing animals have been observed occasionally in the vicinity of the trenches and could transport contamination to the surface of the ground if they burrowed through contaminated soil. Two ground squirrels caught in 1984 in the southwest corner of the site were analyzed at Argonne National Laboratory using gamma spectroscopy. Only naturally occurring potassium-40 was reported.

SUMMARY

The Sheffield LLW site operated from 1966 until 1978. It has been closed in accordance with the Agreed Order of 1988 which specifies the actions required to safely close the site and assure it continuing safety in the future.

Environmental monitoring of the Sheffield site started in 1967. No radioactive material above natural background was found in any of the monitoring wells until 1976. In 1976, tritium was detected migrating in a narrow pathway extending to the northeast and terminating in Trout Lake. The quantities of tritium migrating remain below the applicable maximum permissible concentration set in the Agreed Order of 1988. The tritium concentrations in the public and private drinking water supplies remain at background levels. By 1988, the buffer zone was extended to include Trout Lake.

The new, low permeability cap was completed in late summer 1989. The graph of tritium in the Northeast Pathway Wells demonstrates the tritium concentrations prior to the completion of the cap and subsequent to it. Prior to installation of the cap, the tritium concentrations averaged about 400 nanocuries per liter (nCi/L) around the rising trend line. After installation of the cap, the concentrations continued to increase at an average rate of approximately 107 nCi/L and peaked at 890 nCi/L in well No. 575 about the third quarter of 1990. Subsequently, the concentrations have decreased at a rate of 86 nCi/L per year. These data suggest that the decrease in concentrations may be due to the effectiveness of the low permeability cap.

Only background radioactivity has been found from the air sampling data. Potassium-40 and radium-226, naturally occurring radionuclides, have been found in the soil samples. Radionuclides from fallout and tritium from the trenches have been detected in vegetation samples. The fish samples have contained strontium-90 from fallout and naturally occurring radionuclides. Only naturally occurring potassium-40 was found in squirrels.

Direct radiation measurements indicate that although the direct radiation levels were elevated during the period that radioactive waste was temporarily stored above ground at the site, direct radiation levels returned to background after the waste was placed in the trenches and covered.

Data collected through 1994 indicate that the closure activities specified in the Agreed Order are functioning as designed. Levels of tritium in both ground and surface water are decreasing; residual contamination is mostly contained within the buffer zone and only minute quantities of radioactive material from the site are detected in ground and surface water beyond the buffer zone.[2-1] Results of

sampling and analysis have not detected any off-site exposures attributable to the Sheffield low-level radioactive waste facility. No known exposure to nearby residents has occurred.[2-1]

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CHAPTER 3

Environmental Summary of the Maxey Flats, Kentucky Low-Level Radioactive Waste Disposal Site

INTRODUCTION

Background

The Maxey Flats site has been owned by the State of Kentucky since 1963 and was leased by NECo in that year. The site was used for radioactive waste disposal from May 1963 until December 1977. The Cabinet Health Services (Cabinet for Human Resources) issued an order closing the site to the receipt of commercial waste in December of 1977. In May 1978, the Commonwealth purchased the site from U.S. Ecology (NECO); in addition, the Commonwealth indemnified U.S. Ecology via this agreement.

Kentucky is an Agreement State with licensing authority delegated from the U.S. Nuclear Regulatory Commission (NRC). The Kentucky Natural Resources and Environmental Protection Cabinet is the licensee, while the Cabinet for Health Services (Cabinet for Human Resources) is the agency responsible for the licensing of material in Kentucky.

In 1986, the U.S. Environmental Protection Agency (EPA) placed the Maxey Flats site on its National Priorities List of hazardous sites, based on a Hazard Ranking System score of 31.7. The hazard ranking is the method by which the EPA uses site investigation data in a mathematical formula to rate the magnitude of hazards presented by a particular site. If the hazard ranking is 28.5 or greater, a site is placed on the National Priorities List, making it eligible for cleanup under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, commonly referred to as the Superfund law) and the Superfund Amendments and Reauthorization Act (SARA). CERCLA is intended to protect public health and the environment from uncontrolled releases of hazardous substances into the environment. Whenever possible, the tax money spent on cleanup of a designated site is recovered from potentially responsible parties. Over 832 organizations shipped LLW to the Maxey Flats site. The federal government, cooperatively with the Commonwealth of Kentucky, has the CERCLA oversight lead for conducting additional work at the site.[3-1]

Location

The Maxey Flats commercial low-level radioactive waste disposal facility is located on 102 hectares (252 acres) in Fleming County, Kentucky (Figure 3-1).

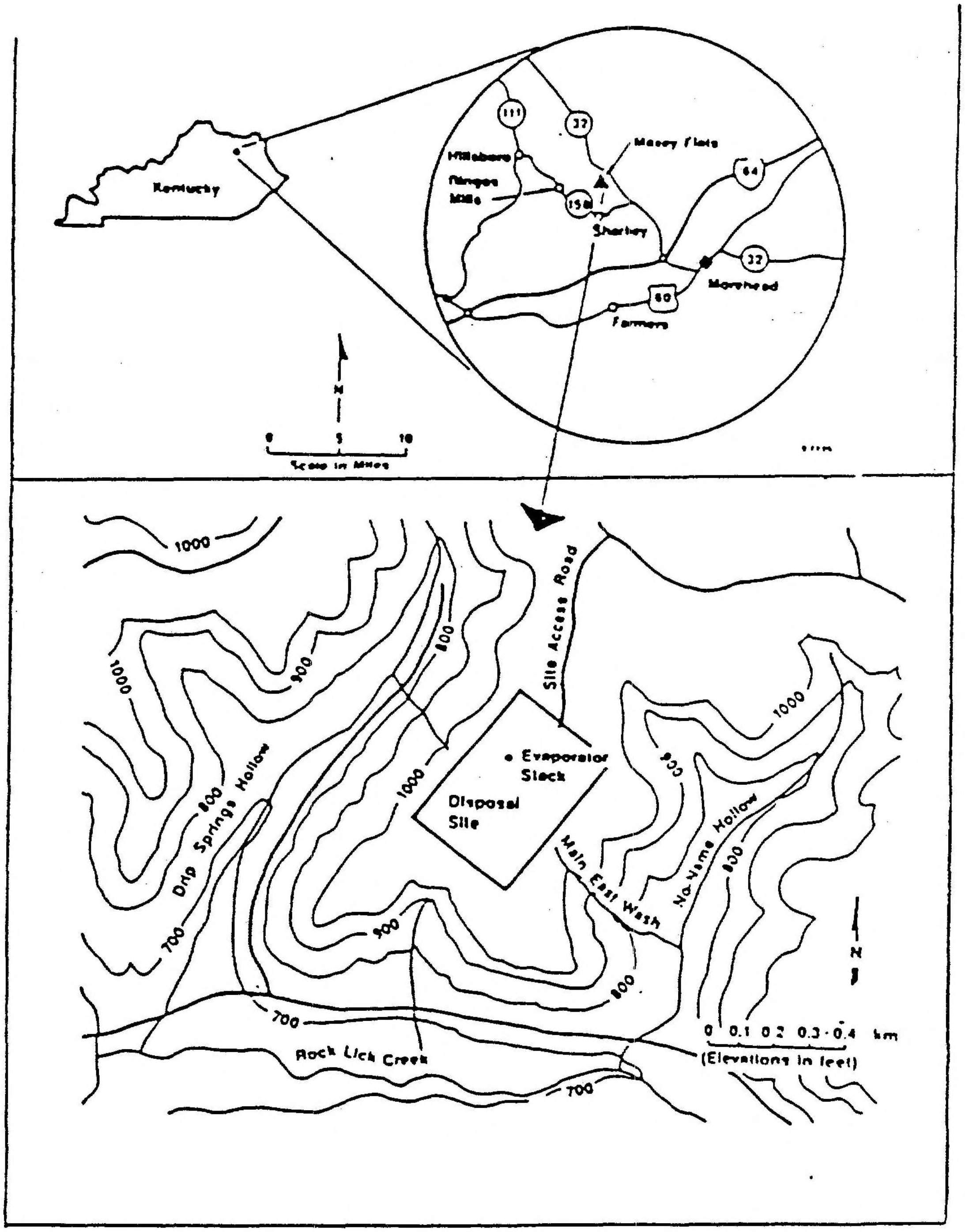

Figure 3-1. Location of Maxey Flats site.

Facility

The designated restricted area (Figure 3-2), where entry is controlled for the purpose of radiation protection, is 17 hectares (42 acres). Wastes were buried (Figure 3-3) in 52 trenches of varied geometry, a number of wells and several special pits. Most of the wastes were solids and were buried in rectangular trenches about 8 m (25 ft) deep. The sides of the trenches were essentially vertical,

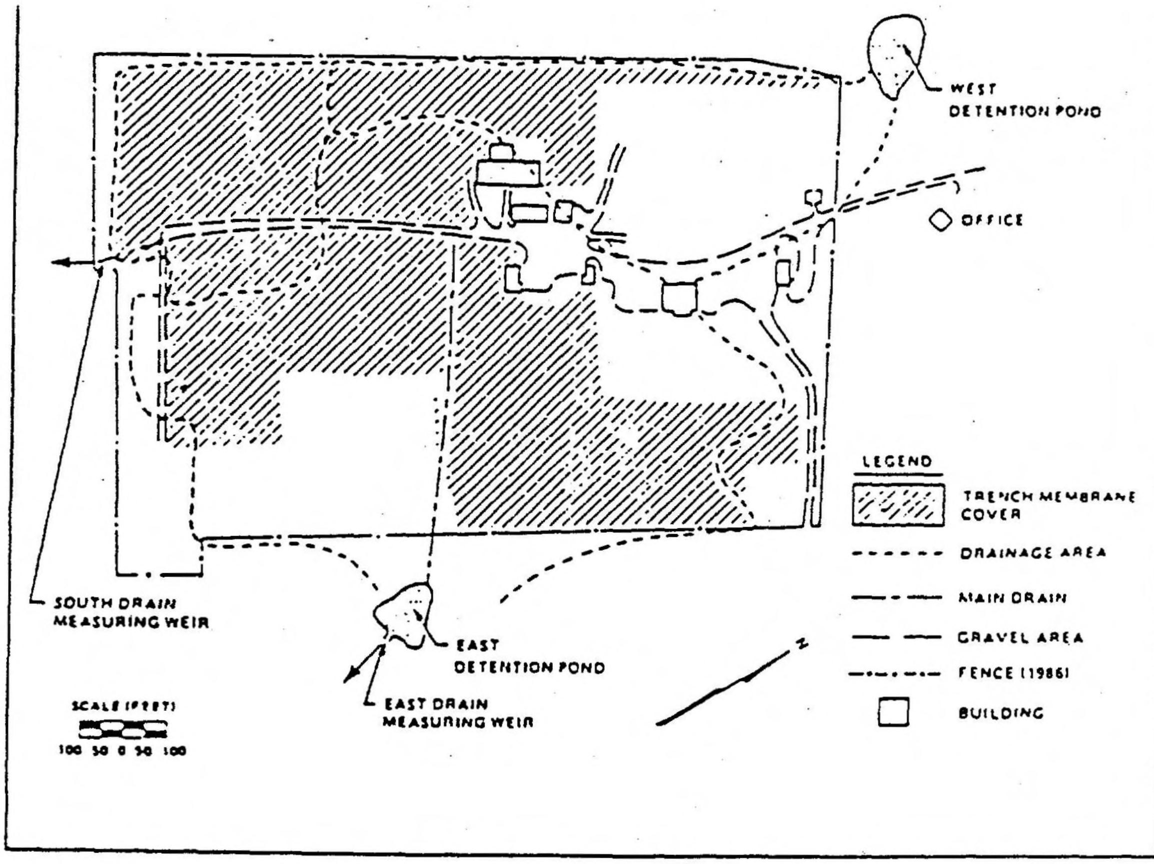

Figure 3-2. General map of the restricted area at the Maxey Flats site.

and adjacent trenches were separated by approximately 3 to 6 m (10–20 ft) of undisturbed soil and rock. The trenches are separated by about 1.5 to 2 m (5–10 ft) of shale containing several thin (less than a meter thick) sandstone beds

Most of the wastes were received in steel drums. Other packages included concrete and steel tanks, concrete vaults, and wooden and cardboard boxes. The materials included animal tissue, paper, cardboard, wood, plastics, organic chemicals, clothing, protective apparel, laboratory glassware, obsolete equipment, duct work, radiopharmaceuticals, plastic tubing, and rubble. Other materials included solidified liquids, shielding, filters, ion-exchange resins, activated metals, and evaporator sludges.

To minimize exposure to site workers, the waste containers were placed in the trench bottom in a random manner. The waste was covered with soil on a regular basis to limit possible direct radiation exposure from the trench. No special attempt was made to fill voids between the waste containers with backfill soil.

When filled, the trenches were covered with approximately 1 to 3 m (3 to 10 ft) of compacted clay and crushed shale.

Trenches 45–51 were filled after the site was closed to the receipt of commercial waste and were used for the disposal of wastes resulting from the site water management program and rubble from the dismantling of surplus facilities and equipment. Most of the trenches were unlined, with dimensions of

the trenches ranging from 3 to 200 m (15 to 670 ft) long, 3 to 20 m (10 to 70 ft) wide and 3 to 10 m (10 to 35 ft) deep. The burial media consisted predominately of a poorly fissile shale interbedded with

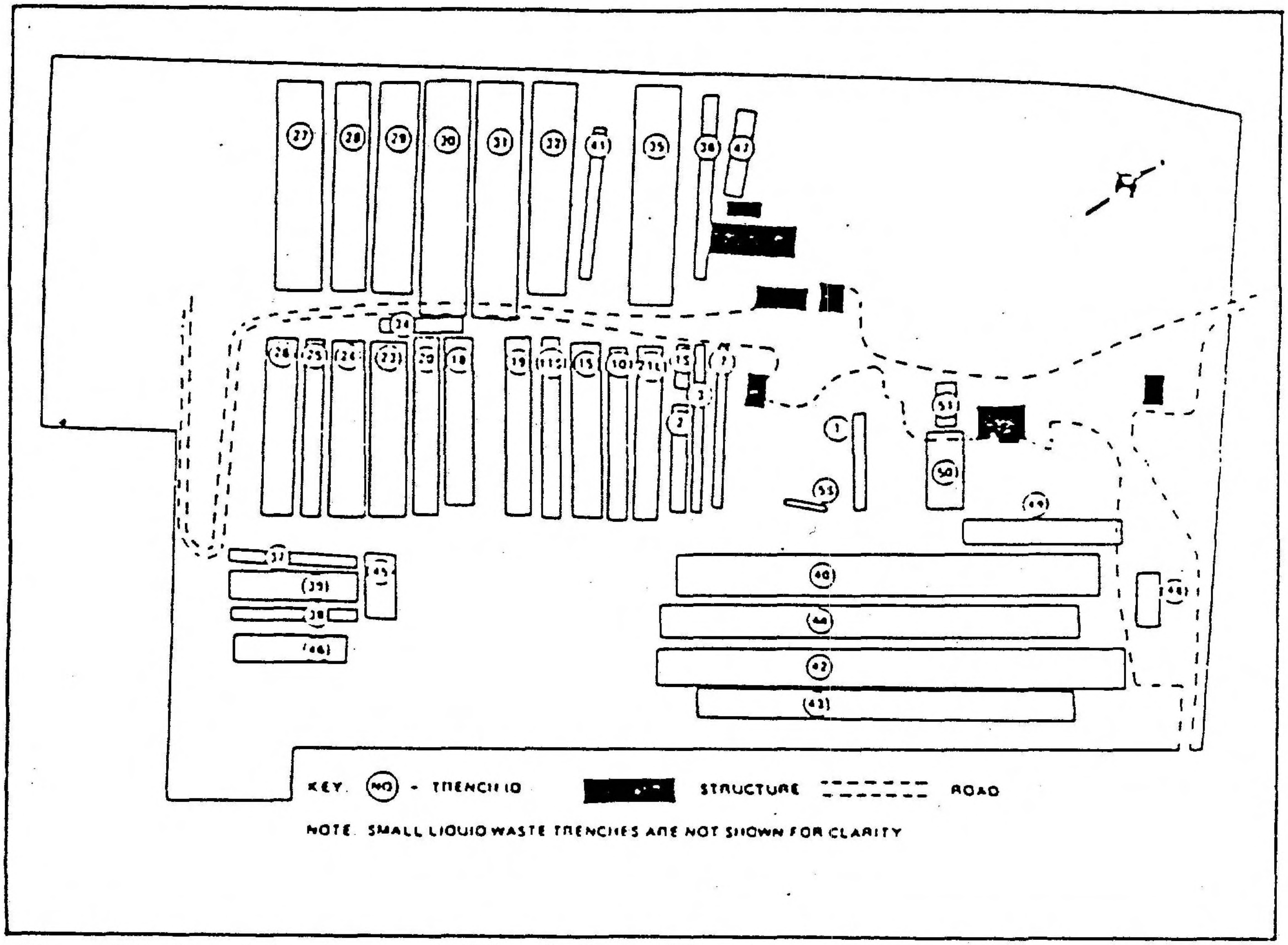

Figure 3-3. Trench locations as of 1987 at the Maxey Flats site.

lenses of fine-grained sandstone and siltstone. The clay-rich cover soils range in depth from less than 1 to 5 m (3 to 15 ft).

As site operations progressed, difficulties occurred due to the method of trench construction, waste placement, and closure.[3-2,3-3] Because the soils under the trenches were generally low in permeability, water collected in the open trenches during site operations (over the 1 to 1-1/2 years before trench cover installation). In addition, precipitation infiltrated through the trench covers and some water entered laterally from adjacent areas.

The waste form also became a significant factor. The original packages contained large void spaces. Degradation and decomposition (a process enhanced by contact with water) produced additional voids. The voids resulted in trench cap subsidence. Surface cracks or depressions were repaired regularly by placing additional fill over the affected area.

Additional water filtered into the trenches and continued the cycle of water entry.[3-4] By the early 1970s, sufficient water had accumulated in the completed trenches that a water management program was implemented. Excess water was pumped out and either solidified or evaporated. Dewatering continued as rainfall infiltrated the trench area.[3-2]

Because the water volume was large and continually replenished by infiltration, pumping and treating was unable to remove all trench water. In addition, chemical agents present in the waste accelerated the leaching of radionuclides. To reduce the likelihood of water contacting the buried waste, site operations were modified, by grading to improve surface drainage, recapping older trenches to reduce cap permeability, improving new trench-capping procedures, establishing a vegetative cover over completed trenches (subsequently eliminated in favor of plastic), eliminating on-site ponds, installing additional trench sumps to facilitate water removal, routinely backfilling waste as it was placed in the trenches, and removing precipitation from the trenches while they were open and being filled.

Because of the Commonwealth's efforts to prevent vertical infiltration, removal of water ceased and the evaporator was shutdown in 1986.

Volume

Approximately 140,000 m^3 (4.8 million ft^3) of waste, containing over 89,000 TBq (2.4 million curies) of byproduct material, 431 kg (950 lb) of special nuclear material, and 240,000 kg (533,000 lb) of source material were buried during the period of commercial operation. The waste included plutonium, strontium, and gamma-emitting radionuclides. The most abundant radionuclide in the waste was tritium. Uncertainty exists regarding the activity of the waste because much of the waste sent to the site was labeled mixed fission products. In some trenches, approximately 50% of the waste was mixed fission products.

Stabilization and Closure

The radioactive materials license issued to the site operator required that disposal be halted when the waste had reached a level approximately 1 m (3 ft) below the original ground surface. One meter (3 ft) of soil was required to be placed over the waste. This soil cover was emplaced and contoured to promote drainage away from the trench. Figure 3-3 is a 1987 map showing the trench boundaries as best identified from old records, geophysical surveys, and trench dewatering well (sump) installations.

Since 1981, over 11 hectares (28 acres) of the site surface have been covered with a polymer membrane (polyvinyl chloride). This trench surface cover, which limits the infiltration of surface water into the trenches, reduces the formation of trench leachate. Trench leachate is formed when water frees constituents from the waste. Several radionuclides have been leached and moved into the environment at differing rates. Although the trench surface cover is effective in reducing the infiltration of water from the surface, some leachate is still being produced.

In order to greatly reduce or prevent the percolation of water into the trenches,[3-4] remedial actions are now being directed toward meeting the Kentucky's regulatory requirement for longer-term stability—both by building a long-lasting, water-repellant closure cap to shed rain water and snow melt

(likely to extend over an area greater than is presently covered) and by horizontal ground water flow barriers.

SITE

Topography

The Maxey Flats site is in the Knobs region of Kentucky on a flat-topped ridge. This region was once a near-flat, upland area. Over time, the terrain was dissected by erosion and, as a result, now consists of a series of elevated, nearly-flat erosional terraces which are separated from wide, flat stream valleys at lower elevation by side slopes which have steep gradients, in excess of 40%.

Maxey Flats is the name given to one of the larger terraces in the region, approximately 6 km (4 mi) in length, with an average width of about 450 m (1,500 ft). The terrace lies about 85 m (280 ft) above the wide valley floors of Crane Creek to the north and Rock Lick Creek to the south. Surface topography of the terrace varies from 320 to 330 m (1,040 to 1,060 ft) above sea level.

The portion of Maxey Flats occupied by the disposal site is a large southern spur of the terrace. The width of the terrace at the site varies from 400 to 600 m (1,200 to 2,000 ft). The spur crest slopes gently to the south, while the disposal site area slopes gently to the west, east, and south.[3-5]

Climate

The climate at the site is typical of the central part of the United States, which has a Koeppen classification of Continental, characterized by warm humid summers and cold winters. Frontal systems move across this portion of the United States from both west and north out of the Gulf of Alaska and Canada, and from southwest to northeast out of Gulf of Mexico.

The average annual precipitation measured (1941–1970) at Farmers, Kentucky, eight miles south of the site, is 102 cm (44.3 in.). The fall season characteristically has the least rainfall, while spring and early summer are the wettest seasons. Precipitation occurs in conjunction with major weather systems and from short-duration spring and summer thunderstorms. Rainfall which occurs during the high-intensity thunderstorms frequently exceeds 5 to 8 cm (2 to 3 in.) and occasionally 12 to 15 cm (5 to 6 in.).

Winds generally blow from the southwest in spring and early summer and from the south in the fall. The total annual evaporation rate, as determined from the U.S. Weather Bureau Climatic Atlas, is about 90 cm (35 in.). Approximately 75% of the evaporation occurs from May to October.

Land Use

The Maxey Flats site includes 102 hectares (252 acres) of rural land. Within the 17-hectare (42-acre) restricted area (Figure 3-2), 10 hectares (24 acres) were used for waste disposal.

At the beginning of the 1990s, approximately 57 residential structures existed within a 1.5 km (1 mi) radius of the Maxey Flats site, housing approximately 152 persons.[3-6] In an area between 1.5 and 4 km (1 to 2.5 mi) distant, 192 residential structures house approximately 511 persons. Of this estimated 663 persons within 4 km (2.5 mi), an estimated 148 (22.3%) are women of childbearing age (15 to 44 years old), and an estimated 148 (22.3%) are children (under age 14). Approximately 11 residences are within 1 km (0.5 mi) radius, with an actual population of 25 persons (14 male and 11 female).[3-6]

Geology

The Maxey Flats area is underlain by Mississippian and older sedimentary rocks. Table 3-1 is a summary of the stratigraphic sequence exposed in the vicinity of the site. The site subsurface is representative of the eastern flank of the Cincinnati Arch and consists generally of gently-dipping sedimentary rocks, including clay-shale, siltstone, fine-grained sandstone, and fissile carbonaceous shale.[3-2,3-7] Disposal trenches were located within the weathered surface soils and the Nancy Member of the Borden Formation. Near-vertical fractures are common in the media underlying the site, but the detailed locations and extent of fractured formations cannot be ascertained. The stratigraphic sequence extends to the Crab Orchard Formation because this formation is considered to be the lower boundary to the ground water system in the vicinity.[3-7]

The uppermost rock unit is the Nancy Member of the Borden Formation, which is predominantly a massive, poorly-fissile, dark-blue-to-greenish shale interbedded with lenses of finely-grained sandstone and siltstone. When excavations are made within the Nancy Member, the shales which comprise the majority of this member deteriorate along the excavated surface, causing the shales to appear cracked and broken. Stress relief occasioned by the excavation and weathering due to exposure

Table 3-1. Stratigraphy of the Maxey Flats site.[3-2]

Geologic formation	Description	Average thickness (ft)
Borden formation	Nancy Member—Predominantly massive shale, with some thin sandstone layers, irregularly spaced vertical joints (0.5–0.25 m, 2–10 in.)	45
	Farmer Member—Predominantly sandstone, silty sandstone with minor shale; vertical joints (predominantly in the upper portion)	35
	Henley Bed—Basal portion of the Farmers Member; commonly contains a few sandstone beds or lenses 0.3–0.6 m (1–2 ft) thick in upper part	6
Sunbury shale	Fissile black shale with vertical joints	18
Bedford shale	Bluish-gray shale with thin sandstone with vertical joints	25
Ohio shale	Fissile black shale	185
Crab orchard	Greenish-gray poorly fissile shale (upper portion)	80–130

of the shale to the atmosphere is the likely cause.[3-2] This condition is not representative of the Nancy Member where the shales are not weathered or exposed at the surface.

Weathering of the Nancy Member forms the regolith at Maxey Flats. The sandstone beds are very fine grained silty sandstones in some areas, but are siltstones in others. An upper sandstone bed is near the top and ranges in thickness from less than 0.1 m (4 in.) to about 1 m (3 ft), averaging about 0.5 m (1.5 ft). The lower sandstone bed is near the middle of the regolith and ranges in thickness from 0.1 to 1 m (less than 4 in. to 3 ft), and averages about 0.3 m (1 ft). The sandstone beds are absent locally due to nondeposition or erosion of the upper bed in places but both are present over most of the Maxey Flats site.[3-2]

The Farmer Member (a sandstone unit) is exposed in the East Main Drainage Channel to the east and south of the site, where it stands nearly vertically and serves as a barrier to erosion. The Farmer Member is not exposed on the western slope which is covered with regolith to the valley floor.

The hillsides at the site are covered with a layer of rock fragments and soil materials referred to as colluvium. The colluvium extends to the valleys, where it is referred to as alluvium.

Surface Water

The entire Maxey Flats region lies in the watershed basin of the Licking River, which drains into the Ohio River near Cincinnati, Ohio. Greater than 90% of the water draining the 102 hectare (252 acres) site discharges to Rock Lick Creek, which empties into Fox Creek. Fox Creek enters the Licking.

Drainage to the east carries approximately 62% of the surface water exiting the restricted area. Discharge over the eastern slope is regulated by a detention pond which discharges into an unnamed hollow (referred to as No Name Creek).

Approximately 15% of the site restricted area drains to the south directly into Rock Lick Creek. Approximately 20% discharges via the west detention pond into Drip Springs Creek which empties into Rock Lick Creek.

Ground Water

The shales and fine-grained sandstones of the site generally have low primary permeability. Ground water flow occurs mainly in joints and fractures in these rocks.

Water is found in the rock structure beneath the site, in at least two separate units. Water levels in these units are about 8 m (25 ft) and over 90 m (300 ft) below land surface. Other distinct hydrologic units may be present, but have not been identified.

The hydrological characteristics of the relatively shallow (average 12 m or 40 ft) Nancy Member of the Borden Formation are of particular importance because all waste burial trenches were

constructed in these strata. Also, most problems, such as the accumulation of water in the trenches and subsurface lateral migration of leachate, result from movement of water in these strata.

The importance of the upper and lower sandstone beds to ground water recharge and discharge became more apparent after drilling by the U.S. Geological Survey (USGS). Abrupt changes in the occurrence, thickness, amount of fracturing and its orientation (particularly with regard to the lower bed) were found to be characteristic of, and appear to determine, the movement of water from the trenches to perimeter wells.[3-8]

Previous estimates[3-2,3-7] of ground water flow in the lower sandstone bed were 15 m/y (50 ft/y). Based on yields of wells on the west hillside, this estimate may be low by one or more orders of magnitude. Radionuclide and organic chemical movement has been found in ground water flowing in the lower sandstone bed in a triangular shaped area in the northwestern section of the site.

The extent of contaminated ground water appears to be controlled by the thickness of the lower sandstone bed beneath the south edge of Trench 41, the plugging of fractures with colluvium just inside the western hillside outcrop area, and the complete absence of the lower bed along a line from the east end of Trench 41 to a point near the northwest fence. The absence of this lower bed apparently prohibits the lateral movement of contaminated water from reaching other subsurface or outcrop areas.[3-8] Subsurface migration occurs from trenches south of Trench 41. Trench 41 received little waste and was closed early; furthermore, Trench 35 is the only major trench north of Trench 41.[3-11]

The rate at which rainfall percolates to the ground water system is low because of the silty nature of the surface soils and the consistently high runoff of incident precipitation. Ground water circulation within shallow ground water systems is influenced by the topography of the areas. Extreme relief enhances lateral ground water flow toward topographically low areas. Because of the presence of low permeability shales, much of the water which does percolate to the ground water system discharges through hillsides rather than recharging the deeper strata. Only about 10% of the water which infiltrates the bedrock at the burial site is estimated to percolate to the Ohio shale.[3-7] This conceptual flow model of the site indicates that 70% of the water which infiltrates the site bedrock discharges to the hillside above the lower part of the Farmers Member.[3-7]

Ground water discharging to the ground surface on hillsides may be evaporated, transpired, or may eventually flow into the valley alluvium of Rock Lick Creek. Ground water discharge from rocks underlying the trench area may contribute as much as 0.5% of the mean annual base flow of Rock Lick Creek.[3-7] This percentage is further diluted by surface runoff. An average dilution factor of 2,000 is estimated at the USGS gaging station on Rock Lick Creek,[3-7] with mean annual base flow at the USGS gaging station estimated to be 7 m^3/s-d (240 ft^3/s-d).

Ecology

The site is in a humid environment. Predominantly oak-hickory forests occupy the steep slopes on the eastern, southern, and western sides of the site. The forests, because of their locations in relation to the burial trenches, are in a position to intercept radionuclides that might be transported downslope (Figure 3-4) by surface water runoff or subterranean water flow from the site.[3-4]

ENVIRONMENTAL MONITORING

Overview

In October 1974, Kentucky informed the U.S. Atomic Energy Commission (predecessor of NRC) of the results of a special six-month environmental study at Maxey Flats.[3-9] The study concluded that the disposal site was contributing trace amounts of radioactivity to the local environment, although the

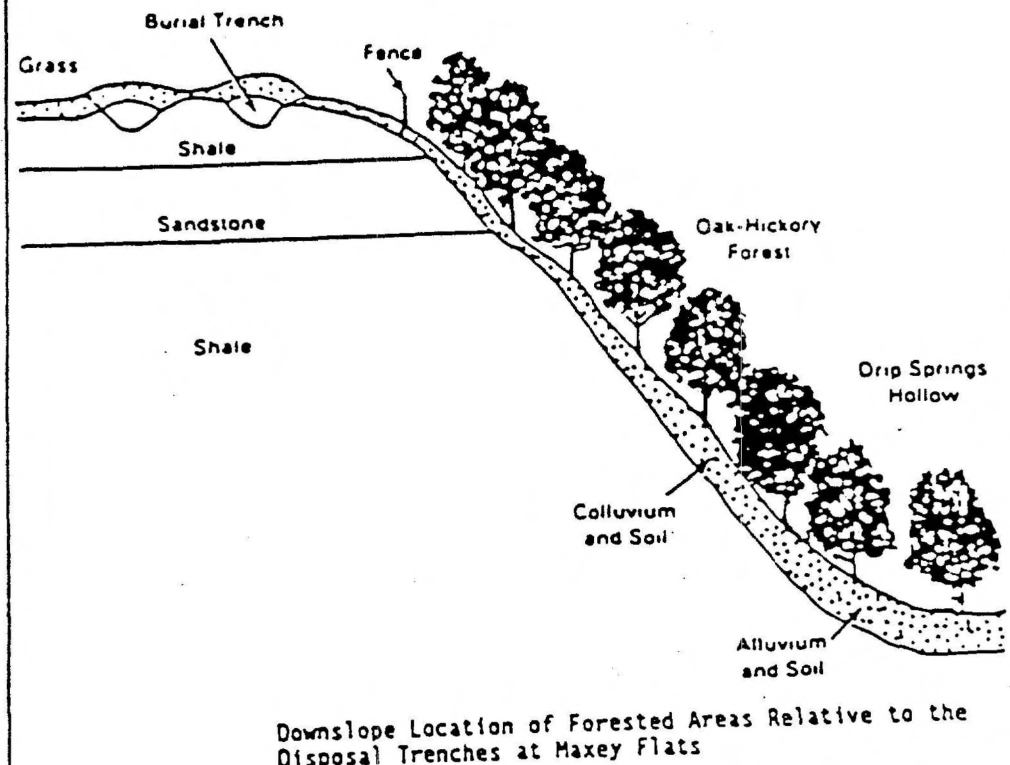

Figure 3-4. Downslope location of forested areas relation to the Maxey Flats site.

levels did not represent a public health hazard. Tritium, cobalt-60, strontium-89, strontium-90, cesium-134, cesium-137, plutonium-238, and plutonium-239 were identified in individual samples in the unrestricted environment. Kentucky recommended longer-term studies at the facility to assess the health and safety significance of their findings.

In 1977, radioactivity in water was detected moving through the joints of a sandstone bed, a distance of approximately 90 m (300 ft) from the apparent source trench. In May 1977, Trench 46 was opened and water was detected on the side wall. The events associated with this subsurface movement resulted in closure of the site to commercial waste by the Cabinet in December 1977.[3-11]

Interpreting data from the site environs is complicated by the fact that other past routes existed for radionuclide movement besides subsurface aquifer transport. Radioactive liquids were spilled. Reworking of trench subsidence areas to form new caps resulted in localized spread of contamination, although removal action has reduced the amount of this radioactivity now available for surface dispersal to the off-site environment. At least four pathways have been identified since the 1970's by studies carried out by the Commonwealth of Kentucky, Commonwealth contractors, the NRC, the U.S. Geological Survey (USGS), and the U.S. Department of Energy (DOE):

1. Surface water runoff

2. Atmospheric fallout from the evaporator (prior to closing in 1986)

3. Lateral movement of liquids from trenches through the soil

4. Movement of liquids from the trenches through fractures in the surrounding rock.

Features of the site which create ongoing conditions which affect the environmental monitoring are:

- The very low overall permeability of the rock formations at the site which allow accumulation of liquids within the trenches

- Fractures, which exhibit a much greater permeability than the unfractured bulk of the rock, creating uncertainty regarding the direction and occurrence of ground water movement and making a thorough understanding of hydrologic conditions at the site difficult. This in turn makes it difficult to implement a ground water monitoring program that will give a high level of assurance that migration will be observed, should it occur

- Long-term consolidation of loosely placed waste in the trenches, leading to subsidence events which can damage trench cover and increase infiltration of precipitation

- Accumulation of water in contact with the waste for a period of time sufficient to become contaminated, creating a potential environmental hazard if the leachate exits the trench by fracture flow or overflow

- The controlled migration of radionuclides and other hazardous materials to the environment—leachate buildup within the trenches was controlled by pumping it and processing it through the leachate evaporator system for volume reduction, with some release of radionuclides to the atmosphere.[3-10] Leachate is no longer removed from the trenches. The site has stabilized in regards to infiltration/exfiltration because of the presence of covers.

The Kentucky Radiation Control Branch routine environmental monitoring program at the Maxey Flats site is designed to address these features of and pathways for potential release of radioactivity from the site. For example, sampling in 1991 included surface water (off-site and washes), drinking water wells, USGS test wells, and soil lysimeters. During 1991, 2,209 water samples were collected to a distance of 7 km (4.5 air mi). The Kentucky Radiation Control Branch Laboratory conducted 7,788 analyses and 4,894 additional quality control analyses to insure the accuracy and precision of the tests.

All water samples collected are analyzed for tritiated water (HTO) and gross alpha and beta radioactivity. Water samples from selected locations are analyzed for gamma-emitters, strontium-90, and specific alpha-emitters by alpha spectroscopy. Extended radionuclide and other analyses (gamma-emitters, carbon-14, strontium-90, plutonium, uranium, HTO, pH conductivity, and gross alpha and beta) are conducted on water from the USGS test wells surrounding the site and the seeps on the east hillside. The radionuclide analyses of the water samples provide valuable information regarding the spread of contamination from the burial trenches. Sampling frequency and locations are such that any changes in radionuclide levels would be detected within sufficient time for remedial action to be formulated.[3-11]

Ground Water

In order to characterize the ground water conditions of the site, over 100 wells have been drilled as part of the site evaluation and site monitoring activities. Locations of all wells (except the initial eight wells installed prior to site operation) are shown in Figure 3-5. None of these sampling points are usable as drinking water sources because of their locations in and around the controlled area. A history of the drilling program and details of the well designs are available.[3-7,3-12,3-13,3-14]

Many of the wells have very low water yields. As a result, representative periodic sampling proved to be difficult. Samples were bailed mechanically from the wells or sampled with a non-contaminating pump (peristaltic).

Generally, ground water samples are analyzed for tritium oxide concentrations and specific conductance. When the volume of the sample is sufficient, analysis includes gross alpha activity concentrations, gross beta activity concentrations, and concentrations of gamma-emitting radionuclides. Since the ground water monitoring program is intended to provide advance warning of radionuclide escape, analysis of samples for tritium activity is given priority. This is appropriate since tritium, appearing in the form of tritiated water, travels at the same rate as the ground water; dissolved or suspended radionuclides travel at slower rates. Tritium will likely precede the escape of other radioactive materials by a considerable period. Data from well samples collected during 1987–1989 are presented in Table 3-2.

Table 3-2. Selected ground water well sampling data for tritium (pCi/L) at the Maxey Flats site.[3-10,3-15,3-16]

Well name	1987	1988	1989
N2B	8.7×10^8	1.8×10^8	5.8×10^8
UE-1	1.4×10^9	1.7×10^9	1.9×10^9
UE-2	1.1×10^9	1.3×10^9	1.7×10^9
UE-3	6.2×10^8	5.2×10^8	3.6×10^8
UG-1	6.5×10^8	1.2×10^8	1.2×10^8
UG-2	1.5×10^8	1.6×10^8	1.5×10^8
UG-12	1.5×10^8	8.5×10^7	8.8×10^7
UK-1	6.0×10^8	1.1×10^9	9.7×10^9
UK-2	2.3×10^9	1.2×10^9	1.8×10^9
UK-4	1.0×10^3	$<4.0 \times 10^2$	5.0×10^2
UK-6	8.0×10^2	6.0×10^2	2.6×10^3
UF-1	8.7×10^8	8.2×10^8	8.2×10^8
UF-2	8.7×10^8	7.2×10^8	8.5×10^8
UF-11	1.0×10^3	8.0×10^2	4.0×10^2
UF-20	2.0×10^3	1.4×10^3	1.1×10^3
UF-38	7.0×10^3	5.0×10^3	5.0×10^3
UF-47	1.1×10^4	1.9×10^4	1.1×10^4

Table 3-3. Kentucky maximum permissible concentrations of radioactivity in air and water.[3-17]

	Air (pCi/m^3)		Water (pCi/L)	
	Soluble	Insoluble	Soluble	Insoluble
Tritium	2×10^5	2×10^5	3×10^6	3×10^6
Cobalt-60	1×10^4	3×10^2	5×10^4	3×10^4
Cesium-137	2×10^3	5×10^2	2×10^4	4×10^4
Strontium-90	3×10^1	2×10^2	3×10^2	4×10^4
Plutonium-238	7×10^{-2}	1	5×10^3	3×10^4
Plutonium-239/240	6×10^{-2}	1	5×10^3	3×10^4

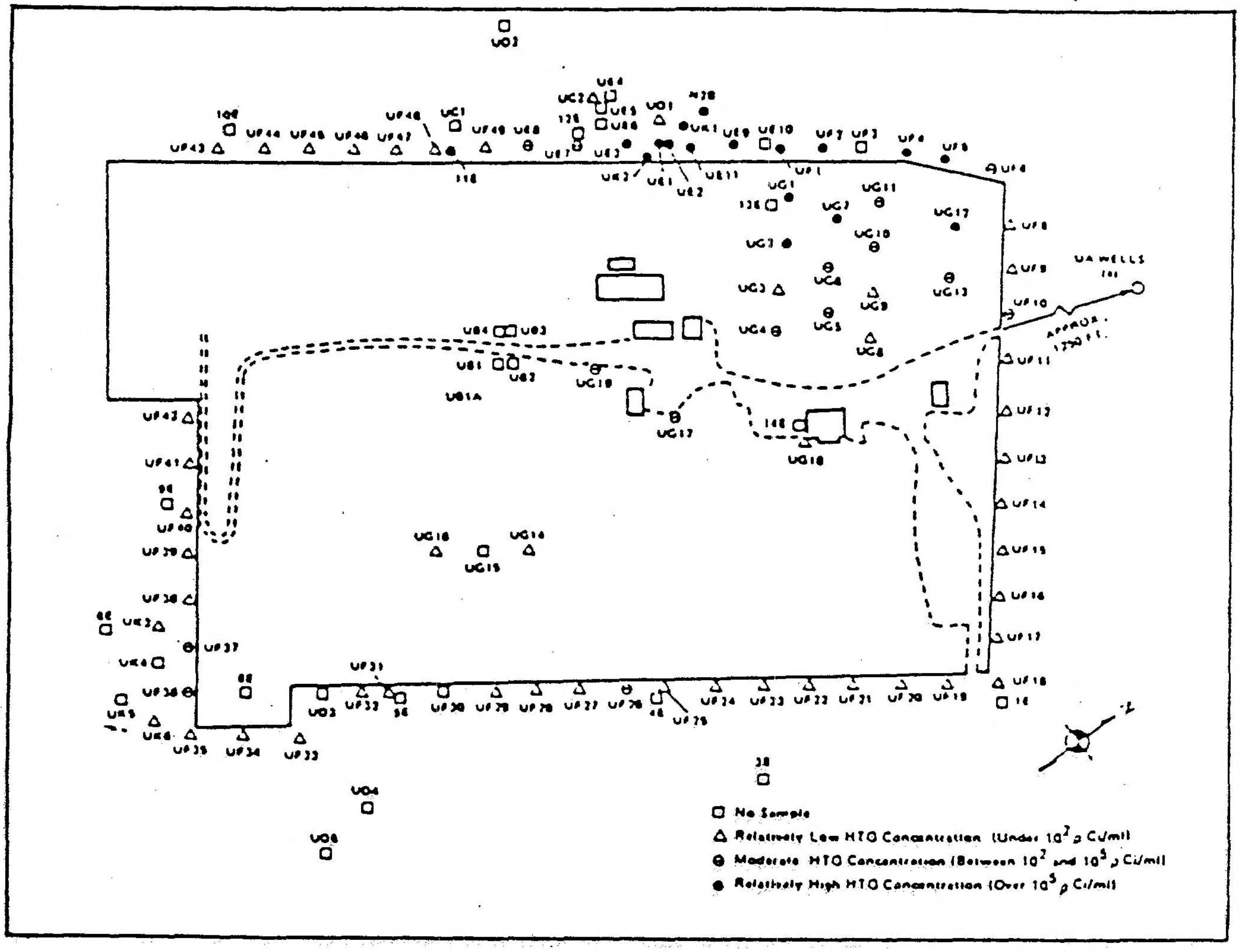

Figure 3-5. Well locations and tritium concentrations (pCi/mL) at the Maxey Flats site.

Water collected from wells located on the western boundary of the site restricted area contain the highest tritium levels. These may be compared to Kentucky regulations (Table 3-3). The highest average annual concentration of tritium observed was 9.7×10^9 pCi/L at Well UK-1 (Figure 3-5), which is located near Trench 35 along the site restricted area fence. Generally, as illustrated in Figure 3-5, the highest concentrations of tritium oxide in ground water were observed in this area. The high concentrations in the wells in the northwest quadrant of the site suggest that trench leachate has moved via the lower sandstone marker bed to distances of over 150 m (500 ft) from the trench area. Of the 78 wells sampled in both 1986 and 1987, 14 wells demonstrated an increase in average tritium concentrations, 33 had declines, and 33 showed no significant change.

Surface Water

Surface water samples are collected on the site and off-site, including washes, to a distance of 7 km (4.5 air mi).

Mean tritiated water concentrations for off-site sample locations—outside or at the site boundary—ranged from 1.1×10^5 pCi/L at the site boundary in the East Main Drainage Channel to

100 pCi/L in Rock Lick Creek about 3 km (2 mi) upstream from where No Name Creek empties into Rock Lick Creek.

Erosion continues to be a problem in all drainage areas and especially in the East Main Drainage Channel and Wash 7 on the west hillside. If erosion continues in these drainage areas, migration pathways could be intercepted leading to an increased release of radionuclides. Erosion control in the East Main Drainage Channel is critical to the stability of the site in light of the finding of seeps and springs along the east hillside.

Locations in the north drain of Trench 33L on the west hillside and the East Main Drainage Channel showed mean HTO concentrations which ranged from 3×10^3 to 2×10^6 pCi/L; however, many of these locations were dry for a substantial part of 1991. In the East Main Drainage Channel (at approximately 250 m—800 ft—above mean sea level, which can be sampled throughout the year), the mean HTO concentration was 3.1×10^5 pCi/L for 1991, compared to 2.7×10^5 pCi/L for 1990.[3-11] The elevated HTO at surface water location 144 is a result of the leaching of radionuclides from EPA solidified leachate stored on-site until November 1991 and from subsurface movement to the east drainage areas from the disposal trenches. The activity of HTO at location 144 did increase by the placement of waste solidified and stored on-site; however, migration is occurring from the 40 Series trenches to the east hillside and then into the main drainage channel. Seeps were first detected in August 1990 by the Radiation Control Branch and these seeps are routinely monitored. The soils in the area of the seeps are saturated at the ground surface during all seasons. The saturated area is expanding down slope towards the east main drain. Since the activity of HTO in the seep water is approximately 20,000 pCi/ml, saturation movement closer to the main drainage area could have a major impact on activity levels at location 144.[3-11]

Biota

Vegetation samples have been taken from pasture fields adjacent to the site and from a garden located almost 500 m (550 yd) north of the site's main office building. Vegetation samples are analyzed by various methods to determine the concentrations of tritium, strontium-90, plutonium-238, Pu-239/240, and gamma-emitting nuclides present. Tritium, strontium, and plutonium are present in measurable concentrations for all samples except cucumbers and tomatoes; tritium was not detected in the cucumber and tomato samples. No gamma-emitting radionuclides were reported above the minimum detection limits.

Nonradiological samples collected in the food crop study area indicate no site-related hazardous chemical contamination in these off-site locations. Dieldrin, a pesticide detected in one food crop sample, is likely to be related to farming activities rather than the site.

Soils

Toluene was the most widely-detected chemical contaminant at the Maxey Flats site, ranging from 40 to 250 parts per billion (ppb). Other volatile organic contaminants detected in soils include acetone and methylene chloride in low concentrations. Pesticides, polychlorinated biphenyls (PCBs), and semi-volatile contaminants were not detected in study area soil, with the exception of dieldrin, which was detected in a food crop study area. All soil samples showed inorganic chemical concentrations within

ranges considered normal for soils, with the exception of arsenic, which was found at 60 to 106 parts per million. Organic and inorganic analyses performed on these soil samples indicate that standard toxicity test (EP toxicity and TCLP) results would be negative and that other hazardous constituents would be within standards (under regulations of the Resource Conservation and Recovery Act).

SUMMARY

Radioactive materials, as described in the previous sections, were released to the environment as a result of the ongoing operations to stabilize and decommission the Maxey Flats site. These materials include radionuclides such as tritium (generally, in the form of tritiated water), strontium-90, plutonium (in Pu-238, Pu-239, and Pu-240), and various gamma-emitting radionuclides, such as cesium-137.

The Kentucky Radiation Control Branch has concluded[3-11] that analyses of test wells, soil moisture, seeps and surface water indicate that water continues to accumulate in the trenches and exfiltration from the trenches continues to occur. The radioactive material leaving the site is diluted substantially as it enters the environment. Direct measurement of the impact of the diluted concentrations of radioactive material is impractical; pathways followed by these materials to humans are evaluated using computer models and potential doses are calculated. All such calculations have documented very low exposures for all pathways. No exposures to the general public exceed federal or Kentucky regulatory standards.[3-11]

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CHAPTER 4

Environmental Summary of the Beatty, Nevada Low-Level Radioactive Waste Disposal Site

INTRODUCTION

Background

The Beatty, Nevada low-level radioactive waste (LLW) disposal facility operated by US Ecology was the first commercial low-level radioactive waste site in the United States. The Beatty site began operations in September 1962, and was closed on December 31, 1992. The LLW facility occupies 0.17 square kilometers (40 acres) of a 0.34 square kilometers (80 acres) tract which is leased to US Ecology by the State of Nevada (Figure 4-1). The remainder of the approximately 0.14 square kilometers (33 acres) is used for the disposal of hazardous chemical and toxic wastes (including PCBs). The hazardous waste site was licensed in 1970 under EPA Permit No. 330010000.

The Beatty site was originally operated by California Nuclear, Inc., and then by Nuclear Engineering Company (NECO), which is now known as US Ecology. Activities at the site are regulated by the Radiological Health Section of the Nevada State Department of Human Resources. Nevada is an Agreement State, with licensing authority delegated by the U.S. Nuclear Regulatory Commission (NRC). The site operator (US Ecology) holds a radioactive material license from the State of Nevada.

Although the State of Nevada assumed licensing responsibility for the site in 1972, the AEC, and later the NRC, retained regulatory responsibility for special nuclear material until 1977, during which time the state regulated source and byproduct materials. In 1977, the NRC license was cancelled and the state assumed licensing responsibility for all activities at the site.

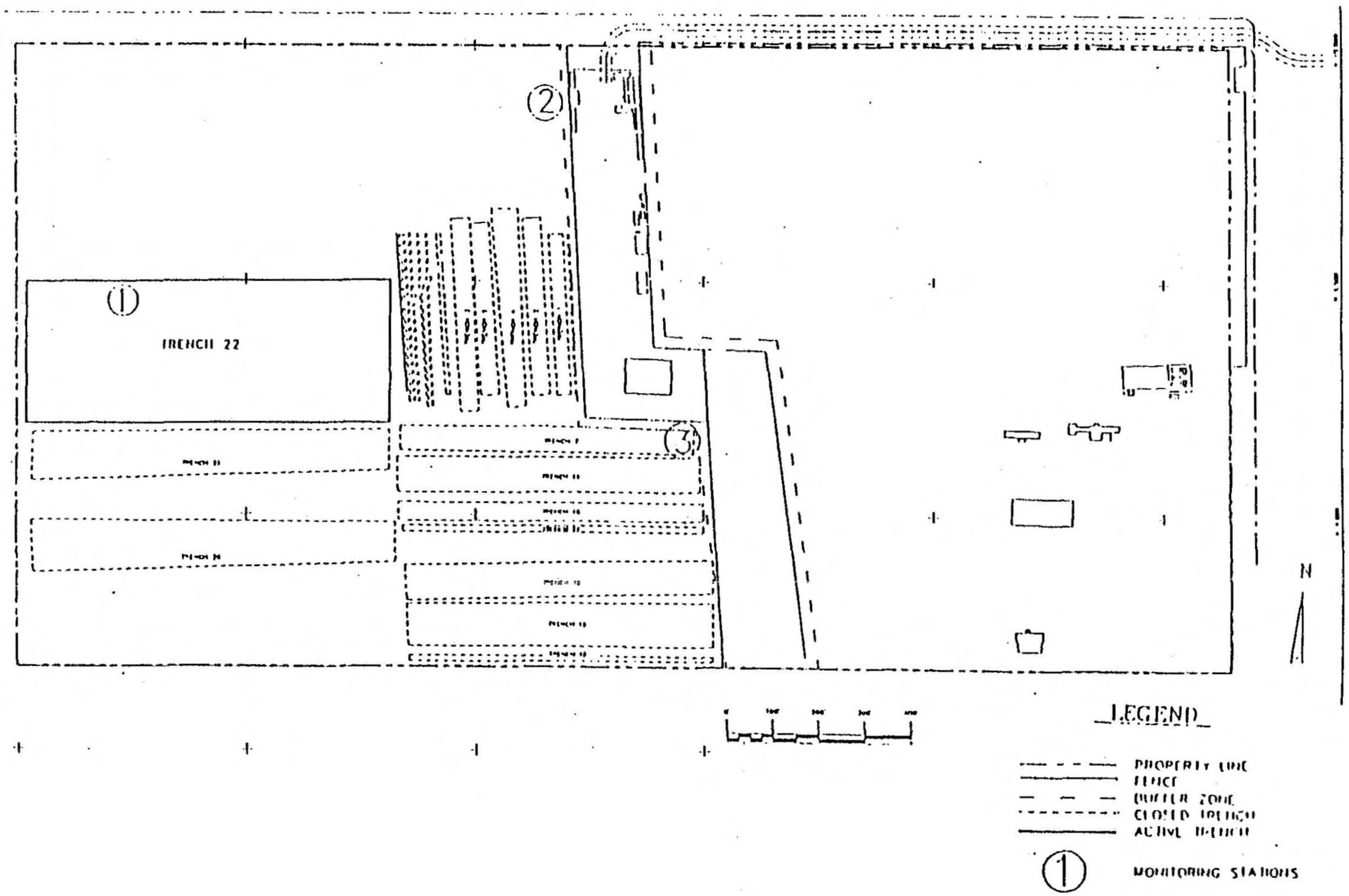
Location

The Beatty LLW facility is located in Nye County, Nevada (latitude N 36° 46' 69", longitude W 116° 41' 23"), in the Amargosa Desert, approximately 17.7 km (11 mi) south of the town of Beatty, and 169 km (105 mi) northwest of Las Vegas, Nevada (Figure 4-1).

Facility

From September 1962 through December 1992, the site received a total volume of 139,500 cubic meters (4.93 million cubic feet) of low-level radioactive waste, with a total radioactivity of approximately 2.65 E+16 becquerels (0.715 million curies) (Table 4-1). The LLW facility is separated

Figure 4-3. Airborne activity monitoring stations of the Beatty (NV) LLW site.



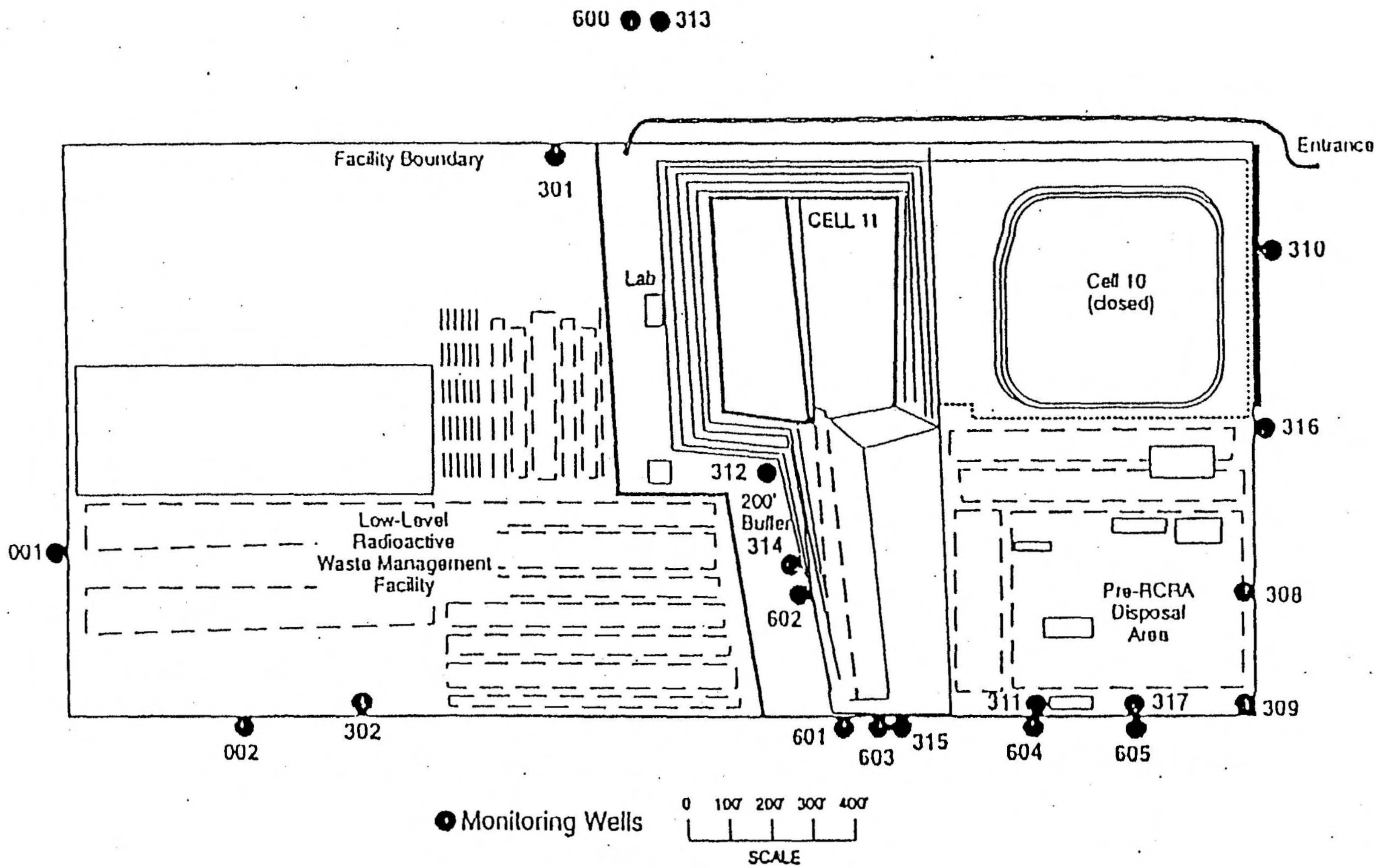


Figure 4-4. Monitoring wells of the Beatty (NV) LLW site.

Table 4-1. History of radioactive waste disposal volume and activity at the Beatty LLW site, 1962–1992.

Year	Cubic feet	Curies
1962-1965	371,500	19,400
1966	173,800	14,000
1967	94,300	11,000
1968	131,800	7,100
1969	159,900	9,800
1970	145,900	6,700
1971	173,600	4,000
1972	151,900	5,800
1973	134,700	10,600
1974	144,900	23,000
1975	174,200	15,800
1976	136,400	2,500
1977	177,500	22,800
1978	301,700	4,800
1979	230,700	9,800
1980	450,100	146,300
1981	188,300	46,100
1982	52,700	80,800
1983	39,200	1,400
1984	72,900	500
1985	48,800	500
1986	92,000	700
1987	336,000	11,000
1988	93,400	86,900
1989	116,200	42,700
1990	59,500	11,300
1991	160,300	29,700
1992	514,700	90,200
TOTAL	4,926,900	715,200

vehicles were frequently driven down ramps, and the waste was offloaded directly into the trench. Three feet of final backfill were placed over the filled trenches. An additional two feet of soil were then used as an interim cover. The radioactive waste was placed into 22 separate disposal trenches, which are identified by permanent concrete posts marked with the trench number, dates opened and closed, trench boundary coordinates, and waste characteristics; i.e., total volume and activity, as well as the quantity of source and special nuclear materials. The site records are keyed to these markers. US Ecology maintained records of waste received at the site, and compiled periodic summaries during the years of operation.

Between March 1976 and December 1979, a series of events involving the improper handling and disposal of low-level radioactive waste resulted in the temporary suspension of the site operator's radioactive materials license. Although no significant radiation exposures were reported for the workers or the public, a number of new license conditions were imposed, with the objective of tightening management control over the site operations, generators, and shippers of the waste. Additionally, a permitting system for waste shipments was established. The state also placed an inspector at the site to observe operations and to independently validate compliance of incoming shipments with regulatory requirements. In April 1981, a third-party inspection system of all generators shipping to Beatty was initiated and required. Under the inspection system, which was conducted by a contractor to the state, permits were issued only after an initial audit had been performed to verify the generator's compliance with federal and state regulations and the disposal facility license requirements. The inspection contractor also performed unannounced follow-up audits of the permitted generator.

Closure

US Ecology submitted to the State of Nevada a proposed site stabilization and closure plan for the LLW facility which provides for post-closure monitoring. The state has reviewed and approved the closure plan, and US Ecology began implementation in November 1993. As of early 1996, the site is in a post-closure and observation phase.

SITE

Topography

The Beatty site is approximately 17.7 km (11 mi) south of the town of Beatty, and 169 km (105 mi) northwest of Las Vegas (Figure 4-1). The Amargosa Desert region is part of the Basin and Range Province, which is characterized by relatively barren mountain ranges and broad, relatively flat, sparsely vegetated valleys.

Climate

The site is situated in one of the most arid parts of the United States. Mean annual precipitation is about 11.4 cm (4.5 in.) at Beatty and 7.4 cm (3 in.) at Lathrop Wells. Most of the precipitation falls during the winter months as rain. Snow is uncommon at Beatty and it persists on the ground for no more than a few hours. Summer rainfall occurs predominantly during convective storms that may yield

intense rainfall over small areas. On several occasions during late August or in September, tropical storms have come inland from the Pacific Ocean, crossing the California coast between San Diego and Los Angeles, and moved northeast across southern Nevada. Such a storm, in August 1977, produced nearly 5 cm (2 in.) of rain in 24 hours at Beatty. During 1981 through 1988, an annual average of 12.4 cm (4.9 in.) of precipitation, ranging from as little as 4.4 cm (1.73 in.) in 1985 to as much as 22.5 cm (8.9 in.) in 1983, was recorded at the waste disposal facility. Estimated mean annual potential evaporation at Beatty is about 190 cm (75.0 in.). Seasonal variation in potential evaporation ranges from 4.0 cm (1.58 in.) in December to 33.0 cm (13 in.) in July. There are no perennial streams within about 16 km (10 mi) of the site.

The temperature distribution and ranges at Lathrop Wells are similar to those at Beatty. The mean annual maximum daily temperature for the period 1949–79 is 25°C (77°F). The mean annual minimum daily temperature is 6°C (42.8°F), and the mean annual daily temperature is 15°C (59°F). The mean daily maximum temperature exceeds 32°C (89.6°F) from June through September. The hottest month is July, with a mean daily maximum temperature of 37°C (98.6°F); the mean daily minimum temperature for this month is 18°C (64.4°F). Average daily minimum temperatures fall below 0°C (32°F) during December, January, and February. The coldest month is January, with a mean daily minimum temperature of -3°C (26.6°F); several days in early January have long-term mean daily minimum temperatures below -5°C (23°F).

Land Use

The US Ecology facility is located in Nye County, Nevada, approximately 19.2 km (12 mi) southeast of the town of Beatty, in the Amargosa Desert. The facility is located approximately 48 km (30 mi) northwest of the town of Lathrop Wells and 9.7 km (6 mi) west of the Nevada Test Site. Land in the area is owned by the U.S. Government and is managed by the Bureau of Land Management.

The buffer zone between the 0.34 square kilometer (80 acre) LLWF/HWMF and the federally owned land is approximately 402 m (1320 ft) wide.

As the facility is located in a desert, there are no business, recreational, or residential activities conducted in the area adjacent to the facility. The region is maintained as open range land with occasional mineral extraction activities. A gold mine is operated approximately 6.4 km (4 mi) west of the town of Beatty. The town of Beatty is also located approximately 9.6 km (6 mi) east of the northern entrance to Death Valley National Park. As a result, the town experiences some tourist trade.

Geology

The site is located on unconsolidated deposits of alluvial sand, clay, silt, and gravel approximately 183 m (600 ft) thick, formed by weathering action on the adjacent mountain ranges (Figure 4-5). Underlain by folded metamorphic and sedimentary bedrock, the site surface is approximately 854 m (2,800 ft) above sea level. A regional ground water table lies at a depth of 79 to 101 m (260 to 330 ft) below the surface in the alluvial soils.

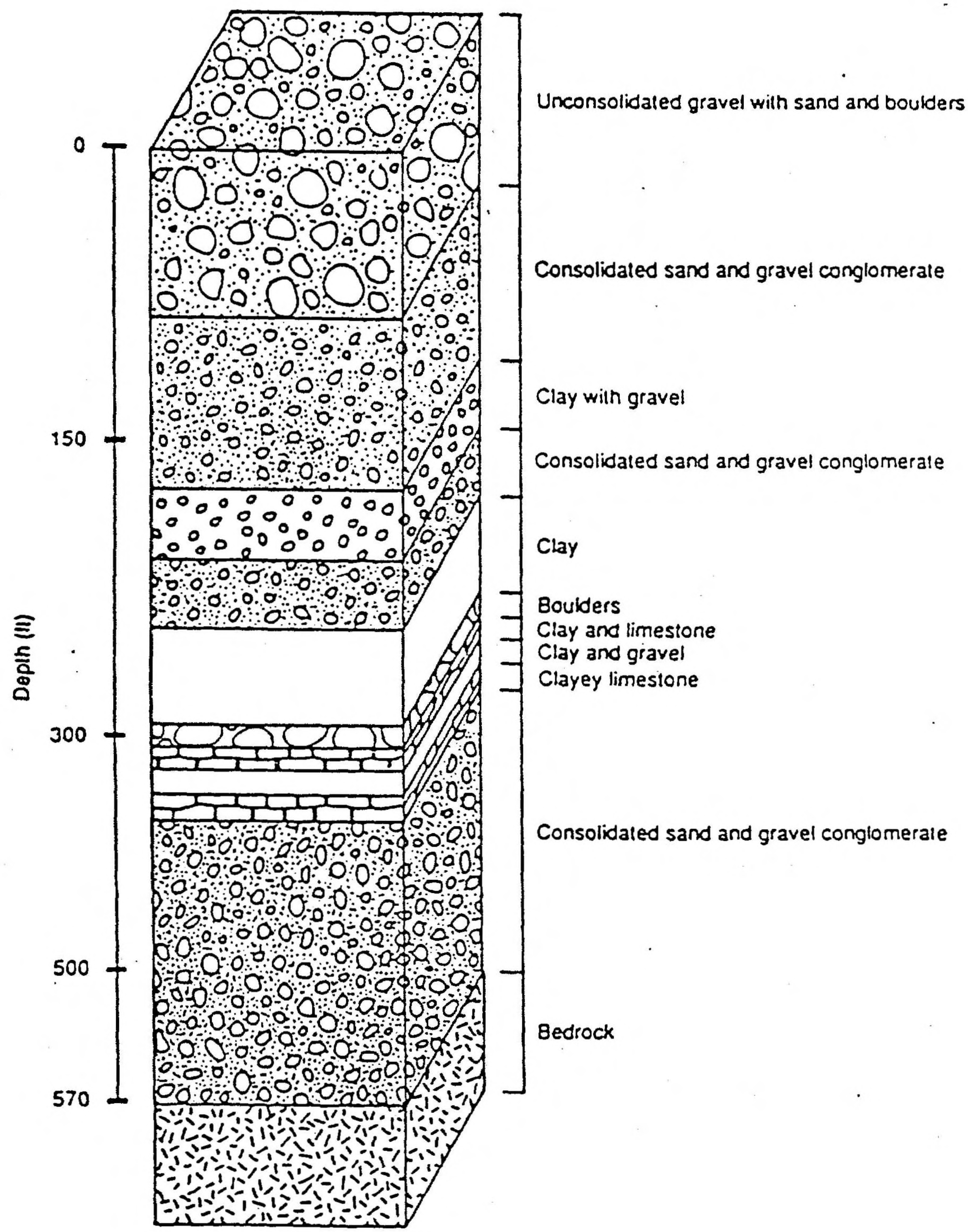


Figure 4-5. Site geology of the Beatty LLW site.

The Amargosa Desert is bounded, in large part, by mountain ranges composed of lower Paleozoic carbonate and clastic sedimentary and metasedimentary rocks. The valley floor is presumably underlain at depth by rocks of these same types. Tertiary volcanic rocks also occur in several of the ridges between the southern end of Bare Mountain and Lathrop Wells on the east side of the valley.

The geologic structure of the region surrounding the Amargosa Desert is complex. The major structural features include large-scale normal and thrust faults. Many of the surrounding mountain ranges are bounded by normal faults producing the typical Basin-and-Range structure shown by the topography of the area. Within the surrounding ranges, the rocks are folded and for the most part intensely faulted by small-scale thrust, tear, normal, and strike-slip faults. Superimposed on this highly complex pattern of folding and faulting are several shear zones including the Las Vegas Valley shear zone which extends northwestward to Mercury, Nevada, just south of the Amargosa Desert, and shear zones in Death Valley and the Amargosa Desert.

Surface Water

The intermittently flowing Amargosa River is 8 km (5 mi) from the site and is the principal drainage channel in the area. No source of perennial water is found within 16.1 km (10 mi) of the site (Figure 4-1). Precipitation is sparse in the area, averaging less than 10 cm (4 in.) a year, but surface runoff is even more rare. The dry channel of the Amargosa passes about 3 km (1.86 mi) west of the waste burial site.

The waste burial site is located in the drainage basin of the Amargosa River which is part of the Death Valley hydrographic area. The terminus of the dry channel of the Amargosa River is at the southern end of Death Valley, but no flow has been observed along that part of the river in historic times.[4-1]

Ground Water

Few wells have been drilled in the northern Amargosa Desert and, consequently, knowledge of the ground water system beneath the area is poorly known.

Knowledge of the ground water system beneath the waste burial site is based almost solely on the information obtained from the drilling and testing of a well at the waste burial site in 1961. The data obtained from this well suggests the presence of a principal water bearing zone in the valley-fill deposits in the depth interval from 99 to 103 m (325 to 338 ft) below land surface. Another, less productive zone exists from 132 to 173 m (433 to 568 ft). This zone may be in hydraulic continuity with the water-bearing bedrock aquifer that is presumed to underlie the valley fill. Depth to water beneath the waste burial facility is approximately 85 m (280 ft).

The ground water system beneath the site eventually terminates in Death Valley.

Ecology

Perennial plant species that occur in the vicinity of the Beatty site include: *Larrea tridentata* (creosote bush), *Ambrosia dumosa* (bur-sage or burro bush), *Krameria parvifolia* (range ratanyl), *Acamptopappus shockleyi* (goldenhead), *Atriplex confertifolia* (shadscale), *Atriplex canescens* (four-winged salt bush), *Ephedra nevadensis* (mormon tea), *Lycium andersonii* (desert thorn or wolfberry), and *Lycium pallidum* (box-thorn).

Winter and early spring rains are more important for growth than the local, infrequent summer rains. As soil moisture is depleted and soil temperatures rise in the summer, some species start to lose their leaves and become dormant. Some species also can have a dormancy period in the winter. Shrub species that never shed all their leaves and are therefore considered evergreens and are able to grow after spring, summer, or fall rains include *Larrea tridentata* and the *Atriplex* species. The *Larrea tridentata* vegetational grouping contains 23 species. The *Larrea tridentata* grouping is the most widespread and diversified, and is considered the most stable vegetation cover in this area and consequently represents a climax community. The soil surface itself is structured into highly and poorly productive areas which is of major importance to the maintenance of perennial desert ecosystems.

Wildlife is dominated by rodents. These include *Thomomys bottae* (pocket gophers), *Lepus californicus* and *Sylvilagus audobonii* (rabbits), *Dipodomys merriami* (kangaroo rats), and *Onychomys torridus* and *Peromyscus spp.* (mice).

ENVIRONMENTAL MONITORING

Overview

Environmental monitoring at the Beatty LLW facility is performed to demonstrate compliance with federal, state, and local regulations; to confirm adherence to environmental protection policies; and to support the environmental management decisions. These regulations require that effluents to the general environment be maintained as low as reasonably achievable (ALARA) and that annual doses due to effluents not exceed 0.25 millisieverts (25 millirems) to the whole body, 0.75 millisieverts (75 millirems) to the thyroid, and 0.25 millisieverts (25 millirems) to any other organ of any member of the public.

The major goals of the environmental radiation program are to identify, assess and initiate appropriate corrective actions needed to prevent any potential exposure to the public or contamination of the environment before a significant problem develops. The program is designed to evaluate radioactivity levels in the environment over a period of time, both to assess compliance with appropriate standards and to determine trends. Trend analysis is necessary to identify a potential problem and to initiate corrective action to reverse the trend.

Environmental monitoring started in May 1961 prior to site operations. Soil and vegetation samples were taken from the vicinity of the four facility corners. Ground water sampling from the on-

site well started in October 1962. Monitoring locations and the analysis performed on environmental samples were modified from time to time over the 30 years of operations.

Environmental monitoring included radioanalysis of ground water, air particulates, air tritium, surface soil, vegetation, and ambient gamma measurements using thermoluminescent dosimeters (TLDs). Monitoring of the LLW disposal facility is conducted on-site by the site operator, US Ecology, Inc. The Nevada Radiological Health Section conducts independent monitoring on-site and off-site, with all samples analyzed by a contract laboratory. The samples are scanned for gamma-emitters and analyzed for gross alpha and gross beta activity.

Action levels for gross alpha and gross beta in soil and vegetation were established by the State of Nevada in 1977. These are shown in Table 4-2.

Gross alpha, gross beta, and hazardous constituent data obtained from monitoring of the adjacent chemical waste disposal site are also reviewed by the Nevada Radiological Health Section.

Ground Water

The Beatty Site Well (a specific well) was completed on July 17, 1961, and has a 175 m (575 ft) boring with the screened area starting at 84 m (275 ft) from the bottom. Beginning in the fourth quarter of 1962, the Beatty site well was analyzed for gross alpha, gross beta and, beginning in January 1972, for tritium concentration. From 1962 through 1972, only the on-site well was sampled. In the third quarter of 1982, sampling from two new wells—an upgradient well (#301) and a downgradient well (#302)—was started (Figure 4-4).

The results of the gross alpha, gross beta and tritium concentration in ground water samples are listed in Table 4-3 and Figures 4-6, 4-7, and 4-8. The mean concentration of gross alpha and beta in the Beatty Site Well samples from 1962 to 1972 were 0.22 Bq/L and 0.92 Bq/L (5.9 and 24.8 pCi/L)

Table 4-2. Action levels for gross alpha and gross beta in soil, vegetation,[a] and ground water (including tritium in ground water only).

Material	Gross Alpha	Gross Beta	Tritium
Soil	1.11 Bq/gm (30.0 pCi/gm)	3.33 Bq/gm (90.0 pCi/gm)	
Vegetation	0.74 Bq/gm (20.0 pCi/gm)	7.4 Bq/gm (200.0 pCi/gm)	
Ground water	1.11 Bq/L (30.0 pCi/L)	3.3 Bq/L (90 pCi/L)	74 Bq/L (2,000 pCi/L)

a. Dry plant mass.

Table 4-3. Gross alpha, gross beta, and tritium activity in ground water.

Year	Gross alpha[a] pCi/L	Gross beta[a] pCi/L	Tritium pCi/L
1962	3 ± 2	54 ± 4	No data
1963	No data	No data	No data
1964	8 ± 3	50 ± 26	No data
1965	20 ± 5	60 ± 31	No data
1966	10 ± 5	60 ± 34	No data
1967	10 ± 4	40 ± 28	No data
1968	14 ± 5	52 ± 3	No data
1969	6 ± 3	41 ± 41	No data
1970	39 ± 7	94 ± 30	No data
1971	No data	No data	No data
1972	10 ± 4	9 ± 4	No data
1973	46 ± 7	549 ± 47	No data
1974	16 ± 10	132 ± 77	No data
1975	47 ± 9	173 ± 55	No data
1976	12 ± 5	40 ± 32	No data
1977	<3	<30	No data
1978	3 ± 2	<20	No data
1979	10 ± 5	<20	3,800 ± 1,100
1980	<5	10 ± 4	1,700 ± 900
1981	21 ± 7	31 ± 4	0
1982	710 ± 183	340 ± 49	24,000 ± 1,000
1983	140 ± 98	930 ± 150	49,000 ± 29,000
1984	63 ± 29	140 ± 24	5,000 ± 4,000
1985	25 ± 18	26 ± 10	1,100 ± 600
1986	15 ± 9	14 ± 5	<500
1987	No data	No data	No data
1988	31 ± 11	10 ± 3	<500
1989	20 ± 14	30 ± 23	1,548 ± 508
1990	78 ± 24	63 ± 11	<500
1991	10 ± 6	11 ± 5	1,079 ± 551
1992	7 ± 3	13 ± 3	<500

Action Levels: gross alpha = 30.0 pCi/L; gross beta = 90.0 pCi/L; tritium = 2,000 pCi/l.

a. Indicates highest value for each year.

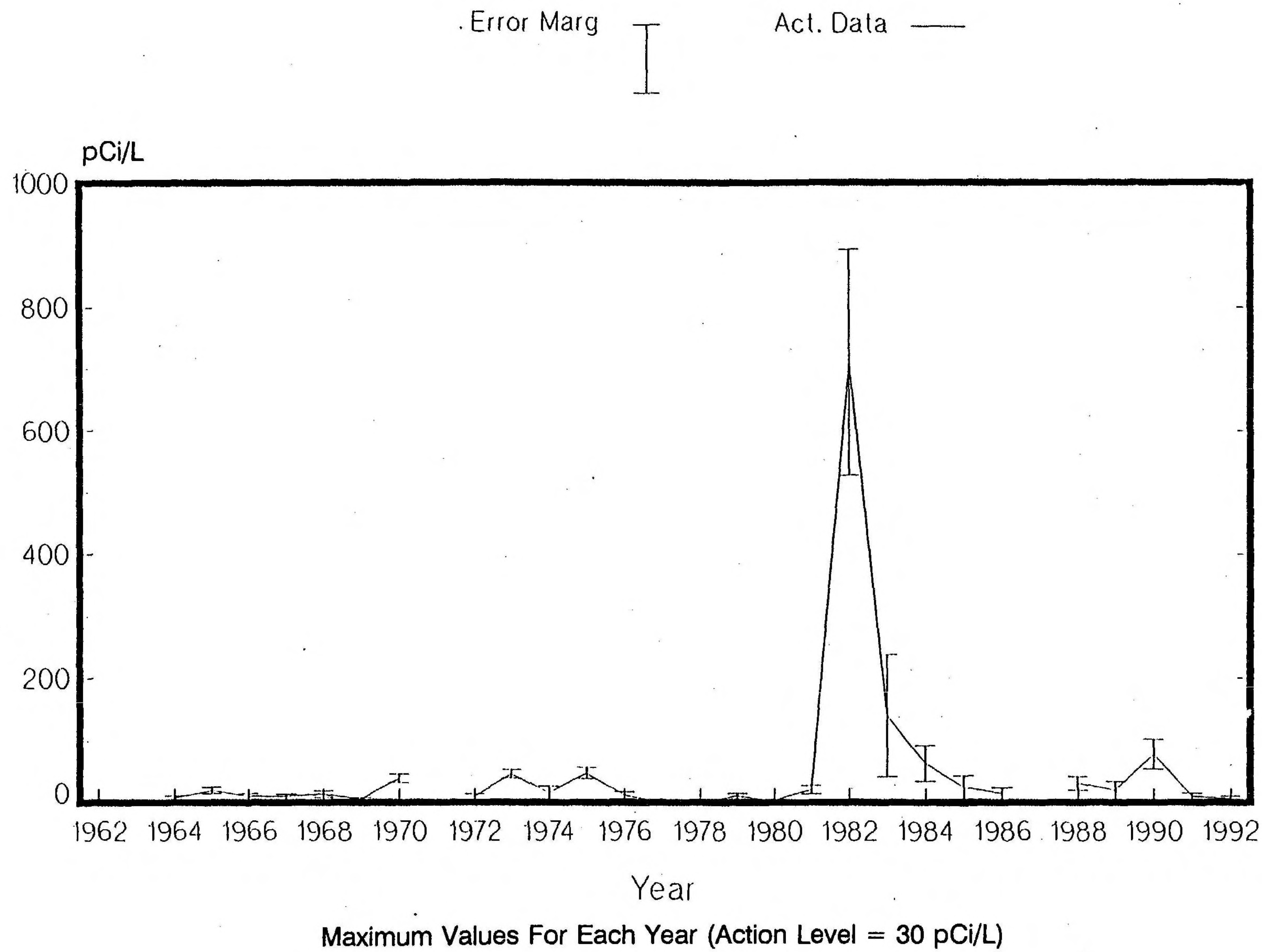


Figure 4-6. Gross alpha groundwater samples: Beatty, Nevada.

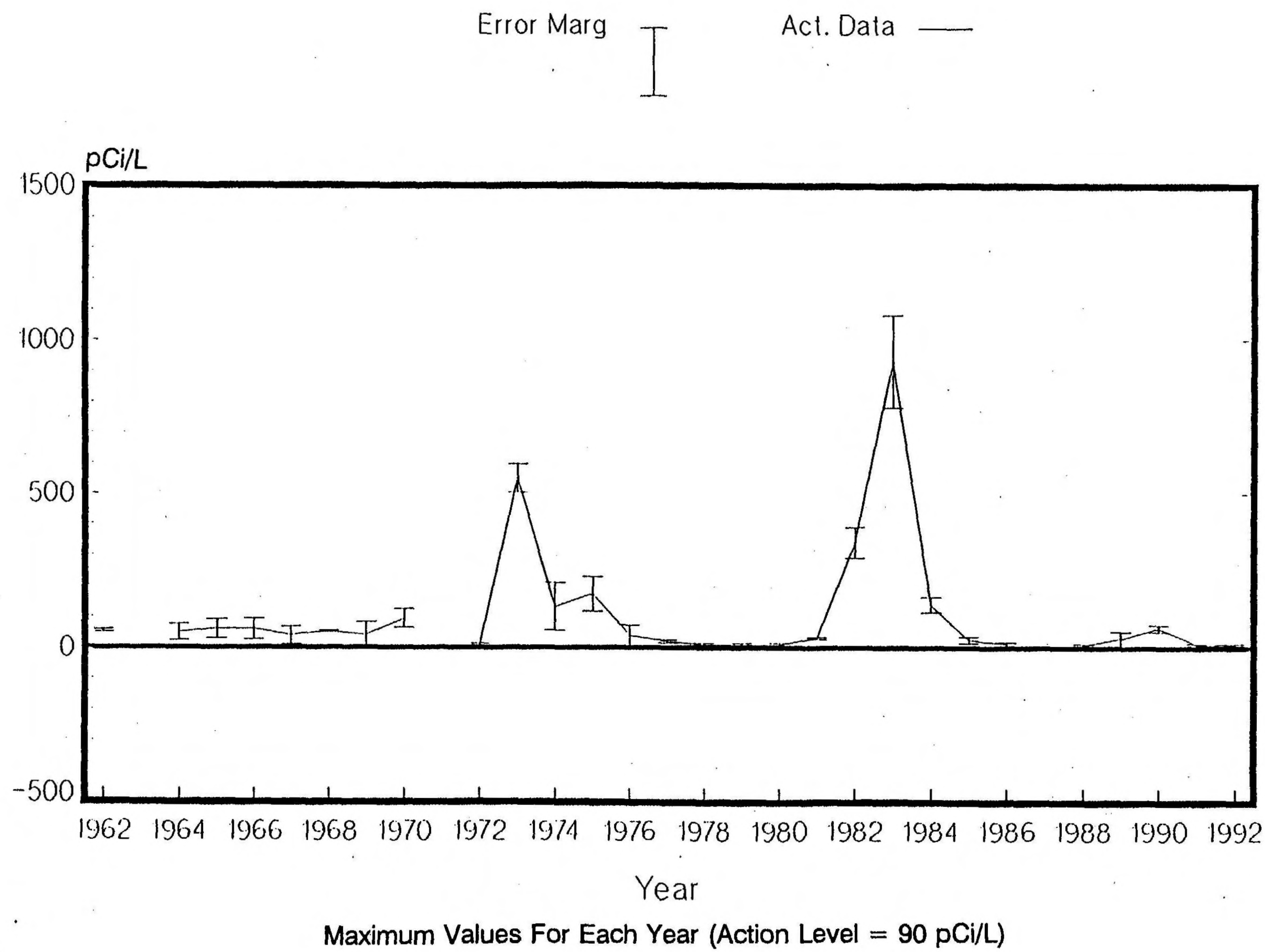


Figure 4-7. Gross beta groundwater samples: Beatty, Nevada.

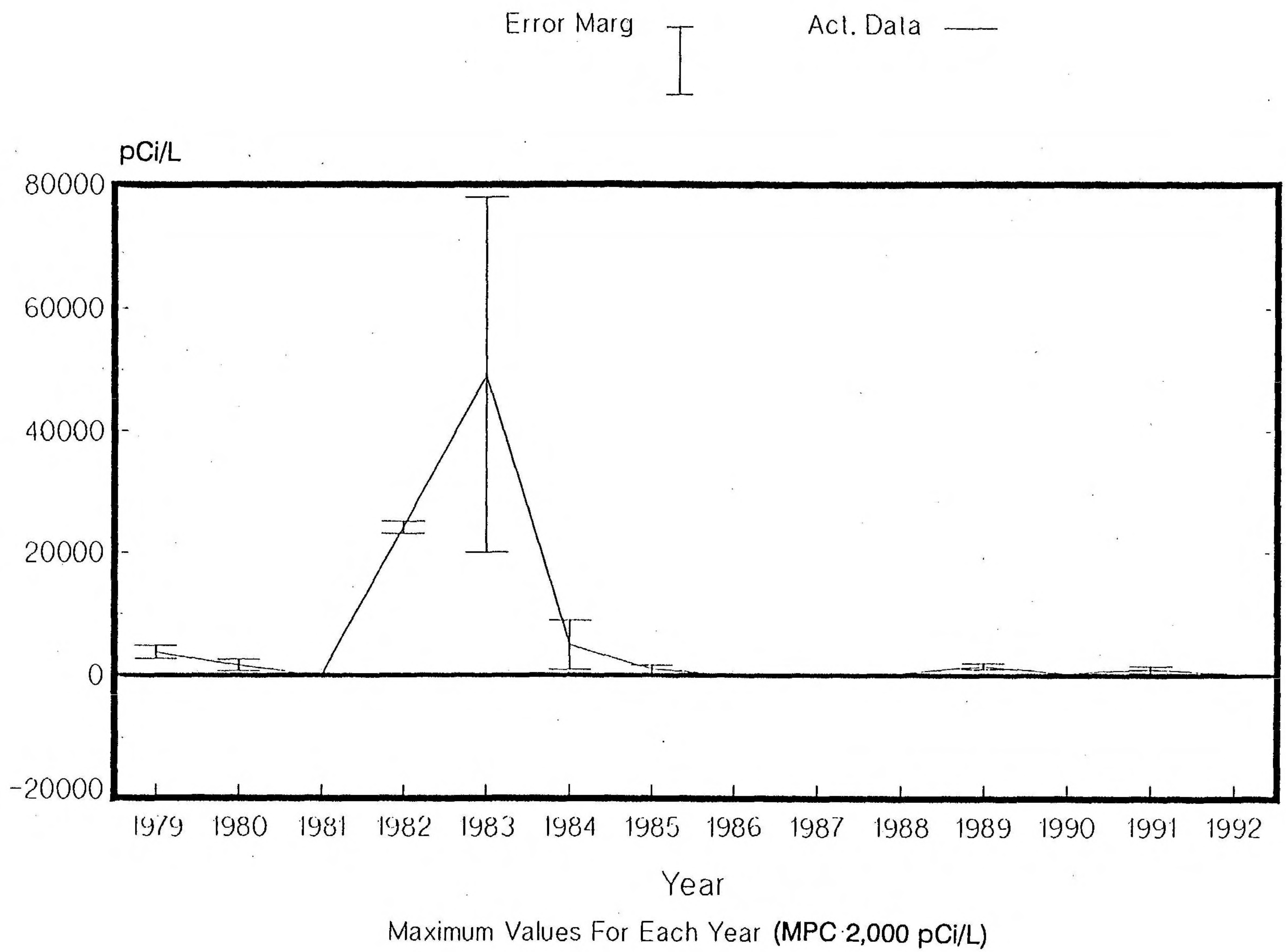


Figure 4-8. Tritium groundwater samples: Beatty, Nevada.

respectively. The gross alpha concentration varied from less than detectable to 0.74 Bq/L (20 pCi/L) for a December 1965 sample. The gross beta concentration varied from less than detectable to 3.5 Bq/L (94 pCi/L) in July 1970. The trend during these years was a reduction in both the gross alpha and beta concentration, most likely due to changes in the instrumentation and methodology used by the vendor laboratories.

In 1974, water from the Lathrop Wells was used as a control or background comparison to the site wells sample analysis. In 1979, analysis for tritium was performed on all ground water samples. From 1974 until September 1982, there was no significant difference between the concentration of gross alpha, gross beta and tritium in any of the ground water samples.[4-2]

A review of the analysis results for tritium in ground water (Table 4-3 and Figure 4-8) indicate that for most years the tritium activity has been below the action level of 74 Bq/L (2000 pCi/L). The exceptions have been the years 1979, 1982, 1983, and 1984, when the tritium concentration exceeded the action levels and showed activities as high as 15,170 ± 370 Bq/L (410,000 ± 10,000 pCi/L) during 1982 (not included in Table 4-3 or Figure 4-8) for the downgradient well #302. These abnormally high values are still well below the federal regulatory limits for tritium in water for both restricted areas (0.41% 10 CFR 20 values) and unrestricted areas (13.7% 10 CFR 20 values).[4-2]

After 1984, a gradual reduction in the concentration occurred. The results of ground water samples of Well 302 since February 1986 have been less than the minimum detection limits, 18.5 Bq/L (500 pCi/L).

Subsequent to the detection of tritium in Wells 301 and 302, the monitoring frequency was increased. Sampling was increased from quarterly to monthly and during 1983 it went to bi-weekly. Ground water samples were evaluated by analyzing both the dissolved and suspended fraction. The sediments in the ground water were analyzed using gamma spectroscopy and fluoroscopy to evaluate whether non-natural radionuclides were contributing to the gross alpha and beta concentrations. Sediments from Well #301 were positive for Co-60 in a May 1985 sample at 0.1 ± .02 Bq/L (2.7 ± 0.6 pCi/L). All other elevated gross alpha and beta concentrations were shown to be due to K-40, natural uranium and its decay products, and natural thorium and its decay products.

The maximum tritium concentrations in Well 302 were less than 14% of the allowed concentration listed in the Nevada Administrative Code, Section 459.334, Table of Concentrations in Air and Water Above Background, Table II, Column 2.[4-2]

Since the July 1984 sample, there have been only two positive tritium samples, both from Well 302. The gross alpha, beta, and tritium concentrations in the ground water samples have not varied significantly between sample locations. An upward trend has been identified in the gross beta concentration since the second quarter of 1980, which is most likely due to a reduction in the minimum detectable concentration of gross beta activity in water. The gross beta concentration increased and then remained constant with no significant difference between the three sampling locations.

Analysis demonstrated that the gross alpha, gross beta, and tritium concentrations were seldom greater than the minimum detectable concentration.[4-2]

Surface Water

The intermittently flowing Amargosa River is 8 km (5 mi) from the site and is the principal drainage channel in the area. No source of perennial water is found within 16.1 km (10 mi) of the site, and therefore no surface water monitoring has been conducted.

Air

The continuous air monitoring program was instituted in June 1989. Air sampling was performed at the three monitoring points (Figure 4-3) to determine the concentration of airborne tritium and air particulate.

Tritium was sampled using a silica gel cartridge which was changed on a monthly basis in order to allow for the collection of a sufficient amount of moisture in the silica gel column. Results of tritium concentration in air (1989–1992) are provided in Table 4-4. None of the values exceeded the action level of 7.4 E-4 Bq/cc (2.0 E-8 μCi/cc).[4-3,4-4,4-5,4-6,4-7]

Air particulate sampling was performed at the same three locations as tritium sampling (Figure 4-3). Filters were analyzed for gross alpha and gross beta concentration on an approximately weekly basis. Results of this analysis[4-4,4-7] showed that the concentrations of gross alpha and gross beta in air particulate samples were below the action levels of 1.9 E-9 and 1.1 E-5 Bq/cc (5 E-13 μCi/cc and 3.0 E-9 μCi/cc) for gross alpha and beta, respectively.

Soil

Regular soil sampling started in December 1963. Soil samples were originally taken from dry wells located near the disposal trenches and the vicinity of the four corners of the disposal site. The dry wells were constructed in order to intersect any potential subsurface migration from completed trenches. Dry wells were normally located at the south side of the completed trenches and extended to a minimum of 3.0 m (10 ft) below the established bottom of the trench. In addition to the dry wells associated with each completed burial trench, two dry wells were located south of the site. The sample medium in all of the dry wells is the soil at the bottom. Surface soil samples were also taken from locations outside the licensed disposal area. The soil samples taken outside the site are located

Table 4-4. Tritium activity in air (μCi/cc).[a]

1989	0.92 ± 0.75 E-10
1990	4.50 ± 0.50 E-10
1991	8.70 ± 0.75 E-10
1992	1.56 ± 0.50 E-10

Action level of tritium in air = 2.0 E-8 μCi/cc

a. Indicates the highest value for each year.

approximately 61 m (200 ft) from the fenced disposal area, to the north, southeast, east, and west. These areas are identified by markers in the ground to ensure sample reproductivity. Samples are taken within a 4.6 m (15 ft) radius of these markers. Starting in May 1977, control samples for soil were taken from the Lathrop Wells area. The Lathrop Wells area has similar flora and geologic formations to the Beatty LLW disposal facility.

By 1977, the soil sampling locations had become standardized and consisted of 19 sampling areas. Soil samples were taken quarterly and analyzed for gross alpha and beta. Occasionally, additional locations were sampled. The primary soil sampling locations included:

- The control sample from Lathrop Wells
- Dry wash 305 m (1,000 ft) southeast of LLW disposal site
- Office area
- West Quadrant 61 m (200 ft) outside the fence
- North Quadrant 61 m (200 ft) outside the fence
- East Quadrant 61 m (200 ft) outside the fence
- Dry Wells R-1 through R-6, R-14, R-16, R-19, P-1, P-3, and P-4.

Surface soil samples were taken from undisturbed areas, using a ring of approximately 10 cm (4 in.) inside diameter, pressed into the soil 5 cm (2 in.) deep. Dry wells were sampled by pouring approximately 500 ml of clean tap water or, after 1983, deionized water in the dry well; and after approximately a three-hour wait, a sample collection tube was allowed to free-fall down the dry well to compact a sample into the tube.

The soil samples were analyzed for gross alpha and beta concentrations. Action levels were established in 1977 and were 1.1 Bq/gm (30 pCi/gm) for gross alpha and 3.3 Bq/gm (90 pCi/gm) for gross beta concentrations. When action levels were exceeded, the State of Nevada representative was notified and a gamma spectrum analysis was performed on the sample. Radioanalysis results of gross alpha, gross beta, and gamma spectrometry in soil samples are provided in Tables 4-5 and 4-6, respectively. Graphical presentations of gross alpha and gross beta are shown in Figures 4-9 and 4-10, respectively.

In September 1984, the State of Nevada deleted the requirement for soil sampling of the dry wells. Dry well soil sampling was discontinued because most of the soil had been removed from the dry wells during the years of sampling and only rocks were present in the bottom of many of the wells making it no longer possible to extract a representative soil sample.

The analysis of the dry well soil samples during the previous seven year period never resulted in a concentration exceeding the established action levels.

Table 4-5. Soil sample analysis—Beatty LLW Site.

Year	Gross alpha[a] pCi/gm	Gross beta[a] pCi/gm
1962	No data	No data
1963	No data	No data
1964	No data	No data
1965	1.9 ± 0.63	72 ± 4.4
1966	2.7 ± 1.2	73 ± 5.3
1967	1.7 ± 0.64	3.5 ± 0.34
1968	2.94 ± 0.41	5.03 ± 0.57
1969	9.5 ± 3.7	37 ± 4.1
1970	No data	No data
1971	8.9 ± 3.8	80 ± 4.9
1972	13 ± 5	108 ± 32
1973	6 ± 3	110 ± 40
1974	18.2 ± 8.2	253.6 ± 111
1975	64 ± 15	614 ± 60
1976	42 ± 7.7	257 ± 28
1977	20 ± 6.1	60 ± 24
1978	18 ± 6	60 ± 24
1979	31 ± 13	80 ± 31
1980	23 ± 6.1	90 ± 16
1981	32 ± 9.8	60 ± 15
1982	25 ± 6	66 ± 18
1983	24 ± 7	79 ± 4
1984	25 ± 7	52 ± 15
1985	16 ± 3	40 ± 17
1986	10.2 ± 1.6	9.6 ± 1.0
1987	1.3 ± 0.3	7.0 ± 0.8
1988	5.7 ± 1.1	6.6 ± 0.9
1989	9.3 ± 2.5 (wet)	21.5 ± 1.3 (wet)
1990	12.8 ± 3 (dry)	51.5 ± 7 (dry)
1991	3.5 ± 1.0 (dry)	22.0 ± 1.3 (dry)
1992	5.4 ± 2.7 (dry)	28.4 ± 2.3 (dry)

Action Levels: gross alpha = 30.0 pCi/gm; gross beta = 90.0 pCi/gm.

a. Indicates highest value for each year.

Table 4-6. Gamma spectroscopy analysis of soil samples (pCi/gm) (April 1982).[a]

Location	Analysis	Concentration
320 ft. south of Trench 18, 70 ft. east of Rad/Buffer Zone, 10 ft. NW sample point	K-40	26 ± 0.41
	Mn-54	0.019 ± 0.013
	Cs-137	0.29 ± 0.017
	Ra-226	1.00 ± 0.076
	Ra-228	2.0 ± 0.076
	Th-228	1.9 ± 0.027
320 ft. south of Trench 18, 70 ft. east of Rad/Buffer Zone, 10 ft. SW sample point	K-40	25 ± 0.4
	Co-60	0.02 ± 0.013
	Mn-54	0.04 ± 0.0085
	Cs-137	0.72 ± 0.021
	Ra-226	1.0 ± 0.032
	Ra-228	2.0 ± 0.075
	Th-228	1.9 ± 0.027
320 ft. south of Trench 18, 70 ft. east of Rad/Buffer Zone, 10 ft. NE sample point	K-40	25 ± 0.39
	Mn-54	0.037 ± 0.007
	Co-60	0.064 ± 0.014
	Cs-137	0.2 ± 0.021
	Ra-226	0.95 ± 0.031
	Ra-228	1.9 ± 0.07
	Th-228	1.8 ± 0.025
320 ft. south of Trench 18, 70 ft. east of Rad/Buffer Zone, 10 ft. NW sample point	K-40	26.3 ± 0.4
	Mn-54	0.021 ± 0.01
	Co-60	0.087 ± 0.015
	Cs-137	0.45 ± 0.019
	Ra-226	0.99 ± 0.032
	Ra-228	1.9 ± 0.072
	Th-228	1.8 ± 0.026

a. Data for other years are not available.

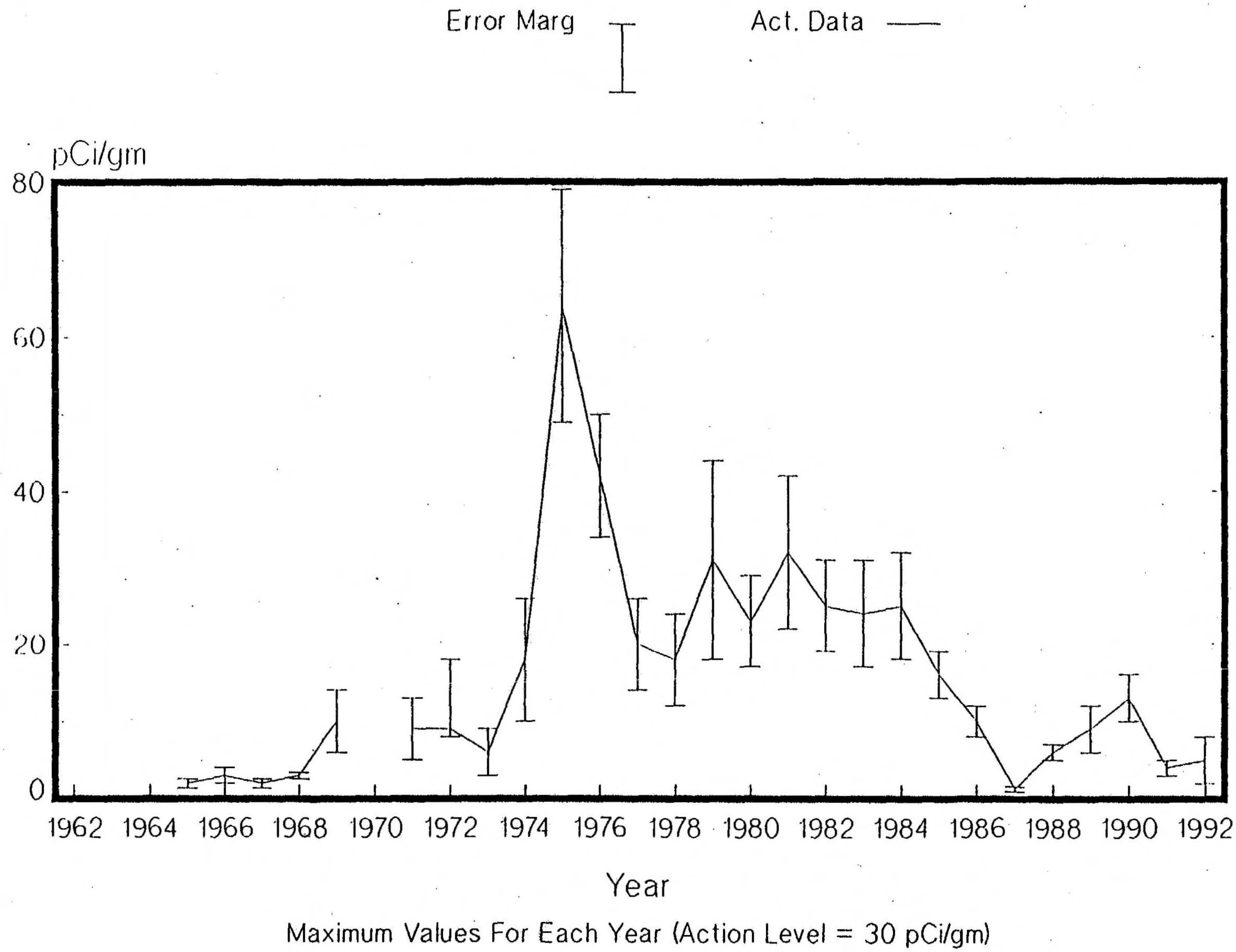


Figure 4-9. Gross alpha soil samples: Beatty, Nevada.

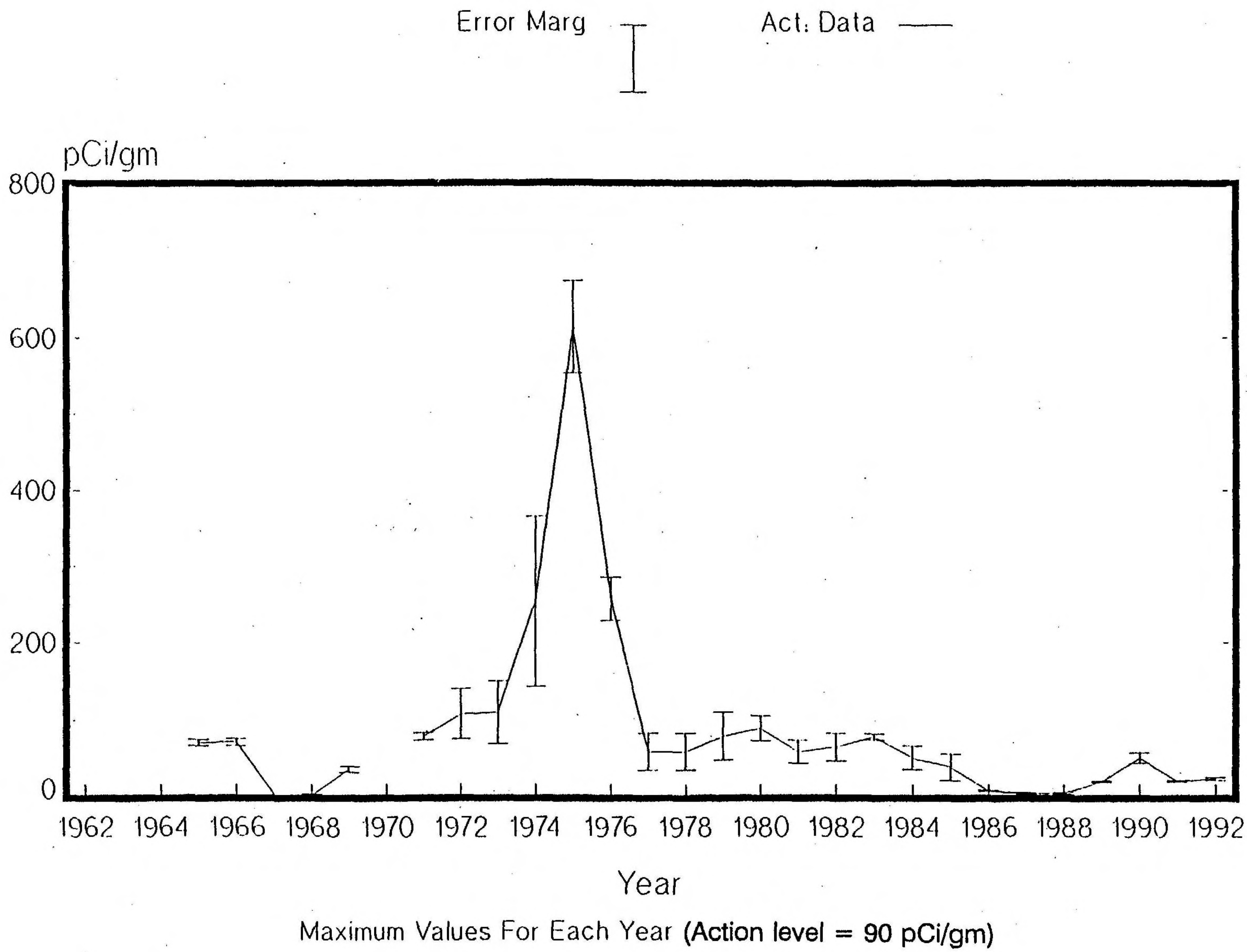


Figure 4-10. Gross beta soil samples: Beatty, Nevada.

Biota

The protocol for the sampling and analysis of vegetation samples parallels that of soil. Vegetation samples were analyzed for gross alpha and beta concentrations beginning in 1961. Sample locations and time periods during which samples were gathered varied substantially from 1961 until 1977. By 1977, samples were being taken quarterly in Lathrop Wells as the control sample, at a dry wash 306 m (1,000 ft) southeast of the site, in the office area, and at 61 m (200 ft) outside the north, west, and east quadrants of the site. The results of the radioanalysis of the vegetation samples for gross alpha and gross beta concentration are listed in Table 4-7. Graphical presentations of these data are shown in Figures 4-11 and 4-12.

Vegetation samples consisted of pruned green leafy or foliage material from plants in the sample area. At least 250–300 grams were required for laboratory analysis. Often there was not sufficient green material present, and an analysis could not be performed. Action levels were established in 1977 as 0.74 Bq/gm (20 pCi/gm) of dry plant mass for gross alpha contamination and 7.4 Bq/gm (200 pCi/gm) of dry plant mass for gross beta contamination. If an action level was exceeded, the State of Nevada was notified and gamma spectral analysis of the vegetation sample was performed.

Tritium and gamma spectroscopy analyses of vegetation were performed in 1982 from samples collected outside the facility boundary. The results are listed in Table 4-8.

Direct Radiation

External dose rate monitoring of direct (penetrating) radiation began in 1965. Measurements were performed using film dosimeters placed at the north, east, south, and west fencelines. The film badges were posted quarterly or semiannually and were analyzed by Radiation Detection Company. Monitoring during the early years of operations showed fenceline exposures higher than the monitoring results obtained for later years. During the fourth quarter of 1965, the west fence film dosimeter read 5.30 millisieverts (530 mrem) and two film dosimeters placed at the north side of the burial ground read 6.80 and 6.40 millisieverts (680 and 640 mrem), the south fence film dosimeter read 12.0 millisieverts (1200 mrem) during the second quarter of 1966, and the west fence film dosimeter read 4.80 millisieverts (480 mrem) during the second quarter of 1967. In 1968, the federal government began monitoring the site boundary and a control location at US Highway 95. Seven locations were monitored on a quarterly basis. Only six measurements since 1968 have exceeded 1.0 millisievert/quarter (100 mrem/quarter). The maximum exposure was 11.40 millisieverts (1,140 mrem) at the south fenceline during the third quarter of 1976.[4-2] The south boundary exposure rates were significantly higher than the other locations. In 1977, in addition to the federal government's monitoring, the facility operator performed area monitoring at 14 locations, using environmental thermoluminescent dosimeters (TLDs). The annual maximum exposures (1977–1992) are listed in Table 4-9, and shown in Figure 4-13. Exposure rates have trended down over the years of operations. The maximum annual exposure was 4.15 millisieverts (415 mrem) at the east boundary in 1978. The south boundary exposure rate remained significantly higher than all other locations. None of the locations exceeded the 1.25 millisieverts/quarter (125 mrem/quarter) action level.

Table 4-7. Vegetation sample analysis–Beatty LLW Site.

Year	Gross alpha[a] pCi/gm	Gross beta[a] pCi/gm
1962	0.73 ± 0.32	126 ± 3.1
1963	No data	No data
1964	No data	No data
1965	0.13 ± 0.04	21 ± 0.5
1966	0.9 ± 0.45	110 ± 5.4
1967	0.39 ± 0.22	8.0 ± 0.4
1968	0.16 ± 0.04	13.3 ± 0.2
1969	0.17 ± 0.12	31.3 ± 0.27
1970	No data	No data
1971	0.19 ± 0.16	2.8 ± 0.3
1972	1.4 ± 1.0	722 ± 35
1973	0.36 ± 0.32	27.2 ± 3
1974	3.8 ± 4.1	420 ± 110
1975	3.49 ± 2.2	146 ± 30
1976	9 ± 3	220 ± 20
1977	0.3 ± 0.006	39.6 ± 14.5
1978	0.7 ± 0.03	36.9 ± 9
1979	0.7 ± 0.6	29.3 ± 4.2
1980	2.4 ± 1	50 ± 5.1
1981	9 ± 4	17.6 ± 1.4
1982	2.4 ± 2	30 ± 4.9
1983	6 ± 3	55.7 ± 4.9
1984	6.3 ± 1.8	15.5 ± 2.3
1985	7.2 ± 1.3	16 ± 1
1986	0.8 ± 0.2	5.8 ± 0.2
1987	5.3 ± 2.7	77.6 ± 2.5
1988	3.2 ± 0.4	10 ± 0.3
1989	0.6 ± 0.2 (dry)	65.5 ± 8.1 (dry)
1990	3.1 ± 2.4 (dry)	16.3 ± 3.6 (dry)
1991	0.5 ± 0.2 (dry)	5.9 ± 0.3 (dry)
1992	11.4 ± 2.3 (dry)	48.9 ± 2.8 (dry)

Action Levels: gross alpha = 20.0 pCi/gm; gross beta = 200.0 pCi/gm.

a. Indicates highest value for each year.

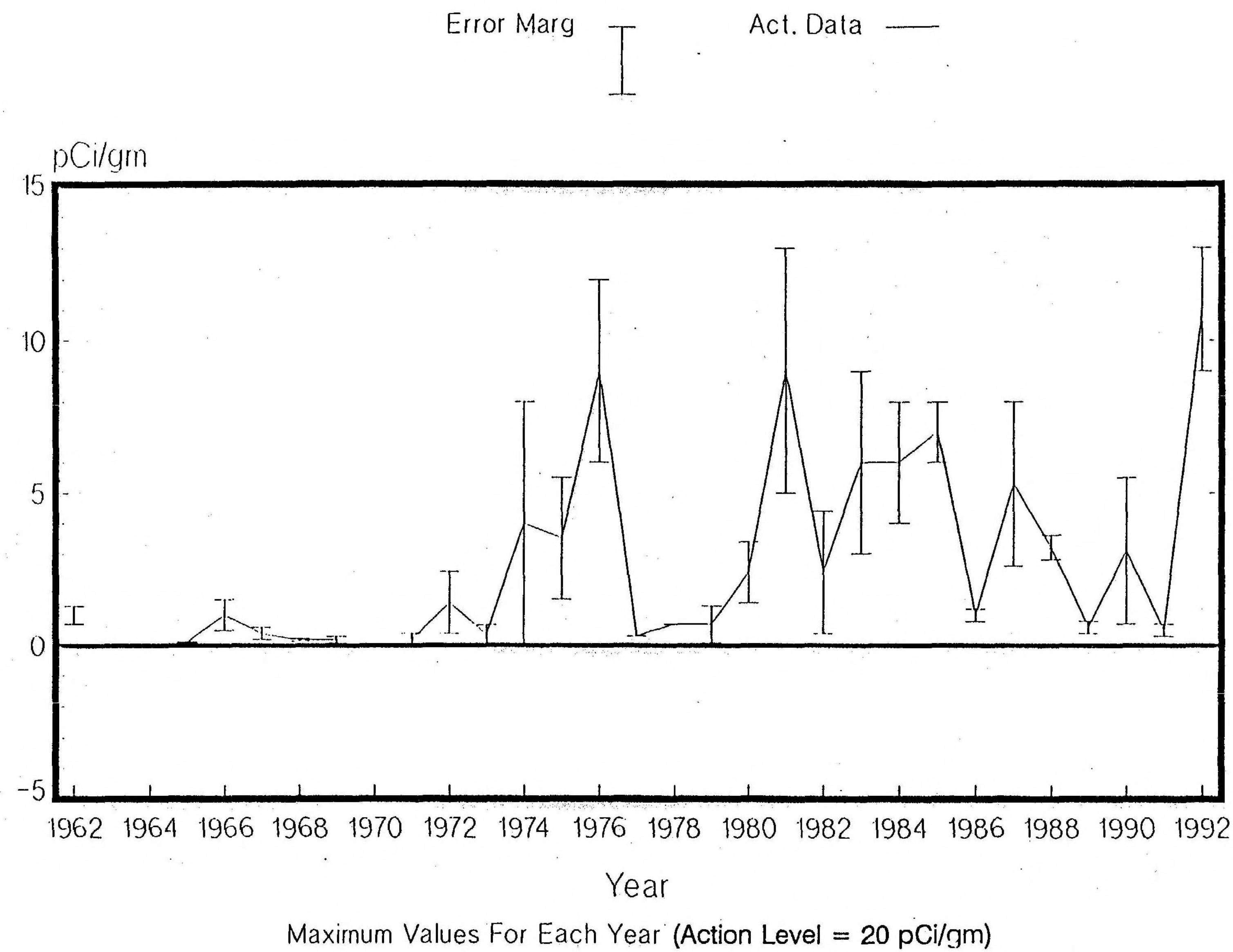


Figure 4-11. Gross alpha vegetation samples: Beatty, Nevada.

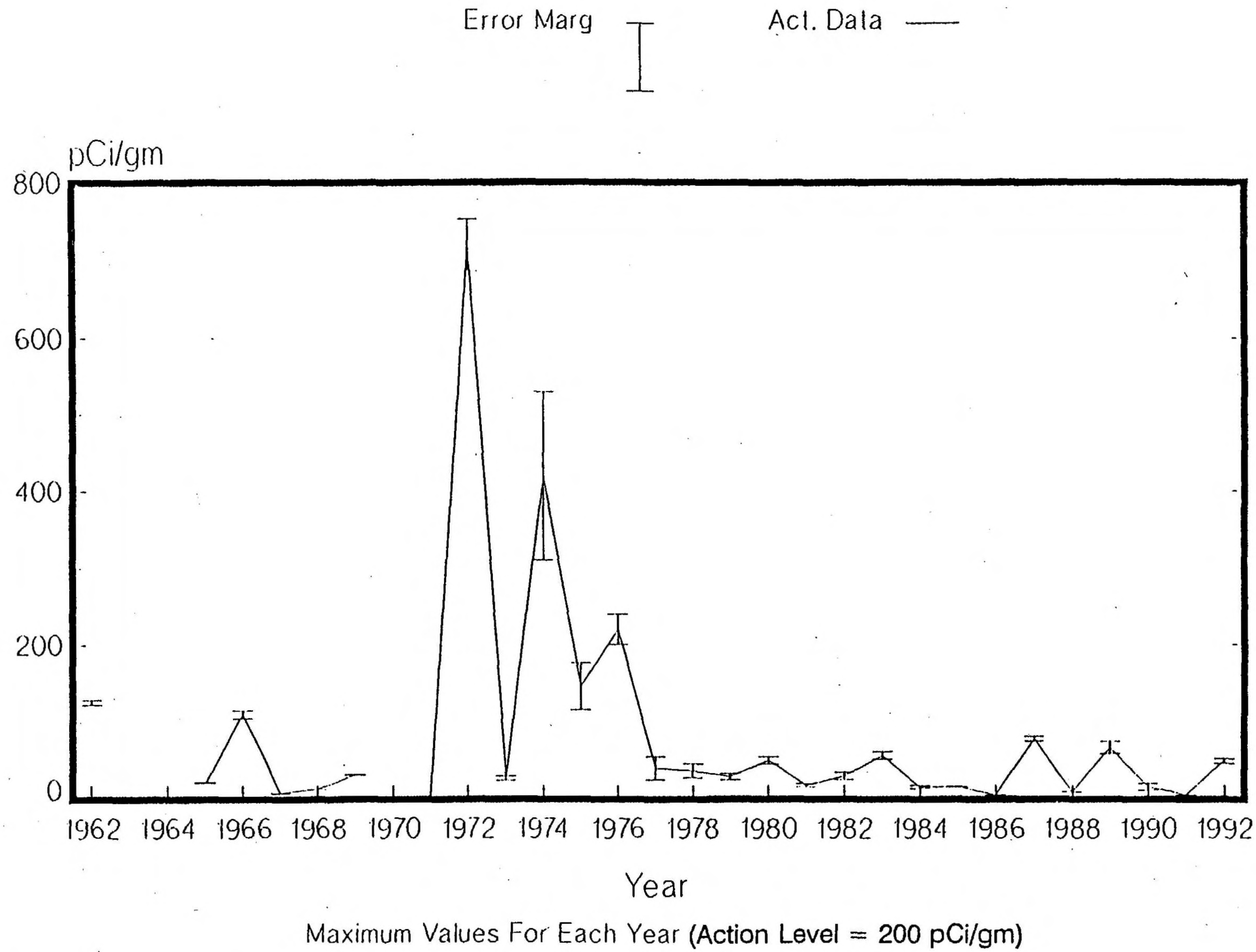


Figure 4-12. Gross beta vegetation samples: Beatty, Nevada.

Table 4-8. Tritium and gamma spectroscopy analysis of vegetation samples (March 1982).[a]

Location	Analysis	Concentration
200 ft southeast of south fence in dry wash	H-3	34 ± 2 pCi/mL
	Cs-137	1 ± 0.4 pCi/gm
240 ft southeast of south fence in dry wash	H-3	1,000 ± 100 pCi/mL
	Cs-137	1.5 ± 0.6 pCi/gm
300 ft southeast of south fence in dry wash	H-3	630 ± 10 pCi/mL
	Cs-137	1.4 ± 0.5 pCi/gm
400 ft southeast of south fence in dry wash	H-3	340 ± 10 pCi/mL
	Cs-137	0.9 ± 0.5 pCi/gm
320 ft south of south fence, NE	H-3	60 pCi/mL
	Cs-137	0.8 ± 0.3 pCi/gm
320 ft south of south fence, SE	H-3	170 ± 10 pCi/mL
	Cs-137	1.5 ± 0.4 pCi/gm
320 ft south of south fence, SW	H-3	15 ± 1 pCi/mL
	Cs-137	0.5 ± 0.3 pCi/gm
320 ft south of south fence, NW	H-3	11 ± 1 pCi/mL
	Cs-137	1.3 ± 0.4 pCi/gm

a. Data for other years are not available.

SUMMARY

The environmental monitoring program began in May 1961 at the Beatty LLW facility. On-site environmental monitoring has been conducted by the site operator (US Ecology, Inc.) to demonstrate compliance with federal, state and local regulations; to confirm adherence to environmental protection policies; and to support the environmental management decisions.

An oversight environmental radiation program at the Beatty LLW facility has been conducted by the Nevada Radiological Health Section to provide independent on-site and off-site monitoring to ensure the adequacy and accuracy of the licensee's program. The environmental data summary report includes radioanalysis of ground water, air particulate, air tritium, surface soil, vegetation, and ambient gamma measurements using thermoluminescent dosimeters (TLDs).

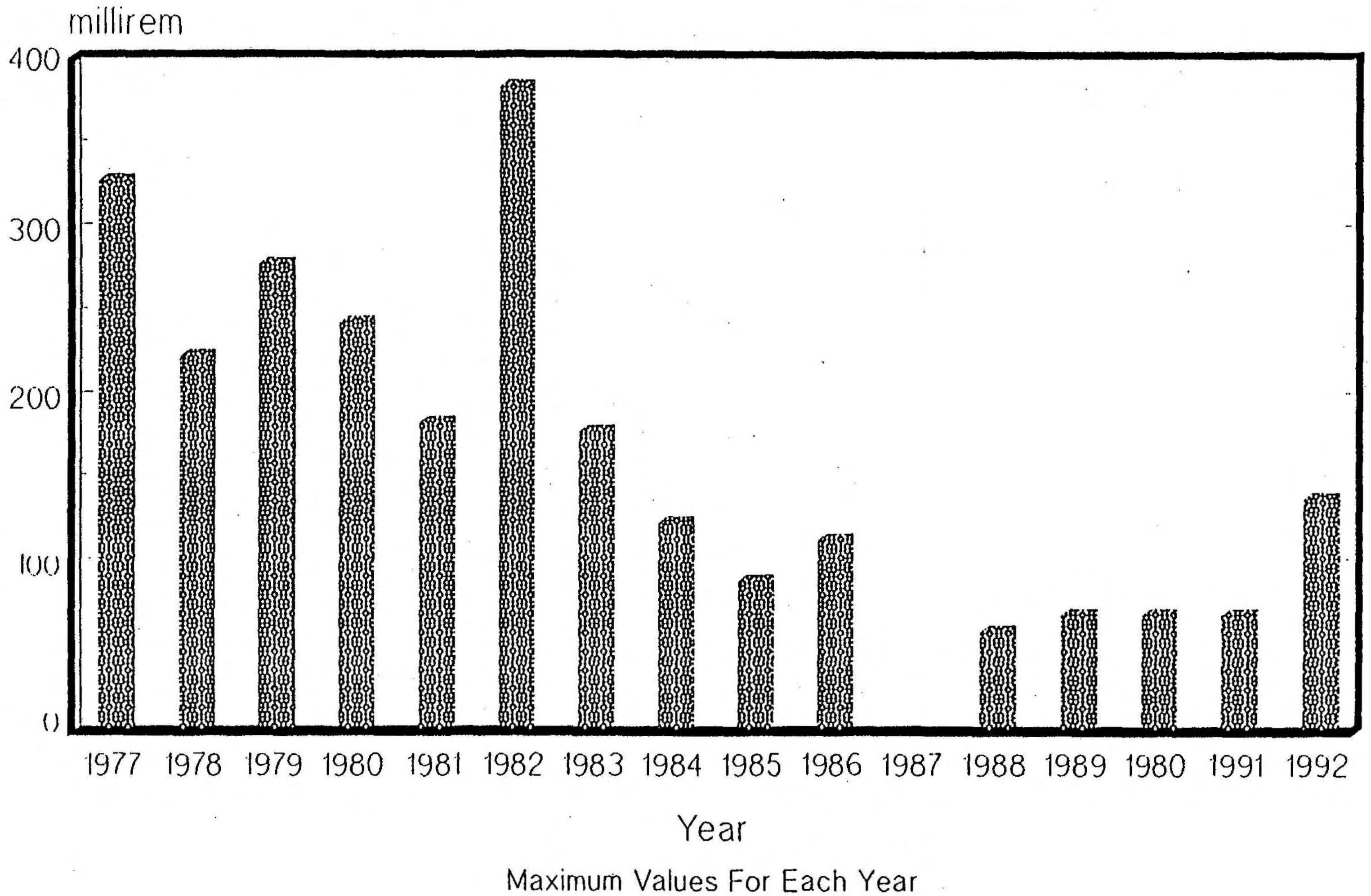


Figure 4-13. Ambient gamma: Beatty, Nevada.

Table 4-9. Direct radiation.

Year	mrem/yr[a]
1977	330
1978	225
1979	280
1980	245
1981	185
1982	385
1983	180
1984	125
1985	90
1986	115
1987	No data
1988	60
1989	70
1990	70
1991	70
1992	140

a. Indicates the highest value for each year.

Results of the ground water samples (collected from site wells, the office area, and from Lathrop Wells) analyzed for gross alpha, gross beta, and tritium concentrations are presented in Table 4-3. The ground water was also analyzed for the presence of gamma-emitting radionuclides. Results of analysis from 1985 through the end of 1992 indicate a downward trend in both gross alpha and beta concentration in ground water.

Tritium activity in ground water for most years has remained below the action level of 74 Bq/L (2,000 pCi/L) with the exception of 1979, 1982, 1983, and 1984, when a marked increase in tritium concentrations was observed from the downgradient well (#302). These values were well below the federal regulatory limits for tritium in water for both restricted areas (0.41% 10 CFR 20 values) and unrestricted areas (13.7% 10 CFR 20 values). After 1984, tritium concentrations in ground water have remained below the action level.

The gamma isotopic analysis of well water samples has indicated no detectable concentrations of manmade radionuclides in ground water.[4-2–4-7]

Sampling for airborne tritium was performed at three monitoring stations on the site (Figure 4-3). All samples were less than the action level of 7.4 E-4 Bq/cc (2.0 E-8 μCi/cc).

Air particulate sampling was performed at the same three locations as air tritium sampling. All samples analyzed for gross alpha and gross beta airborne activity concentrations were less than action levels of 18.5 E-9 Bq/cc (5.0 E-13 μCi/cc) for alpha activity and 11.1 E-5 Bq/cc (3.0 E-9 μCi/cc) for beta activity.[4-4–4-7]

No trends were indicated in the gross alpha concentration data during site operations. The environmental sampling program has demonstrated that alpha-emitting radionuclides are not migrating through the soil to off-site locations.

During 1972–1976, gross beta concentration in soil samples showed an upward trend. The change in concentration is believed to be more a function of the vendor performing the analysis than any actual change in radioactivity in the soil.[4-2] From 1977 to October 1985, the gross beta concentration in soil did not vary significantly. The mean remained about 1.3 Bq/gm (35 pCi/gm) throughout every sampling period.[4-2] Subsequent to October 1985, the gross beta concentration in soil has been below the action level of 3.3 Bq/gm (90 pCi/gm).

A review of the historical data presented in environmental reports for the Beatty site[4-2–4-7] shows that the gamma spectrometry analysis of soil was performed only once during April 1982. The results of this analysis are presented in Table 4-6.[4-2] Although no action levels were exceeded, Cs-137, Co-60, and Mn-54 were detected at concentrations less than 0.03 Bq/gm (0.8 pCi/gm) for Cs-137, 0.003 Bq/gm (0.09 pCi/gm) for Co-60, and 0.002 Bq/gm (0.04 pCi/gm) for Mn-54. The State of Nevada was notified and soil and vegetation samples were split between US Ecology and the state for analysis.

Vegetation samples were collected from locations near the facility boundaries, as well as from Lathrop Wells. There was no significant difference between the different sampling points, nor any trends with respect to time at any of the sampling points.[4-2–4-7]

The gross beta concentration in vegetation samples varied from a low of 0.1 Bq/gm (2.8 pCi/gm) in 1971 to a high of 26.7 $\pm$ 1.3 Bq/gm (722 $\pm$ 35 pCi/gm) taken in 1972. Several trends in the gross beta activity in the vegetation samples have been observed during the years 1972-1976. Subsequent to 1976, a general downward trend was observed in the gross beta concentration, which has remained much below the action level of 7.4 Bq/gm (200 pCi/gm).[4-2–4-7]

In 1982, tritium and gamma spectral analyses of vegetation from samples outside the facility boundary were performed. The results are listed in Table 4-8. The tritium concentrations varied from 0.4 Bq/ml to 37.0 Bq/ml (11 to 1,000 pCi/ml). The State of Nevada split samples of the vegetation and the analysis varied from 2.3 E-4 to 2.4 E-4 Bq/ml (0.0061 to 0.0065 pCi/ml). The difference was striking and not easily explained. The most probable explanation to the differing laboratory results is chemiluminescence.[4-2] Chemiluminescence can significantly interfere with liquid scintillation analysis for tritium and can be the result of the organic components in the liquid, which is derived from the

vegetation samples. The gamma spectral analysis identified Cs-137 with concentrations varying from 0.02 to 0.06 Bq/gm (0.5 to 1.5 pCi/gm).

A review of the historical direct radiation data [4-2] demonstrated that during the early years of operation, the fenceline exposures were 5.3 mSv (530 mrem) for 1965, and 12 mSv (1200 mrem) for 1966 and decreased in later years from 3.30 mSv (330 mrem) in 1977 to 0.60 mSv (60 mrem) in 1988.

REFERENCES

4-1. William D. Nichols "Geohydrology of the Unsaturated Zone at the Burial Site for LLW Near Beatty, Nye County, Nevada," U.S. Geological Survey, Carson City, Nevada (1986).

4-2. Beatty Site Environmental Reports - 1962–1987, US Ecology.

4-3. Beatty Site Environmental Report - 1988, US Ecology.

4-4. Beatty Site Environmental Report - 1989, US Ecology.

4-5. Beatty Site Environmental Report - 1990, US Ecology.

4-6. Beatty Site Environmental Report - 1991, US Ecology.

4-7. Beatty Site Environmental Report - 1992, US Ecology.

CHAPTER 5

Environmental Summary of the West Valley, New York Low-Level Radioactive Waste Disposal Site

INTRODUCTION

Background

The state-licensed disposal area (SDA) was constructed and operated by Nuclear Fuel Services, Inc. (NFS), during a period extending from 1963 until 1975, at which time disposal activities at the SDA were discontinued. From 1975 until March 1983, the SDA was actively maintained by the NFS. From March 1983 until present the New York State Energy Research and Development Authority (NYSERDA) has been responsible for the continued maintenance of the SDA. The SDA is presently under active maintenance. Ultimate disposition of the SDA is still undetermined.

Location

The Western New York Nuclear Service Center (Center) is located 20 miles south of Buffalo, New York, near the town of West Valley. The 3,340 acre Center is the site of the world's first commercial nuclear fuel reprocessing plant. Facilities at the Center include the nuclear fuel reprocessing plant and its ancillary facilities consisting of a fuel receiving and storage pool, high-level liquid waste storage tanks, two radioactive waste disposal areas, and a low-level liquid waste treatment plant. One of the disposal areas is the State-Licensed Commercial Low-Level Radioactive Disposal Area (SDA). All major facilities are located on a 200 acre plot near the center of the site (Figure 5-1).

Facility

Nuclear Fuel Services Co., Inc. (NFS) operated the site from 1963 to 1982 under a lease with the State of New York. The fuel reprocessing plant has not operated since 1972, and the SDA has been shut down since 1975. In February 1982, the U.S. Department of Energy (DOE) took possession of facilities at the Center (except for the SDA) for the purpose of carrying out the West Valley Demonstration Project (WVDP). The primary purpose of the WVDP, pursuant to the West Valley Demonstration Project Act (PL 96-368), is to solidify the high-level liquid wastes stored at the Center and to decontaminate and decommission the facilities used in the project. On March 30, 1983, responsibility for the SDA was officially transferred to NYSERDA.

The radioactive waste burial activities at West Valley, New York, consisted of two distinct activities: (1) commercial low-level radioactive waste burial under a New York Agreement State license from 1963 to 1975, when NFS voluntarily stopped accepting LLW, and (2) NRC-licensed

burial of the higher activity reprocessing plant waste from 1966 to 1986 at the NRC-licensed Disposal Area (NDA), sometimes also referred to as the "hulls burial area." These licenses were issued to co-licensees NFS and the former New York State Atomic and Space Development Authority (ASDA). The two activities and the operation of the reprocessing plant were carried out in close physical proximity. Both activities were initially carried out by the site operator and co-licensee, NFS.

This chapter will address primarily the SDA. The SDA was licensed to handle three types of radioactive wastes: (1) by-product materials including tritium, carbon-14, cobalt-60, iodine-125, iodine-131, cesium-137, and americium-241; (2) source materials including thorium-232, uranium-238, and natural uranium; and (3) special nuclear materials including uranium-235, plutonium-238, and plutonium-239. From 1963 to 1975, about 2.35 million cubic feet of wastes (equivalent to 319,600 55-gallon drums) containing approximately 740,000 curies were disposed of in the SDA. The waste was received from a variety of sources including medical and academic institutions, industries, government facilities, nuclear power plants, waste brokers, decontamination companies, and the NFS operations at the site.

The SDA occupies approximately 6 hectares (15 acres), located about 300 m (1,000 ft) southeast of the reprocessing plant and is adjacent to the NRC-licensed disposal area (NDA). The SDA consists of two distinct sets of parallel trenches, identified as north and south disposal areas as shown in Figure 5-2. The northern area consists of five trenches (1, 2, 3, 4, 5), and two "special" trenches (6 and 7). Trench 7 is a narrow, shallow concrete vault in which wastes were disposed of and Trench 6 is actually a series of holes for the disposal of high-activity wastes requiring immediate shielding. Disposal operations were conducted in this area from 1963 to 1969, except for Trench 6 which was used until 1973. The southern disposal area consists of seven trenches (8-14). This area was developed from 1969 to 1975 and incorporated a number of changes in construction practices based upon the experience gained from the northern area of the SDA: (1) topsoil and coarse surface materials were removed, (2) separation distance between trenches was increased to 3 m, from 1.2 to 1.8 m (10 ft, from 4 to 6 ft), (3) trench floors were sloped southward from wastes previously disposed of, and (4) the trenches were covered with individual caps. The trenches had nominal dimensions of approximately 180 m long x 8.25 m wide x 6 m deep (600 ft long, 27.5 ft wide and 20 ft deep). Construction and operational practices by NFS at the SDA have resulted in surface contamination of soils in and near the SDA. This contamination has the potential to complete the interpretation of data from the ongoing environmental monitoring program.

The commercial low specific activity (LSA) waste, having radiation levels of less than 200 mRem/hr at the surface, was buried in the trenches. According to NFS estimates, approximately 55% of the available volume in the disposal trenches was utilized resulting in an overall activity level of less than 0.1 curie per cubic foot of trench space. The volume per trench actually used varies from 23% to 82% of that excavated. The difference reflects the use of soil for shielding and backfilling and the existence of air spaces between the containers. Because of the presence of non-compacted waste forms, the buried material is undergoing a gradual volume reduction through biodegradation and compaction, causing voids and some difficulties in maintaining the integrity of the caps on the trenches.

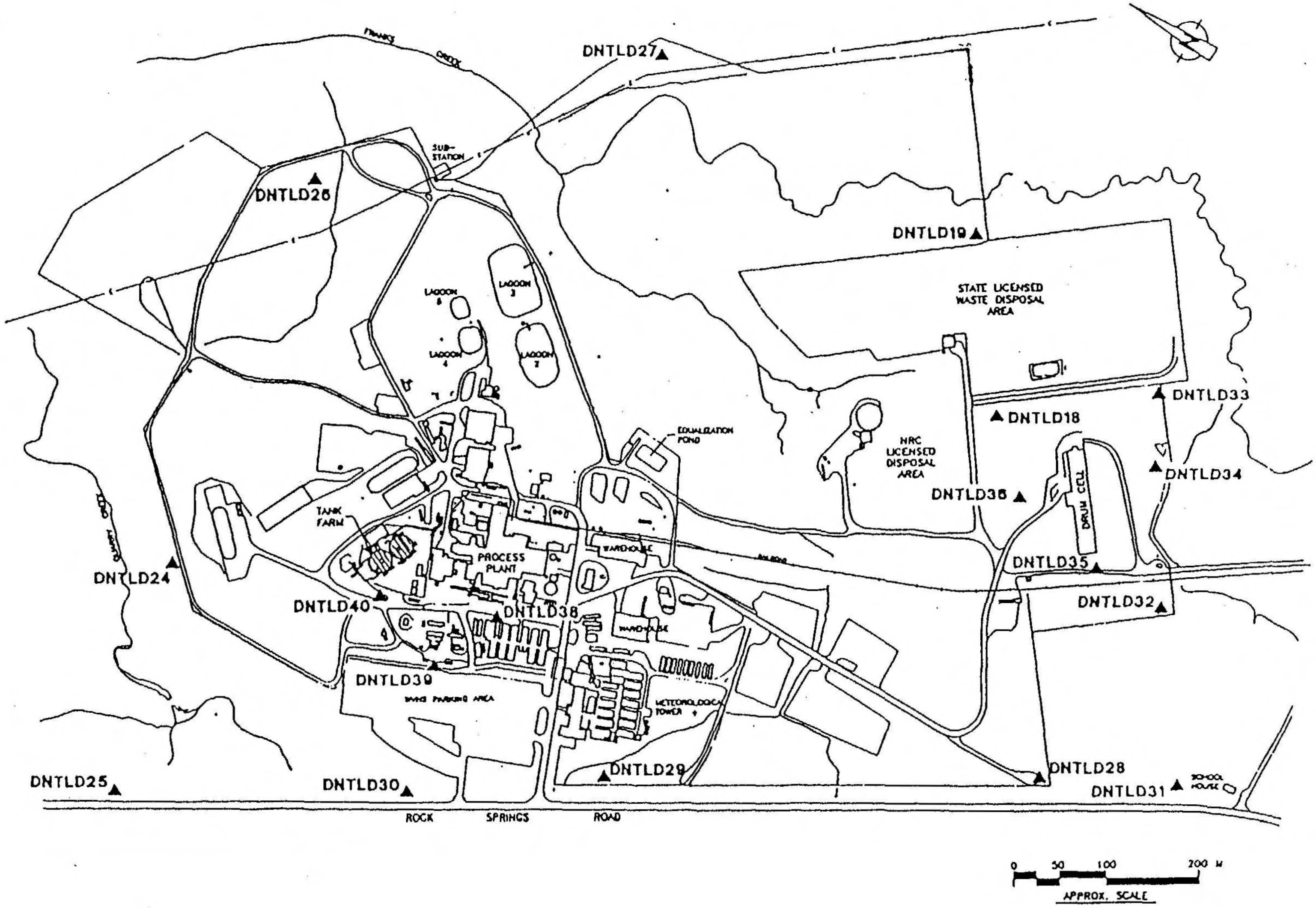


Figure 5-1. Principal facilities at the West Valley LLW site.

Table 5-1 summarizes the sources of the material buried through 1972. Most of the material was buried in the original shipping containers: steel drums, wooden crates, and cardboard boxes. The waste that originated at nuclear power plants consists primarily of evaporator bottoms, filter sludges, and filters, all in 55-gallon drums or in disposal liners.

A detailed summary of the wastes disposed of in the SDA through 1972 is contained in a New York State Department of Environmental Conservation (DEC) report.[5-1]

Table 5-1. Sources of waste in the state-licensed disposal area through 1972.[5-2]

Type of facility	Number of facilities	New York based facilities	Waste volume (%)
Medical and educational institutions	30	21	1.8
Industrial, pharmaceutical, research and development institutions	70	38	21.5
Federal government	7	4	12.0
Waste disposal and decontamination companies	9	5	19.2
Nuclear fuel services	1	1	23.0
Nuclear power plants	8	3	22.5
	125	72	100.0

Recently, as part of the environmental impact statement (EIS) for site closure, work has been done to estimate the radionuclide source term for waste management areas at the Center including the SDA. NFS estimates of the radioactivity of wastes disposed of at the SDA are shown in Table 5-2.

Since the SDA accepted waste for disposal prior to the U.S. Environmental Protection Agency (EPA) hazardous waste regulations, little indication of chemical constituents exists in the disposal records. Disposal records maintained by NYSERDA do not contain sufficient information to determine whether hazardous wastes were disposed of at the SDA. However, NYSERDA, has made an effort to chemically characterize the leachate contained in the SDA. The data provide an indirect indication of chemical constituents in each of the trenches from which samples were taken and analyzed. The results of these analyses show that in the SDA the water collecting in the trenches may come into contact with buried waste and become contaminated with chemical and radiological constituents. Due to the presence of radionuclides, these materials would be mixed wastes.

The SDA lagoon was located approximately 15 m (50 ft) west of Trench 14 in the southern part of the SDA. From 1975 to 1981, the lagoon was used to store and pre-treat leachate pumped from the SDA burial trenches. The lagoon was approximately 27 m (90 ft) long, 12 m (40 ft) wide and originally could accumulate liquid to a maximum depth of 2.1 m (7 ft). Maximum capacity was about 100,000 gallons. The lagoon was unlined, and was filled in 1991 with soil over a liner. Figure 5-2 shows the location of the lagoon.

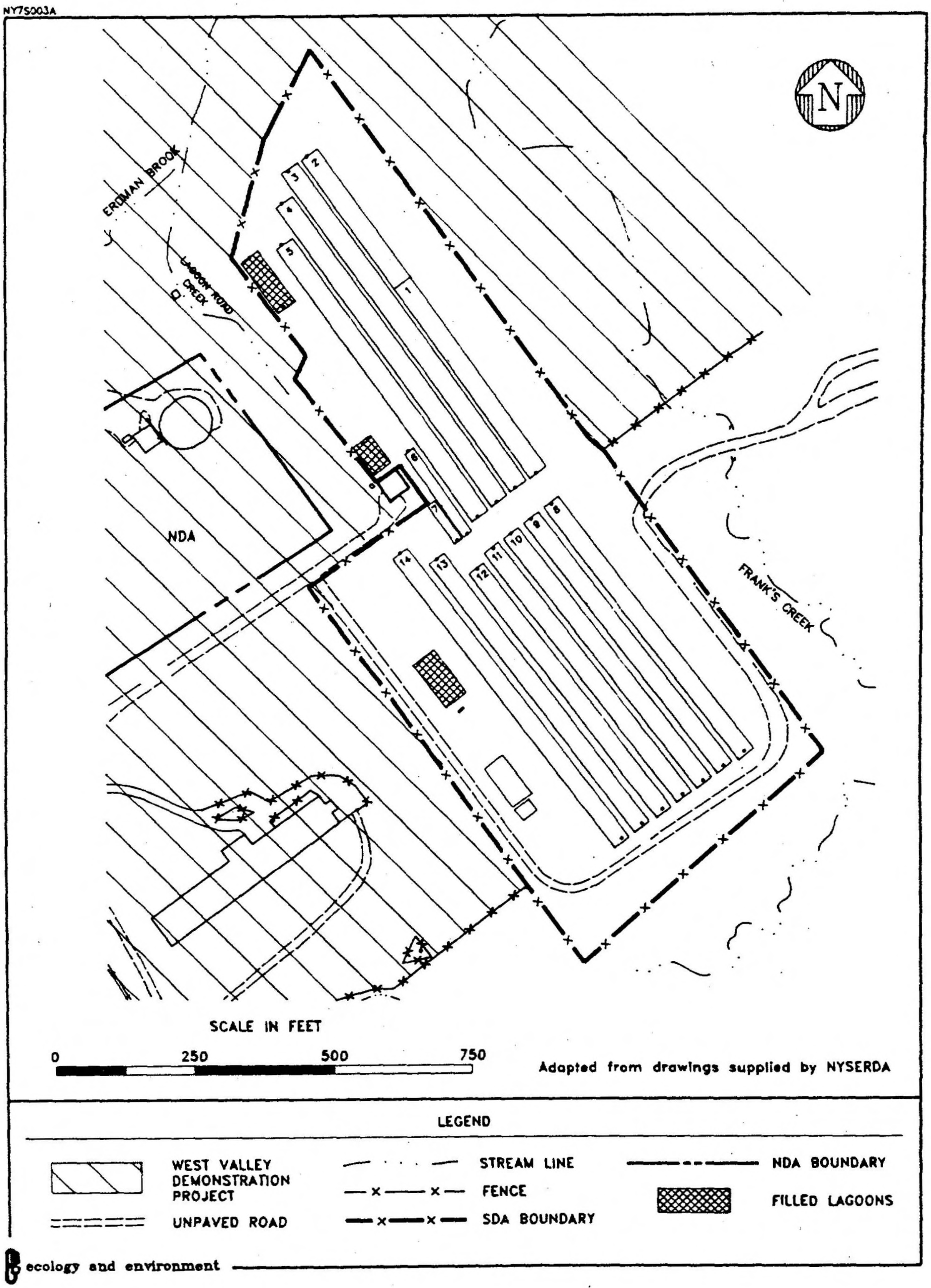


Figure 5-2. State-licensed trenches at the West Valley LLW site.

Two other lagoons were excavated adjacent to the north trenches. The lagoons held rainwater that was pumped out of the open trenches during disposal operations to provide reasonably dry working conditions. These two lagoons were closed by filling them with soil in 1975 and 1977. In 1975, a third lagoon was constructed adjacent to the south trenches to hold water pumped from the completed trenches that were accumulating water. This lagoon was closed in 1991 by installing a barrier membrane over the sediments, then filling it with native soil and adding a clay cap.

During the fall of 1990, and the spring, summer, and fall of 1991, new equipment was installed at the SDA, including an enclosed storage tank to hold contaminated water from Trench 14 and several FRAC tanks intended to provide emergency storage for trench water should levels rise unexpectedly. In the summer of 1992, a slurry wall was constructed on the west side of Trench 14 in order to minimize water infiltration into the southern SDA trenches. Trenches 14, 13, and half of trench 12 were recapped using membrane liners. These developments will be reviewed in subsequent sections of this report. Subsequently, a new geomembrane cover was placed over all trenches other than Trench 9 which had a bioengineered cover added to it.

SITE

Climate

Prior to the opening of the site, extensive climatological studies were undertaken by the U.S. Department of Commerce Weather Bureau. The average temperature was found to be 9°C (48°F), and rain and snowfall averaged 1 and 2.25 m (40 and 90 in.), respectively, over a 10- to 15-year period.[5-4]

Land Use

The area surrounding the site is rural/residential. Significant crops include trees and shrubs (for transplant) and a variety of grains and vegetables. Beef and dairy products are also produced. Population density for Cattaraugus County is less than 100 persons per square mile.

Topography and Surface Water

The West Valley site occupies a plateau which is cut by the Buttermilk Creek and its tributaries. Buttermilk Creek empties into Cattaraugus Creek which in turn flows into Lake Erie, approximately 40 miles to the northwest. The site includes most of the Buttermilk Creek Valley. At this time, and during the operating history of the site, none of the villages or cities located downstream from the site to Lake Erie uses surface water from the Buttermilk or Cattaraugus Creeks for domestic purposes. However, people do fish in the Buttermilk and Cattaraugus Creeks. The burial site is bounded by Erdmann Brook and by a small seasonal tributary of this creek (Frank's Creek). Erdmann Brook flows into the Buttermilk Creek.

The burial sites are located in the central area of the reservation, about 414 m (1,380 ft) above sea level. Buttermilk Creek and its tributaries cut through the area at an elevation of approximately 400 m (1,300 ft). The valley walls of Buttermilk Creek and its tributaries are steep, and badly slumped

in places. The site is generally well drained with the exception of a marshy area to the south of the burial area.

Geology and Ground Water

Extensive geologic and hydrologic studies were undertaken by the New York State Geological Survey (NYSGS) and the United States Geological Survey (USGS) before and during 1963. These studies included a boring program of 108 augured holes and 14 deep wells.[5-5] These wells and borings indicated deep, low-permeability clays, which were thought at the time to make the site promising for a disposal area. Figure 5-3 shows a geological cross section of the West Valley site. Subsequent experience with the site has shown that burial trenches have a tendency to fill with water and that the potential for horizontal leachate migration is not as minimal as originally thought due to the presence of sand lenses and other permeable structures within the weathered till and upper layers of unweathered till. The primary direction of ground water flow at the SDA is downward. The disposal trenches were excavated into the native Lovery till, which because of its high clay content and high degree of over-consolidation, is highly impermeable at depth. Samples taken from boreholes have indicated, however, that the upper three meters of the till are weathered as a result of desiccation. The weathered till is highly fractured and is generally more permeable than the unweathered till.

ENVIRONMENTAL MONITORING

Overview

The SDA began operations in 1963, three years prior to the beginning of operations at the NFS reprocessing plant. During this three year period, environmental monitoring at West Valley was carried out by the New York State Department of Health to establish background levels for the subsequent monitoring of the reprocessing plant. Also, during this period, the off-site monitoring program consisted of the following: (1) monthly surface water sampling for gross beta and selected radionuclides including iodine-131, cesium-137, barium-140, strontium-89, and strontium-90 carried out in the Cattaraugus Creek watershed at the Springville Dam and upstream of the NFS plant; (2) air monitoring for gross beta at several locations in the immediate vicinity of the NFS plant; and (3) monthly analysis of milk from 16 local dairy herds for iodine-131, cesium-137, barium-140, strontium-90, and strontium-89. All data prior to April 1966 were regarded by Nuclear Fuels Services and the State Health Department as background data. Gross beta levels in water were 1-3 pCi/L, air gross beta was generally less than 1 pCi/L, and no significant concentration of radionuclides was observed in milk.

In November 1966, gross beta concentrations increased from about an average of 3 pCi/L to an average of 252 pCi/L in the Cattaraugus Creek at the Springville Dam. During this same period, other sampling sites upstream of the plant showed levels between 1 and 3 pCi/L. Levels in air and dairy herd levels showed no significant change. By the end of 1966, the downstream creek environment had concentrations of various nuclides significantly higher than before plant operation. No off-site samples, however, showed levels that exceeded the concentration limits set forth in 10 CFR 20 of the U.S. Atomic Energy Commission regulations. There was no detectable rise in radioactivity due to stack discharges in the area surrounding the plant up to the end of 1966.

Table 5-2. West Valley trench inventory.[5-3]

Trench No.	Length (feet)	Trench volume (ft^3)[a]	Waste volume (ft^3)	Activity (curies)
1	365	233,000	55,300	4,100
2	335	213,000	114,200	2,200
3	695	443,000	198,000	17,100
4	660	421,000	274,400	67,100
5	535	341,000	278,400	92,800
6[b]	160	112,300	500	339,600
7[c]	73	11,000	2,500	1,600
8	565	360,000	252,400	38,700
9	560	360,000	175,800	34,200
10	560	360,000	185,800	54,900
11	560	360,000	182,800	53,500
12	555	355,000	196,700	11,200
13	610	390,000	207,800	7,400
14	655	420,000	229,800	12,300
Total (without 6)		4,297,000	2,354,600	397,100
Total (with 6)			2,355,100	736,700

a. Excavated trench volume calculated by using an average width of 8.7 m (29 ft), average depth of 6.6 m (22 ft) times the length, except for trenches Nos. 6 and 7.

b. Trench No. 6 consists of 19 separate holes in an area 4.5 m (15 ft) wide and 48 m (160 ft) long. Depth averaged 36 m (12 ft). Utilization rate based on the total hold volume is 4%, and 2% based on the overall trench excavation volume.

c. Trench No. 7—special purpose concrete vault—21.9 m (73 ft) long, about 3 m (10 ft) wide, and about 4.5 m (15 ft) deep.

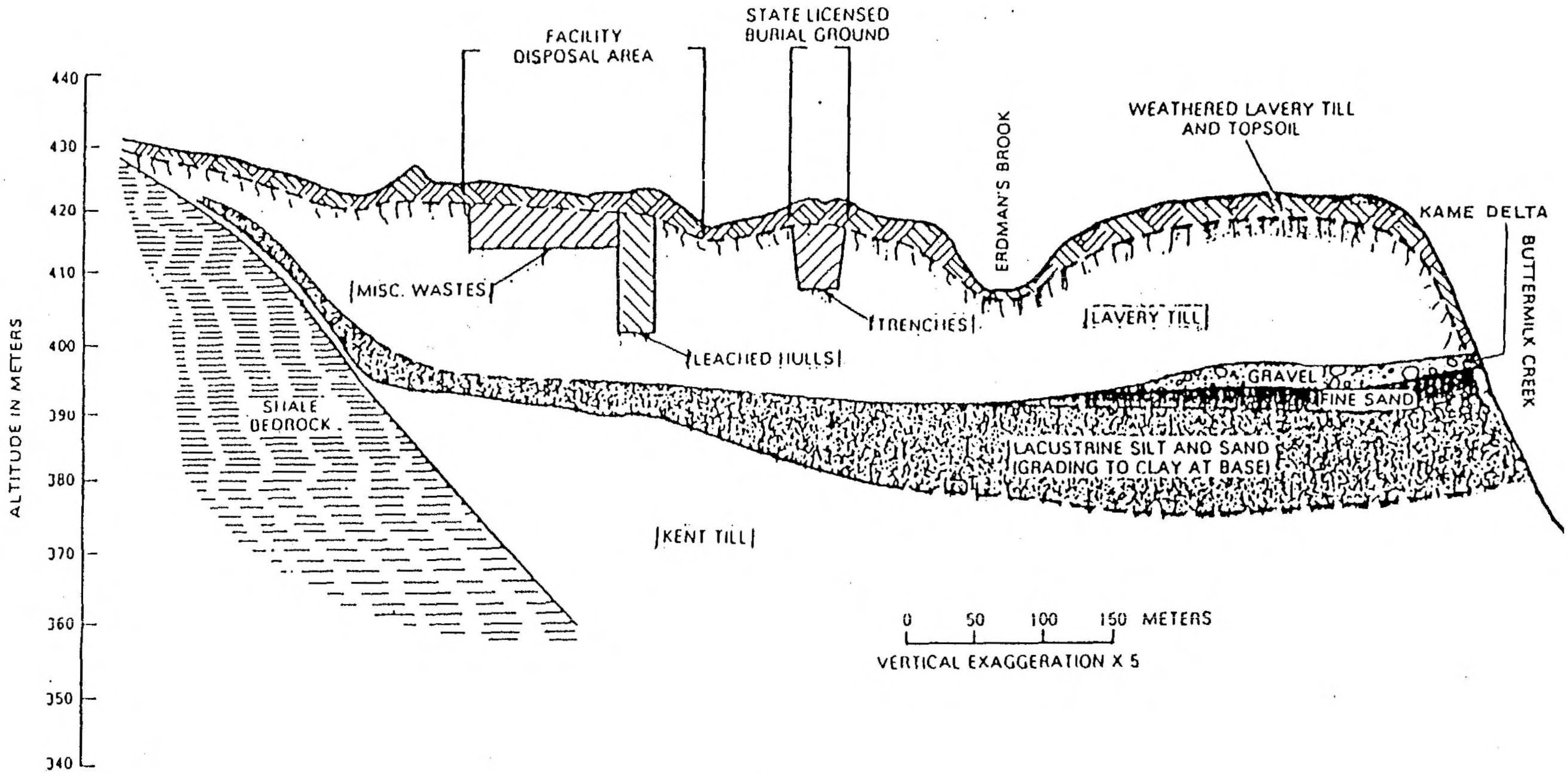
During this period, the effects of the discharges from the NFS plant were evident on the Buttermilk and Cattaraugus Creeks sampling stations. The U.S. Atomic Energy Commission did not establish limits for the section of Buttermilk Creek which received the wastes because that section was within the NFS site boundary and under the control of NFS. Concentration limits were applied to Cattaraugus Creek after the confluence of Buttermilk Creek. The limits for gross beta were considered to be 300 and 600 pCi/L for the yearly and maximum values, respectively, if an isotopic analysis was not made. The allowable concentrations in pCi/L for each specific radionuclide averaged over a year's period were as follows: strontium-90 - 300, cesium-137 - 20,000, zirconium-Nb-95 - 60,000, barium-140 - 30,000, strontium-89 - 3,000, and tritium - 3 million.

Through 1968, the program and the results thereof were essentially unchanged. On a yearly basis, the average concentrations allowed by the U.S. Atomic Energy Commission in Cattaraugus Creek were not exceeded. A single sample taken from Cattaraugus Creek on September 23, 1968, at Felton Bridge showed a gross beta concentration of 721 pCi/L. This sample was analyzed for specific nuclides and reported.[5-6] The sample was within limits allowed by the U.S. Atomic Energy Commission.

In 1968, the New York State Department of Health published the first analysis of deer and fish from the West Valley area and the Cattaraugus Creek. The first three deer were taken from the 36 hectare (90 acre) exclusionary zone within the site for sampling in December of 1967. The highest concentration of cesium-137 was found to be approximately 67,000 pCi/kilogram. It was thought that the deer ingested the radioactive material by drinking the relatively highly contaminated water in the waste lagoons or from the discharges of these lagoons. Also, cesium-134 was present, which is indicative of wastes from spent fuel. Based on these results, the New York State Department of Health instituted a regular sampling program for deer in the 1320 hectare (3,300 acre) preserve, but outside the 27 hectare (90 acre) exclusion area. Deer taken from outside the exclusion area were found to have much lower concentrations of radionuclides. The State Health Department subsequently required barriers at the deer access points to the high exclusion area and NFS erected them. The exclusion area, however, is not considered to be deer-proof.

In the same time period, fish samples began to be taken in the creek system above and below the NFS discharge point. In most cases, the entire fish including bone, flesh, intestines, and scales was analyzed. The results indicated that fish, mostly suckers, tend to reconcentrate strontium 90. Suckers are taken from Cattaraugus Creek for food especially in the springtime. The State Health Department collected samples and determined that some of the highest values for strontium-90 found in the fish and determined that the Radiation Protection Guide for an individual might be exceeded if that person were to eat 78 lbs. of fish per year. It is considered unlikely that one individual would be able to take this amount of fish from Cattaraugus Creek in the vicinity of Buttermilk Creek. However, because of the possibility that in the future the concentrations might go higher, the matter was brought to the attention of the U.S. Atomic Energy Commission with an expression of concern on the part of the New York State Department of Health. The AEC at this point (1968) requested that NFS reduce the level of radioactivity in the discharges.

During March, June, and September of 1968, three separate releases of airborne contaminants occurred due to filter failures at the main plant. The New York State Department of Health investigation concluded that contamination from the incidents was contained within the parking lot



Source: West Valley Groundwater Monitoring Program, Engineering Science, 1988

SOURCE: Bergeron et. al. - Nicholson, T.J. 1985

Figure 5-3. Geological cross-section at the West Valley LLW site.

adjacent to the plant and did not migrate off-site. Several Aerial Radiological Measuring Surveys (ARMS) were conducted by EG&G in 1968, 1969, and 1970 using NaI detector arrays. These surveys did not show significant contamination from the filter failures. Subsequent ARMS carried out in 1979 and 1984 with more sensitive instrumentation indicated a cesium prong extending NW of the site. Off-site sampling carried out in 1982 showed elevated levels in soil samples taken from the prong area. Between 1993 and 1995, NYSERDA characterized this area.

In 1970, extensive studies of ingestion dose pathways for radionuclides from the NFS plant were begun by the EPA [3]. Three major pathways were examined: (1) dose from ingestion of fish from the Cattaraugus Creek, (2) dose from consumption of venison taken near the West Valley site, and (3) dose from radionuclide concentrations in diets of populations living in the vicinity of the NFS plant. The last study used a 'market basket' approach sampling selected dietary items purchased in Riceville and West Valley which could have originated locally and homegrown garden vegetables and fruits from seven homeowners near the plant perimeter. The vegetables and fruit were consumed by the families and not sold commercially. Vegetables and fruits from produce farms in Chafee, New York and Winchester, Massachusetts served as controls. These samples were analyzed for gamma-emitters, strontium-90, and tritium. The results of these studies were published in 1974.[5-7] From the results of these studies, the following estimates were made by the Health Department concerning the dose commitments to the population fishing and hunting in the vicinity of NFS resulting from waste discharges from the plant:

1. Whole body doses to population fishing the Cattaraugus Creek during 1971:

   Integrated population dose—0.06 person-rem (0.04 person-rem external, 0.02 person-rem from ingestion)
   Maximum individual dose—1.4 mrem (1 mrem external, 0.4 mrem from ingestion)

2. Dose to bone from ingestion of strontium-90 for population fishing Cattaraugus Creek during 1971:

   Integrated population dose—0.3 person-rem
   Maximum individual dose—0.7 mrem

3. Whole-body doses to population from ingestion of venison from deer kill in 1970:

   Integrated population dose—0.1 person-rem
   Maximum individual dose—1.4 mrem

4. Dose to bone from ingestion of strontium-90 in venison resulting from the NFS discharges could not be determined from the available data.

The sampling of fish, venison, and farm produce has continued to date as part of the regular West Valley monitoring program.

Levels of strontium-90 in Cattaraugus Creek continued to rise through 1970 despite NFS efforts to reduce concentrations. Figures 5-4 and 5-5 show strontium-90 and tritium concentrations in the

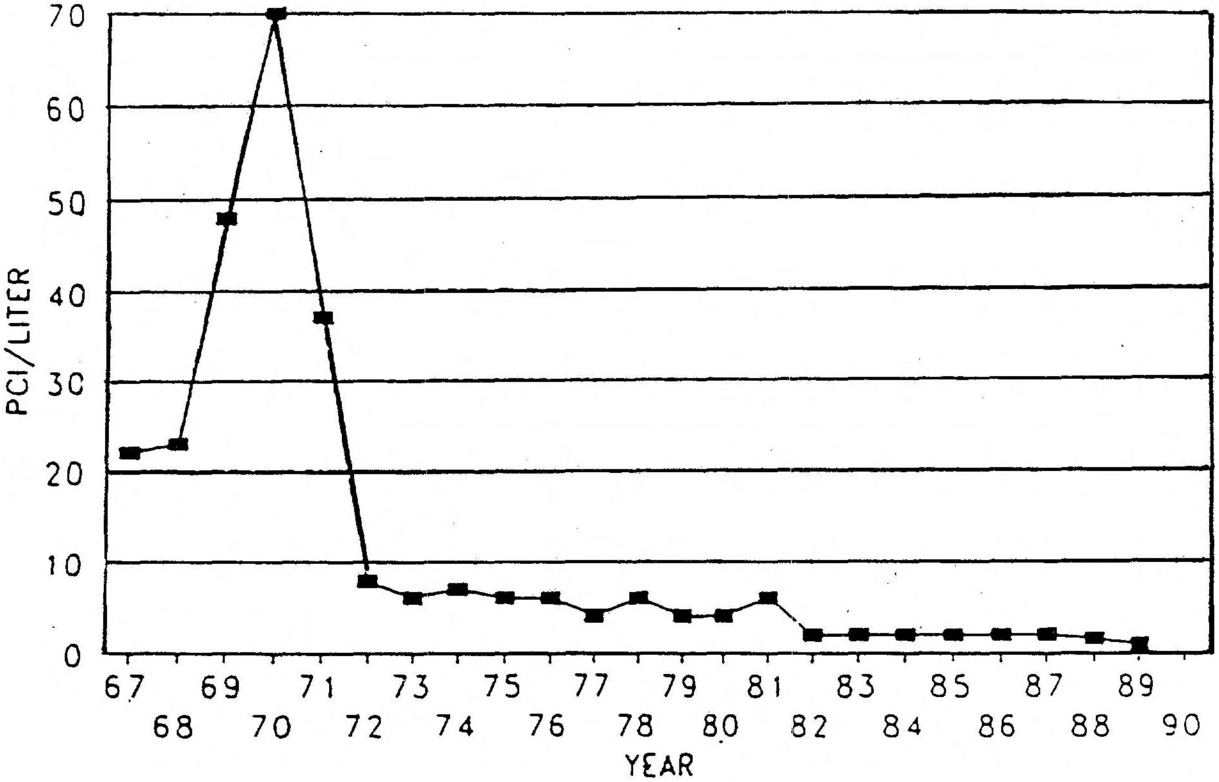


Figure 5-4. Strontium-90 in Cattaraugus Creek at Springville Dam.

Cattaraugus Creek from 1967 to 1989. In November of 1971, NFS suspended fuel reprocessing operations.

All of the monitoring procedures discussed above were intended to monitor releases from the NSF plant. Monitoring of the low-level radioactive waste disposal site was only incidental. In the early 1970's, however, the newly created DEC assumed responsibility for the monitoring of environmental radiation levels in New York State. Awareness of the need to monitor the SDA burial trenches for possible release of radionuclides into ground or surface waters increased. Therefore, beginning in 1972, additional surface locations near the trenches were sampled for radionuclides, and a sampling program for wells, springs, and public water supplies in the area surrounding the NFS plant was begun. Iodine-129 and -125 were given specific attention in these new sampling programs using a liquid scintillation technique. Additionally, various fauna including rabbits and woodchucks were taken and analyzed for radionuclide content, particularly I-129 contained in the thyroid. Also during 1972, a regular program of sampling radionuclide concentrations in the lagoons was initiated, as was sediment sampling at water sampling locations downstream of the NFS facility.

Prior to 1972, precipitation entering an open trench, which came in contact with waste packages before covering, was pumped to the surface or to holding lagoons in order to provide dry working conditions for workers in the trench. The waters in the lagoons were analyzed and discharged at a controlled rate into Erdmann Brook. This direct discharge was eliminated during November 1972 and water from the burial site holding lagoons was thereafter pumped to the main NFS plant for treatment

in the low-level radioactive waste treatment plant. This change in procedure contributed to the lower radionuclide levels observed in the Cattaraugus Creek in the early 1970's.

In 1975, radioactivity levels in watercourses below the NFS main plant and below the low-level radioactive waste disposal site increased because of the trench water seepage out of the cover and the subsequent pump out of the trenches at the low-level burial site. The water levels in Trenches 4 and 5 at the north end of the burial site reached elevations such that a physical breakthrough of the trench water through the soil cover was observed in the north end of Trench 4 and along the west side of Trench 5 in early March. The breakthrough caused increased activity in streams below the burial site and main plant. It was necessary to pump 270,000 gallons of water from Trenches 3, 4, and 5 to lower the water level in the trenches and prevent further breakthrough. The water was pumped out of the trenches to the burial site holding lagoons and eventually transferred to the main plant for treatment and discharge. An increase in activity, primarily tritium, in streams below the NFS main plant discharge occurred from June 14 to July 1, 1975, due to the controlled release of the treated trench water.

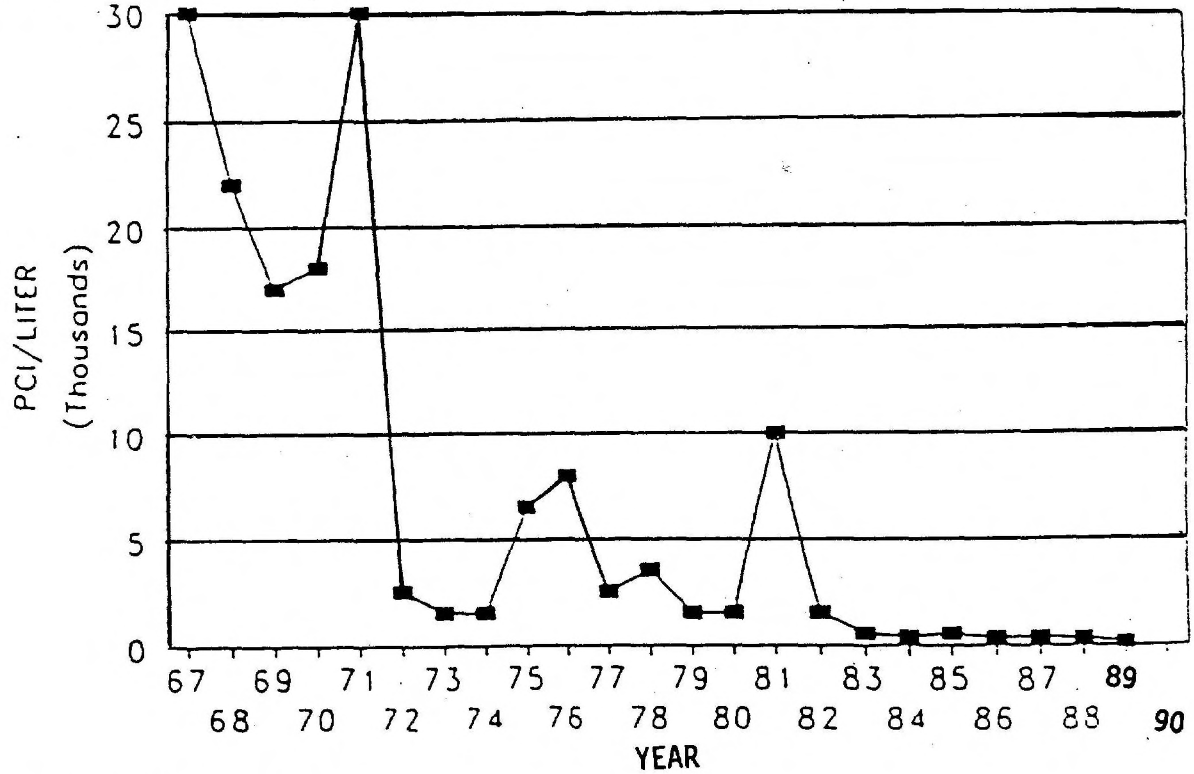


Figure 5-5. Tritium on Cattaraugus Creek at Springville Dam.

A second pump-down, designed to prevent further trench water breakthrough, was initiated on September 29, 1975. On October 6, 1975, during a routine monitoring visit to the burial site, a DEC representative discovered there had been leakage from the north burial site holding lagoon. Upon notifying NFS officials, it was learned that the seepage through the wall of the lagoon had been observed on October 5, 1975. The level in the lagoon had been lowered on October 5 by pumping the waste to the south lagoon until the seepage had ceased. DEC estimated that approximately 7,000 gallons of untreated trench water had been released to the environment.

Figure 5-6 shows the NFS plant area and the LLW burial area and on-site surface water sampling locations. The highest gross beta, tritium, and strontium-90 concentrations for 1975 were found at sites 53 (Erdmann Brook), 35 (Buttermilk Creek), and 42 (Cattaraugus Creek). They were obtained from samples collected on October 6, 1975, and were a direct result of the burial site lagoon seepage. The maximum concentration of tritium in the weekly composite samples at Springville Dam following the lagoon seepage was 10.7% of the NFS's maximum allowed levels for Cattaraugus Creek. Strontium-90 maximum level reached 15% of the technical specifications for Cattaraugus Creek. [The NFS technical specifications in 1975 stated that the concentration of radioactivity in the Cattaraugus Creek would not exceed either: (1) 10% of the prorated concentration listed in Appendix B, Table II, 10 CFR Part 20 averaged over any quarterly period; or (2) 20% of the prorated concentration listed in Appendix B, Table II, 10 CFR Part 20 for any weekly composite sample taken in accordance with Technical Specification 5.1.1.].

During 1975, the other routine monitoring programs at West Valley (air, venison, fish, farm produce, water supplies, milk, fauna, etc.) showed generally decreasing levels of radioactivity.

From 1976 to 1981, the overall monitoring program remained essentially unchanged. There were no significant incidents involving release of radionuclides to the environment. Water levels in some trenches, however, showed a consistent tendency to rise. Water was pumped from several trenches during this period. This water was pumped out of the trenches to the burial site holding lagoons and eventually transferred to the main plant for treatment and discharge. An increase in tritium in streams below the NFS main plant discharge point occurred due to the controlled release of the treated trench water. At no time during this period did the radionuclide concentrations at Springville Dam or Cattaraugus Creek approach the technical specifications for the site.

In October 1982, the New York State Department of Health reassumed responsibility for the monitoring of environmental radiation levels in the state, a task previously performed by the Department of Environmental Conservation. This did not have a major impact on the format of the monitoring program. Some of the biological sampling programs, specifically the sampling of thyroids from rabbits and woodchucks, were curtailed about 1982.

From 1982 to 1986, the monitoring program continued unchanged and with uneventful results. In 1987, a remedial action program was instituted for Trench 14 including removal of a sand lens to prevent potential ground water migration of radionuclides from the trench. This program was completed late in the summer of 1987. The effectiveness of the sand lens removal in slowing the rate of rise in water levels in Trench 14 initially appeared to be good. Recent developments, discussed in later sections of this report, have further reduced the rate of water infiltration into Trench 14.

Figure 5-7 shows the location of the SDA and the nearby currently used air, milk, and water sampling locations and Figure 5-8 shows the locations of all on-site sampling. Table 5-3 shows the 1989 locations and sampling frequencies of TLD sites used to monitor radiation levels.

Ground Water Monitoring

Prior to 1990, ground water has been monitored less for the SDA than would be required by current standards for new LLW facilities. From 1975 to 1983, the USGS conducted ground water

monitoring and sampling at a limited number of wells on or near the SDA. Data gathered in this study was used to develop a model of ground water flow characteristics for West Valley including, but not restricted to, the SDA. A variety of ground water studies addressing ground water flow characteristics were carried out between 1975 and the present, none of which provided sufficient information on ground water quality at the SDA to provide a thorough understanding for characterization.

In 1987, NYSERDA began to prepare a more comprehensive ground water monitoring program for the SDA, which was integrated with the DOE ground water monitoring program for the Western New York Nuclear Service Center. Unlike previous efforts, this program addresses potential horizontal migration of trench water from the SDA. The program is summarized in a report prepared for NYSERDA.[5-7] Much of the information presented below is taken from this report. The new program is designed to be compatible with the NRC performance objectives for LLW in 10 CFR Part 61.41 and 10 CFR 61.53, which require maintenance of a monitoring system capable of providing early warning of releases of radionuclides before they leave the site boundary. The NRC identifies ground water as the most probable path of migration for release of radionuclides from a low-level radioactive waste disposal site.[5-9] Because the trenches contain hazardous constituents as well as radioactive materials, the new monitoring plan was designed to take into account the requirements of the Resource Conservation and Recovery Act (RCRA).

In order to determine whether and at what rate water contained in SDA trenches is migrating through the ground water regime, it is useful to categorize that water for purposes of identification. Accordingly, analysis of trench water was performed by NYSERDA. Tritium, strontium-90, and carbon-14 are the chief radioactive components of the trench water.[5-10] Dissolved metals present included sodium, potassium, and iron, while the highest observed levels of dissolved non-metals were for chloride and organic carbon.[5-11] Finally, NYSERDA conducted an analysis of water taken from all trenches which identified the most abundant organic compounds as being toluene, benzine, phenols, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, methylene chloride, naphthalene, and ethylbenzene.[5-12] In preparing the SDA ground water monitoring program, NYSERDA's consultants included these organic compounds as indicator analytical parameters due to their abundance and toxicity.[5-13]

The ground water monitoring program (Figure 5-9) includes ground water elevations to be measured in 11 of the existing USGS wells. Other extant wells will not be utilized due to inappropriate construction or other defects. None of the older wells will be sampled for leachate indicator and ground water quality parameters. Twenty-one new wells have been installed are sampled for leachate indicator and water quality parameters. Since the main purpose of the new wells is to detect contaminants in the ground water that flows into and out of the SDA, it is important that the well screens intersect ground water flow paths. NYSERDA's consultants identified two main potential ground water flow paths at the SDA; (1) through the weathered till, and (2) vertically through the unweathered till to the deep lacustrine deposit.[5-6] In some locations, wells were installed in triplets or pairs and screened at different depths in order to monitor the weathered till, the unweathered till, and the lacustrine unit. Wells employ stainless steel construction rather than the polyvinyl chloride (PVC) used for past wells.

Sampling of the wells during the first three years of operation was carried out in order to facilitate the identification of seasonal variations. Sampling is currently semi-annual. Parameter concentrations

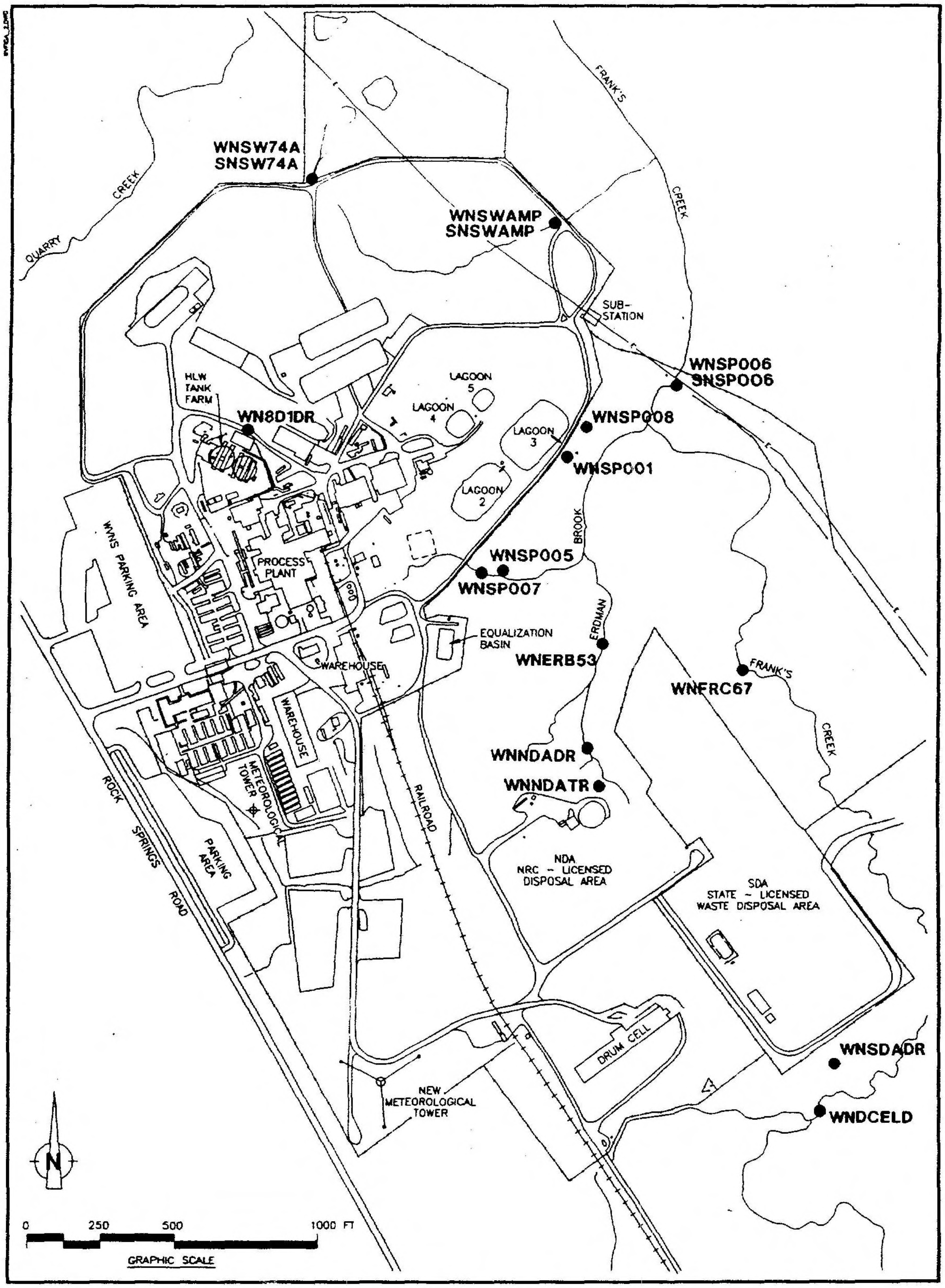


Figure 5-6. On-site surface water sampling locations at the West Valley LLW site.

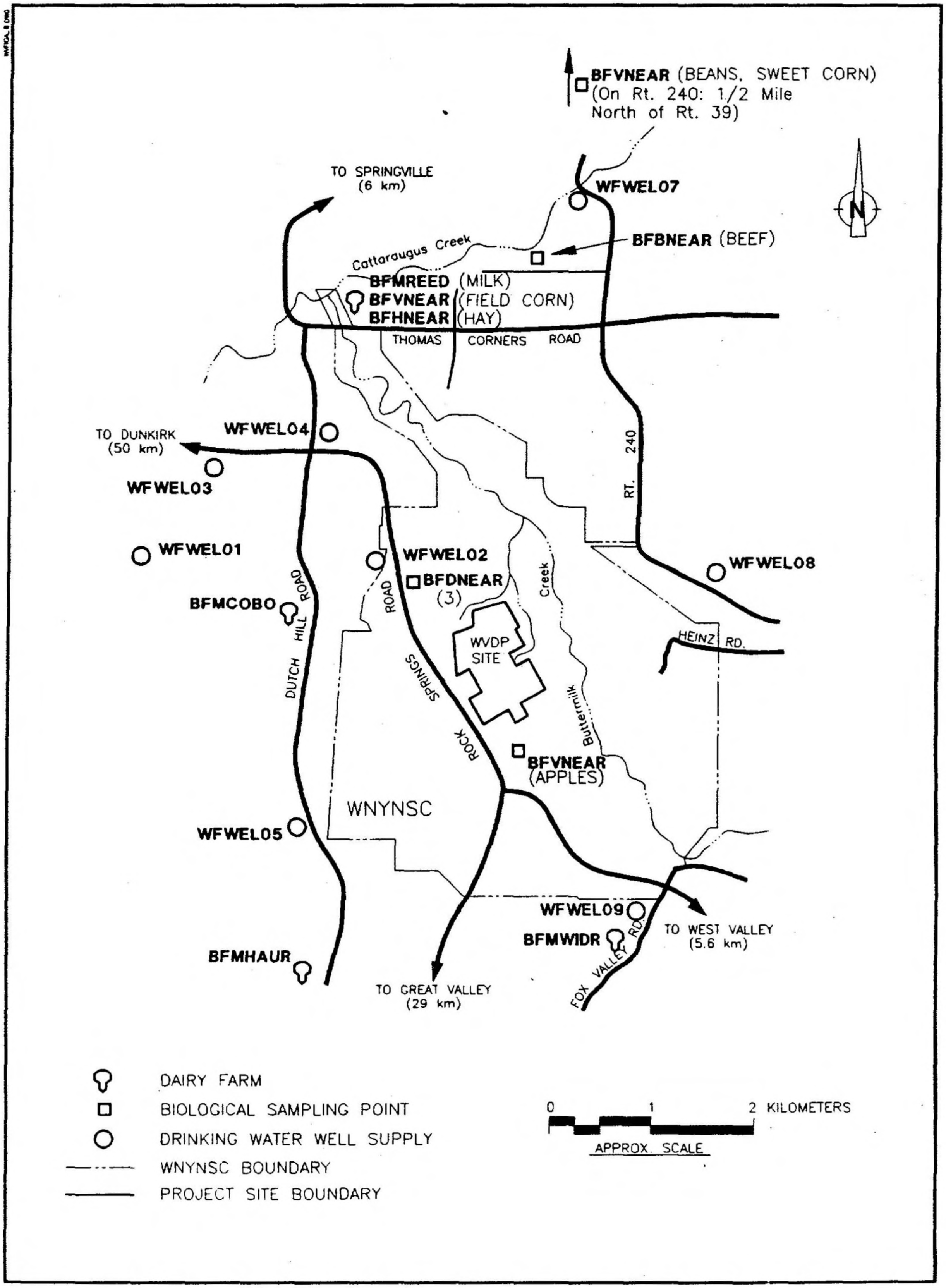


Figure 5-7. West Valley demonstration project sampling site.

in down-gradient wells exceeding three times the background level will trigger resampling and possible sampling for additional parameters with the additional parameters selected from the same group of compounds, elements, or radionuclides.

Results for several rounds of sampling for radionuclides are now available. Tritium levels in well 1107A near Trench 5 have leveled out at 20,000 pCi/L.

During the winters of 1990-1991 and 1991-1992, water levels in several trenches at the SDA, particularly Trenches 13 and 14, rose substantially. Trench water level data from these two trenches seemed to imply a hydraulic connection between them just below the boundary between the weathered and unweathered till. In an attempt to arrive at a better understanding of the source of the intrusive water and in order to develop corrective measures to prevent further influx, NYSERDA and its consultants, in conjunction with DEC technical staff, installed a network of 20 new piezometers at and around the SDA concentrated in the Trench 14 area. In order to minimize further rises in trench water levels, a slurry wall approximately thirty feet deep was installed on the west site of Trench 14 during the summer of 1992. In conjunction with this, all trenches (except Trench 9) have been recapped using a geo-membrane liner. Nine slit wells have been installed around the southwest SDA perimeter to monitor the effects of slurry wall installation and recapping.

Until the winter of 1990-1991, NYSERDA monitored water levels in all trenches on a monthly basis. Rising water levels in several trenches, particularly Trenches 13 and 14 have prompted bi-weekly monitoring of trench water levels in 1991 and 1992. Also, during the summer of 1991, preliminary closure of the SDA lagoon was undertaken. Monitoring of radionuclide levels in lagoon water has been replaced by additional ground water monitoring efforts in the lagoon area.

An issue with geology and groundwater is the fact that the trenches will slowly fill with water due to the "bathtub effect." If left uncontrolled, the contaminated water would eventually overflow laterally into the environment. Therefore, it is important to monitor water levels in the trenches to make sure that appropriate actions can be taken to ensure this does not happen.

The recent improvements in ground water monitoring at the SDA are likely to lead, within a few years time, to an enhanced understanding of the potential for contaminant migration at this facility. As data are accumulated, additions, modifications, and improvements will be made to the existing monitoring system.

Surface Water

In accordance with the NYCRR Part 380 Land Burial Permit, NYSERDA is also sampling surface water. The north and east slopes of the SDA are steep ravines leading to Frank's Creek and Erdman Brook, respectively. These slopes may intersect lateral flow in the weathered till resulting in a seep. Samples taken from seeps and other surface water may provide a useful check on possible migration of ground water from the SDA trenches. Samples taken to date, however, give no clear indication of extensive horizontal migration. There are four off-site surface water monitoring points historically used by NFS that continue to be used by WVDP: two in Buttermilk Creek, one in Cattaraugus Creek, and one at Springville Dam. Figures 5-10 and 5-11 show tritium and strontium-90

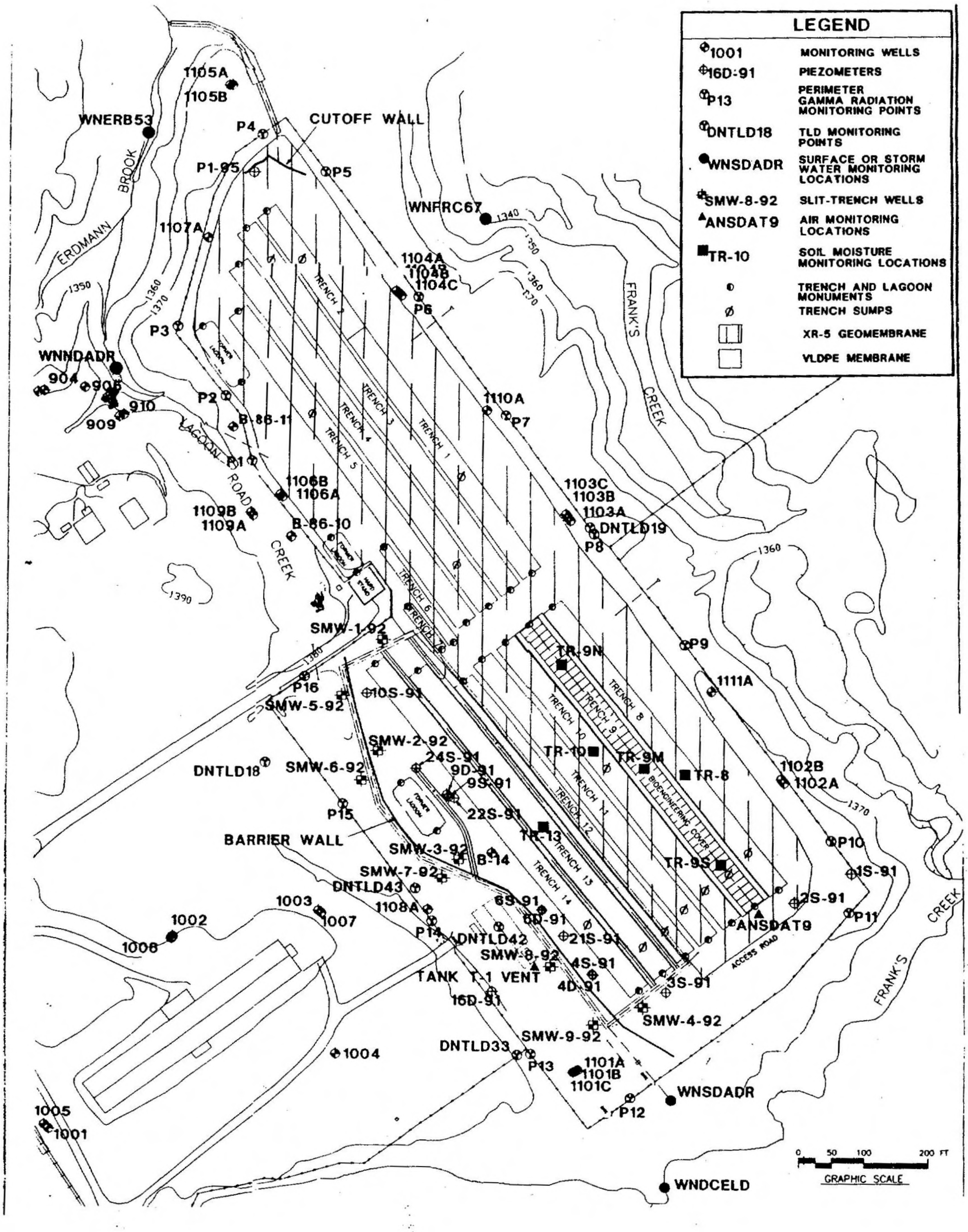


Figure 5-8. West Valley demonstration project on-site sampling.

concentrations at the Springville Dam from 1967 to 1991. Tritium levels in 1975, 1976, and 1981 are indicative of pumping of trenches at the SDA. Prior levels are attributed to NSF plant discharges.

Air

Currently there are nine perimeter and offsite air sampling locations associated with the Center. In addition, each individual emission point is routinely sampled. For the SDA, air is sampled from the T-1 tank stack semiannually. Ambient air is sampled and analyzed at the SDA near Trench 9 in accordance with the NYCRR Part 380 permit for the bioengineering project.

Direct Radiation

There are seven thermoluminescent dosimeter (TLD) locations which are sampled quarterly. These measure direct radiation. Additionally, area radiation monitoring system (ARMS) surveys were

Table 5-3. West Valley demonstration project sites.[5-8]

Map location	Type	Location	Frequency
1	Air	NE of site 1 mile	Weekly
2	Milk	N of site 1 mile	Monthly
	Milk	WNW of site 1.9 mile	Monthly
	Water	Swamp drainage	Monthly
3	Water	Buttermilk Creek (at Fox Valley Rd. bridge)	Monthly
		Erdman Brook on site	
	Water	Cattaraugus Creek (at Bigelow bridge)	Monthly
	Water	Buttermilk Creek (at Thomas Corners Rd.)	Quarterly
		Cattaraugus Creek (at Felton bridge)	
4	Water	Erdman Brook	Monthly
		Brook near burial site	
5	Water	Springville dam	Monthly
		Buttermilk Creek	
6	Water	Springville dam	Monthly
7	Water	Near site	Monthly
	Water	Near site	Monthly
	Sediment	Within site boundary	Annually
	Sediment	Farm near site	Semi-Annually
	Vegetation	Springville dam	Annually
	Vegetation	7 locations	Annually
	Deer		Annually
	Beef		Annually
	Fish		Annually
	TLD		Quarterly

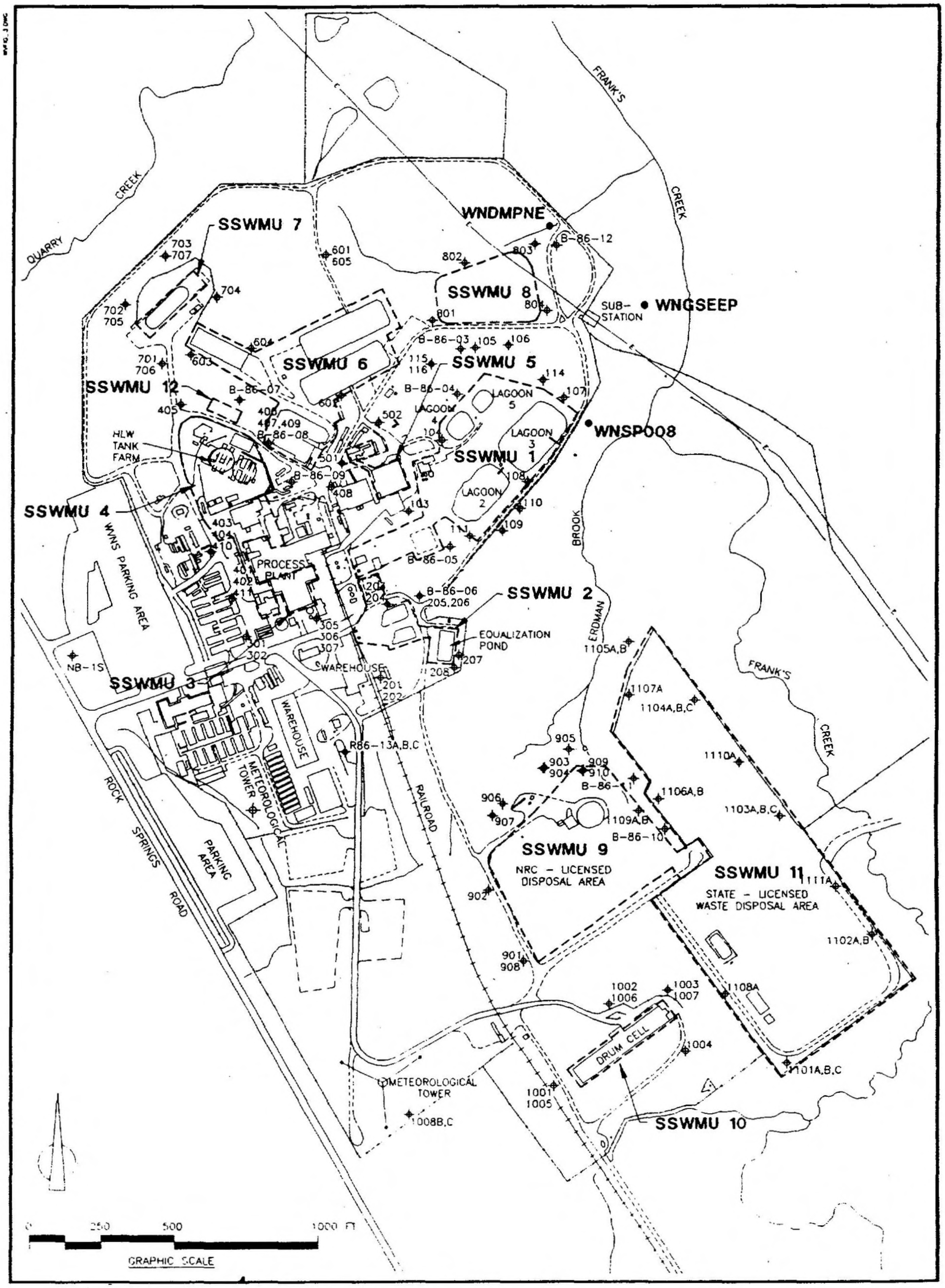


Figure 5-9. West Valley on-site ground water monitoring network.

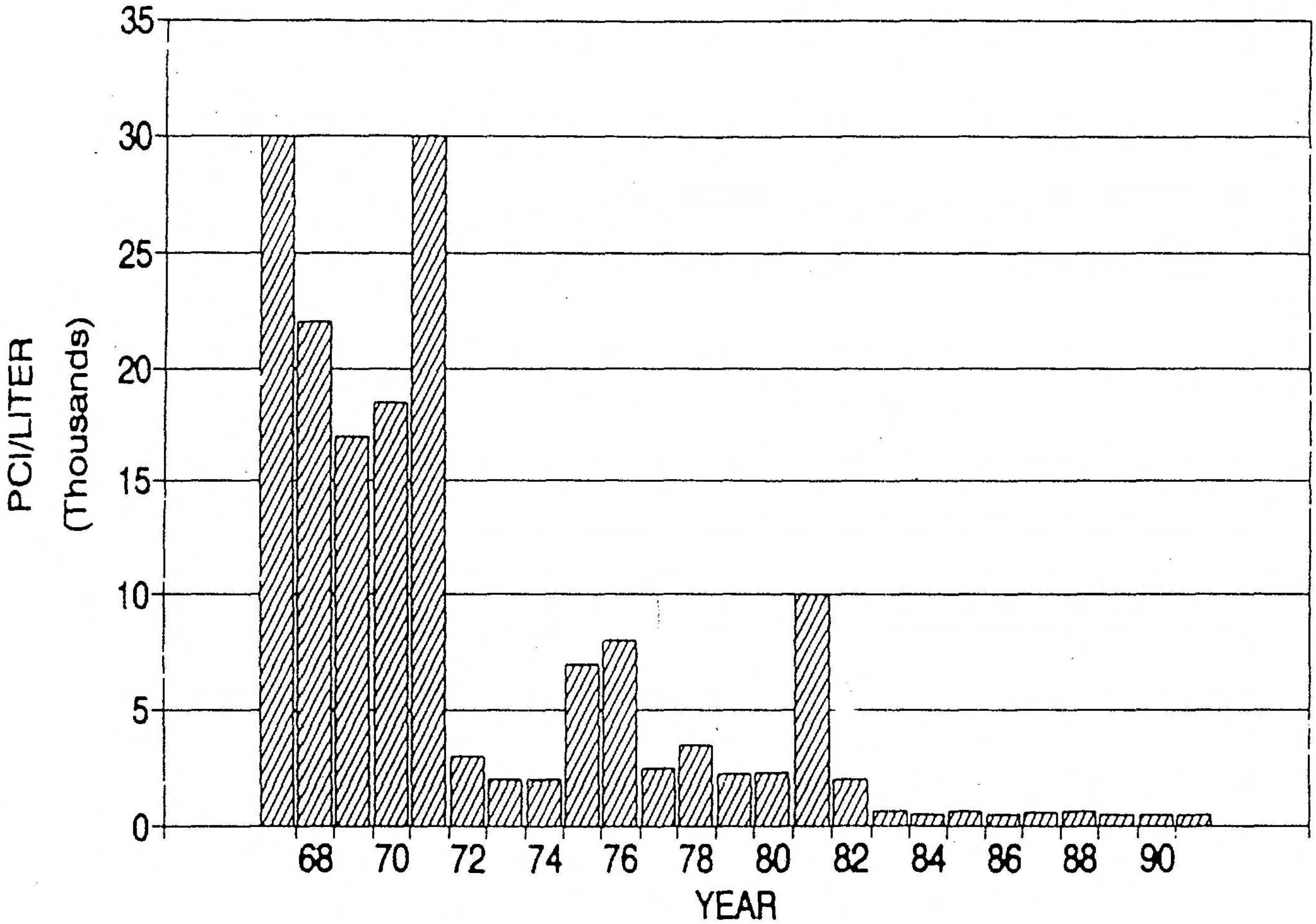


Figure 5-10. H-3 at Springville Dam.

conducted in 1968, 1969, 1970, 1979, and 1984. Direct radiation levels at the SDA are routinely monitored by NYSERDA and the DEC during inspections. Much of the direct radiation observed during these inspections is attributable to the proximity of the main plant and a nearby drum-storage facility.

Soil

Soil samples are routinely taken on and around the SDA by NYSERDA and the DEC during the course of scheduled inspections. Additionally, soil samples are taken in support of construction projects such as the recent slurry wall project. Exploratory soil borings were taken in preparation for the excavation carried out at the SDA. Borings taken in preparation for the slurry wall project indicated elevated levels of tritium in several borings located to the west of Trench 14.

Surveys of previously installed slump-monitoring stakes were undertaken during the fall of 1991, by NYSERDA, in order to determine the overall rate of soil movement on the north slope of the SDA. Preliminary results indicate a soil movement rate not greater than six inches in 20 years. This result, coupled with recent stabilization efforts, such as hydroseeding of the north slope, should assure slope stability for the immediate future.

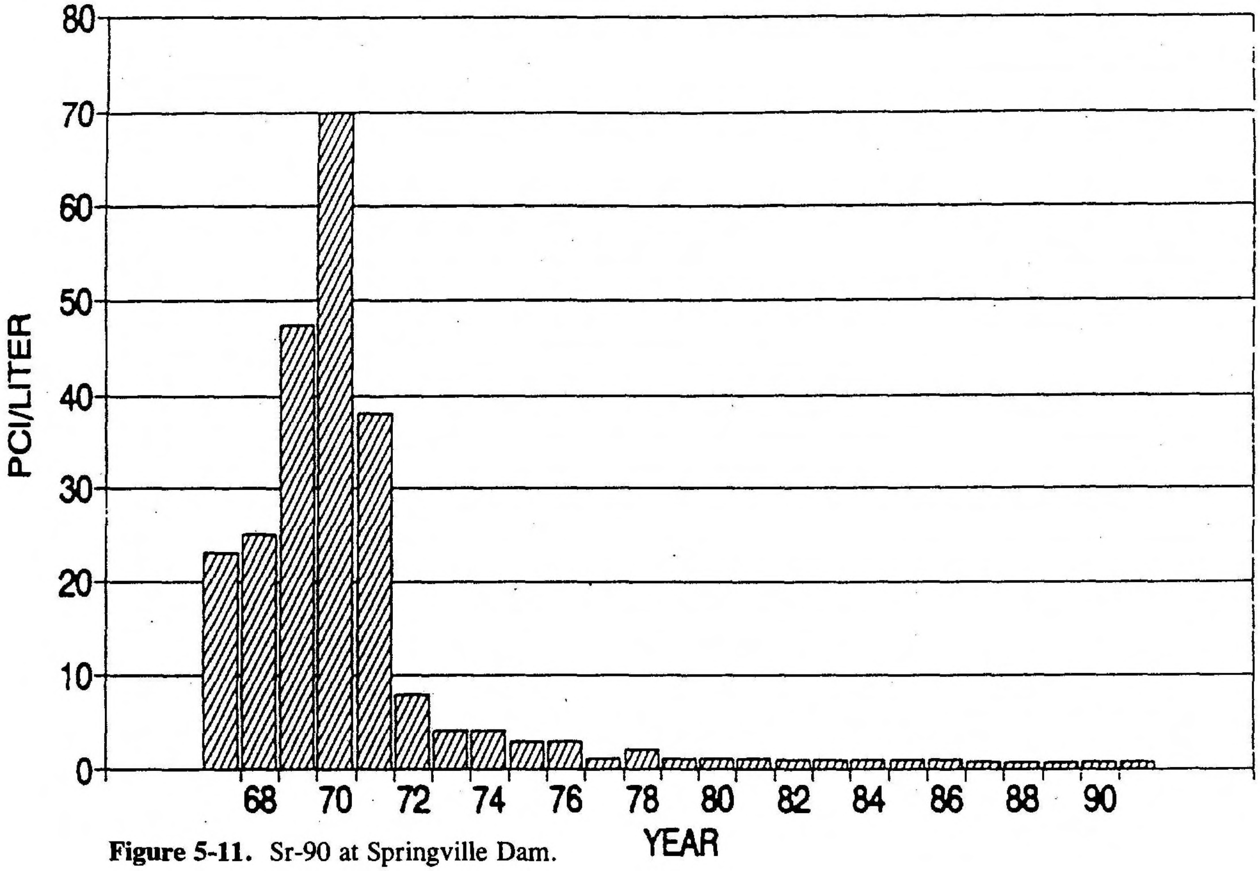


Figure 5-11. Sr-90 at Springville Dam.

Biota

Two local dairy farms are monitored on a monthly basis for radionuclides in milk. Area farm produce and venison are sampled on a yearly basis, and fish are now taken from the Cattaraugus Creek near Springville on a semiannual basis and monitored for radionuclide content.

SUMMARY

Prior to 1975, the monitoring of the SDA was carried out solely as part of the monitoring of the NFS plant at West Valley. Aside from occasional monitoring of water levels in the covered trenches and pump-outs of open trenches, the SDA received little individual scrutiny. Releases of radionuclides to the environment were primarily attributable to the operations of the NFS plant. This has resulted in some confusion with respect to the record of the SDA prior to 1975.

In 1975, significant problems at the SDA developed due to the "overflowing" of Trenches 4 and 5 and the subsequent pumpings needed to prevent more overflow incidents. At no time during or after 1975 did the levels of radionuclides released by the SDA approach the levels released by the NSF plant prior to its closing in 1971. The 1975 overflow incident did increase regulatory awareness of the potential for contaminant migration through ground and surface water from the SDA and resulted in the establishment of several monitoring stations designed to detect the entrance of contaminants from the SDA into Erdman Brook. Results were consistently negative and the State Health Department no longer consistently monitors these stations. The milk, produce, and animal flesh monitoring programs have provided better estimates of dose pathways to the general population. However, the effects of the SDA are difficult to separate from those of the Fuel Reprocessing Plant.

The newly installed ground water monitoring wells and piezometers at the SDA have eliminated the most serious deficiency in the environmental monitoring program for the SDA providing a more reliable method of estimating the extent of ground water migration of radionuclides from the SDA. Additionally, the new monitoring program serves as a preparation for remedial actions and eventual closure of the SDA.

Releases of radionuclides from the SDA have been trivial when compared to the Fuels Reprocessing Plant. This makes a precise evaluation of the SDA's effect on the environment difficult. The releases from the SDA have not exceeded regulatory standards at the site boundary and, to 1995, the SDA has not posed a significant threat to human health and safety. The SDA has required active maintenance and remedial measures to ensure that releases are kept to a minimum. Further work must be done to stabilize the site, especially with respect to water levels in the SDA trenches.

Disposal records for the SDA are being examined in depth as part of a New York State Energy Research and Development Authority project to inventory wastes in Trenches 12 through 14. This inventory will provide a much needed supplement to the 1972 DEC report for Trenches 1 through 11.

NYSERDA (or New York State) has focused its efforts on minimizing water infiltration through an active maintenance program, establishing a comprehensive environmental monitoring program, and collecting site-specific data to allow for decisions to be made on eventual stabilization and closure of the SDA. The strategy for closure of the SDA will be developed as part of an ongoing (joint DOE/NYSERDA) effort to review the impacts from all waste management areas at the Center including the SDA.

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CHAPTER 6

Environmental Summary of the Barnwell, South Carolina Low-Level Radioactive Waste Disposal Site

INTRODUCTION

Background

A commercial low-level radioactive waste disposal facility near Barnwell, South Carolina has been operated by Chem-Nuclear Systems, Inc. since 1971. The site is owned by the State of South Carolina and is leased to Chem-Nuclear by the State Budget and Control Board.

South Carolina is an Agreement State, with authority delegated from the U.S. Nuclear Regulatory Commission (NRC). Most activities at the site are regulated by the South Carolina Department of Health and Environmental Control. The site operator holds a license from the state for possession and disposal of source and byproduct material as well as a license from NRC for possession and disposal of special nuclear material.

Location

The Barnwell site is located about 8 km (5 miles) west of the town of Barnwell, South Carolina (Figure 6-1). The site (Figure 6-2) is adjacent to the closed Allied General Nuclear Services Barnwell Fuel Facility on the west; International Paper Company on the north; Osborne Road on the south; Barnwell County Road 585 on the east; and St. Paul Church at the southeast corner. The site is approximately 0.3 km (0.2 mi) from the easterly boundaries of the U.S. Department of Energy Savannah River Site and is 0.8 km (0.5 mi) from South Carolina Highway 64. The facility is an irregular polygon covering 121 hectares (300 acres) of land measuring roughly 1,500 m (4,950 ft) in the north-south direction and 750 m (2,475 ft) in an east-west direction.

Facility

Waste disposal was initiated at the Barnwell site in 1971. Approximately 75% of the waste volume received at the site is fuel cycle waste. All other generators—including medical, industrial, academic, and research facilities—generate the remaining waste volume.

Class A, B, and C wastes (as defined in 10 CFR 61) are accepted for disposal at the site. Approximately 97% of the volume of waste received at the site is Class A waste. The majority of the remaining 3% is Class B waste with less than 1% by volume being Class C waste. The Class C waste, however, composes the majority of the radioactivity in curies of the waste received.

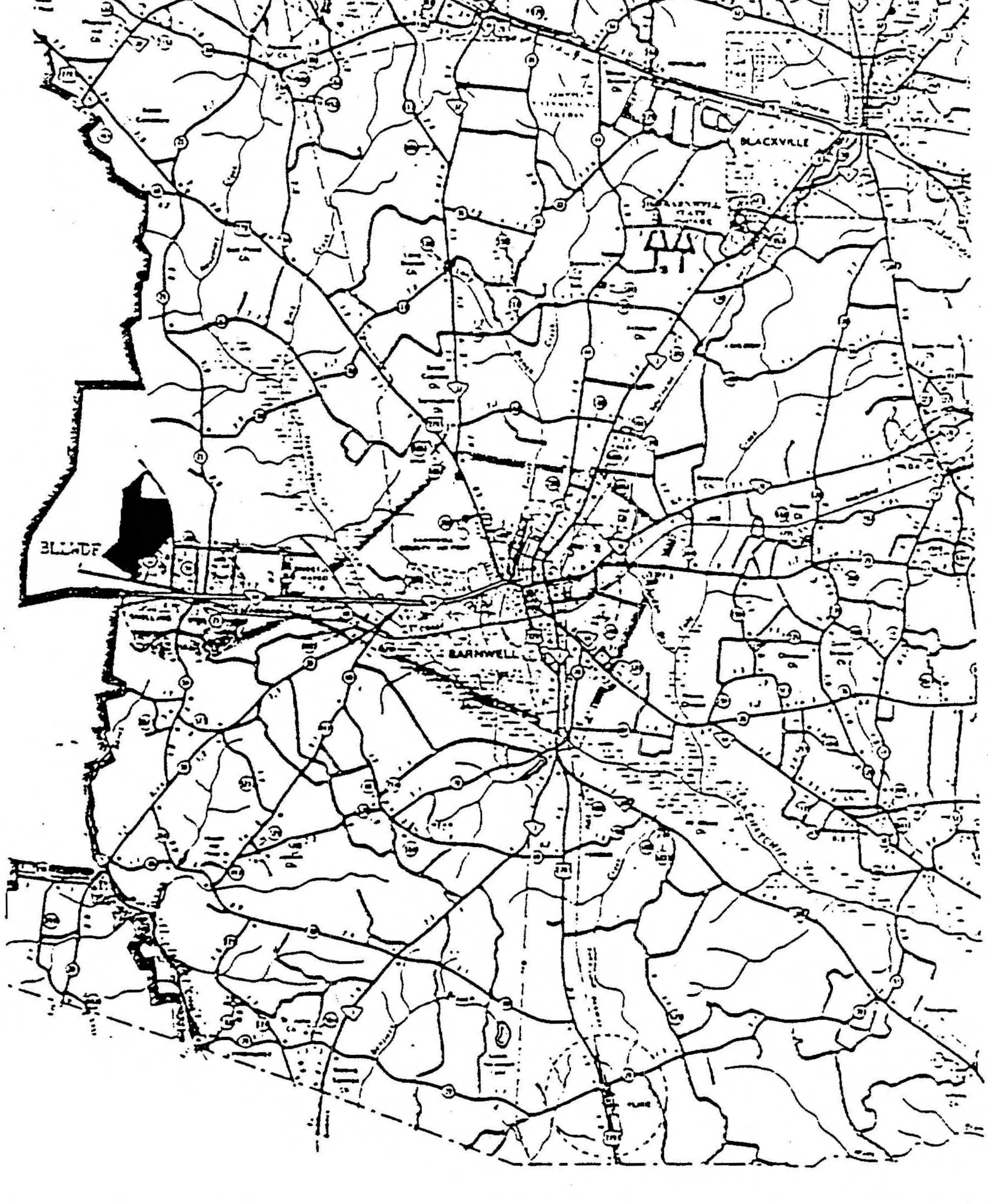

Figure 6-1. Location of Barnwell site.

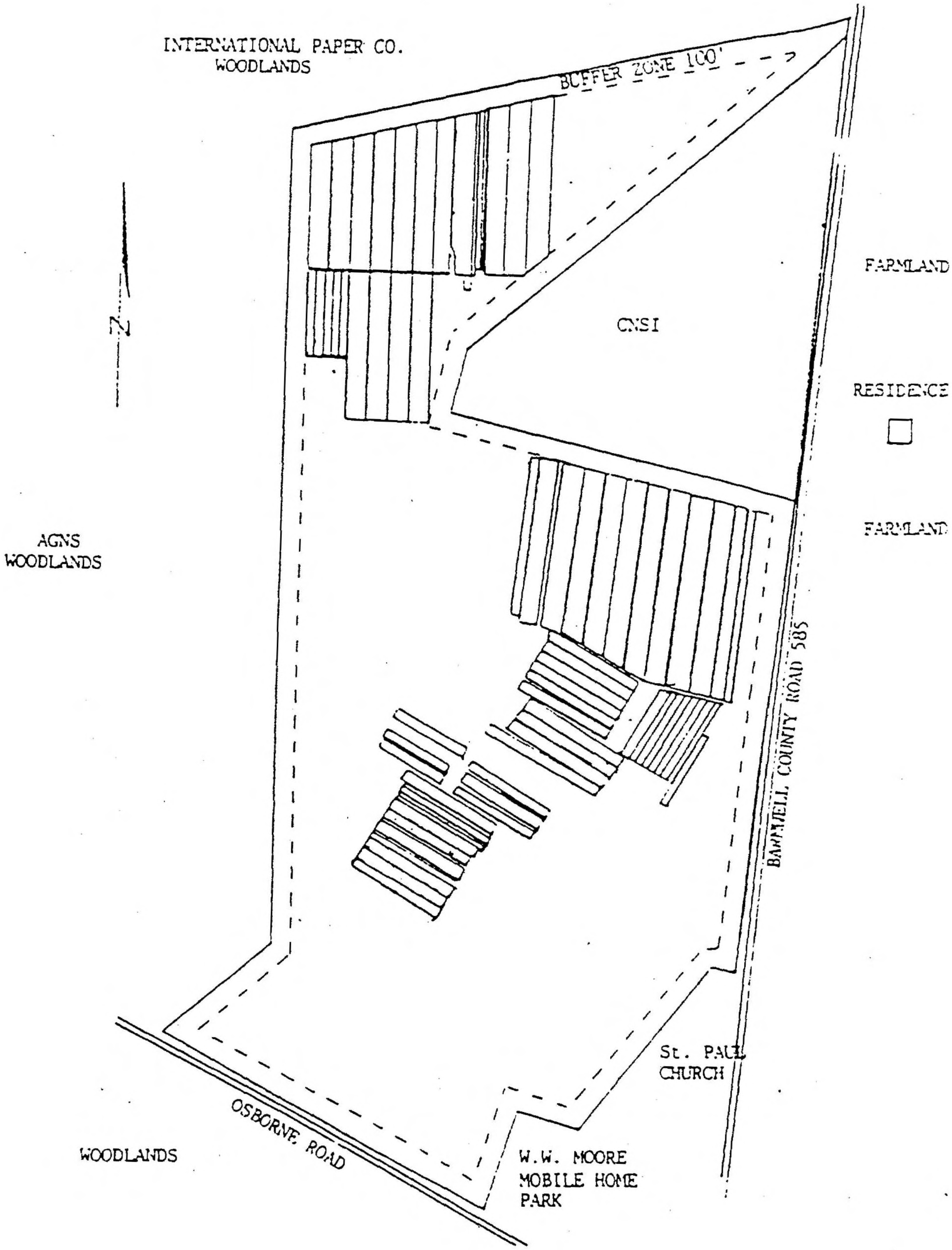

Figure 6-2. Plan view of the Barnwell site showing adjacent land owners.

Shipments received at the site are designated as non-exclusive use or exclusive use shipments. Non-exclusive use shipments may contain packages which are not radioactive in addition to packages which are radioactive. In addition, the packages may be transferred from one truck to another by the carrier. Radiation levels for non-exclusive use shipments are limited to 200 mRem/hr at any point on the external surface of each package, 10 mRem/hr at any point on the external surface of the vehicle, and 2 mRem/hr in any space normally occupied by the driver. Exclusive use shipments are shipments which contain only radioactive material. The material must remain in the truck in which it is loaded until it reaches its destination. Radiation levels for exclusive use shipments are limited to 1,000 mRem/hr on contact with the surface of the package (closed vehicle), 200 mRem/hr at any point on the external surface of the vehicle, 10 mRem/hr at 2 meters from the external surface of the vehicle and 2 mRem/hr at any space normally occupied by the driver. Inspections performed by the state's resident inspectors[6-1] and Chem-Nuclear personnel of 100% of the shipments confirm radiation levels of the transport vehicles are below these regulatory limits.

Shipments enter and leave Barnwell County via routes SC-41 and US-278, SC-3, SC-64, and SC-70 which are two lane routes through rural areas. By using these routes, the shipments are not carried through the center of the town of Barnwell. Vehicles carrying shipments of radioactive waste to the Barnwell site travel routes which do not pass through or near heavily populated areas unless there is no practical alternative.

Waste received at the site is packaged to meet U.S. Department of Transportation requirements in Title 49 of the Code of Federal Regulations. In addition, certain other specific requirements are placed by license condition on waste received at the site. The waste is to be received and buried in closed containers. The burial containers must have less than 0.5% free standing liquid (High Integrity Containers are allowed to have up to 1% free standing liquid). The burial containers must have appropriate lifting devices.

The majority of the containers received at the site are free of removable contamination on their surfaces. This greatly reduces the potential for airborne contamination. Occasionally a container is received which has removable contamination on its exterior. Special procedures which prevent the spread of contamination are used to offload and bury these containers.

Figure 6-3 illustrates a typical disposal trench. Three trench designs are used. The Type A trenches are for Class A waste only and are generally 300 m (1,000 ft) long, 30 m (100 ft) wide, and 7 m (22 ft) deep.

Class B and C wastes are segregated from Class A waste. Type B trenches are for both Class B and Class C waste, and are generally 150 m (500 ft) long, 11.1 m (36.5 ft) wide, and 5 m (16.5 ft) deep. Concrete structural overpacks are used in Type B trenches to allow disposal of polyethylene High Integrity Containers. Slit trenches are used for Class C waste which have high radiation levels on the exterior of the package. Slit trench length varies according to the location. The trenches are 7 m (22 ft) deep and are 3 m (10 ft) wide at the top, narrowing to 1.2 m (4 ft) wide at the bottom.

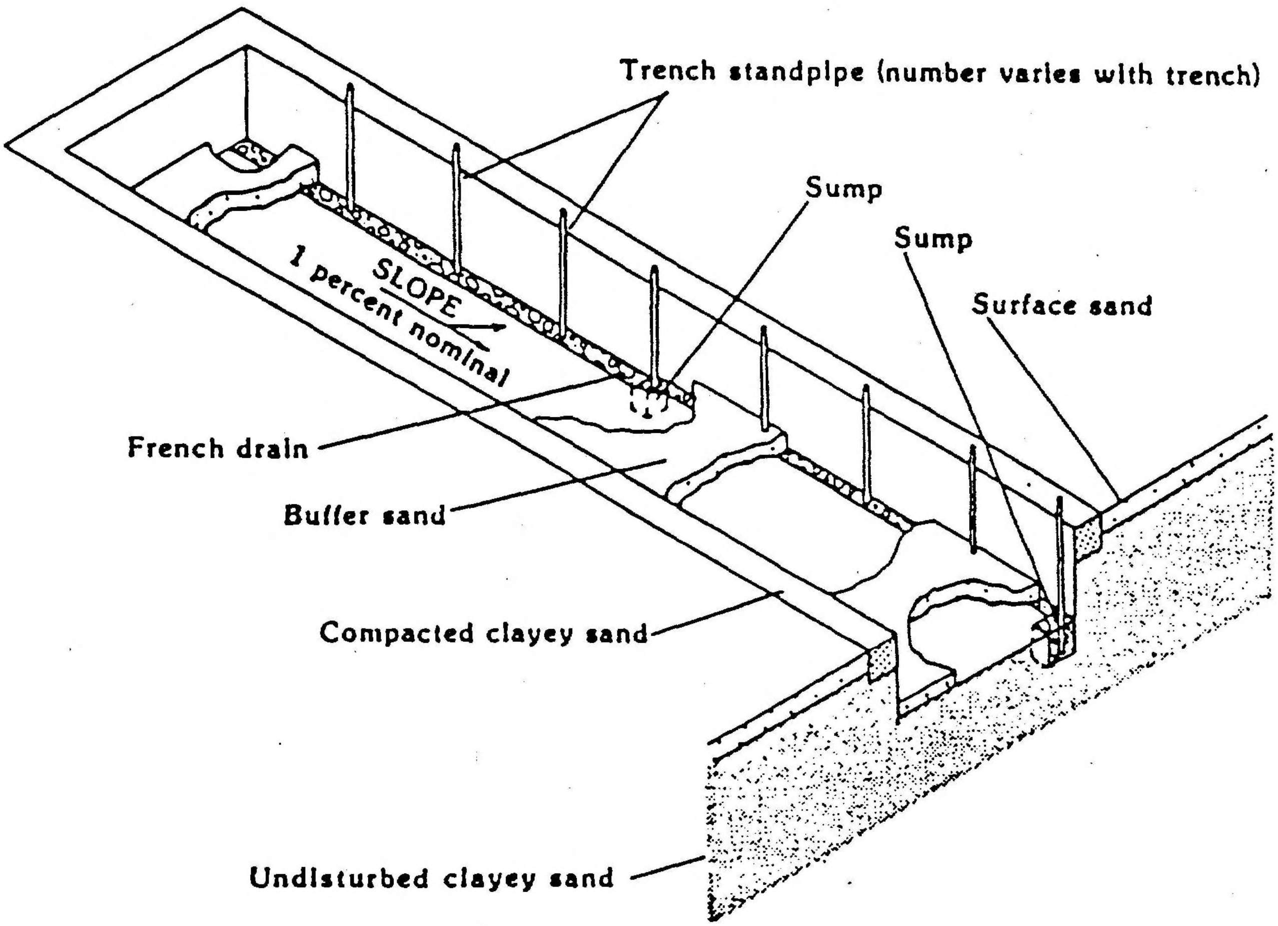

Figure 6-3. Typical disposal trench at the Barnwell site.

After waste has been placed and covered in the slit trench, a 15 cm (6 in.) thick concrete intrusion barrier is constructed over the trench. All trenches are required to have a minimum of 2.4 m (8 ft) of separation between adjacent trench and a minimum of 1.5 m (5 ft) of separation between the trench floor and the highest recorded level of the water table in order to prevent water infiltrating from below into a trench. The trench drainage system consists of a sand floor, French drain along one longitudinal wall, sumps, and standpipes.

Disposal Volume

During the first year of operation, approximately 1,400 m^3 (50,000 ft^3) of waste containing 160 TBq (4,200 Ci) of byproduct material was accepted and disposed. The disposal rate rose steadily over the next nine years to the point where the annual rate reached over 63,000 m^3 (over 2.2 million ft^3) in 1979. Table 6-1 shows volumes of waste disposed.

Table 6-1. Barnwell site burial volumes.

Year	Volume[a] (Feet^3)	(Meters^3)
1971	50,219.34	1,422
1972	159,933.47	4,529
1973	599,886.28	16,987
1974	624,759.55	17,691
1975	643,564.44	18,224
1976	1,393,587.55	39,462
1977	1,636,425.12	46,830
1978	2,220,519.72	62,878
1979	2,238,322.13	63,383
1980	2,444,810.72	69,230
1981	1,543,278.67	43,701
1982	1,228,200.83	34,779
1983	1,240,668.21	35,132
1984	1,231,715.28	34,878
1985	1,214,422.99	34,388
1986	1,053,791.68	29,840
1987	958,275.82	27,135
1988	931,974.01	26,391
1989	1,103,299.56	31,242
1990	788,031.88	22,315
1991	789,082.85	22,344
1992	828,750.74	23,467
1993	605,443.07	17,144
Total	25,528,962.76	722,904

a. Values include waste volumes, pallets under waste packages, waste generated during site operations and waste received by approved exemptions.

By late 1979, the Barnwell site was the most heavily used site in commercial radioactive waste disposal history and, for a brief time, was the only operating commercial low-level radioactive waste disposal site in the United States. In October of 1979, when the monthly waste acceptance rate had risen to over 7,000 m^3 (about 250,000 ft^3) implying an annual rate of 68,000 m^3 (2.4 million ft^3), the Governor of South Carolina announced that the monthly acceptance would have to be reduced to just over 2,800 m^3 (100,000 ft^3) by October 31, 1981. The 1980 disposal rate was reduced due to restriction on the annual volume of waste received. Waste received through 1980 totaled 323,523 m^3 (11,424,900 ft^3). The total volume received through 1993 is almost 723,000 m^3 (about 25,500,000 ft^3).

Through 1993, wastes containing about 272,000 TBq (7,137,000 Ci) of radioactivity have been disposed. The decay corrected radioactivity through 1993 is approximately 113,200 TBq (2,971,000 Ci). In addition, about 15.3 million kg (33.6 million lb) of source material and approximately 3,056 kg (6,732 pounds) of special nuclear material have been disposed through 1993.

Stabilization and Closure

Individual trenches are closed and capped with compacted on-site clay materials as they are filled. The conceptual topography of the site at closure was identified in the early 1980's and trench surfaces have been completed near those grades since that time. Due to the migration of tritium in the groundwater from some of the early disposal trenches, enhanced caps are being installed on the early disposal trenches. These enhanced caps have a cross section as shown in Figure 6-4.

In 1991, an area of approximately 5 hectares (12.5 acres) was covered and in 1993, an area of approximately 4 hectares (10 acres) was covered with an enhanced cap. Plans are underway to install another enhanced cap over approximately 10 hectares (25 acres) of disposal trenches during 1994. The enhanced caps virtually eliminate infiltration into the trenches thereby eliminating the water source driving the contaminants.[6-2]

After the completion of the third cap, all disposal trenches completed through 1982 with significant quantities of tritium will be covered. Enhanced caps may not be necessary on the later disposal trenches for the following reasons, but this would require substantial evaluation. High integrity containers have been used for high concentration wastes (waste with radionuclide concentrations of one microcurie per cubic centimeter or greater of radionuclides with five year or longer half-lives) since 1981. Improved solidification media were required in 1983 with the implementation of the NRC Branch Technical Position on Waste Form. Also in 1983, 10 CFR Part 61 required more detailed characterization and classification of waste and stability requirements for Class B and C waste materials. The lower concentration Class A wastes were also required to be segregated from the Class B and C waste materials.

After the remaining closure activities are completed, the site will have gently sloping surfaces of native grass vegetation. Surface water runoff will be directed towards an on-site retention pond. Maintenance of the site surface and environmental monitoring will continue through the institutional control period.

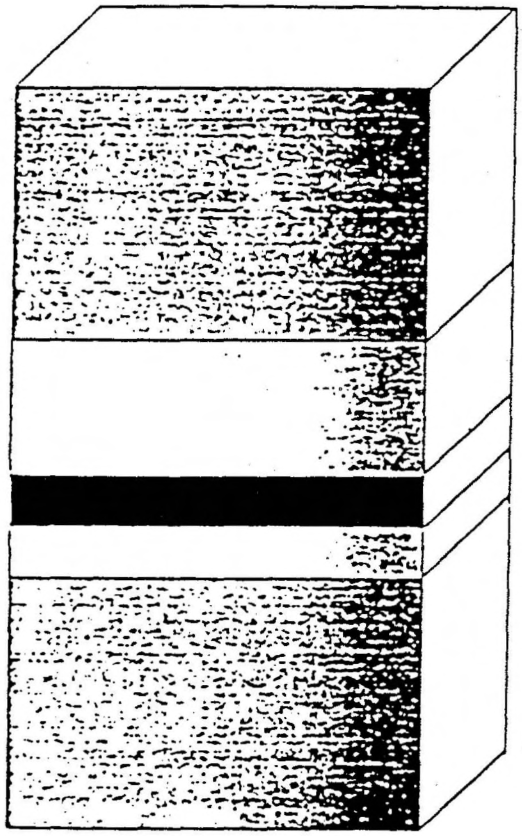

Figure 6-4. Barnwell site enhanced cap cross section.

SITE

Topography

The Barnwell site is in the Upper Coastal Plain Physiographic Province, with flat to gently-rolling topography at elevations averaging 74 to 80 m (243 to 262 ft) above mean sea level. Drainage on and around the site is considered good with the exception of undrained "sinks" or "Carolina Bays." Carolina Bays are circular depressions of undetermined origin which occur throughout the area. Several Carolina Bays exist on the disposal site and represent areas which are generally unsuitable for waste disposal under existing conditions.

Climate

The climate of the Barnwell site is mild and relatively humid, with mean temperatures ranging from 9°C (48°F) in January to 27°C (81°F) in July. The precipitation averages 108 cm (42.7 in.) per year. Historical rainfall data are given for Barnwell County in Table 6-2. Ice storms and damaging winds are rare. Measurable snow occurs at approximately 10 year intervals and usually does not remain for great periods of time. The largest recorded snowfall for the area was 45.7 cm (18 in.) over

Table 6-2. Rainfall for Barnwell County.

Year	Total inches
1984	48.43
1985	44.04
1986	33.21
1987	42.10
1988	36.25
1989	49.53
1990	45.60
1991	54.44
1992	53.66

National Weather Service, Blackville, South Carolina.

a two-day period in February 1973. Freeze/thaw cycling of the soil, waste, and disposal containers are not a concern since less than one third of the winter days have a minimum temperature below freezing.

Land Use

A buffer zone of 30 m (100 ft) is provided within the outermost perimeter fencing around the 95 hectare (236 acre) exclusion area. Approximately 35 hectares (86.6 acres) of the site had been used for disposal of waste through 1993 and approximately 15 hectares (36.7 acres) remain for disposal of waste.

The site is bounded by woodlands on the north, west, and south, and farmland on the east. The nearest residence is less than one-tenth of a mile from the site boundary.

The 1990 estimated population of Barnwell County was 20,293 in the 1,444 square kilometers (553 square mile) area giving a population density of about 37 per square mile. Approximately one-third of the population of the county is in the city of Barnwell. During the period between 1980 and 1986, the county experienced a 5.7% population growth. During the period between 1986 and 1990, the county experienced a 3.4% population decline. Manufacturing represents over one-third of the county's employment. Farming provides less than 15% of the county's employment.

Geology

The site is near the eastern edge of the Aiken Plateau portion of the Atlantic Coastal Plain on a layer approximately 300 m (1,000 ft) thick of southeasterly-dipping, loose, unconsolidated sediments of upper Cretaceous, Tertiary, and Quaternary ages (Figure 6-5) which unconformably overlie an older, well-consolidated Triassic Age basement. The Quarternary age soils, which immediately underlay the

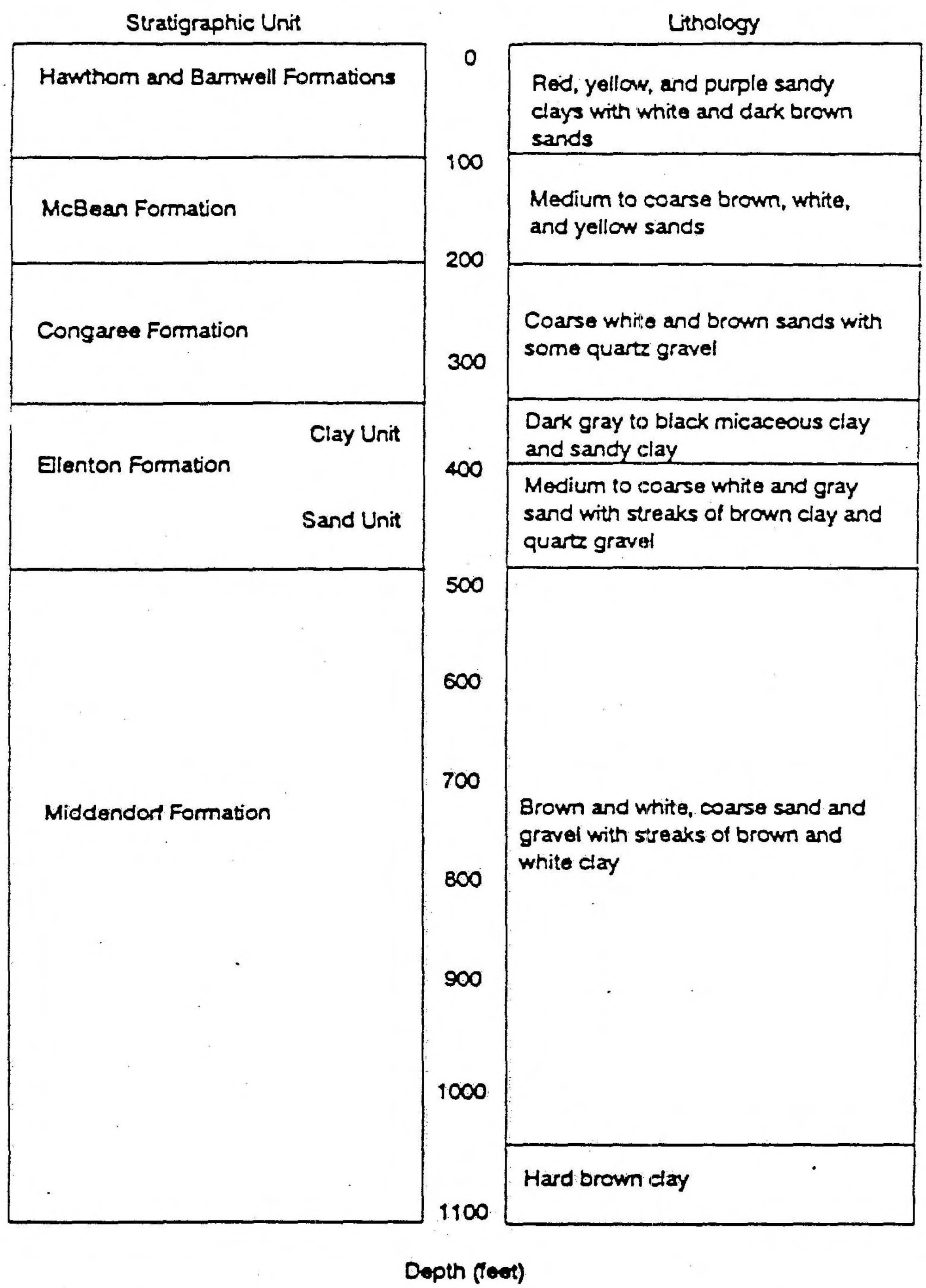

Figure 6-5. Stratigraphic and lithographic interpretation of the Barnwell site.

topsoil, consist of loose to moderately dense fine and silty sands and range from a few centimeters to meters in thickness. Underlying this sandy layer is the Tertiary System which consists of the Hawthorn, Barnwell, McBean, and Congaree Formations. The Hawthorn Formation, which is about 8 m (26 ft) thick, consists of tan to reddish color sandy clay with patches of kaolinite material disseminated throughout in the upper part of the formation, and yellow clayey sand to dark red sandy clay at the base of the formation. The Barnwell Formation underlies the Hawthorn Formation, is approximately 15 m (50 ft) in thickness, and is composed of brown, maroon, and red clayey sand which changes to yellow sand near the contact with the McBean Formation. The McBean Formation is about 35 m (115 ft) thick and consists of white, tan, brown, and yellow clays interbedded with medium to course quartz sand. Beds of McBean Formation limestone occur east and southeast of the burial site. The Congaree Formation, with a thickness of about 44 m (144 ft), provides the interface with the Cretaceous system and consists of sands to sandy gravel.

The Cretaceous System includes the Ellenton Formation and the Middendorf Formation. The Ellenton Formation consists of an upper clay unit composed of dark grey to black clay and sandy clay, and a lower sand unit composed of medium to course white and grey sand with streaks of brown clay and quartz gravel. The Middendorf Formation consists of course sand and gravel interbedded with diversely colored clay beds or lenses. Figure 6-5 provides a stratigraphic and lithographic interpretation of a well at the Allied General Nuclear Services Plant adjacent to the Barnwell site.

Surface Water

The Barnwell site is geographically located between the Salkehatchie River on the east and the Savannah River on the west. The Salkehatchie, at 4.1 km (2.5 mi), is the closest river, but the site is in the surface drainage area of a Savannah River tributary, called Lower Three Runs Creek. There is no flowing stream on the site. The nearest seepage point, named Mary's Creek, is 1 km (0.6 mi) to the south and originates as a small constant flowing stream. Mary's Creek is a tributary of Lower Three Runs Creek and part of its 470 square kilometer (180 square mile) watershed area.

Surface run-off from the site is directed away from the trenches and is collected for infiltration and evaporation in two surface collection ponds, formally a Carolina Bay, located along the western boundary of the site. Active trenches are constructed with a slight upward grade to the edge of the trench to prevent surface water from flowing into the trenches. Water which collects in the open trenches is allowed to evaporate and is not transferred to the surface collection ponds except under extreme conditions of heavy rainfall, and then only after it is monitored to assure no elevation in radioactivity.

The closest reach of the Savannah River is approximately 22.5 km (14 mi) southwest of the site. Downstream, the Savannah River is used for sport fishing and pleasure boating. The Savannah River is a drinking water supply for Port Wentworth, Georgia, providing for a consumer population of about 20,000, and at Hardeeville, South Carolina, providing for a consumer population of approximately 80,000. There is commercial shipping on the 27 m (90 ft) wide, 3 m (10 ft) deep channel maintained between Augusta and Savannah, Georgia.

Ground Water

The ground water table at the site is contained within the Hawthorn Formation and ranges in depth from about 9 to 18 m (30 to 60 ft) with a mean of about 12 m (40 ft). The ground water in the area is acidic with a pH ranging from 4.8 to 6.5 and is therefore corrosive to metals.

There are no potable water wells in service as drinking water wells on the site. There are no users of ground water directly downstream of the site. The town of Barnwell is the nearest municipal user of ground water. The water is withdrawn from fairly-permeable zones within the McBean Formation which extends to about 90 m (300 ft) below the surface in the Barnwell area. Ground water at the site does not flow toward the town of Barnwell. Water from the underlying Cretaceous Middendorf Formation forms the principal ultimate source of potable water for the area.

Ecology

The Barnwell area is composed of habitats varying from very sandy, dry uplands to continuously flooded swamps. Organic matter thrives in the low-lying areas due to the supply of nutrients. The local vegetation includes wild grass, scrub oak, and pine. The area developed for the waste disposal facility was previously used for pulpwood production and agriculture.

The Carolina Bays support natural systems such as ponds, swamp forests, and herbaceous vegetation. These systems support animal populations including tree frogs, cricket frogs and other amphibians; several bird species, and small snakes. Larger predators which include hawks, owls, snakes, weasels, and foxes, prey on cotton rats and amphibians. The Barnwell county ecosystem supports over 68 species of land animals and birds. A list of some of the mammals and birds found in Barnwell County are given in Table 6-3.

ENVIRONMENTAL MONITORING

Environmental monitoring is performed at the Barnwell site by both Chem-Nuclear and the South Carolina Department of Health and Environmental Control. The monitoring programs include ground water, surface water, air, precipitation, soil, sediments, vegetation, and direct radiation. Sample frequency is continuous for air and external gamma radiation, quarterly for groundwater and annually for all other samples. Groundwater samples are collected by Chem-Nuclear and are split for analysis by both Chem-Nuclear and by the state. All other sampling is performed independently and results are compared for consistency.

Ground Water

Figure 6-6 shows the locations of boundary monitor stations which include well clusters (WB-) screened at approximately 12, 15, and 18 meter depths. The depths of the shallow wells vary from 11 to 12 m (35 to 40 ft). The depths of the intermediate wells vary from 12 to 15 m (40 to 50 ft). The depths of the deep wells vary from 15 to 21 m (50 to 70 ft).

Table 6-3. Biota found in Barnwell County.

Mammals

Common Name	Scientific Name
Opossum	*Didelphis marsupialis*
Eastern Cottontail	*Sylvilagus floridanus mallurus*
Gray Squirrel	*Sciurus carolinensis carolinensis*
Gray Fox	*Urocyon cinereoagenteus cinereoagenteus*
Raccoon	*Procyon lotor solatua*
White Tail Deer	*Odocoileus viginianus viginianus*
Bobcat	*Lynx rufus floridanus*
Beaver	*Castor canadensis carolinensis*
Southern Flying Squirrel	*Claucomys volens saturatus*

Birds

Common Name	Scientific Name
Mallard Duck	*Anas platyrhynchos*
Wood Duck	*Aix sponsa*
Turkey Vulture	*Cathartes aura*
Red-Tailed Hawk	*Buteo jamicensis*
Sparrow Hawk	*Falco sparverius*
Bobwhite	*Colinus virginianus*
Morning Dove	*Enaidura asistica*
Screech Owl	*Otus asio*
Common Crow	*Corvus brachyrhynchos*
Carolina Wren	*Thryothorus ludovicanus*

Table 6-4 shows the concentrations of tritium for the boundary wells and for several streams (WC-) in the vicinity of the site. Liquid scintillation analysis is used to detect the presence of tritium. In 1992, the average tritium level in boundary wells was just over 1,300 pCi/L (1,306 pCi/L). The highest was just over 2,000 pCi/L (2,040 pCi/L).[6-3]

The boundary monitoring wells were installed in the early 1980s. These wells have been sampled routinely and the results of analyses have been reported to the South Carolina Department of Health and Environmental Control. These analyses show no significant concentrations of tritium above background. The records of the analyses are maintained by Chem-Nuclear and the Department.

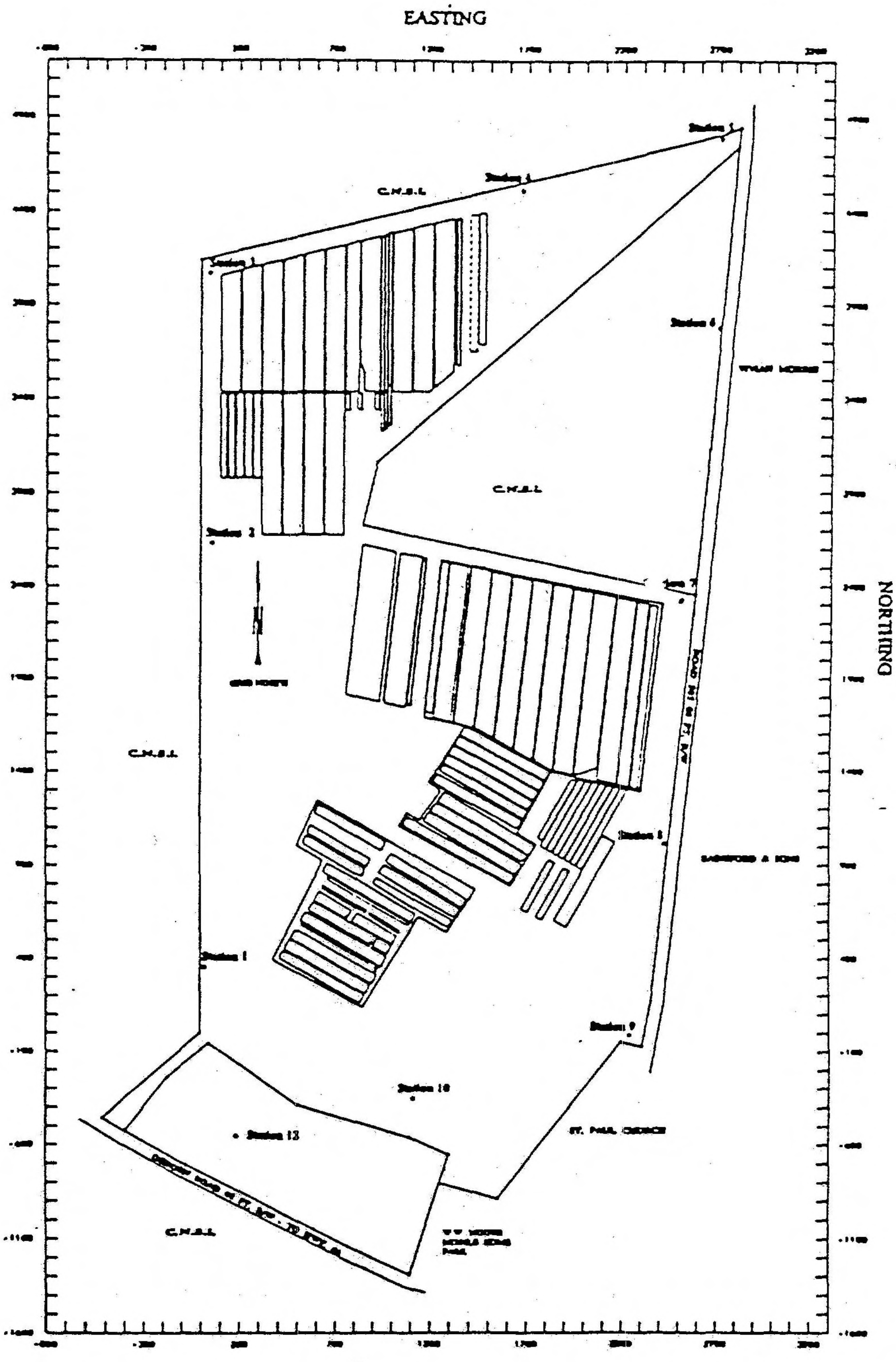

Figure 6-6. Plan view of the Barnwell site showing adjacent land owners/boundary sampling stations.

Table 6-4. 1992 tritium monitoring data for ground waters and streams near the Barnwell site.[6-3]

Well number	High	Average	Low
WB-0101	1850	1441	875
WB-0102	1870	1450	760
WB-0103	1380	1098	640
WB-0201	1860	1560	880
WB-0202	1200	1050	790
WB-0301	1590	1350	970
WB-0401	1260	900	500
WB-0402	1870	1370	1000
WB-0403	2040	1400	780
WB-0501	1690	1350	650
WB-0502	1500	1250	800
WB-0601	1640	1225	870
WB-0602	1980	1567	1550
WB-0603	1930	1780	1550
WB-0701	1370	1114	796
WB-0702	1680	1618	1560
WB-0703	1680	1414	942
WB-0801	1600	1228	645
WB-0802	1670	1515	1330
WB-0901	1440	1115	826
WB-0902	1390	1129	628
WB-0903	1590	1145	830
WB-1001	1820	1461	1005
WB-1002	1284	964	450
WB-1003	1640	1159	600
WC-0001 (Duncannon Spring)		790 ± 210[a]	
WC-0002 (Railroad Track Spring)		1100 ±220[a]	
WC-0003 (Mary's Creek Spring)		975 ± 210[a]	
WC-0004 (Mary's Creek Grist Mill)		740 ±00a	

a. These values are pCi/L ± one standard deviation.

Air

Air is monitored by South Carolina Department of Health and Environmental Control at two locations, the western (upwind) side of the site and the eastern (downwind) side of the site at the boundary of the site (Figure 6-6). The filters are analyzed for total concentrations of alpha and beta particles and concentrations of specific gamma emitters.

Table 6-5 shows the average concentration of activity in the filters averaged over a one year period for 1992. Air samples are collected for 45 minutes each hour for periods of two weeks. The air is drawn through a particulate filter which is analyzed for gross alpha and beta activity and is analyzed for specific gamma emitters using a germanium detector. Concentrations of gamma-emitting radionuclides on air sampling filters are below the minimum detectable limits.

Precipitation is monitored at the two air sampling locations. The monitoring data for the two locations and a control location in Columbia, South Carolina is shown in Table 6-6. The table indicates that the gross beta and tritium concentration in the precipitation at the burial site are comparable to those in Columbia, South Carolina. The precipitation is analyzed for gross alpha and beta and for specific gamma-emitters using a germanium detector as well as for tritium using liquid scintillation detection.

Radiation Levels

Direct radiation is measured using thermoluminescent dosimeters (TLDs) at various locations in the vicinity of the site. Table 6-7 lists the annual radiation levels at several different locations around the state and near the site. As indicated by the data, operations at the site have little effect on the general radiation levels in the vicinity of the site.

Table 6-5. 1992 monitoring data for air near the Barnwell site.[6-3]

	Gross beta (pCi/m^3)		
	High	Average	Low
Columbia, SC	0.417	0.024	0.004
East Boundary	0.370	0.028	0.003
West Boundary	0.410	0.043	0.004

Table 6-6. 1992 precipitation monitoring data for the Barnwell site.[6-3]

(pCi/L ± one standard deviation)		
	Gross beta pCi/L annual average	Tritium pCi/L annual average
Columbia, SC	2.9 ± 0.2	830 ± 200
East Boundary	5.4 ± 0.5	1500 ± 250
West Boundary	2.0 ± 0.1	1170 ± 230

Table 6-7. 1992 direct radiation levels of South Carolina locations.[6-3]

80-0001	Columbia, SC	0.20 mRem/day
80-0940	Charleston, SC	0.19 mRem/day
80-1451	Osborne Road[a]	0.23 mRem/day
80-0614	Williston, SC[a]	0.20 mRem/day
80-0660	Barnwell Airport[a]	0.21 mRem/day
80-0661	Williston, SC[a]	0.21 mRem/day

a. Within 10 miles of the Barnwell Site.

Soil

Surficial soil samples are taken from the 10 boundary monitor stations at the site. The samples are analyzed for gamma-emitters using a germanium detector. Table 6-8 shows the concentrations of cesium-137, which is the only gamma-emitter detected in the samples. The concentrations are anticipated background levels.

In addition to surficial soil samples, bore hole samples are taken by Chem-Nuclear and analyzed for tritium and other radionuclides. Sediment samples taken from two surface water sources in the vicinity of the site are analyzed for gamma-emitters using a germanium detector. The concentrations of cesium-137, which is the only gamma-emitter detected, are shown in Table 6-9. The data indicate that the concentrations of radionuclides in the sediment are approximately that of background.

Table 6-8. 1992 monitoring data for soil near the Barnwell site.[6-3]

(pCi/g ± one standard deviation)	
	Cesium-137
SS-0101	0.10 ± 0.02
SS-0201	0.13 ± 0.02
SS-0301	0.19 ± 0.02
SS-0401	0.10 ± 0.03
SS-0501	0.16 ± 0.02
SS-0601	0.25 ± 0.03
SS-0701	0.06 ± 0.02
SS-0801	0.10 ± 0.02
SS-0901	0.08 ± 0.02
SS-1001	0.52 ± 0.03

Biota

Vegetation samples are taken at the 10 boundary monitor stations at the site and are analyzed for gamma-emitters using a germanium detector. The concentration data in Table 6-10 indicate that cesium-137 in the vegetation samples are approximately that of background.

Table 6-9. 1992 monitoring data for sediment near the Barnwell site.[6-3]

(pCi/g dry weight)	
	Cesium-137
SD-0001 Duncannon Spring	0.3 ± 0.1
SD-0002 Railroad Track Spring	< 0.01
SD-0003 Grist Mill	0.11 ± 0.05
SD-0004 Mary's Creek Spring	0.05 ± 0.02

Table 6-10. 1992 monitoring data for vegetation near the Barnwell site.

(pCi/g ± one standard deviation)	
	Cesium-137
VS-0101	<0.1
VS-0201	<0.1
VS-0301	<0.1
VS-0401	<0.1
VS-0501	<0.1
VS-0601	<0.1
VS-0701	<0.1
VS-0801	<0.1
VS-0901	0.10 ± 0.05
VS-1001	0.22 ± 0.05

SUMMARY

Two potential pathways to people exist on-site and off-site during the active life of the burial site at Barnwell. A low probability exists for (1) exposure from radioactive material released to the air and/or ground water and (2) exposure from direct gamma radiation. Release of radioactive material at the burial site is minimized since wastes are received and disposed in closed containers. The ground water and air are monitored on-site and off-site to detect any radioactive material which may be released.

Direct exposure from gamma radiation is highest in the immediate area of the open trenches. The trenches are posted radiation areas and the site access is restricted. The direct radiation levels at the site boundary are monitored continuously using TLDs. Results indicate that actual radiation dose to any member of the public is well below regulatory limits.

The exposure pathways which will exist after closure of the Barnwell site are release of material into the ground water and inadvertent intrusion into the waste. Subsidence of a trench could allow some release of radioactive material to the air, but this is unlikely since repairs will continue to be made during the institutional control period.

In 1978 during routine ground water monitoring, tritium was first detected in monitoring wells at the Barnwell site. This tritium has moved with the ground water away from the disposal area. Since 1987, CNSI has implemented a field program aimed at identifying the extent of tritium movement. Tritium was detected in CNSI monitoring wells further from the site than expected in June 1991. This tritium has entered Mary's Creek on Chem-Nuclear property. Currently, tritium concentrations within Mary's Creek are at background levels at the Chem-Nuclear/Savannah River Site property boundary.

During 1991, CNSI installed an enhanced trench cap over 5 hectares (12.5 acres) of the old trench area. The cap consists of multi-layered synthetic and earthen materials as shown in Figure 6-4. The cap was designed to eliminate virtually all rainfall infiltration and thereby reduce further tritium migration from these early trenches.

During 1992, a year long drilling and geologic mapping project was performed by CNSI to identify the size and location of the plume. These new data show that most of the tritium south of the site is in a long narrow band within the plume. Also, most of the plume area has tritium concentrations less than EPA safe drinking water standard of 20,000 pCi/liter. Figure 6-7 shows the approximate plume outline.[6-4] The geological maps developed during this study show that most of the tritium travels in a high transmissivity zone and eventually exits in a spring in Mary's Creek. The primary findings of the study are summarized below.

1. The tritium plume geometry and flow direction are affected by the nature of the Hawthorn/Barnwell formation contact as well as the potentiometric contours of the horizontal transport zone.

2. The tritium plume is approximately 230 m (750 ft) wide and 940 m (3,100 ft) long for an approximate surface area of about 20 hectares (50 acres). Three-fourths of the plume volume contains tritium concentrations less than 10,000 pCi/L. About 1% of the plume volume is in an elongate narrow projection which has tritium concentrations in excess of 1×10^6 pCi/L.

The tritium plume is entirely on CNSI property except for two state-owned road right-of-ways. No private or public use is made of the ground water zone in which tritium is being transported.

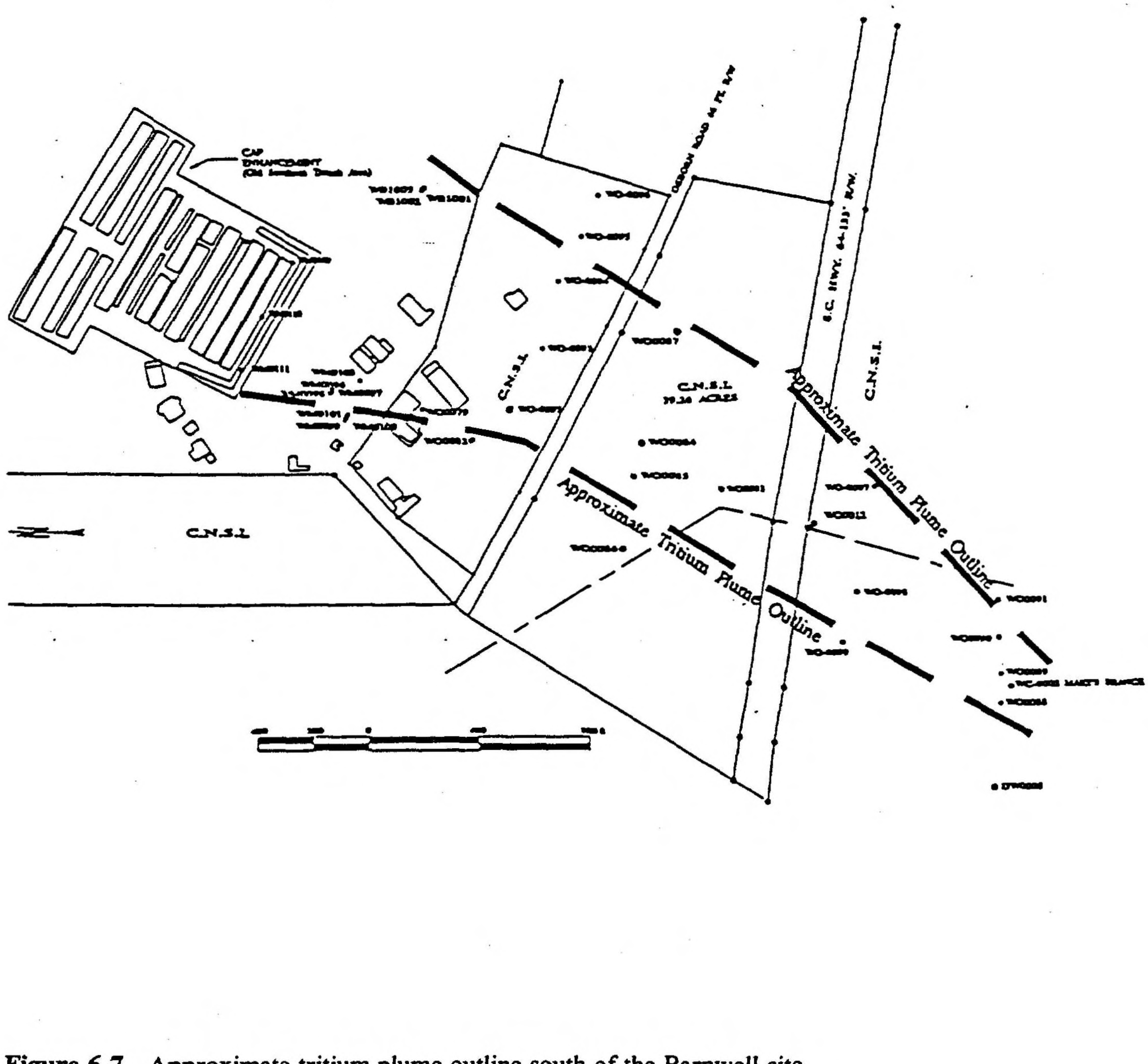

Figure 6-7. Approximate tritium plume outline south of the Barnwell site.

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6-1. *State Inspection Videotape*, CRCPD, Inc., 1993.

6-2. *Interim Site Stabilization and Closure Plan for the Barnwell Low-Level Radioactive Waste Disposal Facility*, 1993 Closure Plan Revision, Chem-Nuclear Systems, Inc., September 1993.

6-3. South Carolina Department of Health and Environmental Control (DHEC), 1992 Summary Report Radiological Environmental Monitoring Around Chem-Nuclear Systems, Inc., Bureau of Radiological Health, June 1993.

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CHAPTER 7

Environmental Summary of the Richland, Washington Low-Level Radioactive Waste Disposal Site

INTRODUCTION

Background

The Richland commercial low-level radioactive waste (LLW) burial site operated by US Ecology began operations in 1965. It is unique among comparable sites in that it is the only one located on federal land. The LLW facility occupies 0.4 square kilometers (100 acres) of land leased by US Ecology, Inc., on the Hanford Reservation that is in turn leased by the State of Washington from the U.S. Department of Energy (DOE).

Location

The burial site is located in north central Benton County, in the southeastern part of the state, about 37 km (23 mi) northwest of Richland, Washington (Figure 7-1). It is just southwest of the 200-East (200-E) Area and about 4.0 km (2.5 mi) east of the 200-West (200-W) Area, within the Separations Area of the Hanford Site (Figure 7-1). The Separations Area near the center of the Hanford site covers 212 square kilometers (82 square miles) and includes the 200-East and 200-West Areas, where several retired reactors, irradiated uranium fuels processing facilities, plutonium separation facilities, as well as major radioactive waste storage and disposal facilities are located and are still in active use.

Facility

The Richland site was originally operated by California Nuclear, Inc., and then by Nuclear Engineering Company, which is now known as US Ecology. The site received approximately 0.35 million cubic meters (12.3 million cubic feet) of low-level radioactive waste, with a total radioactivity of approximately 8.14 E+16 becquerels (2.2 million curies), as of December 31, 1992. The waste consists of solid or solidified materials, contaminated equipment, cleaning wastes, tools, protective clothing, gloves, and laboratory wastes. Unless specifically authorized by the Washington Department of Health, all radioactive waste is required to be received and buried in closed containers. Cardboard, corrugated paper, wood, and fiberboard (although in use during the early years) are prohibited burial containers.[7-1]

All waste and waste containers have been emplaced in trenches excavated into the surficial sediments. When completely filled, each trench is covered with at least 2.44 m (8 ft) of soil to grade, capped with a 15.24 cm (6 in.) layer of gravel, and then surcharged with spoils. Older trenches were covered with 0.915 m (3 ft) of soil prior to gravel placement. At present, the waste is contained in

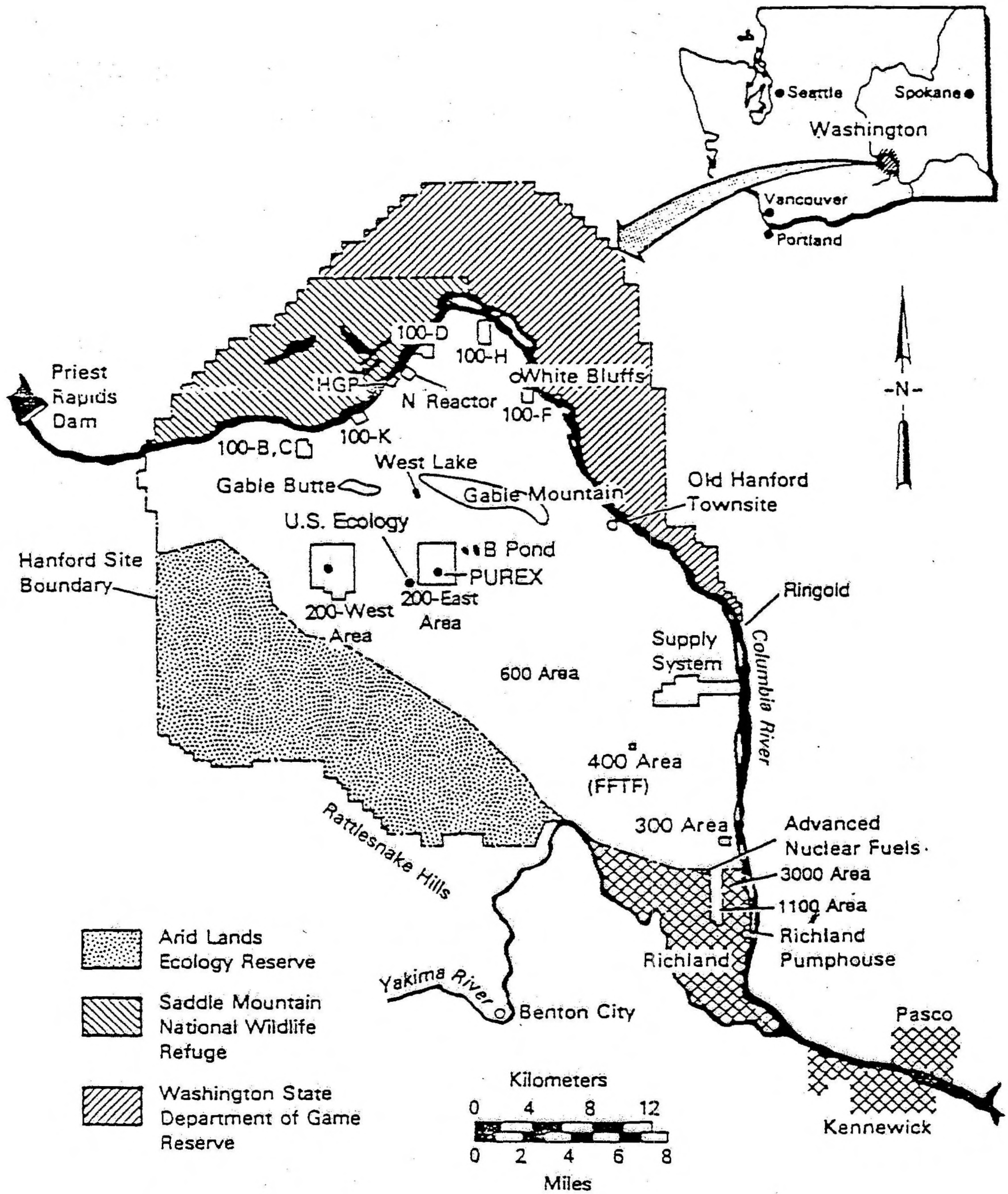


Figure 7-1. DOE Hanford site.

19 separate trenches located on about 0.128 square kilometers (32 acres) in the southeast and east-central part of the facility (Figure 7-2). Trench size is variable, but the newer trenches are up to 45.75 m (150 ft) wide, 305 m (1,000 ft) long, and 13.73 m (45 ft) deep, with a horizontal to vertical slope ratio of 1:1.

Radioactive wastes received at the Richland LLW facility are inspected by a permanent on-site Department of Health (DOH) inspector. The inspector reviews all shipping documents; surveys transport vehicles for radiation levels; visually inspects individual packages for appropriate markings, labels, and container integrity; and randomly inspects contents of containers. The inspector also verifies compliance with the radioactive materials license (WN-I019-2) issued by the State of Washington to US Ecology, Inc.[7-1]

A final Resource Conservation and Recovery Act (RCRA) Facility Assessment Report (FAR) was completed at the commercial LLW site by PRC Environmental Management, Inc. under contract from the U.S. Environmental Protection Agency (EPA). The FAR was performed to evaluate the facility's past and present solid waste practices. The US Ecology facility is not presently authorized to receive mixed or hazardous waste, but did dispose of material that is currently considered mixed waste such as scintillation fluids in Trenches 1 through 11A prior to EPA's determination that such waste was subject to RCRA. The U.S. DOE Hanford site is seeking a RCRA permit to handle hazardous waste, and according to the EPA, the US Ecology facility, as part of the site, is therefore subject to investigation for corrective action.

The FAR concluded that Trenches 1 through 11A would require further investigation, which would include soil borings and additional ground water sampling. Soil borings would be analyzed to help determine whether constituents have migrated from the units. Ground water samples from the existing monitoring wells would be collected and analyzed for specific hazardous constituents (such as benzene and toluene) to determine if migration has occurred in those trenches.

SITE

Topography

The Hanford site occupies an area of about 1,450 square kilometers (560 square miles), north of the confluences of the Snake and Yakima rivers with the Columbia River (Figures 7-1, 7-3, and 7-4). Adjoining lands to the west, north, and east are principally flat or rolling range and agricultural land in Benton and Franklin Counties.

Climate

The Cascade Mountains to the west greatly influence the climate of the Hanford site. This range creates a rain shadow effect and also serves as a source of cold air drainage, which has a considerable effect on the wind regime. The prevailing wind direction on the 200 Area plateau, which includes the LLW site, is from the northwest in all months of the year. The secondary wind direction is from the southwest. Summaries of wind direction indicate that winds from the northwest quadrant occur most often during the winter and summer. During the spring and fall, the frequency of southwesterly winds increases with a corresponding decrease in the northwest flow. Monthly average wind speeds are

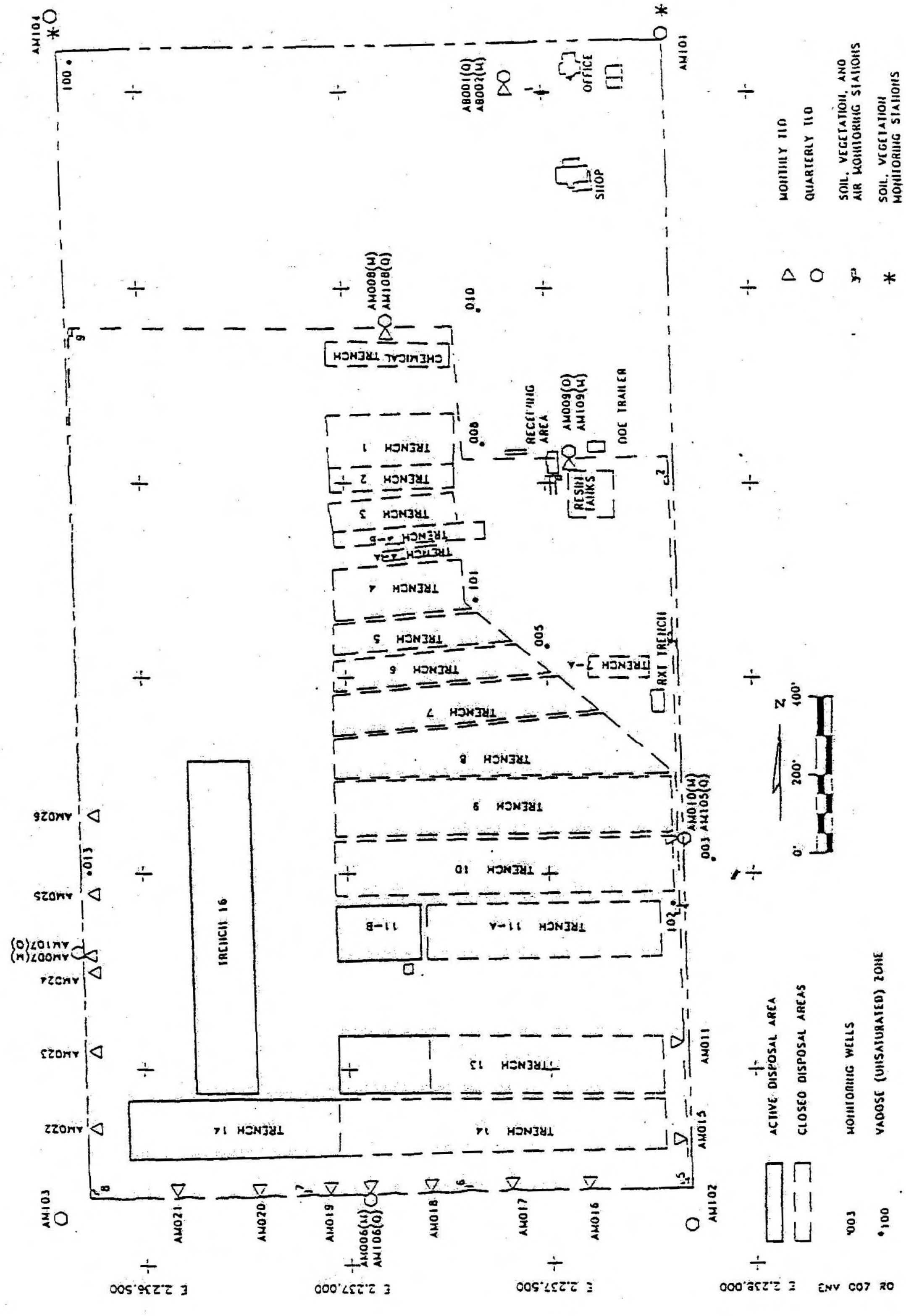


Figure 7-2. Low-level radioactive waste management facility, US Ecology, Inc., Richland, Washington.

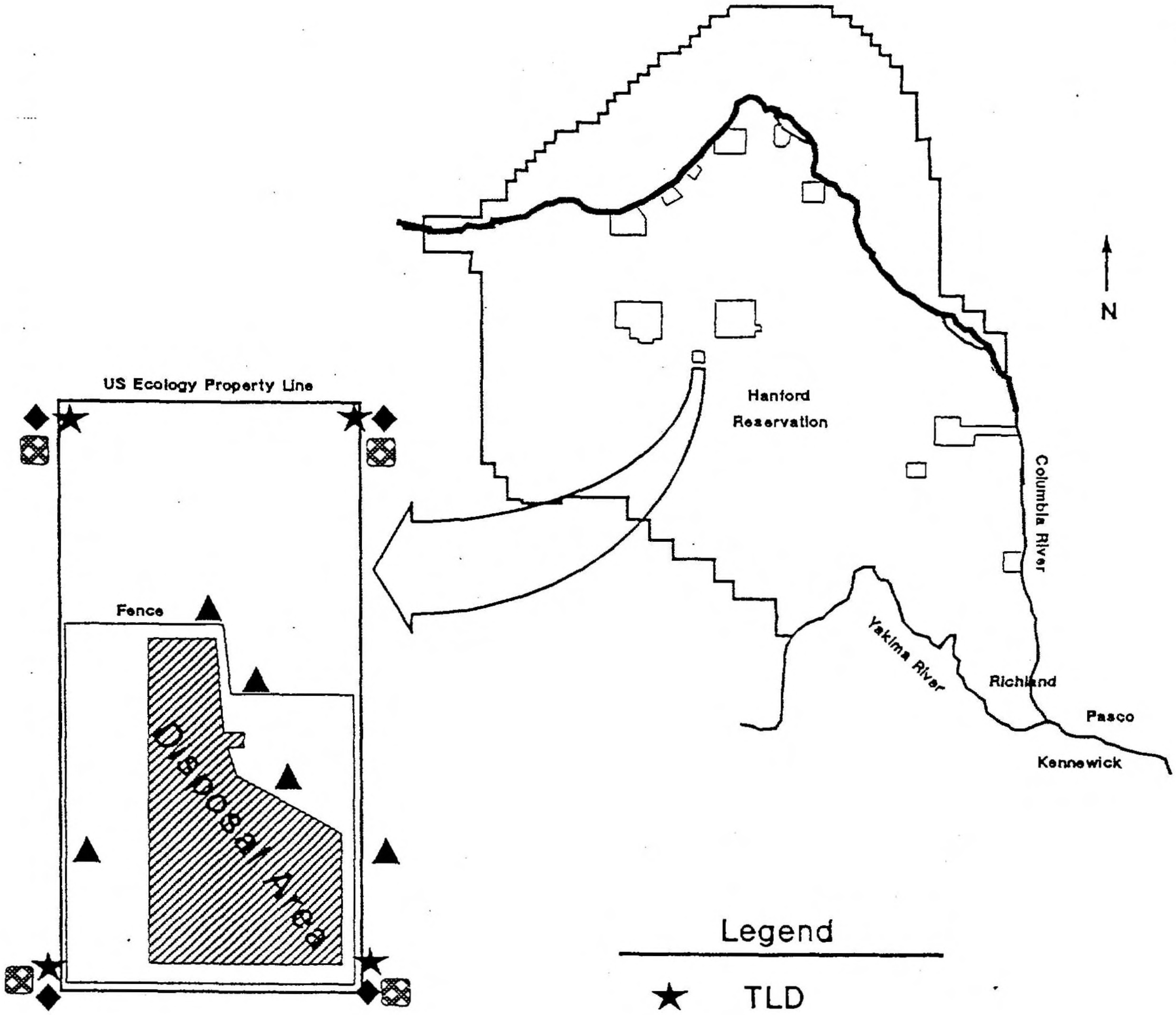


Figure 7-3. Environmental radiation sampling stations at the US Ecology site.

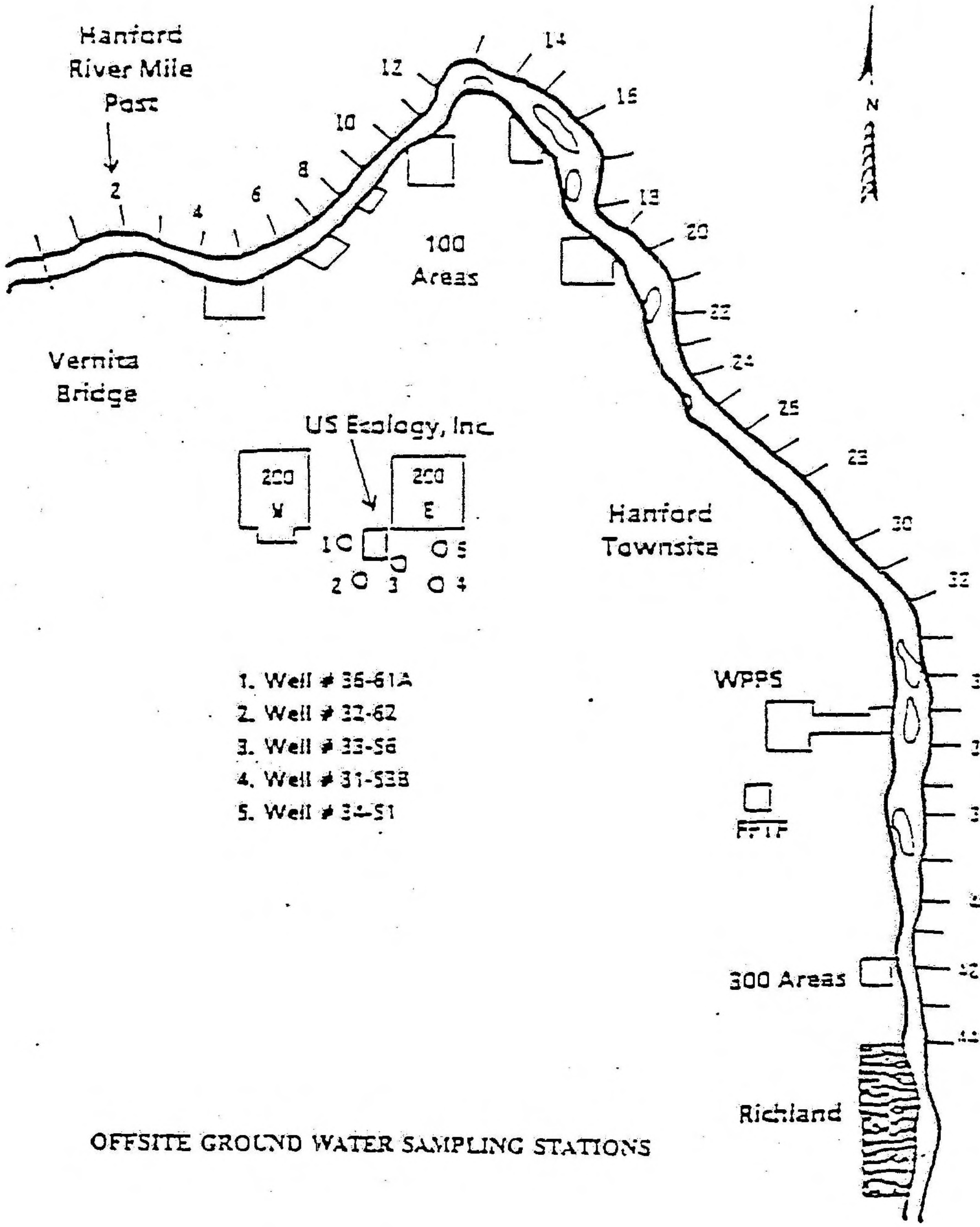


Figure 7-4. Environmental radiation sampling stations in the vicinity of the Hanford site.

lowest during the winter months, averaging 2.68 to 3.13 m/sec (6 to 7 miles per hour), and highest during the summer, averaging 4 to 4.5 m/sec (9 to 10 miles per hour). Wind speeds that are well above average are usually associated with southwesterly winds. However, the summertime drainage winds are generally northwesterly and frequently reach 13.4 m/sec (30 miles per hour). These winds are most prevalent over the northern portion of the site.

The record maximum temperature is 46°C (115°F), and the record minimum temperature is -32.8°C (-27°F). The average monthly temperatures have ranged from a low of -1.5°C (29.3°F) in

January to a high of 24.7°C (76°F) in July. During the winter, the highest monthly average temperature at the Hanford Meteorological Station (HMS) was 6.9°C (44.4°F), and the record lowest was -5.9°C (21.4°F); both occurred during February. During the summer, the record maximum monthly average temperature was 27.9°C (82.2°F) in July, and the record lowest was 17.2°C (63°F) in June. The annual average relative humidity at the HMS is 54%. It is highest during the winter months, averaging about 75%, and lowest during the summer, averaging about 35%. Average annual precipitation at the HMS is 16 cm (6.3 in.). Most of the precipitation occurs during the winter, with nearly half of the annual amount occurring in the months of November through February. Monthly climatological data from the HMS for 1991 is provided in Table 7-1.[7-2]

Good dispersion conditions associated with neutral and unstable stratification exist about 57% of the time during the summer. Less favorable dispersion conditions (when the wind speed is light and the mixing layer is shallow) are most common during the winter, when moderately to extremely stable stratification exists about 66% of the time. Occasionally there are extended periods, primarily during winter months, of poor dispersion conditions that are associated with stagnant air in stationary high-pressure systems.

Land Use

The Hanford site in southcentral Washington State is about 1,450 square kilometers (560 square miles) of semiarid shrub-steppe located just north of the confluence of the Snake and Yakima rivers. This land, with restricted public access, provides a buffer for the smaller areas historically used for the production of nuclear materials, waste storage, and waste disposal. About 6% of the land area has been disturbed and is actively used.

The Hanford site was acquired by the federal government in 1943. For more than 20 years, Hanford site facilities were dedicated primarily to the production of plutonium for national defense and management of the resulting wastes. In later years, programs at the Hanford site were diversified to include research and development for advanced reactors, renewable energy technologies, waste disposal technologies, and cleanup of contamination from past practices. The U.S. DOE has ended the production of defense-related nuclear materials at Hanford.

Non-DOE operations and activities include commercial power production (near the 400 Area), a commercial low-level radioactive waste burial facility (near the 200 Areas), a commercial nuclear fuel fabrication facility, and a low-level radioactive waste decontamination, supercompaction, and packaging disposal facility adjacent to the southern boundary of the Hanford site.

Land use in surrounding environs includes urban and industrial development, irrigated and dryland farming, and grazing. In 1989, wheat represented the largest single crop in terms of area planted in Benton and Franklin counties, with 864 square kilometers (216,000 acres). Corn, alfalfa, potatoes, asparagus, apples, cherries, and grapes are other major crops in Benton and Franklin counties. More than 20 processors in Benton and Franklin counties produce food products, including potato products, canned fruits and vegetables, wine, and animal feed.[7-4]

Table 7-1. Monthly climatological data from the Hanford Meteorological Station, 1991.

HANFORD METEOROLOGY STATION, 25 MILES N.W. OF RICHLAND, WA
Latitude 46°34'N, Longitude 119°35'W, Elevation 733 Feet

Month	Temperature (°C)								Precipitation (cm)				Relative Humidity (%)		50-Foot Wind[a]				
	Averages				Extremes						Snowfall						Peak Gusts		
	Daily Maximum	Daily Minimum	Monthly	Departure[b]	Highest	Date	Lowest	Date	Total	Departure	Total	Departure	Average	Departure	Average Speed (km/h)	Departure	Speed (km/h)	Direction	Date
J	2.6	-6.3	-1.8	-1.4	15.0	13	-15.0	4	0.8	-1.2	9.7	-0.2	78.3	+1.9	8.4	-2.1	69	SSE	13
F	12.8	1.0	6.9	+3.6	18.9	19	-3.3	28+[c]	0.5	-1.1	0	-5.1	68.1	-2.2	10.5	-1.1	71	SW	19+
M	13.1	0.4	6.7	-0.8	20.6	31	-5.6	2	2.8	+1.6	0.3	-0.5	58.7	+2.8	12.4	-1.0	98	SW	3
A	19.5	5.0	12.2	+0.7	27.8	21	-0.6	8+	1.1	+0.1	0	T[d]	43.7	-3.5	16.1	+1.6	80	S	3
M	22.7	8.8	15.8	-0.5	28.3	21	3.3	25+	1.2	-0.1	0	-[e]	45.8	+3.1	14.3	-0.3	72	NW	30
J	25.8	11.5	18.7	-2.3	33.9	10	6.7	17	3.7	+2.7	0	-	48.1	+9.3	13.4	-1.4	76	W	29
J	33.9	17.2	25.6	+1.0	40.6	3	12.8	20+	0.7	+0.3	0	-	34.6	+1.1	13.7	-0.5	74	NW	31
A	34.3	17.8	26.1	+2.1	39.4	21+	8.3	26	0.2	-0.5	0	-	36.4	+0.6	12.4	-0.3	68	SSW	18
S	29.6	12.3	20.9	+2.2	35.0	6+	5.6	22	0	-0.8	0	-	36.6	-6.1	11.4	-0.5	69	WNW	20+
O	18.9	4.3	11.6	0	31.1	1	-5.0	30	1.4	+0.4	3.0	+2.8	47.8	-7.4	10.8	+0.3	88	WSW	16
N	8.8	1.5	5.2	+0.6	18.3	12	-5.0	30+	3.7	+1.4	T	-4.6	78.2	+4.8	9.6	-0.6	77	N	28+
D	6.9	-0.5	3.2	+3.6	15.0	11	-6.7	19+	1.0	-1.6	1.5	-13.0	82.1	+1.8	9.3	-0.2	90	W	12
(f) Y	19.1	6.1	12.6	+0.7	40.6	Jul 3	-15.0	Jan 4	17.1	+1.2	14.5	-20.6	54.9	+0.6	11.9	-0.5	98	SW	Mar 3

(a) Measured on a tower 50 ft above the ground.
(b) Departure columns indicate positive or negative departure of meteorological parameters from 30-year (1961-1990) climatological normals.
(c) + after date indicates latest of several occurrences.
(d) Trace.
(e) - means no record of any snowfall during these months.
(f) Yearly averages, extremes, and totals.

Estimates by the U.S. Census Bureau for 1990 place the population totals for Benton and Franklin counties at 112,560 and 37,473, respectively. The 1990 estimates for the Tri-Cities populations are Richland, 32,315; Kennewick, 42,159; and Pasco, 20,337. The populations of Benton City, Prosser, and West Richland totaled 10,244 in 1990. The population of Benton and Franklin counties is predominantly young, with 56% of the total population under the age of 35, compared with 54% of the total state population. An examination of age groups in 5 year increments reveals that the largest age group in Benton and Franklin counties ranges from 5 to 9 years old, representing 9.3% of the total bi-county population; the largest group in the state ranges from 30 to 34 years, which represents about 9% of the total state population.[7-4]

Geology

The Hanford site lies within the Pasco Basin on the semi-arid alluvial plain of the Columbia River. The burial site is situated in glaciofluvial deposits from the ancestral Columbia River, which consists of sand, silt, and gravel in various combinations. These deposits range to about 61 m (200 ft) in depth and overlay the Ringold Formation, which is a layer of sedimentary material ranging to 366 m (1,200 ft) thick. Below this formation is bedrock consisting of the Yakima Basalt.[7-4] Near the 200-West Area, the Ringold and Hanford Formations are separated by well-developed buried soil and fine-grained wind deposits. The stratigraphic and structural relationships between these units are displayed in Figure 7-5.[7-4]

Surface Water

The Columbia River is the dominant surface water body on the Hanford site and is approximately 12.9 km (8 mi) from the LLW site. The Columbia, which originates in the mountains of eastern British Columbia, Canada, drains a total area of approximately 70,680 square kilometers (27,300 square miles) en route to the Pacific Ocean. Flow of the Columbia River is regulated by 11 dams within the United States, 7 upstream and 4 downstream of the site. Priest Rapids is the nearest dam upstream of the site, and McNary is the nearest dam downstream. The Hanford Reach of the Columbia River extends from Priest Rapids Dam to the head of Lake Wallula (created by McNary Dam), near Richland. This Reach is the last stretch of the Columbia River in the United States above Bonneville Dam that remains unimpounded. The width of the river varies from approximately 300 to 1,000 m (984 ft to 3,281 ft) within the Hanford site.

The Columbia River flows eastward through the northern part of the Hanford site and then turns south, forming part of the eastern boundary. The Yakima River runs along part of the southern boundary and joins the Columbia River below the city of Richland. The Columbia River flows through the reservation about 27.4 km (17 mi) from the waste disposal site.

No surface water bodies are on or near the Hanford site. A number of man-made ponds have been created by U.S. DOE for the disposal of reactor cooling water and liquid wastes.

Typical flow rates of the Columbia River range from 999 to 6,995 cubic m/sec (35,310 to 247,170 cubic ft/sec), with peak spring runoff flows of up to 12,590 cubic m/sec (444,906 cubic ft/sec). The minimum regulated flow is 1,019 cubic m/sec (36,016 cubic ft/sec).

GEOLOGIC CROSS-SECTION OF THE SITE

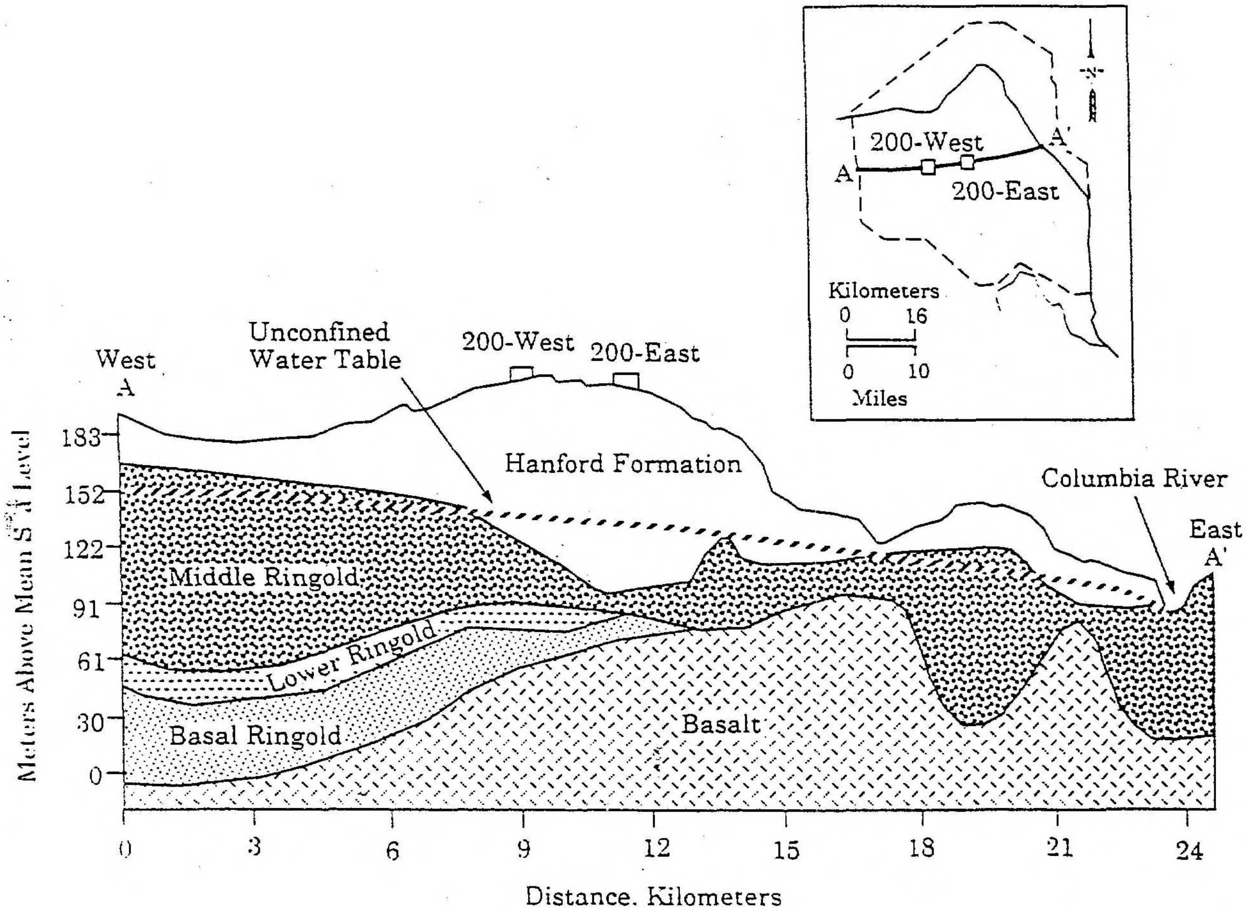


Figure 7-5. Geological cross-section of the Hanford site.

The temperature of the Columbia River varies seasonally. Minimum temperatures are observed during January and February, and maximum temperatures typically occur during August and September. Mean monthly temperatures for the river range from approximately 3°C (37°F) to about 20°C (68°F).

Ground Water

Both confined and unconfined aquifers are present beneath the Hanford site. The confined aquifers, where ground water is under pressure greater than that of the atmosphere, are found primarily within the Columbia River basalts. In general, the unconfined or water table aquifer is located in the Ringold Formation and glaciofluvial sediments, as well as some more recent alluvial sediments in areas adjacent to the Columbia River. This relatively shallow aquifer has been affected by wastewater disposal by U.S. DOE. Therefore, the unconfined aquifer is the most thoroughly monitored aquifer beneath the Hanford Reservation.

The unconfined aquifer is bounded below by either the basalt surface or, in places, the relatively impervious clays and silts of the Ringold Formation. The water table defines the upper boundary of the unconfined aquifer. Laterally, the unconfined aquifer is bounded by the basalt ridges that surround the basin and by the Yakima and Columbia Rivers. The basalt ridges have a low permeability and act as a barrier to lateral flow of ground water where they rise above the water table. Depth from the ground surface to the water table ranges from less than 0.30 m (1 ft) at the Columbia River to more than 106 m (348 ft) in the center of the Hanford site. The depth to ground water at the US Ecology LLW site is about 97 m (317 ft).

The operational discharge of water by U.S. DOE facilities has created ground water mounds near each of U.S. DOE's major waste water disposal facilities in the 200 Areas. These mounds have altered the aquifer's local flow pattern, which is generally from the recharge areas in the west to the discharge areas (primarily the Columbia River) in the east. Water levels in the unconfined aquifer have changed continually during site operations because of variations in the volume of waste water discharged. Consequently, the movement of ground water and its associated constituents has also changed with time.[7-4]

Ground water mounding also occurs in the 100 and 300 Areas. Ground water mounding in these areas is not as significant as in the 200 Areas because of differences in discharge volumes and subsurface geology. In the 100 and 300 Areas, water levels are also greatly influenced by river stage.

Ecology

The Hanford site is a relatively large, undisturbed area of shrub-steppe that contains numerous plant and animal species adapted to the region's semiarid environment. Table 7-2 lists some of the mammals, birds, and vegetation found in the area.

More than 240 species of plants have been identified on the entire Hanford site, and cheatgrass is the dominant plant on fields that were cultivated 40 years ago.[7-4]

More than 300 species of terrestrial and aquatic insects, 12 species of reptiles and amphibians, 44 species of fish, 187 species of birds, and about 39 species of mammals have been found on the Hanford site. Deer and elk are the major large mammals on the site; coyotes are plentiful, and the Great Basin pocket mouse is the most abundant mammal. Waterfowl are numerous on the Columbia River; the bald eagle is a regular winter visitor along the river. Salmon and steelhead are the fish species of most interest.

Table 7-2. Common species of mammals, birds, and vegetation.

Mammals and birds	Vegetation
Mule deer (*Odocoileus hemionus*)	Bluebunch wheatgrass (*Agropyron spicatum*)
Coyote (*Canis latrans*)	Cheatgrass (*Bromus tectroum*)
Badger (*Taxidea taxus*)	Bitterbrush (*Purshia tridentata*)
Black-tailed hare (*Lepus californicus*)	Greasewood/saltgrass (*Sarcobatus vermiculatus*)
Great basin pocket mouse (*Perognathus parvus*)	Winterfat (*Eurotia lanata*)
Deer mouse (*Peromyscus maniculatus*)	Thyme buckwheat (*Eriogonum thymoides*)
Western meadowlark (*Sturnella neglecta*)	Tumble mustard (*Sisymbrium altissimum*)
	Willow (*Salicaceae*)
	Sandberg's bluegrass (*Poa sandbergii*)
	Sagebrush (*Artemisia tridentata*)

No federally designated threatened or endangered animal species are known to inhabit the facility or the leasehold. However, the bald eagle (*Haliaeetus leucocephalus*), a threatened species, and the peregrine falcon (*Falco peregrinus*), an endangered species, have been seen on the Reservation and may pass over the facility.

ENVIRONMENTAL MONITORING

Overview

Environmental monitoring is performed at the Richland LLW facility to demonstrate compliance with federal, state, and local regulations; confirm adherence to environmental protection policies; and support the environmental management decisions. These regulations require that effluents to the general environment be maintained as low as reasonably achievable (ALARA) and that annual doses due to effluents not exceed 0.25 millisievert (25 millirems) to the whole body, 0.75 millisievert (75 millirems) to the thyroid, and 0.25 millisievert (25 millirems) to any other organ of any member of the public.

The Department, with assistance from many other agencies, operates a statewide environmental radiation monitoring program. It also audits surveillance programs required of licensees and other

nuclear facilities. The state's independent program also serves to verify the adequacy and accuracy of a facility's program.

The major goals of the environmental radiation program are to identify, assess, and initiate appropriate corrective actions needed to prevent any potential exposure to the public, or contamination of the environment before a significant problem develops.

The environmental monitoring program at the Richland LLW facility monitors all pathways through which individuals living outside the Hanford site could be exposed to radiation or radioactive materials released from the site. These include direct radiation, atmospheric exposure, and from radionuclide releases into the ground water.

Environmental monitoring programs are conducted by the State of Washington and US Ecology, Inc. at the LLW facility. The monitoring of potential environmental pathways of exposure include nine fixed environmental air stations, routine monitoring of both soil and live vegetation (when available), environmental thermoluminescent dosimeters, five ground water wells (Figures 7-2 and 7-3), and vadose zone monitoring. The specific requirements for environmental monitoring are defined in the Facility Standards Manual[7-3] and are described in detail in the US Ecology Annual Environmental Reports.[7-4]

Environmental monitoring began in the first quarter of 1966. Soil and vegetation samples were taken from the vicinity of the four facility corners by the facility operators (US Ecology, Inc., formerly California Nuclear, Inc., then NECo). Starting in the first quarter of 1964, the U.S. AEC provided the licensee with the results of the analysis of ground water samples taken from wells near the 200-W and 200-E areas (Figure 7-6) which were closest to the facility. Until the first quarter of 1973, only gross beta concentrations were monitored in ground water. Beginning in 1977, Battelle gathered the ground water samples, U.S. Testing analyzed the samples and provided the analytical results to the State of Washington, and Battelle then distributed the data to the facility operator (US Ecology). In 1986, US Ecology began performing ground water sampling in the newly constructed on-site ground water wells, with U.S. Testing performing the analysis.

Environmental sampling for air and particulate airborne radioactivity was initiated in January 1987. Prior to that time (beginning in December 1978), downwind operational low-volume air sampling was performed at a location near the east fence. As new trenches became operational, this location was moved to the south fence.

Ambient gamma measurements were performed, using thermoluminescent dosimeters (TLDs) posted at the facility corners, which were then collected quarterly. Monthly TLDs were posted at the north, south, east, and west fencelines and at a downwind location.

Monitoring of the milk pathway at the Hanford site is not possible because no farms or cattle are near the site. However, milk is collected every other week throughout the year from farms east of the Hanford Reservation (approximately 32 km (20 mi), in the prevailing downwind direction) and analyzed for radionuclides. Wildlife is collected at the Reservation and is analyzed annually. Analysis of vegetation samples serves to provide an indication of any radionuclides which could be included in the diet of wildlife.

ENVIRONMENTAL RADIATION SAMPLING STATIONS
IN THE VICINITY OF HANFORD

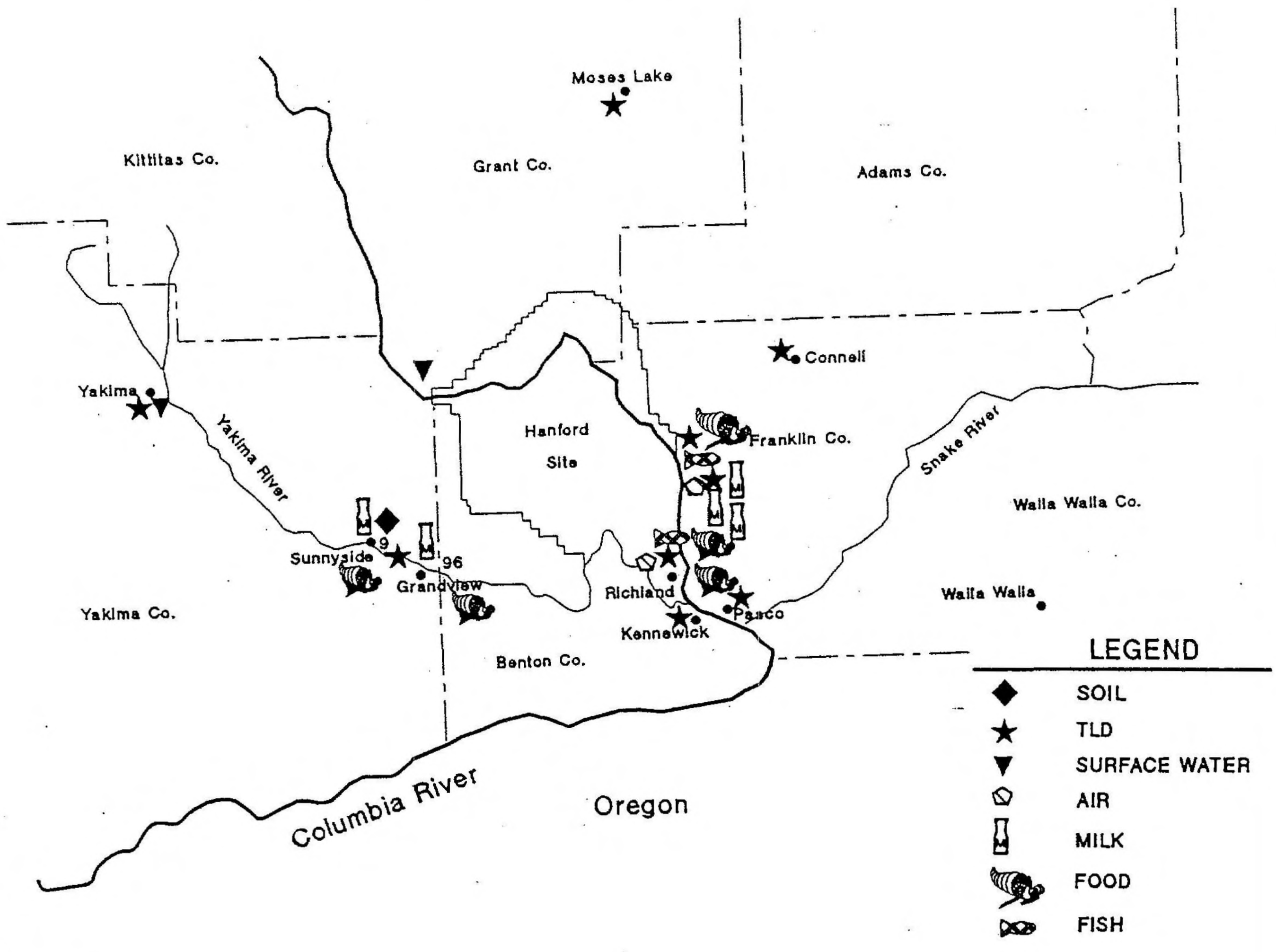


Figure 7-6. Off-site ground water sampling stations near the Hanford site.

Table 7-3 describes the environmental monitoring program and action levels as required by the Washington State Department of Health. Actions required whenever environmental action levels are exceeded are given in Table 7-4. Table 7-5 summarizes the requirements for minimum detectable concentrations for gamma spectroscopy of environmental samples. Figures 7-2, 7-3, 7-4, and 7-6 show the locations of all environmental monitoring stations on the facility; these are described in Table 7-3.

Table 7-3. Environmental/occupational monitoring requirements.

MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	ACTION LEVELS		
				INVESTIGATION LEVEL	REPORTING LEVEL	ACTION CATEGORY[1]
Direct Gamma Dose (TLD)	NW, NE, SW, SE Corners and N, S, E, W Fencelines	Continuous, Quarterly	Tissue dose using thermo-luminescent dosimeters	120 mrem/qtr	500 mrem/year	3, 4
	N, S, E, W Fencelines and Fenceline position(s) nearest each active disposal trench	Continuous, Monthly	Tissue dose using thermo-luminescent dosimeters	40 mrem/month	500 mrem/year	3, 4

NOTES 1) Table 6.4 presents the action required based upon action categories.

2) If Ac-227 is listed on manifest or known to be present, the reporting level is 3.0×10^{-13} uCi/cc.

3) The required minimum detection concentrations (MDC's) are listed in Table 4.3.

4) NA = Not applicable or none established.

5) Dry to wet ratio will be obtained

6) Total uranium analysis is defined as the sum of the concentrations of uranium isotopes reported.

7) These are interim reporting levels

8) Concentrations will be evaluated and reported annually in the enviromental report.

9) Field blank analysis is the same as well sample analysis.

10) Used for sample QA.

Table 7-3. (continued).

MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	ACTION LEVELS: INVESTIGATION LEVEL	ACTION LEVELS: REPORTING LEVEL	ACTION CATEGORY[1]
Soil[5]	Env. Monitoring Stations 1-9 and NE, NW Corners	Grab, Quarterly	Gross Beta	35 pCi/g (dry)	35 pCi/g (dry)[7]	3, 4
			Total Uranium[6]	1 pCi/g (dry)	1 pCi/g (dry)[7]	3, 4
			Pu-238	0.03 pCi/g (dry)	0.03 pCi/g (dry)[7]	3, 4
			Pu-239/240	0.03 pCi/g (dry)	0.03 pCi/g (dry)[7]	3, 4
			Co-60	0.3 pCi/g (dry)	0.3 pCi/g (dry)[7]	3, 4
			Cs-137	0.25 pCi/g (dry)	0.25 pCi/g (dry)[7]	3, 4
			Gamma Spec	5 x MDC[3]	5 x MDC[3,7]	3, 4
Vegetation[5]	Env. Monitoring Stations 1-9 and NE, NW Corners	Grab, Quarterly for deep rooted	Gross Beta	100 pCi/g (dry)	100 pCi/g (dry)[7]	3, 4
			Total Uranium[6]	0.25 pCi/g (dry)	0.25 pCi/g (dry)[7]	3, 4
			Pu-238	0.02 pCi/g (dry)	0.02 pCi/g (dry)[7]	3, 4
			Pu-239/240	0.02 pCi/g (dry)	0.02 pCi/g (dry)[7]	3, 4
			Co-60	0.1 pCi/g (dry)	0.1 pCi/g (dry)[7]	3, 4
			Cs-137	0.2 pCi/g (dry)	0.2 pCi/g (dry)[7]	3, 4
			Gamma Spec	5 x MDC[3]	5 x MDC[3, 7]	3, 4
	Filled and capped trenches	Grab, Annually	Gross Beta	100 pCi/g (dry)	100 pCi/g (dry)[7]	3, 4
			Total Uranium[6]	0.25 pCi/g (dry)	0.25 pCi/g (dry)[7]	3, 4
			Pu-238	0.02 pCi/g (dry)	0.02 pCi/g (dry)[7]	3, 4
			Pu-239/240	0.02 pCi/g (dry)	0.02 pCi/g (dry)[7]	3, 4
			Co-60	0.1 pCi/g (dry)	0.1 pCi/g (dry)[7]	3, 4
			Cs-137	0.2 pCi/g (dry)	0.2 pCi/g (dry)[7]	3, 4
			Gamma Spec	5 x MDC[3]	5 x MDC[3,7]	3, 4
			H-3	NA[4,8]	NA[4, 8]	

Table 7-3. (continued).

MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	ACTION LEVELS: INVESTIGATION LEVEL	ACTION LEVELS: REPORTING LEVEL	ACTION CATEGORY[1]
Groundwater	Wells	Grab, Quarterly	Gross Alpha	12 pCi/L	15 pCi/L	3, 4
	#013 (upgradient)		Gross Beta	12 pCi/L	50 pCi/L	3, 4
	#010		H-3	3,600 pCi/L	20,000 pCi/L	3, 4
	#008		C-14	250 pCi/L	2,000 pCi/L	3, 4
	#005		Total Uranium[6]	4.5 pCi/L	30 pCi/L	3, 4
	#003		Pu-238	0.03 pCi/L	See Pu-239/240	3, 4
			Pu-239/240	0.03 pCi/L	40 pCi/L (total Pu)	3, 4
			Co-60	6 pCi/L	100 pCi/L	3, 4
			Cs-137	7 pCi/L	200 pCi/L	3, 4
			Gamma Spec	5 x MDC[3]	5 x MDC[3, 7]	3, 4
			Specific Conductance	NA[4, 8]	NA[4, 8]	NA[4]
			TDS	NA[4, 8]	NA[4, 8]	NA[4]
			TOC	NA[4, 8]	NA[4, 8]	NA[4]
			Nitrates	NA[4, 8]	NA[4, 8]	NA[4]
			Temperature	NA[4, 8]	NA[4, 8]	NA[4]
Field Blank Deionized Water		1 blank per 10 samples collected	Note 9	NA[4, 10]	NA[4, 10]	NA[4]

Table 7-3. (continued).

				ACTION LEVELS		
MEDIUM	LOCATION	TYPE; FREQUENCY	ANALYSIS	INVESTIGATION LEVEL	REPORTING LEVEL	ACTION CATEGORY[1]
ENVIRONMENTAL AIR	Envir. Monitoring Stations 1-9	Continuous, changed weekly	Gross Alpha	1×10^{-14} uCi/cc	1.7×10^{-14} uCi/cc	3, 4
			Gross Beta	1×10^{-13} uCi/cc	2.6×10^{-11} uCi/cc	3, 4
			I-125	3.5×10^{-14} uCi/cc	2.3×10^{-10} uCi/cc	3, 4
	Envir. Monitoring Stations 1-9	Continuous, Monthly Composite of weekly samples	Co-60	5×10^{-14} uCi/cc	2.6×10^{-11} uCi/cc	3, 4
			Cs-137	5×10^{-14} uCi/cc	1.9×10^{-10} uCi/cc	3, 4
			Gamma Spec	5 x MDC[3]	5 x MDC[3]	3, 4
	Envir. Monitoring Stations 1,2,5	Continuous, changed monthly	H-3	2×10^{-11} uCi/cc	6.1×10^{-8} uCi/cc	3, 4
OCCUPATIONAL AIR	One downwind plus one at each location of potential exposure	Continuous during operations or 1 hour/day; whichever is greater	Gross Alpha	NA[4]	3×10^{-13} uCi/cc	1
			Gross Beta	NA[4]	1×10^{-12} uCi/cc[2]	1
			I-125	NA[4]	5×10^{-10} uCi/cc	1

Table 7-4. Action required when action level met or exceeded.

1.	Type 1 Event Follow reporting level requirements Potential for bioassay examined by facility and corporate radiation office
2.	Type 2 Event Immediate notification of on-site inspector Take corrective action
3.	Investigation Level Notify the facility and corporate radiation office Take corrective actions described in facility safety manual 6.1.5
4.	Reporting Level Notify the facility and corporate radiation office, the Department, the US NRC within 24 hours upon confirmation Take corrective actions described in facility safety manual 6.1.5 Make reports in accordance with facility safety manual 6.1.4.C
5.	Resurvey with dose rate instrument for fixed contamination/radiation level and smears for loose contamination. If does rate <0.1 mR/hr and loose contamination <220 dpm/100 cm^2, no further action is required. If does rate is ≥ 0.1 mr/hr or loose contamination is ≥ 220 dpm/100 cm^2, then take actions per #2 above.

Radon gas monitoring was initiated in 1993 at selected air monitoring stations. This program utilizes track etch detectors to provide data on airborne radon concentrations. Table 7-6 provides the results of this study.

Ground Water

Ground water samples are analyzed for radiological as well as non-radiological constituents. Radiological analyses include gross alpha, gross beta, tritium, C-14, gamma-emitters, isotopic plutonium (Pu-238 and Pu-239/240), and isotopic uranium (U-234, U-235, and U-238). Non-radiological parameters include temperature, specific conductivity, total organic carbon (TOC), nitrates, and total dissolved solids (TDS).

Starting in the first quarter of 1964, the U.S. AEC provided the Richland LLW facility operator with the results of analysis of ground water samples taken from the wells in the vicinity of the LLW disposal site (Figure 7-6). Until the first quarter of 1973, only gross beta concentration was monitored in ground water. Starting in 1974, the samples were analyzed for gross alpha, gross beta, tritium, and by gamma spectroscopy. Samples of US Ecology's on-site wells (Figures 7-2 and 7-3) began during the first quarter of 1986.

Table 7-5. Required minimum detectable concentrations (MDCs) for gamma spectroscopy analysis of environmental samples.

Radionuclide	Water (pCi/L)	Airborne Activity (pCi/m^3)	Soil (pCi/g-dry)	Vegetation (pCi/g-dry)
76As	16	0.02	0.03	0.05
140BaLa	24	0.02	0.05	0.07
141Ce	10	0.01	0.02	0.03
144CePr	92	0.09	0.18	0.10
58Co	10	0.01	0.02	0.03
60Co	11	0.01	0.02	0.03
134Cs	11	0.01	0.02	0.03
137Cs	10	0.01	0.02	0.03
152Eu	56	0.06	0.11	0.17
154Eu	27	0.03	0.05	0.08
155Eu	24	0.02	0.05	0.07
59Fe	17	0.02	0.03	0.05
131I	10	0.02	0.02	0.03
133I	11	0.01	0.02	0.03
54Mn	10	0.01	0.02	0.03
99Mo	69	0.07	0.14	0.21
22Na	10	0.01	0.02	0.03
103Ru	10	0.01	0.02	0.03
106Ru	85	0.09	0.17	0.26
124Sb	10	0.01	0.02	0.03
125Sb	24	0.02	0.05	0.07
65Zn	21	0.02	0.04	0.06
95ZrNb	17	0.02	0.03	0.05

Note: The gamma nuclide library used by the analytical laboratory will contain additional radionuclides as specified by US Ecology. Naturally occurring gamma ray emitters which will be monitored and reported in the annual environmental report are not included in this listing.

Table 7-6. Airborne radon gas measurements.

	Radon in Air 1993[a]		
	Air Sta. 1 (pCi/L)	Air Sta. 2 (pCi/L)	Air Sta. 5 (pCi/L)
May	<1.2	<1.2	<1.2
Jun	<1.0	<1.0	<1.0
Jul	<0.9	<0.9	<0.9
Aug	<1.1	<1.1	<1.1
Sep	<0.9	<0.9	<0.9
Oct	<0.9	<0.9	<0.9
Nov	<1.3	<1.3	<1.3
Dec	1.1	1.0	<0.9

a. Radon gas monitoring was started in May 1993.

Analysis results (alpha, beta, and tritium) for the ground water wells are presented in Table 7-7. The facility's on-site wells consist of four wells downgradient from the disposal unit (wells 3, 5, 8, and 10) and an upgradient well (well 13). Ground water samples are collected quarterly. The mean concentrations of gross alpha, gross beta, and tritium from 1964 to 1986 in the off-site wells (Table 7-7) were 0.26, 0.5, and 21.4 Bq/L (7.1, 13.5, and 581 $\pm$ 725 pCi/L), respectively.[7-3] It should be noted that the US Ecology LLW disposal facility is located adjacent to the 200-East and 200-West facilities of the U.S. DOE Hanford Reservation (Figure 7-6). U.S. DOE's Hanford site Environmental Report for Calendar Year 1990[7-4] states that tritium concentrations in the unconfined aquifer exceed 7.4 E+3 Bq/L (2E+5 pCi/L) in the regions surrounding the 200-East and 200-West areas. It is expected that tritium concentrations from these plumes could increase the levels observed in US Ecology's monitoring wells over the next several years. New wells may be required at the LLW site in order to detect the tritium plumes coming from the U.S. DOE areas. The concentrations in ground water at the U.S. DOE Hanford site regional wells (outside of the 200 Area) range from 0.15 to 11.5 Bq/L (4 to 310 pCi/L) for alpha, 0.6 to 19.6 Bq/L (16 to 530 pCi/L) for beta, and 11.1 to 74.7 Bq/L (300 to 2020 pCi/L) for tritium.[7-4]

Gross Alpha and Beta Activities in Ground Water

The gross alpha activity concentration in the on-site ground water samples varied from less than detectable to a maximum of about 0.43 Bq/L (11.5 pCi/L) (Table 7-7). The investigation level for gross alpha activity is 0.44 Bq/L (12 pCi/L). Gross beta activity varied from a low of 0.16 Bq/L (4.2 pCi/L), to a high of about 0.43 Bq/L (11.6) (Table 7-7). The investigation level for gross beta activity is also 0.44 Bq/L (12 pCi/L).

Table 7-7. Analysis results (alpha, beta, and tritium) for ground water wells.[a]

US Ecology On-site Wells (Figure 3)

(Operations started in 1986) pCi/L

Year	Gross alpha[a]	Gross beta[a]	Tritium[a]
1986	11.50	10.7	3,550
1987	3.68	9.16	3,000
1988	3.06	11.60	1,680
1989	4.82	8.44	1,590
1990	4.75	7.73	1,610
1991	4.0	7.0	1,520
1992	3.6	7.2	2,450
Well #13 (upgradient well)			
1992	3.6	7.2	2,450

a. Indicates the highest value for the year from all five wells.

U.S. DOE Wells (located in the vicinity of the 200 East and 200 West Area of the Hanford facility, Figure 7-4). Some of these wells are located in areas with known ground water impact by U.S. DOE operations.

(pCi/L)

Year	1966–85	1986	1987	1988	1989	1990	1991	1992
Gross alpha	7.1	—	—	—	—	—	—	—
Gross beta	13.5	—	—	—	—	—	—	—
Tritium	581	3,700	2,020	2,360	32,000	39,000	41,100	44,100

Values for 1966–1985 are mean concentration.

Values for 1987–1992 are the highest concentration from all off-site wells for the year.

Gross beta and alpha activity results for 1992 compare favorably with those for previous years. Results from upgradient and downgradient wells are also similar. It can be concluded from upgradient and downgradient ground water monitoring well data that site operations have not resulted in any discernable trends.

Table 7-8. Maximum tritium concentration in ground water (on-site[a]) wells (pCi/L).

Year	Well #3	Well #5	Well #8	Well #10	(Upgradient) Well #13
1986	3,550	952	1,180	884	1,190
1987	3,000	1,140	1,010	883	1,120
1988	1,680	690	690	690	1,090
1989	1,590	—	—	870	1,490
1990	1,610	1,550	1,140	952	1,570
1991	1,520	1,570	997	928	1,440
1992	2,150	1,740	1,707	1,270	2,450

a. On-site wells began operation in 1986 (Figure 3).

Tritium Activity in Ground Water

Tritium is present in ground water at the Hanford site, due to both natural processes and tritium-contaminated liquid waste discharged to the ground from Hanford U.S. DOE facilities. Tables 7-7, 7-8, and 7-9 present maximum yearly tritium concentrations of ground water measured at US Ecology's on-site wells and U.S. DOE's wells in the vicinity of the 200-East and 200-West Areas. The investigation level for tritium in ground water well samples is 133 Bq/L (3600 pCi/L). No analytical results for the US Ecology on-site ground water wells exceeded investigation levels. The reporting level for tritium is 740 Bq/L (20,000 pCi/L) (Table 7-3).

Table 7-9. Maximum tritium concentrations in U.S. DOE ground water wells located in the vicinity of the 200 East and 200 West areas.

Year	Concentration (pCi/L)	Year	Concentration (pCi/L)
1976	1100	1985	—
1977	1600	1986	3700
1978	3300	1987	2020
1979	2100	1988	2360
1980	2300	1989	32,000
1981	2400	1990	39,400
1982	410	1991	41,100
1983	1600	1992	44,100
1984	2200		

Carbon-14 in Ground Water

Analyses for carbon-14 in ground water are also provided in the US Ecology Historical and Annual Environmental Reports.[7-3] All samples for 1991 and 1992 were reported as being less than the minimum detectable concentration of 7.4 Bq/L (200 pCi/L). The investigation level for carbon-14 in ground water is 9.25 Bq/L (250 pCi/L). Analytical results do not indicate any trends in carbon-14 concentrations.

Gamma-Emitting Radionuclides in Ground Water

Water samples from the five on-site environmental monitoring wells were analyzed by gamma spectral analysis to determine the presence of gamma-emitting radionuclides. Results of these analyses are covered extensively in the US Ecology Historical and Annual Environmental Monitoring Reports.[7-3] No positive values were reported for man-made radionuclides in ground water.[7-3] For 1992, Co-60, Cs-137, and Ru-106 samples were less than the minimum detectable concentrations of 0.4 Bq/L (11 pCi/L), 0.37 Bq/L (10 pCi/L), and 3.1 Bq/L (85 pCi/L), respectively. These results were seen to be consistent with historical values reported for previous years. In 1991, ground water samples, cobalt-60, cesium-137, and ruthenium-106 were reported as less than detectable. Based on comparison of 1992 analyses with results reported for previous years, no trends are apparent in the data, and it may be concluded that site operations had no effect on ground water gamma-emitting nuclide concentrations.

Plutonium in Ground Water

Ground water samples taken from site monitoring wells were analyzed for plutonium-238 and plutonium-239/240. Both plutonium-238 and plutonium-239/240 ground water concentrations have been consistently below the reporting level of 1.5 Bq/L (40 pCi/L), and as such, there has never been any problem associated with plutonium in ground water. The plutonium-238 and plutonium-239/240 investigation levels are 1.1 E-3 Bq/L (3.0 E-2 pCi/L).

The results reported for isotopic plutonium are consistent with historical values. Results for 1991 plutonium-238 and 239/240 were all less than 3.7 E-4 Bq/L (1.0 E-2 pCi/L).

Uranium in Ground Water

Analytical results for isotopic uranium for 1989 through 1991 are presented below in Table 7-10.

The maximum values reported in 1992 for uranium-234, uranium-235, and uranium-238 are consistent with results reported in previous years. The data indicate that only natural uranium is present.

Surface Water

Because no surface water occurs on the US Ecology site, no surface water monitoring is performed. The nearest surface water is West Lake, which is located on the U.S. DOE Hanford Site,

approximately 6.5 km (4 mi) north of the US Ecology site. The U.S. DOE monitors West Lake for radioactivity.

Table 7-10. Analytical results for isotopic uranium.

	(Units in pCi/L)		
	U-234	U-235	U-238
1989	1.17 ± 0.218 to 2.86 ± 0.347	0.0044 ± 0.0195 to 0.506 ± 0.0969	0.653 ± 0.15 to 2.12 ± 2.70
1990	1.46 ± 1.99 to 2.02 ± 0.241	0.0182 ± 0.0180 to 0.0507 ± 0.0258	0.804 ± 1.29 to 1.41 ± 0.180
1991	<0.1 ± to 2.3 ± 1.1	<0.1	<0.1 to 1.9 ± 1.1

Air

The environmental air monitoring program involves continuous sampling of particulates, iodine (I-125), and tritium. Air particulates and iodine are continuously sampled at the nine environmental stations located around the facility; tritium is sampled continuously at three stations. Station 1, which is located in the upwind direction and is approximately 305 m (1,000 ft) north of the current receiving area, is used as the control station for the facility. Weekly samples are collected for air particulates and I-125, while monthly composites are collected for air tritium. Analyses performed on samples include gross beta, gross alpha, I-125, tritium (in air moisture), and gamma spectroscopy. Gamma spectral analysis is performed on monthly samples of air moisture collected on silica gel columns. Sampling locations are shown in Figures 7-2, 7-3, 7-4, and 7-6.

Gross beta and gross alpha measurements of particulate air samples for the years 1978 through 1992 are presented in Table 7-11. Except for a small spike (believed to be an artifact of the small volume of air pulled through the air filter and the measurement instruments used in monitoring the particulate filters),[7-3] these data do not appear to be significantly different from the normal background concentrations at locations surrounding the US Ecology LLW facility.

The 1992 annual mean concentration for I-125 at all nine stations was 3.4 E-10 Bq/mL (0.92 E-14 μCi/mL). This concentration is approximately 0.01% of the Maximum Permissible Concentration (MPC) in unrestricted areas (2.96 E-6 Bq/mL, or 8.0 E-11 μCi/mL), referenced in WAC 246-221-290, Appendix A, Table II, Column 1. The annual mean concentrations during 1991 varied from 1.92 E-10 to 4.0 E-10 Bq/mL (0.52 E-14 to 1.08 E-14 μCi/mL).[7-3] The maximum values for I-125 for all nine stations during the years 1987 through 1992 are presented in Table 7-12.

A review of the above data shows a maximum value of 4.5 E-9 Bq/mL (12.2×10^{-14} μCi/mL) obtained for 1987. This value is approximately 0.10% of the MPC value for unrestricted areas.

Table 7-11. Gross beta and gross alpha measurements of particulate air samples from 1978 to 1992.

Year	Gross Beta ($\times 10^{-12}$ μCi/mL) Lowest value	Average value	Highest value	Gross alpha ($\times 10^{-14}$ μCi/mL) Lowest value	Average value	Highest value
1978	0.10	0.50	1.4	Bkgd	Bkgd	Bkgd
1979	0.02	0.66	3.7	Bkgd	Bkgd	Bkgd
1980	0.036	1.1	210.0	Bkgd	Bkgd	Bkgd
1981	0.022	1.1	80.0	Bkgd	Bkgd	Bkgd
1982	0.022	0.26	1.7	Bkgd	Bkgd	Bkgd
1983	0.028	0.30	2.2	Bkgd	Bkgd	Bkgd
1984	0.003	0.62	46.0	8.6	26	63
1985	0.011	0.31	3.1	0.98	3.2	22
1986	0.043	0.73	3.6	1.1	4.8	65
1987	0.008	—	0.08	0.08	—	0.7
1988	0.003	—	0.08	0.016	—	0.8
1989	0.007	—	0.09	0.010	—	0.96
1990	0.004	—	0.047	0.001	—	0.096
1991	—	—	0.08	—	—	0.38
1992	—	—	0.71	—	—	0.03

Table 7-12. Maximum I-125 concentration in the air.

Year	10^{-9} Bq/mL	Maximum I-125 Concentration in Air (10^{-14} μCi/mL)
1987	4.5	12.20
1988	1.16	3.13
1989	3.6	9.77
1990	2.0	5.40
1991	2.6	7.0
1992	2.18	5.90

The results of gamma spectral analysis of the monthly composites of the weekly particulate air samples have been evaluated, and of the 108 composite samples, no man-made radionuclides were detected at concentrations above the required laboratory detection level. Naturally occurring Be-7 and K-40 were detected in expected concentrations.

Table 7-13 lists the results of the tritium analysis for the water vapor collected in the monthly silica gel cartridges for the years 1987 through 1992. The highest value for these years (except 1991) is shown to be 3.8 E-6 Bq/mL (103 E-12 μCi/mL), which represents about 0.05% of the MPC (7.4 E-3 Bq/mL, or 2.0 E-7 μCi/mL) as stated in 10 CFR 20, Appendix B, Table II, Column 1. References 7-3 and 7-4 give values of air moisture tritium concentration for the 200 Areas (on-site) and distant communities. The upper values for these locations are 2.62 E-6 Bq/mL (71 E-12 μCi/mL) and 3.3 E-7 Bq/mL (9 E-12 μCi/mL), respectively.

Table 7-13 also shows the 1991 values for the air moisture tritium concentration to be inconsistent when compared with the values obtained for other years. This discrepancy was due to a change in laboratories in August 1991. Upon reexamination and investigation, laboratory procedures were corrected. This resulted in 1992 data being more consistent with the historical data.

Table 7-13. Tritium air moisture concentrations at environmental monitoring stations 1, 2, and 5 (10^{-12} μCi/mL).

				Hanford report	
Year	Station 1	Station 2	Station 5	On site 200 area	Distant communities
1987	3.70	3.97	56.1	—	—
1988	6.37	4.28	13.4	—	—
1989	3.95	2.70	21.3	3.1	2.4
1990	15.40	103.0[3]	31.3	71.0	3.4
1991	585.0[3]	563.0[3]	633.0[3]	31.0	9.0
1992	14.7	14.0	24.5	—	—

Note: (1) Values given in this table are the highest values for the year.

(2) The Maximum Permissible Concentration (MPC) value for tritium for air in unrestricted areas is 2×10^{-7} μCi/mL (10 CFR 20, Appendix B, Table II, Column 1).

(3) For 1991, there is a degree of uncertainty in data reliability, due to the laboratory procedural problems which occurred during 1990. Procedure corrections were made, and the 1992 data showed consistency with historical values. Even though the tritium concentrations in air for 1991 show higher values in comparison to the historical data, the maximum monthly tritium concentration measured at Station 5 was 633.0 E-12, which is approximately 0.3 percent of the value for unrestricted area tritium concentrations in air (2E-7 μCi/mL) listed in 10 CFR 20, Appendix B, Table II, Column 1 (also WAC 246-221-290).

US Ecology also monitors the ventilation exhaust from the on-site package inspection facility. Samples are evaluated for gross beta, gross alpha, and I-125 concentrations. All samples were below action levels during 1992.

The averages of the measured gross beta concentrations during 1991 and 1992 were 1.63 E-8 and 1.73 E-8 Bq/mL (4.4 E-13 and 4.68 E-13 μCi/mL), respectively. These are noted to be less than 0.015% of the MPC for restricted areas as given in WAC 246-221-290, Appendix A, Table I, Column 1.

The averages of the measured gross alpha concentrations during 1991 and 1992 were 3.48 E-9 and 2.48 E-9 Bq/mL (9.4 E-14 and 6.7 E-14 μCi/mL), respectively. These values are well below the MPC for restricted areas as given in the regulations. It should be recognized, however, that air emissions from the facility only occurred during package inspection activities. Therefore, the true annual average would be well below 1% of the MPC.

For I-125, the average concentrations (conservatively calculated) during 1991 and 1992 were below 5.55 E-8 Bq/mL (1.5 E-12 μCi/mL). This is much less than 1% of the MPC.[7-3] Additionally, none of the nine environmental air monitoring stations exceeded the MPC for unrestricted areas.

Soil

Soil samples are collected and analyzed from Stations 1 through 9 and at the northeast and northwest corners. Analysis is performed for gross beta, total uranium, isotopic plutonium (Pu-238 and Pu-239/240), and gamma-emitters. The results of the quarterly soil samples presented in Table 7-14 are the highest values for the year as reported in the US Ecology Historical Report and the Annual Environmental Monitoring Report.

A review of the data shows a decreasing trend in gross beta concentrations in soil, when compared with the early years. Since 1984, the gross beta concentration in soil has remained below, or very close to the reporting level of 1.3 Bq/g (35 pCi/g) (Table 7-3). The values reported for gross beta activity are consistent with typical values found in the region; therefore, no contribution from the site is apparent for gross beta in the soil.

The results of the quarterly analysis for uranium activity in soil are presented in Table 7-14. The soil is analyzed for uranium on a mass basis. The mass of uranium is then converted to an activity, using the conversion factor of 2.5 E-8 Bq/g (6.77 E-7 pCi/g) from 10 CFR 20. All sample results (except 1990) for uranium were below the reporting level of 3.7 E-2 Bq/g (1 pCi/g). The 1990 results show a total maximum value exceeding 3.7 E-2 Bq/g (1 pCi/g), which may be related to the change in analytical laboratories in 1990. Total uranium and isotopic plutonium exceeded reporting levels in various samples; but upon resampling, the concentrations either fell below the reporting level or were consistent with those found throughout the region.

Gross alpha concentration in soil (Table 7-14) has varied from less than detectable to a maximum of 0.53 Bq/g (14.3 pCi/g). In 1987, US Ecology ceased to analyze gross alpha concentration in soil. Since 1987, soil samples are monitored for total uranium and isotopic plutonium concentration. Gross

Table 7-14. Soil analysis (pCi/gm).[a]

Year	Gross Alpha	Gross Beta	Cs-137	Co-60	Pu-238	Pu-239/40	Total U	K-40	Th-232
Action level (in pCi/gm)		35.0	0.25	0.3	0.03	0.03	1.0	1.75	—
1977	—	47.0	—	—	—	—	—	—	—
1978	—	46.0	—	—	—	—	—	—	—
1979	—	42.0	0.81	0.0	0.01	0.003	—	—	—
1980	1.74	20.4	0.54	0.0	0.05	0.04	—	—	—
1981	0.82	42.6	0.66	0.0	0.114	0.02	—	—	—
1982	0.72	36.3	0.84	0.0	0.003	0.02	—	—	—
1983	0.84	57.8	1.39	0.04	0.0	0.03	—	—	—
1984	13.40	23.9	0.07	0.02	0.002	0.004	—	—	—
1985	7.01	24.6	0.05	0.00	0.0	0.007	—	—	—
1986	14.30	23.9	0.07	0.00	0.001	0.015	—	—	—
1987	—	23.2	0.22	0.04	16.3	0.004	0.74	15.4	0.82
1988	—	24.9	0.35	0.23	8.46	0.020	0.57	15.8	0.85
1989	—	24.8	0.31	0.01	23.7	0.009	0.66	15.7	0.86
1990	—	40.1	0.11	0.10	154.0	0.010	1.97	15.2	—
1991	—	13.5	0.75	0.16	<0.01	<0.01	0.33	29.6	—
1992	—	20.6	0.34	0.09	0.07	0.03	0.70	113.6	—

a. Data in this table are the highest values reported in the US Ecology Historical Reports and the Annual Environmental Monitoring Reports (Reference 1).

alpha concentration in soil is not monitored at the Hanford site, nor in the vicinity of the site, by U.S. DOE or its contractors.

Potassium-40 exceeded the action level of 6.5 E-2 Bq/g (1.75 pCi/g). This is due to the current action level for K-40, which is based on laboratory detection limits and is currently set significantly below natural background concentrations. Potassium-40 is naturally occurring and was encountered at levels characteristic of normal background.

Cs-137 is distributed worldwide from nuclear weapons testing and the nuclear accident at Chernobyl. Concentrations of Cs-137 at the Richland LLW facility were not abnormal, considering the location of the facility within the Hanford Reservation and the historical levels found in soil in past years.

Other radionuclides which have been identified are Eu-155, Be-7, Fe-59, Zr-95, Mn-54, Ru-103, Co-60, Ce-144, and Th-232. Based on the infrequent occurrences of positive values together with their small magnitude and the distance to population areas, radiation dose from soil pathways to the general public is very unlikely.

Biota

The protocol for the sampling and analysis of vegetation taken from the US Ecology site parallels that of the soil. Vegetation is sampled in the vicinity of the nine environmental air monitoring stations and at the northeast and northwest corners of the site on a quarterly basis whenever there is sufficient vegetation. Vegetation samples are also collected annually from the trench caps when sufficient vegetation is available. Sampling procedures require the collection of new growth whenever possible. Vegetation samples are analyzed for gross beta activity, total uranium, isotopic plutonium (Pu-238 and Pu-239/240), gamma-emitters, and tritium. The control location for vegetation monitoring, as for all sample media, is at Station 1. This station is in the upwind location and is located away from the operations area. Only deep rooted vegetation was targeted for sample collection.

Gross beta concentrations in vegetation taken at environmental monitoring stations are presented in Table 7-15, and are shown to be below the action level of 3.7 Bq/g (100 pCi/g). The US Ecology Historical Report[7-3] for the years 1986 and before gives a range of beta activity in vegetation of 8.7 E-2 to 4.3 Bq/g (2.36 to 117.0 pCi/g), with a mean concentration of 0.94 Bq/g (25.3 pCi/g). The high for the years between 1987 through 1992 was 3.05 Bq/g (82.5 pCi/g). Gross beta concentration in vegetation is not monitored at the Hanford Reservation by U.S. DOE or its contractors. Typical values worldwide reported for gross beta concentration in vegetation range between 0.3 and 4.55 Bq/g (8.0 and 123.0 pCi/g) of gross weight, and are mainly due to K-40, lead-210, bismuth-210, and the uranium and thorium series.[7-3]

Gross alpha concentration in vegetation is listed in Table 7-15, and was below 0.37 Bq/g (10 pCi/g). The typical concentration of gross alpha in plants worldwide is 5.0 E-3 to 0.12 Bq/g (0.14 to 3.1 pCi/g). There is no significant difference in the gross alpha concentration found in vegetation samples taken from the Richland LLW facility (US Ecology) and the concentration of natural alpha found in plants in the surrounding areas.

Table 7-15. Vegetation sample analysis (pCi/gm).

Year	Gross alpha	Gross beta	Ru-106	Cs-137	Zr-95	Pu-238	Pu-238/40	Total U	Co-60
1980	0.97	53.2	—	0.16	—	0.007	0.04	—	—
1981	0.82	42.6	<0.76	—	<0.04	0.114	0.02	—	0.15
1982	0.87	40.5	0.33	—	0.56	0.003	0.02	—	0.12
1983	0.0	41.0	2.24	0.15	0.34	0.0	0.03	—	0.05
1984	0.0	36.1	<0.6	0.15	<0.1	0.001	0.01	—	0.05
1985	4.15	55.6	<0.45	0.07	0.9	0.002	0.61	—	0.04
1986	3.43	70.6	<0.3	0.20	—	0.001	0.015	—	0.04
1987	—	63.5	0.20	0.15	—	—	0.005	0.08	0.05
1988	—	81.3	0.04	0.03	0.001	0.004	0.002	0.31	0.01
1989	—	82.5	—	0.04	—	0.001	0.002	0.15	0.04
1990	—	81.1	—	—	—	—	0.0015	8.8	2.8
1991	—	15.6	—	0.08	—	<0.01	<0.01	0.18	0.12
1992	—	70.1	—	0.03	—	<0.01	<0.01	<0.1	—

Note: (1) Data in this table are the highest values for the year reported in US Ecology's Historical Reports and Annual Environmental Monitoring Reports (Reference 1).

(2) Action levels for radionuclides in vegetation are provided in Table 7-3, "Environmental/Occupational Monitoring Requirements."

(3) The unusually high reading (8.8 pCi/gm) for total uranium for 1990 was due to laboratory procedures; since then, there has been a change of vendor.

Total uranium concentration in vegetation is measured on a mass basis and then transformed to an activity, using the relationship of 6.77 E-7 Ci/g from 10 CFR 20, Appendix B. Although the reporting level for total uranium was exceeded in 1990, the total uranium concentrations for samples taken at the US Ecology site compare favorably with regional environmental samples.

Vegetation samples from environmental monitoring stations and trench caps were analyzed for Pu-239/240 and Pu-238. Yearly results of plutonium concentrations are provided in the US Ecology Historical and the Annual Environmental Monitoring Reports.[7-3] Analytical results of plutonium samples on the LLW site are consistent with those obtained from the U.S. DOE Hanford Monitoring Program. Consequently, no increase in the Pu-238, Pu-239/240 concentration in vegetation is attributable to LLW facility operations.

Historical data of gamma spectral analysis for vegetation samples are provided in the US Ecology Historical and Annual Environmental Monitoring Reports.[7-3] The detected radionuclides were Cs-137, Pu-239/240, Co-60, Zr-95, Eu-154, and Cs-134. These seven radionuclides have historically accounted for about 91% of the positive indications.

From 1980-1986, the mean concentrations of Cs-137 in the vegetation samples have varied from 2.3 E-3 to 4.4 E-3 Bq/g (0.063 pCi/g to 0.12 pCi/g). Concentrations of Cs-137 in vegetation from Hanford on-site samples vary from less than detectable to 2.1 E-2 Bq/g (0.57 pCi/g). Off-site concentrations varied from less than detectable to 1.0 E-2 Bq/g (0.27 pCi/g).[7-3] These values are not significantly different from values measured at the US Ecology facility.

Although the potassium-40 levels were greater than the action levels, the results reported are consistent with natural background levels of the region.

Iodine-131, cerium-141, and barium/lanthanum-140 were positively identified, but the values were within the range of historical data.

Selected annual trench cap samples of vegetation have been analyzed for tritium for trending purposes. Tritium results from this program have varied from less than detectable to greater than 1.5 E+5 Bq/L (4 E+6 pCi/L) during 1988-1992. Because of this variability, alternative methods are being investigated for performing tritium vegetation analysis.

Direct Radiation

Direct radiation monitoring was conducted using thermoluminescent dosimeters (TLDs) that surround the facility. TLDs are changed monthly at locations on the north, south, east, and west fence lines and at fence line positions nearest each active disposal trench. Quarterly dosimeters are placed at the north, south, east, and west fence lines (the same as for monthly) and at the northeast, northwest, southeast, and southwest corners of the facility. Two control dosimeters (one monthly, one quarterly) are located at environmental air monitoring Station 1.

Table 7-16. Ambient gamma (penetrating radiation) (mrem/yr).

Year	mrem/yr
1978	106.0
1979	103.0
1980	87.0
1981	113.5
1982	94.5
1983	93.6
1984	94.0
1985	
	178.6
1986	172.0
1987	175.0
1988	118.0
1989	130.0
1990	161.0
1991	172.0
1992	174.0

Note: (1) The above data indicate the highest annual ambient gamma values from all sample stations at the Richland (US Ecology) LLW facility, as reported in the Annual Environmental Reports, DOH, State of Washington (Reference 8).

(2) The action level for direct gamma radiation is 500 mrem/yr, and is provided in Table 3, "Environmental/Occupational Monitoring Requirements."

TLD data (1978-1992) for the Richland LLW facility are provided in Table 7-16 and shown in Figure 7-7. These data are the highest ambient gamma values for each year obtained from TLDs located around the facility perimeter. A review of these data indicates that the annual readings remained well below the regulatory limit of 5.0 E-3 sievert/y (500 mrem/year) during the years of operation of the LLW facility. The highest value (1.78 E-3 sievert/y for 1985, or 178 mrem) is only about 35% of the applicable regulatory limit at that time.

NON-RADIOLOGICAL ENVIRONMENTAL PROGRAM

The non-radiological environmental monitoring program consists of ground water monitoring at the five wells (the same as those used also for radiological monitoring), and the experimental vadose zone soil gas monitoring program.

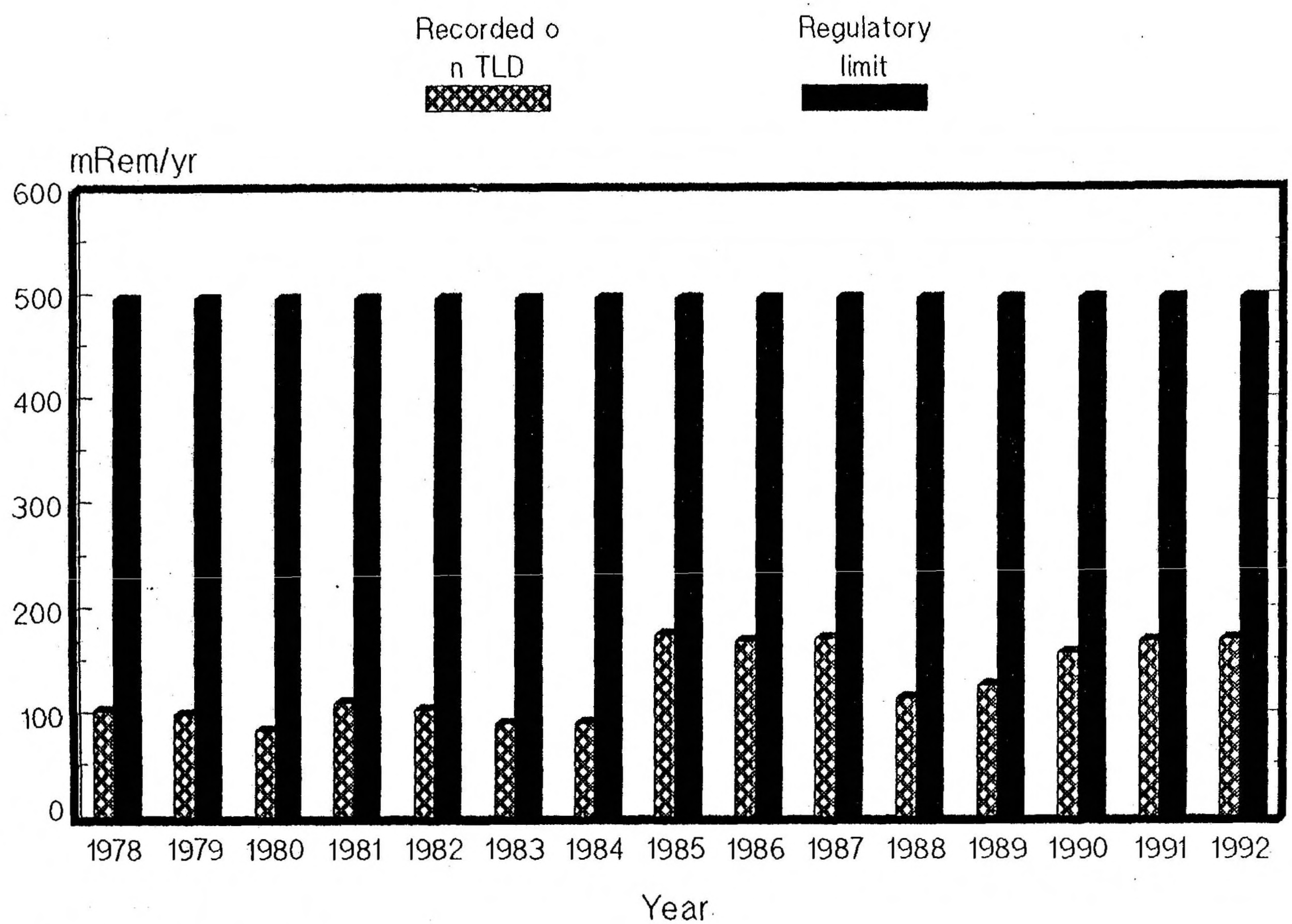


Figure 7-7. Ambient gamma (mrem/yr).

Non-Radiological Ground Water Analysis

Ground water monitoring for non-radiological constituents is performed quarterly. The procedure for gathering these samples is the same as that for radiological samples, with the exception that non-radiological samples are placed in an ice chest and maintained at 4°C (39°F). On-site ground water samples are analyzed for specific conductivity, total organic carbon, nitrates, and total dissolved solids. A review of the results of these analyses (Table 7-17) shows that specific conductivity of the ground water samples (1992) varied from 300 umho/cm to 439 umho/cm. These data, when compared with previous years, show that the trend has not changed appreciably since analysis began in 1986. Likewise, results for total organic carbon (TOC), nitrates, and total dissolved solids (TDS) were consistent with the values received for previous years.[7-3]

Vadose Zone Monitoring Program

In November 1991, US Ecology installed three wells into the unsaturated soil zone as part of a two-year research project required by the Washington State Department of Health. Well VW-101 was installed between Trenches 4 and 5 at the east end of the site. Well VW-102 was installed between Trenchs 10 and 11A, also on the east end. A background well VW-100 was installed away from current disposal areas in the northwest corner of the site.

Organic vapors of xylene, toluene, and methane/combustible gases are included in the vadose zone monitoring testing program.

SUMMARY

The Richland facility performs environmental monitoring to demonstrate compliance with federal, state, and local regulations; confirm adherence to environmental protection policies; and support environmental management decisions.

Due to the location of the facility within the Hanford Reservation, there is an extremely low probability of any effluents reaching the general population. Analysis of vegetation samples serves to provide an indication of any radionuclides which could be included in the diet of wildlife.

The Washington State Department of Health conducts an independent environmental radiation monitoring program at the Richland (US Ecology) facility. This program conducts extensive data evaluation and selective monitoring to ensure the adequacy and accuracy of the licensee's program.

The results from past environmental monitoring demonstrate that disposal operations have not resulted in measurable increases on a long-term basis in the concentration of radioactivity in air, soil, vegetation, or ground water in the vicinity of the facility. However, some of the media have exhibited apparent short-term increases from time to time. Due to the location of the facility within the Hanford Reservation, the origin of the radioactivity is not easily determined. With this in mind, the siting of environmental monitoring points at locations surrounding the disposal facility has assisted in providing environmental data that can be used to determine the radiological impact from the disposal facility.

Table 7-17. Chemical analysis of on-site well samples—1992.

Well number	Qtr.	Temp °C	Specific conductivity (umho/cm)	TOC (ppb) P1	P2	P2	P4	Nitrates (ppm)	TDS (ppm)
3	1	19.4	424	B	B	B	B	4.6	277
	2	21.2	310	B	B	B	B	4.6	258
	3	22.5	360	B	B	B	B	5.8	235
	4	19.7	439	B	B	B	B	4.4	219
5	1	18.6	392	B	B	B	B	4.6	269
	2	20.0	300	1200	1200	B	B	4.3	258
	3	22.3	360	B	B	B	B	4.7	224
	4	18.8	435	B	B	B	B	4.3	123
8	1	19.4	388	B	B	B	B	4.1	275
	2	21.1	300	B	B	1600	B	4.2	255
	3	23.1	360	1300	1700	1200	1200	5.1	232
	4	18.0	430	B	B	B	B	4.3	216
10	1	18.0	403	B	B	B	B	4.3	278
	2	21.5	300	B	3400	B	1900	4.0	270
	3	21.4	350	B	B	B	B	2.0	209
	4	18.7	428	B	B	B	B	3.7	224
13[c]	1	19.3	397	B	B	B	B	3.7	287
	2	20.8	300	B	B	B	1300	4.9	266
	3	21.7	350	B	B	B	B	4.5	202
	4	19.5	429	B	B	B	B	4.4	228

B - TOC results reported as less than 1000 ppb minimum detectable concentration.

C - Upgradient well.

The environmental monitoring data are summarized below:

- The gross alpha and gross beta results for air are consistent with background concentrations reported in previous years, and no trends were found which would indicate a contribution from the site.

- The results of gamma spectral analysis of the monthly composites of the weekly particulate air samples showed that no man-made radionuclides were detected. Naturally-occurring Be-7 and K-40 were detected in expected concentrations. The US Ecology air sampling program[7-3] found no man-made nuclides (e.g., Pu-238 and Pu-239/240, Cs-137, Fe-59, Mn-54, Eu-155, Ba/La-140, Zr/Nb-95, Ru-103, Co-60, Ce-141, and Ce-144).

- The tritium in air moisture collected at the US Ecology facility is consistent with the results obtained from surrounding areas and facilities.

- All samples taken from the ventilation exhaust system at the package inspection facility is evaluated for gross beta, gross alpha, and I-125 concentrations. All samples were below action levels during 1992, and none of the nine environmental air monitoring stations exceeded the maximum permissible concentration for unrestricted areas.

Vegetation is sampled in the vicinity of the nine environmental air monitoring stations and at the northeast and northwest corners of the site on a quarterly basis whenever there is sufficient vegetation. Vegetation samples are also collected annually from the trench caps when sufficient vegetation is available. Sampling procedures require the collection of new growth whenever possible. Vegetation samples are analyzed for gross beta activity, total uranium, isotopic plutonium (Pu-238 and Pu-239/240), gamma-emitters, and tritium. Concentrations of radionuclides measured in vegetation were below DOH action levels (Table 7-3).

Direct radiation monitoring is performed using thermoluminescent dosimeters (TLDs) which surround the facility. Results of TLD surveys are given in Table 7-16 and Figure 7-7. The highest direct radiation value recorded was approximately 35 percent of the applicable regulatory limit.

Ground water samples are collected quarterly from US Ecology's on-site wells (3, 5, 8, 10, and 13). Ground water samples are analyzed for radiological as well as non-radiological constituents. Radiological analyses include gross alpha, gross beta, tritium, C-14, gamma-emitters, isotopic plutonium (Pu-238 and Pu-239/240), and isotopic uranium (U-234, U-235, and U-238). Non-radiological parameters include temperature, specific conductivity, total organic carbon (TOC), nitrates, and total dissolved solids (TDS).

Gross alpha and gross beta concentrations for the on-site ground water wells (Table 7-7) have been at normal background concentrations. Since their operation in 1986, the concentrations of gross alpha and beta have remained below the action levels (Table 7-3). Tritium in ground water is present, due to past operations by the Department of Energy. Tritium concentrations (Table 7-7) for US Ecology's on-site wells have been below the investigation level of 133.0 Bq/L (3600 pCi/L).

Carbon-14 in ground water was reported below the minimum detectable concentration of 7.4 Bq/L (200 pCi/L) throughout 1992, as well as for previous years.

Gamma spectral analysis of ground water samples did not reveal the presence of any man-made gamma-emitters above the action levels. Isotopic plutonium concentrations for various samples reported positive results, but all were less than the investigation level.

Isotopic uranium occurred at normally expected concentrations (natural background) throughout 1992, and is consistent with the data for previous years.

The results from the environmental monitoring of radiological and non-radiological analysis demonstrate that disposal operations have not resulted in any measurable increases in the concentration of radioactivity in air, soil, vegetation, or ground water in the vicinity of the facility, and that the 25 mrem annual dose limit has not been exceeded.

REFERENCES

7-1. State of Washington Radioactive Materials License (WN-1019-2), Amendment No. 18, 1992, issued by the State of Washington to US Ecology, Inc., Olympia, Washington.

7-2. Hanford Site Environmental Report for 1991, Pacific Northwest Laboratory, Richland, Washington.

7-3. US Ecology Richland Facility Standards Manual, US Ecology, Inc., Richland, Washington.

7-4. US Ecology's Historical Environmental Monitoring Report (1966-1986) and Annual Environmental Monitoring Reports (1987-1992) for US Ecology's Low-Level Radioactive Waste Disposal Facility, US Ecology, Inc., Richland, Washington.

Envirocare prosecutors place focus on extortion

By Deseret News | Jul 23, 1998, 12:00am MDT

Joe Costanzo, Staff Writer

After teetering for more than a year between bribery and extortion, federal prosecutors appear to have settled on the latter in their investigation of the Envirocare scandal.

The tipoff came Wednesday afternoon, when Envirocare owner Khosrow B. Semnani announced he had entered into a cooperation and plea agreement with the U.S. Attorney's Office.The deal calls for Semnani to plead guilty to a misdemeanor tax charge, pay the maximum $100,000 fine and cooperate fully with prosecutors in their continuing investigation of Larry Anderson, the former director of the Utah Division of Radiation Control.

Anderson himself provoked the investigation with a 1996 civil lawsuit revealing a "consulting" arrangement that called for Semnani to pay him $5 million in fees beyond the $600,000 in real

estate, coins and cash he had already received.

Anderson was heading the state regulatory agency during the decade that Semnani was establishing the Tooele County-based Envirocare as one of the largest low-level radioactive waste dumps in the nation.

"As I have previously stated, I believe I was the victim of extortion," Semnani said during a press conference in the office of his attorney, Rodney G. Snow.

Snow said the cooperation and plea agreement supported Semnani's view of the matter and cleared him of any taint of bribery. If someone makes an inappropriate payoff out of fear of economic harm or under demand of government authority, it's extortion, Snow said.

The misdemeanor charge filed Wednesday afternoon accuses Semnani of aiding and abetting "two Utah residents" - whom Snow identified as Larry and Carolee Anderson - in the filing of a false tax return in 1993. According to the complaint, the return failed to report a $40,000 payment from Semnani as income.

Snow said state sources have told him that Anderson never reported as income any of the property and cash - including a Park City condominium - that Semnani gave him.

While maintaining his client was a victim, Snow said Semnani recognizes that "the way in which the extortion was paid" violated

tax law. Snow also said the government's investigation has concluded that Envirocare gained nothing from the payments to Anderson.

"No corners were cut; there was no impropriety with respect to the licensing of Envirocare," Snow said.

Although the document spelling out terms of the agreement hasn't been released, Snow says it doesn't guarantee his client will be spared jail time. "He has placed himself in harm's way," Snow said, noting the misdemeanor charge carries a possible one-year prison term.

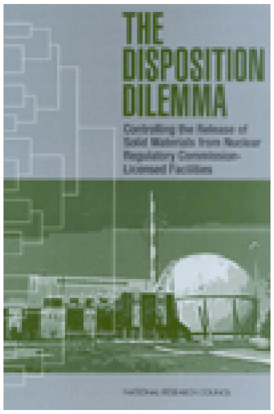
The attorney said a simple case of extortion took on larger proportions because such incidents are rare in Utah and it involved a low-level radioactive waste facility.

Anderson, who lives in Mesquite, Nev., could not be reached for comment. The U.S. Attorney's Office has made no public statement on the cooperation and plea agreement beyond releasing a copy of the misdemeanor complaint against Semnani.

Semnani said he has cooperated with investigators from the outset and looks forward to continuing to do so and concluding the case..

As the investigation heated up in early 1997, Semnani stepped down as president of Envirocare as part of a consent decree to preserve the company's lucrative contracts with the U.S. Department of Energy. The 18-month term of that decree expires at the end of this

year, and Wednesday's development could clear the way for Semnani to resume management of his company.



The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities

Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities, National Research Council

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THE DISPOSITION DILEMMA

Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities

Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities

Board on Energy and Environmental Systems

Division on Engineering and Physical Sciences

National Research Council

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[1]NAE = member, National Academy of Engineering.

[1]NAE = member, National Academy of Engineering.

Preface and Acknowledgments

Statutory responsibility for the protection of health and safety related to civilian nuclear facilities rests with the U.S. Nuclear Regulatory Commission (USNRC). The basic standard for protection against radiation is 10 CFR Part 20, which was first issued in final form by the Atomic Energy Commission in 1957 and was subject to a major revision that was finalized in 1991. Part 20 includes limits on quantities or amounts of radionuclides released in gaseous and liquid effluents below which the effluent would not be subject to further regulatory control, but it does not contain similar regulatory limits applicable to slightly radioactive solid material (SRSM). Absent such limits, the USNRC does have guidance documents regarding how slightly radioactive solid materials are cleared from regulatory control (a practice that licensees make use of routinely), and Section 2002 of Part 20 allows licensees to apply to the USNRC and its agreement states for clearance of solid materials on a case-by-case basis where the guidance documents do not apply. This policy issue could become increasingly important in the future as the eventual decommissioning of nuclear power plants generates large amounts of SRSM.

The USNRC has attempted without success to update and formalize its policies on disposition of SRSM. In 1990, it issued a policy, as directed by the Low Level Radioactive Waste Policy Amendments Act of 1985, that declared materials with low concentrations of radioactivity contamination "below regulatory concern" (BRC) and hence deregulated. However, Congress intervened to set aside the BRC policy in the Energy Policy Act of 1992, following the USNRC's own suspension of the policy. In 1999, the USNRC again examined the issue of disposition of SRSM and published a *Federal Register* notice examining several

policy options. In neither case was the USNRC able to convince consumer and environmental groups that clearance of SRSM could be done safely or to convince some industry groups that clearance is desirable. In August 2000, the USNRC asked the National Research Council to form a committee to provide advice in a written report. The National Research Council established the Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities to address this task and recommend approaches for the clearance of solid materials from USNRC-licensed facilities (Appendix A contains biographical sketches of the committee members).

It became clear to the committee that radioactive waste is generated by many different industries and controlled by several government agencies under the terms of different regulations. This compounded the committee's task. During open information gathering sessions, the committee heard from stakeholders such as the U.S. Department of Energy (DOE) whose concerns focused on wastes that are not controlled by the USNRC; however, these stakeholders feared that any USNRC rulemaking or policy change might influence the disposition of these materials. Other large volumes of waste—e.g., naturally occurring radioactive materials (NORM) or technically enhanced NORM, which is known as TENORM—are not regulated under any specific federal statute. Finally, since the current case-by-case approach seems to be working, there is not a strong, unified impetus for change.

I wish to gratefully acknowledge the hard work of the committee members, who served as volunteers and who provided all the expertise necessary to carry out this difficult task. I am especially appreciative of the many hours they spent at the two writing sessions, which enabled us to complete the task on schedule. The assistance and contributions of the committee's two liaisons, Robert M. Bernero and Gerald L. Kulcinski, greatly enhanced the committee's efforts.

The presentations by U.S. Nuclear Regulatory Commission Chairman Richard A. Meserve; staff from the USNRC, the Environmental Protection Agency, and DOE; stakeholder organizations; nuclear industry representatives; representatives from the European Union and the International Atomic Energy Agency; and a host of other organizations, provided the committee with valuable information and insights into the issue of the disposition of SRSM from USNRC-licensed facilities. The contribution of these presenters is greatly appreciated (see Appendix B for a complete list of presentations).

Robert Meck at the USNRC was our principal point of contact; he ensured the constant flow of written information to the committee in response to our numerous questions and requests for additional information. Special thanks are owed to Al Johnson and Doug Jamieson, Duratek, Inc., for arrangements and a guided tour of Duratek's Bear Creek Operations (Oak Ridge, Tennessee) and Gallaher Road Facility (Kingston, Tennessee) and to Richard Grondin for a tour of the ATG, Inc., facility (Richland, Washington).

A study such as this requires extensive support; we are all indebted to the National Research Council staff for their assistance. I would particularly like to acknowledge the close working relationship I had with the National Research Council study director, Martin Offutt, and the support I received from him. The logistic support that enabled us to concentrate on our task was ably provided by Shanna Liberman and Panola Golson. The efforts and contributions of the consulting technical writer, Robert Katt, greatly enhanced the clarity and sharpness of the report. The committee was also assisted by Alan Fellman, who provided technical consulting.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Vicki M. Bier, University of Wisconsin;
Philip R. Clark (NAE), General Public Utilities, Nuclear Corporation (retired);
Kenneth Eger, Jacobs Engineering Group;
Ann Fisher, Pennsylvania State University;
Gordon Geiger, University of Arizona;
Richard Guimond, Motorola, Inc.;
Ivan Itkin, former Director, Office of Civilian Radioactive Waste Management, U.S. Department of Energy;
David Lochbaum, Union of Concerned Scientists;
Claudio Pescatore, Organization for Economic Cooperation and Development, Nuclear Energy Agency;
John J. Taylor (NAE), Electric Power Research Institute, Inc.; and
Chris C. Whipple (NAE), Environ, Inc.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Frank Parker (NAE) of Vanderbilt University. Appointed by the National Research Council, he was responsible for making sure that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully consid-

ered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Richard S. Magee, *Chair*
Committee on Alternatives for
Controlling the Release of Solid
Materials from Nuclear Regulatory
Commission-Licensed Facilities

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Executive Summary

The U.S. Nuclear Regulatory Commission (USNRC) and its predecessor, the U.S. Atomic Energy Commission (AEC), have attempted since the 1970s to give greater uniformity to the policy and regulatory framework that addresses the disposition of slightly radioactive solid material.[1] The issue remains unresolved and controversial. The USNRC has tried to issue policy statements and standards for the release of slightly radioactive solid material from regulatory control, while such material has been released and continues to be released under existing practices. In 1980 the USNRC proposed regulatory changes to deregulate contaminated metal alloys but withdrew them in 1986 and began work with the Environmental Protection Agency (EPA) to develop more broadly applicable federal guidance. In 1990 the USNRC issued a more sweeping policy, as directed by the Low Level Radioactive Waste Policy Amendments Act of 1985 (LLWPAA), declaring materials with low concentrations of radioactivity contamination "below regulatory concern" (BRC) and hence deregulated. Congress intervened to set aside the BRC policy in the Energy Policy Act of 1992, after the USNRC's own suspension of the policy. Subsequent attempts by USNRC staff to build consensus among stakeholder groups as a basis for future policy articulations were met by boycotts of stakeholder meetings, both in the immediate aftermath of the BRC policy and again in 1999 during public hear-

[1]The phrase "slightly radioactive solid material" is used to mean objects that contain radionuclides from licensed sources used or possessed by licensees of the USNRC and agreement states. These materials typically contain radionuclides at low concentrations, and by virtue of these low concentrations they can be considered for disposition as something other than low-level radioactive waste.

ings on a new examination of the disposition of such materials. The only USNRC standard addressing the disposition of slightly radioactive solid material is a guidance document published in June 1974 by the AEC, whose regulatory authority over civilian nuclear facilities the USNRC assumed upon its creation a few months later in January 1975.

In August 2000, with another examination of this issue under way, the USNRC requested that the National Research Council form a committee to provide advice in a written report. The National Research Council established the Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities to address this task. The committee's task involved evaluating and providing recommendations on the history of the technical bases and policies and precedents for managing slightly radioactive solid material from USNRC-licensed facilities; the sufficiency of technical bases needed to establish standards for release of solid materials from regulatory control ("clearance standards") and the adequacy of measurement technologies; the concerns of stakeholders and how the USNRC should incorporate them; and the efforts of international organizations on clearance standards. The committee was also asked to examine the current system for release of slightly radioactive solid material from regulatory control, to recommend whether the USNRC should continue to use this system and to recommend changes if appropriate. The committee's fact-finding process included two site visits to waste brokering facilities and nearly 40 invited presentations from the USNRC, the U.S. Department of Energy (DOE), and EPA staff; stakeholder organizations; nuclear industry organizations; and other interested parties.

A brief discussion is needed to describe the types of facilities regulated by the USNRC, the types of slightly radioactive solid material originating from these facilities, and which facilities are their principal source. As noted, the USNRC was split off from the AEC to regulate civilian nuclear facilities. It currently regulates 103 operating nuclear power reactors and 36 operating non-power reactors ("reactor licensees"), and approximately 5,000 specific materials licensees, which use or possess source, special nuclear, or byproduct material.[2] Some of the principal categories of facilities holding materials licenses include measuring system gauges and instruments (1,698 licenses), medical applications (1,556 licenses), and research and development facilities (474 licenses). Among

[2]Source material is uranium and thorium in natural isotopic ratios, or ores containing uranium and/or thorium above 0.05 percent by weight. Special nuclear material is plutonium, enriched uranium, and uranium-233. Byproduct material includes any radioactive material (except special nuclear material) yielded in or made radioactive by the process of nuclear fission. A second category of byproduct material is uranium mill tailings, added in 1978 ("11(e)(2) materials"). The foregoing definitions have been paraphrased from their original sources, the Atomic Energy Act and 10 CFR Part 20, to provide greater clarity. Those sources should be consulted with regard to the legal meaning and effect of these terms.

the large facilities with materials licenses are 34 interim spent fuel storage facilities, 18 uranium mills, 7 uranium fuel fabrication plants, 2 uranium hexafluoride plants, and 2 uranium enrichment plants, all of which are components of the nuclear fuel cycle. The USNRC's agreement states[3] license roughly an additional 16,000 specific materials licensees.

Radioactive material is present at USNRC-licensed facilities in containment buildings; vehicles such as trucks and forklifts; and tools, piping, ductwork, or any other part of an object within a nuclear facility that has come into contact with radionuclides during normal operations or decommissioning. Surface contamination occurs when radioactive material remains on the surface of an otherwise uncontaminated object. Unlike volume contamination, it is sometimes easily removed using chemical or mechanical methods. Volume contamination occurs in a variety of ways, such as when radioactive material penetrates via cracks, pores, grain boundaries, or solid-state diffusion into an object or when incident neutrons activate (make radioactive) some of the atoms within an object. Volume contamination can also arise through mixing of radioactive material with solids such as soil. Objects having volume contamination are generally more difficult to decontaminate and are subject to a less-well-articulated system of standards for clearance from further regulatory control, as discussed below. The radiation emitted by radioactive material can have detrimental health effects on the various organs and tissues of the body, including induction of cancer. The unit of dose equivalent in the international system (SI), the sievert (Sv; equal to 100 rem) is used to indicate the biological effect of ionizing radiation and is used in setting radiation protection standards.

In conducting its study, the committee first examined the current system of standards, guidance, and practices used by the USNRC and agreement states to determine whether to release slightly radioactive solid material from further regulatory control under the Atomic Energy Act. The committee found that the current, workable system allows licensees to release material according to preestablished criteria but contains inconsistencies such that nuclear reactor licensees can release materials only if there is no detectable radioactivity[4] (above background levels), whereas materials licensees can do so if small detectable levels are found. The USNRC uses a guidance document for this latter purpose, Regulatory Guide

[3]Section 274 of the Atomic Energy Act (AEA) authorizes the Commission to enter into an effective agreement with the governor of a state to allow that state to assume the USNRC's authority to regulate certain types of materials licensees only. Reactor licensees remain the exclusive domain of the USNRC. Today there are 32 agreement states, which have implemented regulatory programs that are compatible with the USNRC's programs. The materials licensees that a state can regulate include those that use or possess source material, byproduct material, or special nuclear material in quantities not sufficient to form a critical mass (e.g., less than 350 grams of uranium-235).

[4]Reactor licensees can, however, apply to USNRC for approval to release solid materials with small but detectable levels of radioactivity pursuant to Section 2002 of 10 CFR Part 20.

1.86, which includes a table of surface contamination limits that are technology based (measurement based) and not risk based (dose based). These limits are typically incorporated as license conditions or technical specifications in the case of materials licensees and subsequently used by the licensee to release material, whereas, as noted above, reactor licensees cannot release material if radioactivity is detected above natural background. No table of limits exists for volume contamination. Instead, the USNRC and its agreement states decide on a case-by-case basis whether release of volume-contaminated solid materials can occur. The committee found that licensees are currently submitting case-by-case applications at a rate that is being adequately managed by the USNRC and the agreement states.

Materials with levels of radioactivity not detectable above background radiation (with routine radiation measurements) are being released on a daily basis from nuclear power plants under a licensee arrangement with either the agreement states or the USNRC. In addition, some materials with volume contamination are being released on a case-by-case basis. The amount of these materials is not known, because there is no requirement to document the materials released. The annual dose equivalent resulting from these releases on a case-by-case basis has been estimated in draft NUREG-1640 at 10 μSv/yr (1 mrem/yr) or less for most of the radionuclides of interest.

The committee found that in future years the vast majority of slightly radioactive solid materials subject to the USNRC's system of clearance standards and practices will come from closing (decommissioning) nuclear power plants. Metal and concrete will constitute the greatest volume of slightly radioactive solid materials resulting from decommissioning. If power reactors are decommissioned on the schedule set by their current licenses, large quantities of metal and concrete waste will be generated during the next several decades, as shown in Figure ES-1. If licenses are extended for an additional 20 years, which seems probable for most facilities, the schedule shown in Figure ES-1 would be set back by as much as 20 years, with little material generated from decommissioning until after 2030.

The committee considered three general categories of options for disposition of slightly radioactive solid materials. *Clearance*[5] (unconditional—i.e., unrestricted—release) means that the material is handled as if it is no longer radioactive. Under this option, solid material (e.g., a tool) can be reused without restriction, recycled into a consumer product (e.g., a patio table), or disposed of in a landfill. (Classification of the waste as hazardous, for example, under the Resource Conservation and Recovery Act [RCRA], would depend on its other properties.) The committee found only limited support for clearance that allows

[5]Where the term clearance (i.e., no longer under regulatory control) appears, it is understood to mean unconditional clearance.

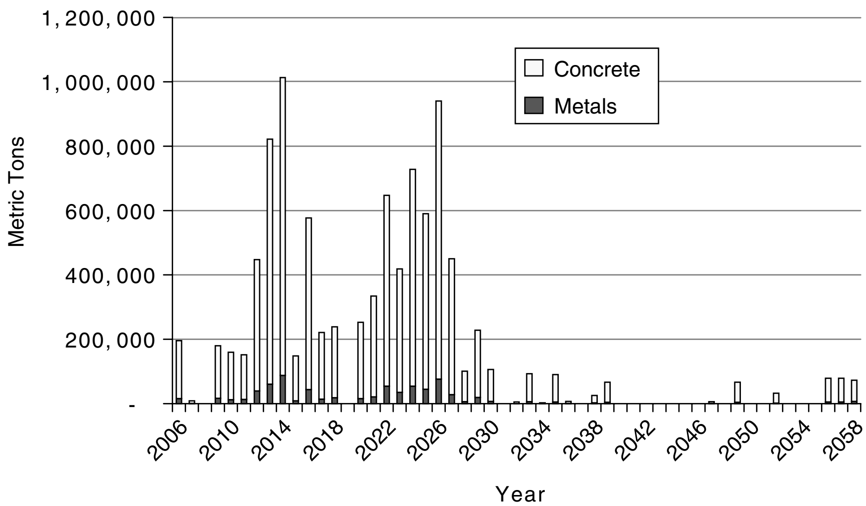

FIGURE ES-1 Time distribution for generation of slightly radioactive solid material from U.S. power reactor decommissionings. SOURCE: Adapted from SCA (2001).

slightly radioactive solid materials to enter commerce for unrestricted recycled use, no matter how restrictive the clearance standard might be. No support for this option exists in the steel and concrete industries.

Conditional clearance (i.e., restricted release from regulatory control) means that material must be used in a specified application and subject to continuing regulatory control until specific conditions are met. For example, slightly radioactive metal released under a conditional clearance standard might be melted into shielding blocks for use at DOE nuclear facilities but could be subject to controls in the process. Other examples might include slightly radioactive concrete that must be disposed of in a Subtitle D landfill or concrete that is released for use in the rubble base for roads. Conditionally cleared material would not be released for use in general commerce.

No release (from regulatory control) means that the slightly radioactive solid material, once it leaves the originating facility, must be sent to a facility licensed to accept radioactive solid material for storage or disposal. Under this option, the slightly radioactive solid material remains under a USNRC or agreement state license continuously.[6] Under current conditions, slightly radioactive solid material would be sent to either Envirocare of Utah or one of two disposal facilities licensed to accept all types of low-level radioactive waste (LLRW)—Barnwell,

[6]Until the expiration of postclosure monitoring requirements.

South Carolina, or U.S. Ecology in Richland, Washington—in accordance with each facility's licenses and permits. Each general disposition option—clearance, conditional clearance, and no release—has minor variants and regulatory complexities, which are discussed in this report.

Each disposition option has economic implications due to associated pricing and handling, regulation, and disposal. (For estimation purposes, only concrete and metal are considered.) If the material is disposed of as radioactive waste, as in the case of "no release," then the disposal fee charged by the facility could range from \$3,120 (U.S. Ecology) to \$16,800 (Barnwell) per cubic meter in the two licensed commercial low-level radioactive waste disposal facilities. The cost to dispose of slightly radioactive metal from all U.S. power reactors would range from \$1.6 billion to \$8.8 billion, depending on whether U.S. Ecology or Barnwell is used, respectively.[7] For slightly radioactive concrete, the committee estimates disposal at Envirocare of Utah could be accomplished at a cost roughly one eighth that of U.S. Ecology, giving a total cost for all concrete from U.S. power reactors of \$2.9 billion.[8] The total cost to dispose of all slightly radioactive solid material—metal and concrete—from U.S. power reactors under the no-release option is thus estimated at between \$4.5 billion and \$11.7 billion. Less costly disposal is possible if the slightly radioactive solid material meets the terms of conditional clearance and can be sent to a landfill. Then disposal can be accomplished at a disposal fee of approximately \$30 per metric ton for a Subtitle D landfill (municipal waste) and approximately \$110 per metric ton for a RCRA Subtitle C landfill (hazardous waste). Disposal of all the slightly radioactive solid material anticipated from U.S. power reactors could cost \$0.3 billion in Subtitle D landfills and \$1 billion in Subtitle C landfills. Clearance of all this material could allow the option of recycle or reuse for some of the material, as appropriate, and would avoid essentially all disposal costs. These estimates are shown to illustrate the relative costs of the different clearance policy options; it should be emphasized, however, that the cost of disposal of slightly radioactive solid materials may in the future be subject to factors that the committee is not able to foresee or take into account. For example, the committee has not considered energy deregulation or the impact on ratepayers caused by any changes that may be made to clearance rules.

Licensees will base decisions on which disposition option is appropriate for

[7]Envirocare of Utah is licensed to accept bulk metal for disposal but does not publish pricing information and determines prices on a case-by-case basis. The committee was not able to find data on such prices for disposal of bulk metals at Envirocare, so it has not estimated the costs of disposal of metal from U.S. power reactors.

[8]Envirocare of Utah charges the U.S. Army Corps of Engineers \$298 per cubic yard (\$388 per cubic meter) for disposal of high-volume, slightly radioactive concrete debris, which is classified as pre-1978 uranium mill tailings by the USNRC.

a particular quantity of slightly radioactive solid material, in part, on measurements of the amounts of radioactive materials present. Measurement of the amount of radioactive material in a solid matrix is a function of instrument characteristics, background radiation levels, and source characteristics. If the sampling and analysis costs are too high, it may be more cost-effective to dispose of the material at a facility licensed to accept low-level radioactive waste rather than demonstrate compliance with a clearance standard to allow landfill disposal. For screening-level concentrations and surface contaminations calculated from dose levels greater than or equal to 10 μSv/yr (1 mrem/yr), for a defined exposure scenario, detection is possible in a laboratory setting for a majority of radionuclides under most practical conditions at reasonable costs. Using field measurements, a more rapid fall-off of detectability is observed at more stringent radiation protection levels, with 31 of 40 key radionuclides detectable at 10 μSv/yr (1 mrem/yr) and 11 of 40 detectable at 1 μSv/yr (0.1 mrem/yr).

The committee evaluated technical analyses of the estimated doses of the final disposition of slightly radioactive solid materials. These analyses were conducted by federal agencies and international organizations, including the International Atomic Energy Agency (IAEA), the European Commission, and other groups. The committee paid particular attention to a draft USNRC document, NUREG-1640, which was developed to support its most recent evaluation of the clearance standard issue. The committee concluded that of the various reports considered, draft NUREG-1640 provided a *conceptual framework*, particularly with regard to incorporating formal uncertainty, that best represents the current state of the art in risk assessment. The committee did find limitations in the report, including its lack of applicability to scenarios of conditional clearance (e.g., landfill disposal), lack of consideration of multiple exposure pathways, and lack of consideration of human error[9] and its possible effect on dose factor prediction. Draft NUREG-1640 has also been clouded by questions of contractor conflict of interest.

To determine if numerical values in the report had been affected by considerations other than science, the committee checked a sample of dose factor analyses and found them reasonable. Once all of the dose factors are checked as the committee recommends and other limitations in draft NUREG-1640 have been resolved—either in the final version of the report or in follow-up reports—the resulting dose factors can be multiplied by appropriate dose-risk coefficients to provide estimates of the risks of releasing individual radionuclides at any hypothetical concentration. The USNRC will then have a sound basis for considering

[9]Human error is used here to mean the violation of scenario assumptions at some infrequent, but nonzero, rate. Categories of relevant human error include mistakes in properly labeling material, mistakes in measurement, or failure to properly decontaminate loose material as assumed in dose factor estimates.

BOX ES-1
Policy Alternatives for Releasing Slightly Radioactive Solid Material

Case-by-Case Approach

- Current approach: USNRC or agreement state approves specific license conditions
- Additional criteria for volume contamination
- Restrictions on reuse (see examples below, under "conditional clearance")

Clearance Standard

- Dose based (based on risk to an individual or population caused by exposure to radiation)
- Source based (based on surface or volume radioactivity concentration of the contaminated solid material)

Conditional Clearance Standard

- Dose based (based on risk to an individual or population caused by exposure to radiation)
  —Beneficial reuse in controlled environments (e.g., metal for shield blocks in USNRC-licensed or DOE facilities)
  —Limited reuse for low-exposure scenarios (e.g., concrete rubble base for roads)
  —Landfill disposal
- Source based (based on surface or volume radioactivity concentration of the contaminated solid material)
  —Beneficial reuse in controlled environments (e.g., metal for shield blocks in USNRC-licensed or DOE facilities)
  —Limited reuse for low-exposure scenarios (e.g., concrete rubble base for roads)
  —Landfill disposal

No Release

- All slightly radioactive solid material is disposed of at licensed LLRW sites.

the total risks associated with any proposed clearance standards and for assessing the uncertainty attached to dose estimates. The committee does not believe it is necessary from a scientific perspective for the USNRC to start all over again.

The committee reviewed efforts by other countries and international organizations to set clearance standards. The European Union has issued a safety direc-

tive containing tables derived using a scenario assessment process against which slightly radioactive solid materials can be evaluated for possible clearance from further regulatory control. Member nations of the European Union are in the process of implementing this directive.

The issue of releasing radioactive materials from further regulatory control, like the issue of nuclear power in general, has received significant stakeholder input. The committee found that in the past, the USNRC failed to convince any environmental and consumer advocacy groups that the clearance of slightly radioactive solid material can be conducted safely and failed to convince certain industry groups that such clearance is desirable. Most of the issues and concerns expressed today by many consumer advocacy and environmental groups and some industry groups are the same as were expressed during the controversy over the BRC policy in 1990. Furthermore, a legacy of distrust of the USNRC has developed among many of the environmental stakeholder groups, resulting from their experience with the BRC policy, the enhanced participatory rulemaking on license termination ("decommissioning rule"), and the USNRC's 1999 issues paper, published in the *Federal Register* on June 30, 1999, on the clearance standards. Reestablishing trust will require concerted and sustained effort by the USNRC.

The committee developed a series of policy alternatives to the current system, detailed in Box ES-1. The committee found that there is time for the USNRC to move forward and select from among the alternatives, since no evidence was found that the problems associated with the current case-by-case approach required its immediate replacement. The committee does not recommend any one particular alternative. Instead, it emphasizes the need for the USNRC to undertake with deliberate speed and a broad range of stakeholder involvement a detailed and thorough analysis and evaluation of various alternative approaches that proceeds from logical starting points based on a sound technical foundation. Should the USNRC choose to develop new regulations for clearance, it has to consider that any action it takes may have implications for the management of materials—e.g., technologically enhanced naturally occurring radioactive materials (TENORM)—that are not currently regulated by the USNRC, DOE, or agreement states.

Considerations include effects on public health, costs and benefits, consistency with existing national and international analysis, practice and legal authority, and public perceptions and acceptance.

RECOMMENDATIONS

In developing its recommendations the committee was guided by two overarching, compelling findings:

1. The current approach to clearance decisions is workable and is sufficiently protective of public health that it does not need immediate revamping. However, the current approach, among other shortcomings, is inconsistently applied, is not explicitly risk based, and has no specific standards in guidance or regulations for clearance of volume-contaminated slightly radioactive solid material. Therefore, the committee believes that the USNRC should move ahead without delay and start a process of evaluating alternatives to the current system and its shortcomings.
2. Broad stakeholder involvement and participation in the USNRC's decision-making process on the range of alternative approaches is critical as the USNRC moves forward. The likelihood of acceptance of a USNRC decision greatly increases when the process (1) engages all responsible stakeholder representatives and viewpoints, (2) is perceived by participants as fair and open, (3) addresses all the advantages and disadvantages of the alternative approaches in an even-handed way, and (4) is open to a broad and creative range of alternatives. Thus, it is essential that the USNRC focus on the process and not prescribe an outcome. The outcome, an approach to disposition of slightly radioactive solid material, must evolve from the process.

While the committee did not want to prescribe the outcome of the decision process, it has made several specific recommendations, conditional on the process arriving at certain decision points. For example, if the USNRC contemplates clearance or conditional clearance standards, the committee recommends that these standards be dose based. The committee also recognized that significant national and international efforts have been completed, or are near completion, that provide a solid foundation for the USNRC to move forward. The committee has recommended the foundation from which to begin the process. Thus, the USNRC should be able to proceed expeditiously with a broad-based stakeholder participatory decision-making process.

Recommendation 1. The USNRC should devise a new decision framework that would develop, analyze, and evaluate a broader range of alternative approaches to the disposition of slightly radioactive solid material. At a minimum, these alternatives should include the current case-by-case approach, clearance, conditional clearance, and no release.

Recommendation 2. The USNRC's decision-making process on the range of alternative approaches to the disposition of slightly radioactive solid material should be integrated with a broad-based stakeholder participatory decision-making process. Elements of this process should include the following:

- The willingness and commitment of the USNRC to establish and maintain a meaningful and open dialogue with a wide range of stakeholders regarding the disposition of slightly radioactive solid material;
- An ad hoc broad-based advisory board that would advise the USNRC in its consideration of approaches to the disposition of slightly radioactive solid material. The advisory board would also suggest additional stakeholder involvement mechanisms that the USNRC could use in the decision process (for example, establishing a National Environmental Policy Act process; alternative dispute resolution; and partnering, arbitration, mediation, or a combination of such methods); and
- Assistance obtained by the USNRC as needed from outside experts in order to (1) assist its efforts to establish the ad hoc stakeholder advisory board and to facilitate dialogue between the USNRC and stakeholder participants in the decision-making process and (2) assess, evaluate, and perhaps conduct portions of the USNRC stakeholder involvement program and make recommendations as appropriate.

Recommendation 3. The USNRC should adopt an overarching policy statement describing the principles governing the management and disposition of slightly radioactive solid material. A review and discussion of the IAEA policy statement *Principles for the Exemption of Radiation Sources and Practices from Regulatory Control* (Safety Series No. 89, IAEA Safety Guidelines, Vienna, 1988) with a broad-based stakeholder group would provide a good starting point in developing a policy statement that would provide a foundation for evaluation of alternative approaches to disposition of slightly radioactive solid material.

Recommendation 4. When considering either clearance or conditional clearance, a dose-based standard should be employed as the primary standard. To employ a dose-based standard, it is necessary to consider a wide range of scenarios that encompass the people likely to be exposed to slightly radioactive solid material. From these people, a critical group is selected and secondary standards (based on dose factors) are derived. These secondary standards are used to limit the radioactivity in materials being considered for release or conditional release.

The USNRC should also consider the pros and cons of the establishment of a separate collective dose standard.

Recommendation 5. An individual dose standard of 10 μSv/yr (1 mrem/yr) provides a reasonable starting point for the process of considering options for a dose-based standard for clearance or conditional clearance of slightly radioactive solid material. This starting point is appropriate for the following reasons:

- A dose of 10 μSv/yr (1 mrem/yr) is a small fraction (less than 0.5 percent) of the radiation received each year from natural background sources.

- A dose of 10 μSv/yr (1 mrem/yr) is significantly less than the amount of radiation that we receive from our own body due to radioactive potassium (one contributor to background radiation) and other elements and to routine medical procedures that involve ionizing radiation.
- A dose of 10 μSv/yr (1 mrem/yr) over a 70-year lifetime equates to an estimated increase of 3.5×10^{-5} in the lifetime cancer risk, which falls within the range of acceptable lifetime risks of 5×10^{-4} to 10^{-6} used in developing health-based standards for exposure to radiation (other than for radon) in the United States.
- Radiation measurement technologies are available at a reasonable cost to detect radioactivity at concentrations derived from this dose standard.
- This dose standard is widely accepted by recognized national and international organizations.

The final selection of an individual dose standard should nonetheless be a policy choice, albeit one informed by the above considerations.

Recommendation 6. For any dose-based alternative approach to disposition of slightly radioactive solid materials, the USNRC should use the *conceptual framework* of draft NUREG-1640 to assess dose implications. To use the actual results of NUREG-1640 in the decision framework discussed in Recommendations 1 and 2, the USNRC must first establish confidence in the numerical values, expand the scope of applicability, and overcome certain limitations in draft NUREG-1640. At a minimum, the following specific actions are required:

- Review the choice of parameter distributions used in the dose modeling, as well as the characteristic values chosen for each parameter distribution.
- Develop complete scenarios and dose factors for conditional clearance options.
- Provide sufficient information to enable calculation of collective doses to support Recommendation 4.
- Expand the current set of scenarios used to compute dose factors to include (1) human error and (2) multiple exposure pathways.

The USNRC should use an independent group of experts to provide peer review of these activities.

Recommendation 7. The USNRC should continue to review, assess, and participate in the ongoing international effort to manage the disposition of slightly radioactive solid material. The USNRC should also develop a rationale for consistency between secondary dose standards that may be adopted by the United States and other countries. However, the USNRC should ensure that the technical basis for secondary dose standards is not adjusted for consistency unless these adjustments are supported by scientific evidence.

1

Introduction

The charge to the committee was to study possible approaches for releasing slightly radioactive solid material from U.S. Nuclear Regulatory Commission (USNRC)-licensed facilities. Accordingly, the analyses in the first nine chapters and the recommendations in Chapter 10 pertain primarily to slightly radioactive solid materials currently under the regulatory control of the USNRC or agreement states.[1]

The term "slightly radioactive solid material" (SRSM) refers to material that contains radionuclides from licensed sources used or possessed by licensees of the USNRC and agreement states. These materials typically contain low concentrations of radionuclides and, by virtue of these low concentrations, can be considered for disposition as something other than low-level radioactive waste (LLRW).[2]

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[1]Section 274 of the Atomic Energy Act (AEA) authorizes the Commission to enter into an effective agreement with the governor of a state to allow that state to assume the USNRC's authority to regulate certain types of materials licensees only. Reactor licensees remain the exclusive domain of the USNRC. Today there are 32 agreement states, which have implemented regulatory programs that are compatible with the USNRC's programs. The materials licensees that a state can regulate include those that use or possess source material, byproduct material, or special nuclear material in quantities not sufficient to form a critical mass (e.g., less than 350 grams of uranium-235).

[2]LLRW is waste that contains concentrations of radioactive materials that are regulated under 10 CFR Part 61. There is no low-end cutoff for the concentrations of radioactive materials regulated as LLRW.

This chapter begins with the historical context for current USNRC regulations pertinent to the release of solid materials from licensed facilities. Next is a review of approaches used by other agencies for release (removal) of radioactive materials from regulatory control and a summary of the current process by which the USNRC decides on the release of solid materials using a case-by-case approach. The chapter concludes with a summary of the committee's task (the full text of the statement of work can be found in Appendix C) and a synopsis of the role each chapter plays in fulfilling that task.

HISTORICAL CONTEXT

The USNRC's basic standards for protection against radiation are set forth in 10 CFR Part 20,[3] a regulation intended ". . . to control the receipt, possession, use, transfer, and disposal of licensed material. . . ." This regulation was first issued as a final regulation by the Atomic Energy Commission (AEC) in 1957 and was used for many years with minor amendments. The 1957 version of 10 CFR Part 20 contains a short section on waste disposal that provides the basis for case-by-case review of disposal procedures not covered within the two succeeding sections that deal with disposal of tritium and carbon-14 in sewerage systems or in soil. The 1957 regulation did not include criteria specifying an amount or concentration of a radionuclide in a solid material,[4] below which the solid material would be exempt from regulatory control or conditional clearance (Box 1-1).[5] However, pursuant to Section 2002 of 10 CFR Part 20, added in a later revision of the regulation, the USNRC and agreement states evaluate requests by licensees for permission to release solid materials on a case-by-case basis, using existing regulatory guidance.[6] The situation for gaseous and liquid materials is different,

[3]References to the United States Code of Federal Regulations (CFR) will be given using the conventional format with the code title (here, Title 10) followed by the acronym CFR and the part or chapter number(s).

[4]For two radionuclides, in one specific application, Part 20 does contain release criteria for solid materials. These criteria allow disposal of volume-contaminated animal tissue containing less than 1.85 kBq/g of ^{3}H or ^{14}C as if it were not radioactive.

[5]The definitions of terms related to release of materials from regulatory control are presented in Box 1-1. The committee notes much confusion about the common usage of terms in discussion of the release of radioactive materials. Without necessarily affirming this approach, the committee decided to use the terms as defined in the American National Standards Institute-Health Physics Society (ANSI/HPS, 1999) Standard N13.12-1999.

[6]The 1957 issue of Part 20 had a short section on waste disposal that included Part 20.302, "Method for obtaining approval of proposed disposal procedures," the basis for case-by-case review of disposal procedures not authorized by the two succeeding sections on disposal in sewerage systems or in soil. The original Part 20 gave general requirements for waste disposal of byproduct material. The 1957 standard did not include any criteria for a floor to the amount or concentration of controlled radionuclides, which criteria might be used as the basis for exemption of waste from regulatory control.

BOX 1-1
Definition of Selected Terms Related to Clearance of Materials from Nuclear Facilities

Background radiation. Natural radiation or radioactive material in the environment, including primordial radionuclides, cosmogenic radionuclides, and cosmic radiation. Primordial radionuclides belong to one of the three radioactive decay series headed by (1) ^{238}U, ^{235}U, and ^{232}Th; (2) ^{40}K; or (3) ^{87}Rb. Cosmogenic radionuclides are produced by collision of cosmic nucleons with atoms in the atmosphere or in the earth, including ^{14}C, ^{3}H, ^{7}Be, and ^{22}Na. Cosmic radiation comes from the secondary particles, mostly high-energy muons and electrons, produced by interactions between the earth's atmosphere and charged particles, primarily protons, from extraterrestrial sources. Naturally occurring radioactive material that has been technologically enhanced is not considered background for the purposes of the American National Standards Institute–Health Physics Society standard.

Clearance. The removal of items or materials that contain residual levels of radioactive materials employed within authorized practices from any further control of any kind.

Conditional clearance. The act of removing items or materials that contain residual levels of radioactive materials from regulatory control albeit with restrictions on the further use of the items or materials.

Exclusion. The designation by a regulatory authority that the magnitude or likelihood of an exposure is essentially not amenable to control through requirements of a standard and that such an exposure is outside the scope of standards (e.g., exposures from ^{40}K in the body, from cosmic radiation at the surface of the earth, and from unmodified concentrations of radionuclides in most raw materials).

Exemption. The designation by a regulatory authority that specified uses of radioactive materials or sources of radiation are not subject to regulatory control because the radiation risks to individuals and the collective radiological impact are sufficiently low.

Surface contamination. Radioactive contamination residing on or near the surface of an item. This contamination can be adequately quantified in units of activity per unit area. When an item has been exposed to neutrons (including structural components and shielding at nuclear reactors), or when an item could have cracks or interior surfaces allowing the distribution of radioactive contamination within the interior matrix, it is considered to be a volume contamination source.

Volume contamination. Radioactive contamination residing in or throughout the volume of an item. Volume contamination can result from neutron activation or from the penetration of radioactive contamination into cracks or interior surfaces within the matrix of an item. (Volume contamination can also occur due to solid-state diffusion.)

SOURCE: Adapted from ANSI/HPS (1999).

and Part 20 does set limits on the amount or concentration of a radionuclide in such materials that may be released to the environment from a nuclear facility. These concentration limits, which have been set for essentially all radionuclides of concern (numbering in the hundreds), are based on calculated dose to the general public. Volume-contaminated facility structures and soils that remain at decommissioned sites are regulated under Part 20, Subpart E, which establishes criteria for unrestricted use.

In June 1974 the AEC issued Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors* (AEC, 1974). This guide provides four alternatives for retiring a reactor facility at the end of its operational life. After the facility or equipment has been decontaminated and if the residual surface radiation levels do not exceed the limits stated in Table I of Regulatory Guide 1.86, the licensee may release the equipment or the USNRC may authorize termination of the facility license. Ever since the guide was issued, Table I has been used as a basis for releasing surface-contaminated material from further regulatory control when appropriate—for example, when incorporated into the conditions of a license.

In 1991 the USNRC, as the successor agency to the AEC for regulating nuclear facilities, issued a major revision to 10 CFR Part 20. The stated purpose of this revision was ". . . to modify the [US]NRC's radiation protection standards to reflect developments in the principles and scientific knowledge underlying radiation protection that have occurred since Part 20 was originally issued more than 30 years ago" (USNRC, 1991c). The revision also discusses its relationship to the recommendations of the International Commission on Radiological Protection (ICRP) and its U.S. counterpart, the National Council on Radiation Protection and Measurements (NCRP). Information was provided about the revisions to the Federal Radiation Protection Guidance on Occupational Exposure—which incorporate the philosophy and methodology of ICRP Parts 26 and 30—and the recently issued revisions in NCRP Report 91 (NCRP, 1987c) of the 1971 recommendations on radiation protection limits. The recommendation in NCRP Report 91 for a negligible individual risk level of 1 mrem/yr (0.01 mSv/yr) was recognized but not adopted by the USNRC for procedural reasons (NCRP Report 91 was issued after the proposed Part 20 rule, and there had been no opportunity for public comment). Box 1-2 contains definitions of the units of measurement used in this report.

The 1991 revision to 10 CFR Part 20 included other references on radiation protection, including a 1988 report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1988), reports by committees of the National Research Council (NRC, 1990) on the Biological Effects of Ionizing Radiation (BEIR), and the 1990 recommendations of the ICRP (ICRP, 1990). The 1991 revision also included allowable limits on the radiation dose that an

individual could receive from exposure to radioactive materials (*dose limits*) and the concentration limits for radioisotopes released in gaseous or liquid effluents.

Even before the 1991 revision to Part 20 was issued, the USNRC, international governments, and non-U.S. agencies had agreed on a principal dose limit for members of the public of 100 mrem/yr, rather than the old limit of 500 mrem/yr. Although the USNRC has agreed to this dose limit set by the ICRP, the U.S. Environmental Protection Agency (EPA) has not yet done so (ICRP, 1985; USNRC, 1991c). This exposure limit was chosen with the recognition that the average exposure due to natural background radiation had been estimated at 240 mrem/yr by UNSCEAR and 300 mrem/yr by NCRP (UNSCEAR, 1982; NCRP, 1987a). In revising Part 20, the USNRC recognized that "when application of the dose limits is combined with the principle of keeping all radiation exposures 'as low as is reasonably achievable' [ALARA] the degree of protection could be significantly greater than from relying upon the dose limits alone." Part 20 as revised sets dose limits compatible with ALARA.

In issuing a standard for the uranium fuel cycle, the EPA allocated a public exposure limit of 25 mrem/yr, whole-body effective dose,[7] to the fuel cycle (40 CFR Part 190). All of the regulatory bodies use these exposure limits in the context of the three principles of radiation protection:

1. Justification of a practice;
2. Optimization (USNRC makes explicit use of ALARA—exposures held as low as is reasonably achievable);[8] and
3. Limitation of individual risk through exposure limits.

In the text of the revised 10 CFR Part 20, the USNRC recognized that the ALARA standard for reactor effluent releases, combined with the EPA fuel cycle standard, in effect set a limit on exposure of the general public to radioactive effluents that was only a few percent of the USNRC dose limit of 100 mrem/yr.

Optimization through an ALARA standard is central to the USNRC's radiation protection strategy. The objective is not merely to meet the dose limit but to go below it as far as is reasonably achievable. One way to address the possibility of doses to some members of the general public arising from multiple exposures to different clearance practices is to rely on the unquantified margin induced by

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[7]Also included in this standard were limits of 75 mrem effective dose to the thyroid and 25 mrem effective dose to any one organ. The system of effective dose predates the system of dose equivalent now in widespread use, and the two are not directly comparable. The EPA has equated 25 mrem/yr whole-body effective dose to 15 mrem/yr dose equivalent (58 Federal Register 66398-66416; December 20, 1993).

[8]The EPA does not apply the optimization principle in the same way that the USNRC does. The EPA implements this principle broadly within its multistatute mission.

BOX 1-2
Units of Measurement for Radiation Dose

This report deals with ionizing radiation. There are two types of directly ionizing radiation. X rays and gamma rays have the same characteristics and properties; they are both electromagnetic radiation and differ only in their source. X rays are emitted from electrical devices, where they are produced when electrons decelerate, or from atoms when energetic electrons move to vacancies in lower orbital shells. Gamma rays are emitted from nuclei of atoms during radioactive decay. The other type of directly ionizing radiation consists of highly energetic subatomic particles carrying a net electric charge, including electrons, protons, and alpha particles.

Neutrons, which are uncharged particles, give up their energy by colliding with atomic nuclei, particularly so when colliding with particles of comparable mass. Neutrons are emitted from atomic nuclei when some radioactive materials undergo fission, thereby splitting into smaller atoms.

Electrons are small negatively charged particles found in all atoms. When radioactive materials decay, the electrons that are emitted from decaying nuclei are known as beta particles.

Alpha particles, which consist of two protons and two neutrons, are identical to the nucleus of a helium atom. Alpha particles are commonly emitted when higher-mass radionuclides such as uranium or radium decay.

The amount of ionizing radiation to which an organism is exposed, which is usually called the radiation dose, can be measured in terms of the energy absorbed in matter. Regardless of the type of radiation, the energy of absorbed ionizing radiation is measured in units of rads. When the amount of radiation is small, the unit used is the millirad (1,000 millirads = 1 rad). One rad is equal to an absorbed dose of 100 ergs per gram of absorbing matter, or 0.01 joule/kg.

an ALARA standard.[9] Another approach is to allocate a fractional part of the dose limit to a practice, as EPA did in the facility standard for the uranium fuel cycle.

Along with establishing a dose limit for individual members of the public, the Part 20 revision for decommissioning allocated a significant fraction of the general limit to individual facilities. This approach appears reasonable, since it is difficult to envision that more than a few facilities would simultaneously be the source of significant exposure to any member of the public because the facilities are at fixed sites.

The USNRC has tried previously to set standards for release of SRSM from regulatory control. A proposed rule (45 Federal Register 70874; October 27,

[9]The USNRC regularly applies ALARA with protection limits but recognizes that the margin induced by ALARA can vary widely from case to case—for example, the contrast in site decommissioning between users of sealed sources and users of unsealed quantities of radioactive materials (59 Federal Register 43208). Also, the ALARA concept would become irrelevant at the proposed de minimis levels of clearance standards.

Doses of ionizing radiation with the same energy but involving different particles do not produce equal biological effects. In general, X rays and gamma rays are less damaging than alpha particles, neutrons, and protons. To account for these differences, a derivative unit is generally used. The unit customarily used in the United States is the rem. A radiation dose in rems is equal to the dose in rads multiplied by a quality factor to allow for the damage effectiveness of the type of particle involved. X-rays and gamma rays have been assigned a quality factor of 1. The electrically charged subatomic particles have quality factors greater than 1.

There are two systems of units employed for measuring radiation doses, the U.S. Customary and the SI systems. The gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule/kg, or 100 rads. The SI unit for dose equivalent is the sievert (Sv). The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the same quality factor used to convert from rads to rems. The conversion factor between the two dose equivalent units is 1 Sv = 100 rem, or 1 μSv = 100 mrem, or 10 mSv = 1 mrem.

The becquerel (Bq) is the SI unit for the amount of radioactivity in a substance, measured by the rate of decay of radionuclides in the material. One becquerel is equal to one disintegration per second. Another unit used for the rate of decay is disintegrations per minute (dpm), and 60 dpm equals 1 Bq. The curie (Ci) is the U.S. Customary unit of measure for the amount of radioactivity as indicated by the rate of decay of a radioactive material; 1 Ci equals 3.7×10^{10} Bq, or 2.22×10^{12} dpm.

Individual dose is the dose received by the exposed individuals in the critical group of the exposed segment of the population.

Collective dose is the sum of the doses received in a given period of time by a specified population from exposure to a specified source of radiation.

1980) to exempt residual levels of radionuclides in smelted alloys from licensing was withdrawn in 1986 (51 Federal Register 8842; March 14, 1986). A more sweeping policy issued by the USNRC, as directed by the Low Level Radioactive Waste Policy Amendments Act of 1985 (LLWPAA), declared materials with low concentrations of radioactivity contamination to be “below regulatory concern” (BRC) and hence deregulated (55 Federal Register 27522; July 3, 1990). However, Congress intervened to set aside the BRC policy in the Energy Policy Act of 1992 after the USNRC’s own suspension of the policy (56 Federal Register 36068; July 30, 1991). Circumstances considered for clearance (unrestricted release) include materials in which radioactive contamination is so low that clearance is warranted. In contrast to the release of a material from regulatory control, *exemption* from control may be considered in some circumstances, for example, when a small amount of radioactive material is added to a product deliberately to serve some justified purpose.

To account for different possible exposures, the exposure limit set for clearance (i.e., unrestricted release) or exemption of a material would have to be a

small fraction of the 100 mrem/yr total limit. The revised Part 20 did not include specific standards for exemption; for case-by-case review, it is identical to the previous version. The 1991 version of Part 20 contains no regulatory statement defining a floor for regulated radionuclide content, other than the reference (noted above) to the NCRP recommendation on negligible individual risk of 10 μSv/yr (1 mrem/yr).

RADIATION PROTECTION STANDARDS DEVELOPED BY ORGANIZATIONS OTHER THAN THE USNRC

Organizations in Europe have developed basic radiation safety standards. Beginning in 1982, the International Atomic Energy Agency (IAEA) published a number of recommendations. Appendix C reviews IAEA Safety Series 89 along with safety standards developed by a number of other agencies. All of these standards recommend an individual dose on the order of 10 μSv/yr (1 mrem/yr) as the basis for clearance of materials from regulatory control.

Dose Comparisons

Standards for releasing SRSM are often based on a small percentage of the dose that a member of the U.S. population receives from what is termed background radiation (see definitions in Box 1-1). Table 1-1 lists the average annual dose to an individual in the United States from both natural and anthropogenic sources of ionizing radiation.

The values in Table 1-1 are averages, and the levels of background radiation are not uniform for individuals in different locations and having different lifestyles (see Table 1-2). A person living at higher altitudes receives more cosmic radiation than someone living near sea level. (For example, a person living in Denver, Colorado, receives 200 μSv/yr [20 mrem/yr] more than a person living on the Atlantic Seaboard, but when all natural sources are included the difference is 600 μSv/yr [60 mrem/yr] [NCRP, 1993].) A person living in a brick house receives an annual dose that is 70 μSv (7 mrem) higher than the dose for a person living in a frame house. An individual flying across the country receives a dose of about 25 μSv (2.5 mrem) per flight.

THE U.S. AND GLOBAL CONTEXTS OF RADIOACTIVE WASTE GENERATION

The ionizing radiation from radioactive materials has been used for more than a century. X rays and radium were soon used in the radiation treatment of cancer. Nuclear medicine followed, when radioactive tracers became available in 1931, after the development of the cyclotron. Nuclear weapons were developed during World War II, and the industrial processes involved also produced large quantities of radionuclides with long half-lives. Nuclear power plants to generate

TABLE 1-1 Average Annual Amounts of Ionizing Radiation to Which Individuals in the United States Are Exposed

	Dose		
Source	mSv/yr	mrem/yr	Percent of Total Dose
Natural			
Radon	2.0	200	55
Cosmic	0.27	27	8
Terrestrial	0.28	28	8
Internal	0.39	39	11
Total Natural	3.0	300	82
Anthropogenic			
Medical[a]			
X-ray diagnosis	0.39	39	11
Nuclear medicine	0.14	14	4
Consumer products	0.10	10	3
Occupational	<0.01	<1.0	<0.03
Nuclear fuel cycle	<0.01	<1.0	<0.03
Nuclear fallout	<0.01	<1.0	<0.03
Miscellaneous	<0.01	<1.0	<0.03
Total anthropogenic	0.63	63	18
Total natural and anthropogenic	3.6	360	100

SOURCE: NCRP (1987a).

[a]UNSCEAR (2000) reports 1.2 mSv as the average medical dose for health care level I countries.

TABLE 1-2 Common Sources of Radiation to Which the Public Is Exposed

Source	Dose Equivalent (μSv) (mrem)
One-way, transcontinental or trans-atlantic airplane flight at mid-latitudes	25 (2.5)
Gas mantles (containing thorium), 1 year's typical use	2 (0.2)
Additional annual dose received from residence in a brick house, versus a wooden frame house	70 (7)
Annual dose from nuclear power plant to maximally exposed person (airborne effluents)	
Pressurized water reactor	6 (0.6)
Boiling water reactor	1 (0.1)
Annual dose received from natural levels of potassium-40 in the body	180 (18)
Additional annual dose from cosmic rays received in Santa Fe, New Mexico, versus sea level	450 (45)
Additional annual dose from natural background received in Denver, Colorado, versus Atlantic Seaboard due to all natural sources (cosmic rays, terrestrial deposits of radionuclides, etc.)	600 (60)

SOURCES: NCRP (1987a, 1987b, 1993); NRC (1999).

electricity soon followed, and over a period of about 30 years the power industry added nuclear capacity to coal, natural gas, and other sources of energy used to generate electricity. In the United States, 103 nuclear power reactor units now produce about 20 percent of the nation's electricity.

Soon after the United States developed nuclear weapons and nuclear power reactors, the developed nations in Europe and Asia followed with their own nuclear development programs. Nuclear power reactors are now used widely to generate electricity in many countries. (In France, approximately 80 percent of the electric power requirements are generated with nuclear fuel.) With the global spread of nuclear weapons and nuclear power, large quantities of radioactive materials have been generated in both developed and developing countries, and the global distribution of radioactive material raises important considerations. With global trade, at least trace amounts of radioactive materials will certainly be shipped across many borders. Detailed discussion of the international aspects of clearance regulations can be found in Chapter 7.

Radioactive waste is generated by many different industries and is regulated within the United States by several federal agencies, with the general exception of naturally occurring radioactive material (NORM) and naturally occurring and accelerator-produced radioactive material (NARM).[10] The larger sources (generators) of regulated radioactive materials are listed below:

1. Licensees of the USNRC and agreement states,
2. U.S. Department of Energy (DOE),
3. U.S. Department of Defense (DoD), and
4. Domestic nonnuclear industries[11] that nevertheless accumulate process wastes with significant radioactive material content.

The control and release practices of each of these generators (or generator categories) are discussed in subsequent subsections. These practices are important to considerations of alternative disposition approaches.

The USNRC System

The USNRC regulates radioactive materials through licenses. Among the licensees are many thousands of small users of sealed sources,[12] about a thousand

[10]DOE guidance applies to the management of NORM at its own facilities, but the regulation of NORM and NARM is otherwise performed only by states under applicable state law.

[11]By "nonnuclear industry," the committee means an industry whose processes are neither based upon nor designed to make use of radionuclide decay or fission reactions. Thus, an industry in which radioactive material may accumulate as an unsought concomitant of the industrial processes being used, such as petroleum drilling or phosphate mining, is a nonnuclear industry.

[12]Sealed sources are byproduct material encased in a capsule to prevent leakage. They typically contain a concentrated form of one radionuclide (e.g., ^{137}Cs).

hospitals, 104 licensed nuclear power reactor units (of which 103 are operating), 36 operating nonpower reactor units, 49 fuel cycle facilities, and 5,288 materials licensees. Agreement states have issued an additional 15,512 materials licenses (SCA, 2001). Generation of SRSM is generally not an issue for licensees using sealed sources—provided the sources are maintained in a safe condition and location.[13] For all licensees, the primary disposal issue is access to disposal options at reasonable cost. For USNRC licensees, most of the SRSM inventory (metals, concrete, soils, equipment, etc.) that may undergo clearance is associated with operating or decommissioning the 104 nuclear power reactor units at 65 sites, which are distributed across the country, with 32 states having one or more units.

In principle, the schedule for decontaminating and decommissioning a nuclear power reactor unit is established by the terms of its operating license. However, because the economics of nuclear power production in the United States have changed dramatically in recent years for a variety of reasons, the trend among licensees is to apply for extensions to their licenses. Because the development of these power plants was closely regulated from the industry's inception, the location, types, and amounts of contamination associated with these plants are known.

Procedures for decommissioning reactors have already been established, based on three options: decontamination, safe storage, or entombment. Some of the alternative approaches to the disposition of SRSM could facilitate decommissioning by markedly reducing costs.

The DOE System

Inventories of contaminated metal scrap have been identified at 13 DOE sites. Although not licensed by the USNRC, DOE manages and disposes of a significant portion of the nuclear material within the United States and is discussed here to show the broader context for the handling and disposition of such material. Because most DOE sites were involved in producing enriched uranium and plutonium, the radioactive materials contain long-lived radionuclides, including actinides such as neptunium and americium. DOE operated 14 plutonium production reactors at the Hanford Site and the Savannah River Site, producing about 100 tons of ^{239}Pu, which has a half-life of 24,390 years. Chemical separa-

[13]Although contamination from maintained sealed sources is not an issue, some sealed sources are lost. If these lost sources, known as orphan sources, enter the scrap metal stream, they pose a serious problem for the steel industry. Orphan sources in the scrap stream are difficult to detect. If by accident they are melted into the production stream, major sections of a steel mill can be contaminated, causing tens of millions of dollars of damage.

tion processes for the recovery of plutonium and uranium generated more than 100 million gallons of radioactive wastes, which are currently stored at several DOE sites (SCA, 2001).

The DOE sites are large—often measured in hundreds of square miles. For example, the Hanford Site is about 560 square miles and the Savannah River Site is approximately 310 square miles. Production facilities at these large sites occupy only a small fraction of the total site area. Because many of the sites are well removed from populated areas, long-term on-site storage or burial has been one option employed for handling wastes. In addition, the Savannah River Site and the Nevada Test Site[14] are currently used for disposal of DOE-generated LLRW.

The facilities at most DOE sites are large relative to most industrial plants. For example, the K-25 gaseous diffusion plant, built in 1943 at Oak Ridge, Tennessee, is a three-level building that occupies 44 acres. In many instances, the DOE facilities are no longer functioning but still contain significant amounts of SRSM. Also, some of the equipment used to produce weapons-grade materials is classified and must be deconfigured at secure sites before disposal.

Production activities at many of the DOE sites began in 1943, when the dangers of ionizing radiation were less well understood or perhaps not of greatest concern. In a climate of wartime urgency, creating an entirely new and huge production complex and running it at full capacity were the critical concerns. Materials were disposed or stored on-site, with limited attention to the safeguards now taken for granted. Today, cleaning up discarded radioactive materials from the 1940s and 1950s at many DOE sites poses major problems for the contractors involved. The projected costs are enormous. Due to the complex history of defense-related operations at DOE facilities, material and waste management practices varied widely over the past half-century. This history often complicates the application of criteria for the release of solid materials during decommissioning of DOE facilities.

The DoD System

The DoD system includes both USNRC-licensed operations, covering a spectrum of operations similar to those found in the civilian world, and assets related to the nuclear Navy. The DoD facilities licensed by the USNRC include hospitals, laboratories, proving grounds, some nuclear reactors, weapons facilities, and missile launch sites. The USNRC does not license the nuclear Navy's assets, which include naval nuclear reactors and associated propulsion units. When nuclear-powered vessels are decommissioned, the reactor compartments are cut from the hull, sealed, and shipped to the DOE Hanford Site for burial. The ship

[14]This site, formerly used for nuclear weapons tests, is the largest in the DOE complex and occupies about 1,350 square miles in a remote area about 65 miles northwest of Las Vegas.

hulls are scrapped. The guidelines followed for clearing materials for reuse or recycle are classified. As of April 1999 the U.S. Navy had shipped 79 reactor compartment packages (representing 77 submarines and 1 cruiser) to the Hanford Site for disposal. There are about 2,800 tons of various types of recyclable metals in a submarine and 6,000 tons in a cruiser (SCA, 2001). Thus, more than 220,000 tons of steel, aluminum, copper, lead, and other metals have been recycled or reused from the Navy's decommissioning efforts.

About 115,000 cubic feet of LLRW is generated annually from DoD facilities. Most of this waste is from cleanup efforts rather than operations. As a group, the USNRC-licensed facilities of DoD appear to raise no unique inventory issues.

Non-USNRC-Licensed Industries

Among the U.S. industries that generate radioactive solids are several that can be described as nonnuclear because the processes employed do not intentionally use nuclear decay or nuclear fission reactions. Among these industries are petroleum production and refining, phosphate and phosphate fertilizer production, coal-fired power plants, and mining. The wastes generated contain NORM or technically enhanced NORM (TENORM). The USNRC estimates that more than 2 million metric tons of TENORM are generated annually (USNRC, 2001a). Much of this material contains significant concentrations of uranium, thorium, and radium radionuclides, all of which have long half-lives.

There are no federal statutes that specifically establish regulatory control of TENORM, although some waste streams fall under the jurisdiction of the EPA. Control of TENORM has been left to the states, and some agreement states regulate TENORM under their general rules governing the possession of radioactive materials. In many states with agreement state authority, the regulation of NORM, TENORM, and NARM comes under the same program used to regulate radioactive materials controlled under the Atomic Energy Act (AEA).

About 75 Superfund sites are contaminated with radioactive wastes[15] (Wolbarst et al., 1999). Many of these are DoD and DOE sites, but more than 20 were created by commercial industrial waste disposal.

STATUS OF THE CURRENT USNRC PROCESS FOR CLEARING SOLID MATERIALS

The USNRC has statutory responsibility for the protection of public health and safety related to the use of source material, byproduct material, and special

[15] "Superfund" is the commonly used term for the Comprehensive Environmental Response, Compensation, and Liability Act.

nuclear material, as defined by the AEA.[16] The USNRC's regulations in fulfillment of these goals include those on protection against radiation (10 CFR Part 20 et seq.), licensing of byproduct material (10 CFR Part 30 et seq.), licensing of source material (10 CFR Part 40), licensing of production and utilization facilities (i.e., nuclear reactors; 10 CFR Part 50 et seq.), licensing of special nuclear material (10 CFR Part 70 et seq.), and so forth.

As noted, the regulations on protection against radiation, 10 CFR Part 20, do not set predetermined levels on amounts or quantities of radionuclides in solid materials below which these materials can be released from further regulatory control. Solid materials potentially available for release from regulatory control include metals, building concrete, on-site soils, equipment, and furniture used in routine operation of licensed nuclear facilities. Most of this material will have no radioactive contamination, but some of it may have surface or volume contamination. Licensees continue to request permission from the USNRC and agreement states to release such solid materials when they are no longer useful or when the licensed facility is decommissioned, pursuant to Section 2002 of 10 CFR Part 20. In addition, as noted, Regulatory Guide 1.86 (AEC, 1974) contains limits applicable to surface contamination that are incorporated into license conditions and allow clearance of SRSM.

The USNRC allows licensees to release solid material according to preestablished criteria. For reactors, if surveys for surface residual radioactivity performed by the licensee on equipment or material indicate the presence of radioactivity above natural background levels, then release is not permissible.[17] If no such surface activity is detected, then the solid material in question need not be treated as radioactive material. This approach sometimes leads to subsequent problems, when detectors of greater sensitivity than were used in the initial survey detect radioactivity above the natural background threshold in previously released material (USNRC, 2001b).

For surface-contaminated SRSM possessed by a materials licensee, the USNRC usually authorizes its release through specific license conditions or technical specifications (USNRC, 2001b). In the case of volume-contaminated SRSM held by reactor and materials licensees, the USNRC has not provided guidance similar to that found in Regulatory Guide 1.86 for surface contamination. These situations are decided instead on an individual basis pursuant to Section 2002 of 10 CFR Part 20, typically by evaluating the doses likely to be associated with the proposed disposition of the material. The case-by-case approach has some distinct advantages and disadvantages, as discussed in Chapter 2 and Chapter 9.

The Commission directed the USNRC staff in June 1998 to consider a rulemaking for establishing a dose-based standard for release of SRSM (USNRC,

[16]Chapter 2 discusses the AEA definitions of these materials.

[17]Reactor licensees can apply to UNSRC for approval for clearance of solid materials with small but detectable levels of radioactivity pursuant to Section 2002 of 10 CFR Part 20.

1998a). The intent was to provide for consistent disposition of SRSM while protecting public health and safety. The USNRC staff was also directed to ensure that opportunities would be provided under the proposed standard for enhanced public participation. The USNRC subsequently published an issues paper outlining possible courses of action were it to proceed with a rulemaking (64 Federal Register 35090-35100; June 30, 1999). As a first option, according to the issues paper, the USNRC could restrict the release of SRSM only for certain authorized uses or disposition options, in which the potential exposure to the public would be small (conditional clearance). For example, restricting the options to disposal of the SRSM in Resource Conservation and Recovery Act (RCRA) Subtitle D landfills[18] is a conditional clearance that would significantly reduce the number of exposure pathways, relative to a situation in which the material is recycled into consumer products. As a second option, the USNRC could permit the release of solid materials for unrestricted use if the potential for exposure to the public from projected uses were less than a specified dose level (clearance). Unrestricted use might include recycle or reuse of SRSM in consumer or industrial products or any other use. As a third option, the USNRC could prohibit both unrestricted and restricted release of SRSM from a licensed facility. Instead, it could require that such material go to an LLRW facility. For each of these alternatives, the impacts on public health and the environment, as well as on cost-benefit factors, should be considered. Consideration of the means of implementing each alternative and its practicality would also be important if a rulemaking is undertaken.

The issues paper notes that consideration of rulemaking alternatives for solid material release would cause the USNRC to examine the existing policies of international bodies, other federal agencies, state governments, and other standard-setting bodies. The IAEA and the Commission of European Communities have made significant efforts to set standards for the release of SRSM. These bodies have adopted sets of standards based on an annual dose of 10 μSv/yr (1 mrem/yr), which is broadly accepted by the radiation protection community as a de minimis dose.[19] Consistency among standards is an important concern because of the potential import or export of released materials between the United States and other countries.

The issues paper further notes the importance of coordination with other federal agencies, such as the EPA. In regulating its licensees, the USNRC imple-

[18]RCRA defines under separate subtitles the land disposal requirements for categories of waste at different levels of potential health or environmental hazard. Subtitle D covers the lowest level of potential hazard—wastes equivalent to general municipal waste. Landfills meeting these requirements are called Subtitle D landfills. Similarly, landfills suitable for most common hazardous materials generally used in or produced by industry are regulated under Subtitle C and are called Subtitle C landfills.

[19]A de minimis dose is one at or below which statutory or regulatory controls would not apply. The legal term "de minimis" is shorthand for *de minimis non curat lex*, which is Latin for the common law doctrine stating, in free translation, that "the law does not concern itself with trifles."

ments the environmental standards set by the EPA. In the absence of EPA standards in areas such as the release of SRSM, the USNRC has the authority to set standards. If proposed USNRC actions are not closely coordinated with the EPA, problems could develop if the EPA later adopted conflicting standards. A majority of the states have entered into agreements with the USNRC to assume regulatory authority over small quantities of byproducts, sources, and nuclear material. Other standard-setting bodies such as the NCRP could play important roles in setting dose standards for release of solid materials. The NCRP, a nonprofit corporation chartered by the U.S. Congress, makes recommendations regarding acceptable levels of radiation exposure to the general public, including levels considered to present a de minimis health risk.

THE STUDY TASK AND APPROACH

The USNRC is considering whether to establish a new regulation that would set specific limits for the release of solid materials with low levels of radioactivity (64 Federal Register 35090-35100; June 30, 1999). The primary reason for a new regulation would be to provide consistency in USNRC's regulatory framework for releases of solid materials, including materials with volume contamination. Standards for the release of radioactively contaminated gaseous and liquid materials have already been established.

The USNRC has sought public input in contemplation of such a rulemaking. Two-day meetings were held in Chicago, San Francisco, Atlanta, and Rockville, Maryland, in late 1999. Hundreds of written and electronic comments from the public at large were received. Following the public meetings, the USNRC contracted with the National Academy of Sciences to study several critical issues related to the release of solid materials with low levels of radioactive contamination. The statement of work, which appears in excerpted form below, outlines five tasks, to be performed by a committee appointed in accordance with the procedures of the National Research Council (see Appendix C for the complete statement of work):

1. As part of its data gathering and understanding the technical basis for the Nuclear Regulatory Commission's (USNRC's) analyses of various alternatives for managing solid materials from USNRC-licensed facilities, the committee shall review the technical bases and policies and precedents derived therefrom set by the USNRC and other Federal agencies, by States, other nations and international agencies, and other standard setting bodies.
2. The committee will review public comments and reactions received so far on current and former USNRC proposals to develop alternatives for control of solid materials. The committee will explicitly consider how to address public perception of risks associated with the direct reuse, re-

cycle, or disposal of solid materials released from USNRC-licensed facilities. The committee should provide recommendations for USNRC consideration on how comments and concerns of stakeholders can be integrated into an acceptable approach for proceeding to address the release of solid materials.

3. The committee shall determine whether there are sufficient technical bases to establish criteria for controlling the release of slightly contaminated solid materials. This effort should include an evaluation of methods to identify the critical groups, exposure pathway(s), assessment of individual and collective dose, exposure scenarios, and the validation and verification of exposure criteria for regulatory purposes (i.e., decision making and compliance). As part of this determination, the committee should judge whether there is adequate, affordable measurement technology for USNRC-licensees to verify and demonstrate compliance with a release criteria. What, if any, additional analyses or technical bases are needed before release criteria can be established?
4. Based on its evaluation and its review, the committee shall recommend whether USNRC (1) continue the current system of case-by-case decisions on control of material using existing, revised, or new (to address volumetrically contaminated materials) regulatory guidance, (2) establish a national standard by rulemaking, to establish generic criteria for controlling the release of solid materials, or (3) consider another alternative approach(es).

   If the committee recommends continuation of the current system of case-by-case decisions, the committee shall provide recommendations on if and how the current system of authorizing the release of solid materials should be revised.

   If the committee recommends that USNRC promulgate a national standard for the release of solid material, the committee shall: (1) recommend an approach, (2) set the basis for release criteria (e.g., dose, activity, or detectability-based), and (3) suggest a basis for establishing a numerical limit(s) with regard to the release criteria or, if it deems appropriate, propose a numerical limit.
5. The committee shall make recommendations on how the USNRC might consider international clearance (i.e., solid material release) standards in its implementation of the recommended technical approach.

Limitations of the Study

In response to the USNRC request, the National Research Council established the Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities (hereafter, the

TABLE 1-3 Risk Assessment Based on a Linear, No-Threshold Model with a Probability of Developing a Fatal Cancer of 5×10^{-2} /Sv (5×10^{-4}/rem)

Incremental Dose	Hypothetical Incremental Lifetime Risk	Hypothetical Lifetime Risk (If dose received each year for 70 years)
1.0 mSv (100 mrem)	5×10^{-5}	3.5×10^{-3}
0.1 mSv (10 mrem)	5×10^{-6}	3.5×10^{-4}
0.01 mSv (1.0 mrem)	5×10^{-7}	3.5×10^{-5}
0.001 mSv (0.1 mrem)	5×10^{-8}	3.5×10^{-6}

"committee"). In completing the five tasks listed above, the committee has worked under several limitations and constraints that are worth noting at the outset. First, for determination of the risk assessments on the health effects of incremental doses, the committee has relied on assessments by UNSCEAR (1988), the National Research Council Committee on the Biological Effects of Ionizing Radiation (NRC, 1990) and the NCRP (1993). These assessments found that a lifetime risk[20] of developing a fatal cancer from low dose or low dose rate irradiation is estimated to be 5×10^{-2}/Sv (5×10^{-4}/rem) for an individual in the general population. Table 1-3 shows the risk estimates developed by NCRP (1993) by applying the linear, no-threshold hypothesis to various incremental annual doses.

Second, the committee did not independently explore the relative validity of various biological risk assessments associated with radiation dose. Such assessments for low doses are controversial. They are subject to the assumptions made according to the model employed. Independent evaluation of the validity of the various risk assessments was beyond the scope of the task before the committee.

A third limitation was the exclusion of soils from major consideration. The amount of soil involved in decommissioning the nuclear power plants is generally small relative to the quantities of concrete and metals as shown in Chapter 3 (Table 3-6). On the other hand, the amount of contaminated soil at DOE facilities can be significant.

Study Process

The committee organized three information-gathering meetings, at which speakers were invited to make presentations before the committee on a range of technical issues. Several stakeholder groups presented their views to the commit-

[20]Lifetime risk is the likelihood of an adverse health effect occurring (fatal cancer, in this instance) at *any* time in the future due to exposure to radiation.

tee. Views from industries affected by proposed clearance of SRSM were also presented. Meetings in which information was presented to the committee were open to the public, and when time permitted, either the speakers or members of the committee addressed questions from the audience. Speakers were encouraged to provide written statements or to provide the audience with copies of their visual aids. Appendix B gives a detailed account of the speakers who provided information to the committee at these meetings.

Certain members of the study committee visited two waste brokers, ATG in Richland, Washington, and Duratek, Inc., in Oak Ridge, Tennessee. The members observed and studied the methods currently used to release solid materials with low concentrations of radioactive contamination from regulatory control.

Report Content

The regulatory framework for controlling the release of solid materials with radioactive contamination is described in Chapter 2, which is organized into three main sections. The first deals with the technical assumptions underlying radiation standards and includes a review of the important concepts employed in establishing radiation standards. The second section discusses the historical evolution of regulatory practices and controls in greater technical detail than the introductory account in this chapter. The third section provides a comparative assessment of existing regulatory regimes in the United States.

Chapter 3 discusses the inventory of radioactively contaminated solid materials from USNRC licensees, DOE, DoD, and various industrial sources. The first section of the chapter deals with waste streams from nuclear reactors. The second section presents a much broader view of the accumulated inventory, including licensed fuel cycle and non-fuel cycle facilities, DOE, DoD, EPA Superfund sites, NORM, and TENORM.

Chapter 4 defines major alternatives for the disposition of solid materials with low concentrations of radioactivity. A decision diagram with decision points and disposition pathways is described. Estimated costs for various disposition alternatives are discussed because disposal costs are markedly affected by the disposal options available to a licensee—for example, which disposal sites can be used by a licensee for different categories of solid materials.

Chapter 5 reviews the technical basis for developing dose-based standards. Implementing a dose-based standard requires a conversion from a concentration of radioactivity in a solid matrix, as measured before release, to estimated doses resulting from exposure of an individual in a critical group to that material. The critical pathways and the assumptions made in performing these conversions are discussed, as are the uncertainties in determining the factors for converting between measurable radioactivity levels and a dose standard.

Chapter 6 discusses the difficulties in quantitatively determining the identity and activity of the radionuclides present in SRSM. It reviews the capability and

costs of instrumentation and measurement procedures to conduct the determination at various proposed screening levels. Also discussed are current measurement practices of waste brokers and approaches to develop an appropriate sampling program.

Chapter 7 reviews the efforts to develop international clearance standards. The final section of the chapter summarizes the status of several countries in establishing clearance standards for the release of SRSM.

Chapter 8 reviews stakeholder concerns and issues regarding past and recent efforts of the USNRC to establish a clearance standard for SRSM. The chapter emphasizes the importance of effective risk communication and establishing trust in building stakeholder acceptance. Consensus-building processes to involve stakeholders are presented.

Chapter 9 presents the committee's version of a decision framework for considering alternatives for controlling the release of solid materials with radioactive contamination. First, the problems with the current USNRC approach are described. Then a systematic decision framework for considering the alternatives for release of radioactive material is presented. The chapter also addresses issues of public perception. A section on process considerations provides options for obtaining enhanced participation from the public and possibly proceeding to a rulemaking.

Chapter 10 contains key findings from the report that serve as a foundation for the committee's recommendations. The committee's recommendations are presented as well.

2

The Regulatory Framework

MECHANICS OF EXISTING AND FORMER STANDARDS GOVERNING RELEASES OF RADIOACTIVELY CONTAMINATED MATERIAL

The technical assumptions underlying existing and former radiation standards are integral to the standards themselves and thus critical to evaluating them. In this section, the study committee reviews several of the most important concepts used in establishing radiation standards, including dose-based versus activity-based standards, the role of calculated simulations in assessing risks, the importance of defining critical groups, and important uncertainties in assessing risks (see Box 2-1 for description of different types of radiation standards).

The general trend in environmental regulation is toward risk-based standards, which typically focus on the estimated increased lifetime risk of cancer posed by the regulated material (NRC, 1994). Certain statutes, however (e.g., sections of the Clean Air Act), continue to use technology-based standards. That is, they prescribe the use of a particular control technology rather than establishing an acceptable exposure level. Calculating the health risks associated with a radioactively contaminated object involves a two-step process. First, the dose must be calculated, which entails constructing a range of scenarios to represent the range of potential doses to individuals. Second, for each estimated dose, the attendant health risk or harm must be estimated. As discussed below, both steps necessarily introduce uncertainties and typically use simplifying assumptions.

The virtues of a risk-based approach are that it establishes standards close to the level of public health concern, ensures that contaminant levels are controlled

BOX 2-1
Different Types of Radiation Standards

Radiation standards are set to protect the public from harmful exposure to radiation from the direct radiation, releases or residues of nuclear materials. Different concepts are used in establishing the radiation standards; the different types are named after the concept on which they are based:

- *Technology-Based Standard.* A technology-based standard requires application of best available technology to reduce exposure to acceptable levels, levels that are the lowest reasonably achievable.
- *Risk-Based Standard.* A risk-based standard requires measurement against a designated level of exposure that defines acceptable risk. A simple example of a risk-based standard is one that sets a limit for chronic radiation exposure at a level that is associated with an acceptable range of probability for the lifetime risk of cancer. A more complex example of a risk-based standard is found in 10 CFR Part 63, the regulation for safe disposal of high-level radioactive waste. This requires that the results of the probabilistic performance assessment for Yucca Mountain be compared directly to the compliance standards set in Part 63.
- *Risk-Informed Standard.* A risk-informed standard is one in which specific bases for acceptance are set in the standard and a separate risk assessment is used to examine whether the standards were prudently chosen. Acceptance is not based on direct compliance with risk terms. Perhaps the broadest example of risk-informed regulation is the USNRC's complex code of standards for licensing nuclear power plants, where specific probabilistic risk assessments (PRAs) are used in supplement to examine the residual risk for plants licensed against these standards. The results of the specific PRAs may be compared to published safety goals, but the plants are not directly licensed to comply with these safety goals. The reactors must comply with the panoply of specific requirements for licensing; the PRA provides a supplemental analysis to estimate whether the reactor achieves the safety goal.
- *Dose-Based Standard.* A dose-based standard is one that sets the maximum radiation exposure from a source, for example, from released slightly radioactive solid material, that might be suffered by the most exposed group in the public.
- *Activity-Based Standard.* An activity-based standard is one that sets limits on the radioactive content of a source, for example, from released SRSM, where the limits are derived from acceptable exposure rates.

to achieve acceptable levels of public health protection, and promotes consistency among different regulations. Risk-based standards are meant to be responsive to public policy decisions on widely acceptable levels of risk and are presumed to be rationally based on carefully conducted estimates of dose and risk. The unavoidable uncertainties in risk-based standards are therefore more than offset by their capacity to incorporate policy determinations into a rigorous, scientifically based framework. However, an important challenge is to ensure

that the methods used, including their simplifying assumptions and inherent constraints, are sufficiently transparent to both technical peers and the concerned public.

As noted earlier, two types of standards exist in the area of radiation safety for slightly radioactive solid material (SRSM). One type is based on the level of radiation exposure, or dose. The other is based on the level of radioactivity of the material in question and is therefore often called an activity-based standard. Superficially, a radioactivity-based standard appears to be the more direct of the two approaches because it prescribes a maximum level of radiation that may be emitted by an object that is to be used or disposed in a specified manner. A radioactivity-based standard does not appear to require the complex process of assessing how individuals might be exposed to the object's radioactivity and what the resulting doses are likely to be. Technical analyses such as draft NUREG-1640 (USNRC, 1998b) derive radioactivity-based limits for selected disposition cases that are based on risk or dose limits (see Chapter 5). However as discussed further below, whether there is in fact a significant difference in complexity between these two types of standards depends on whether the governing regulation is based on technology (i.e., a control or measurement limitation) or on limiting exposure, hence risk.

Technology-Based Regulations

Regulatory standards may be based on the limitations of existing control or measurement technologies. The U.S. Nuclear Regulatory Commission's (USNRC's) existing guidance document concerning release of solid materials with surface contamination from regulatory control, developed in the 1970s, is based on the decontamination survey practices that were in use at that time (see Box 2-2). Some environmental laws, such as specific provisions in the Clean Air Act, base regulations on the "best available control technologies." In this approach to regulation, the focus is not on risk, which is difficult to estimate and even harder to defend, but on promoting the use of the most advanced technologies and fostering their further development.

Regulations that require the use of best available control technology obviate the need for dose estimates. In some instances, specifying activity limits is not necessary. The salient issue is maximizing the use of the most effective control technologies. To achieve this, a regulation could prescribe limits on radioactivity levels (e.g., annual emissions limits on radionuclides) or require that specified instruments or methods, and defined limits, be employed when radioactively contaminated materials are monitored. To a large degree, the existing guidance embodies this latter principle, relying on extensive guidance for procedures and practices (AEC, 1974; USNRC, 1981).

Technology-based regulation has the advantage of being relatively simple to implement. It avoids the complexities of determining the myriad ways in which

BOX 2-2
Regulatory Guide 1.86: Guidance for Unrestricted Release

Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, was published in June 1974. In addition to guidance on reactor license amendments, it included an important section, "Decontamination for Release for Unrestricted Use," which established the guidelines for reactor decommissioning and the clearance of solid materials. This section included a table that codified established standards at many sites for adequate decontamination of surfaces. The key language for the present purposes is contained in Section 4:

> After the decontamination is satisfactorily accomplished and the site inspected by the Commission, the Commission may authorize the license to be terminated and the facility abandoned or released for unrestricted use. The licensee should perform the decontamination using the following guidelines [paraphrased]:
>
> - A reasonable effort should be made to eliminate residual contamination.
> - No covering should be applied to radioactive surfaces.
> - The radioactivity of the interior surfaces should be determined.
> - The USNRC may authorize controlled release to another licensee based on detailed health and safety analysis of premises, equipment, and scrap.
> - Prior to release for unrestricted use, the licensee should report the results of a comprehensive radiation survey.

SOURCE: AEC (1974).

people might be exposed to radiation from radioactively contaminated materials. A major disadvantage, however, is that if the approach were applied in total ignorance of the potential harms, it could result in either serious underregulation and thus increased risk to the public or overregulation and hence increased costs to the regulated industries. Thus, when developing technology-based regulations, regulatory agencies are well advised to conduct at least brief analyses of the risk reduction and cost-benefit achieved by the specific technologies that might be implemented.

Risk-Based Regulations

In practice, many standards are a hybrid of dose-based and activity-based approaches. For example, any risk-based standard, whether its allowed maximum levels are expressed as doses or radioactivity levels, entails that the ultimate dose to a certain class of individuals, termed the "critical group," be assessed. To bound the analysis in the assessment requires fairly elaborate simulations and numerous technical judgments. The inherent uncertainty associated with these

simulations and judgments varies with the quality of data and the range of potential exposure scenarios that must be considered.

Constructing Critical Groups and Exposure Scenarios

Often, relatively clear bounding hypotheses for the analysis can be identified by using conservative assumptions about possible routes of exposure. For example, in developing its analyses for risk-based standards, the Environmental Protection Agency (EPA) has sought to identify plausible examples from which significant exposures could arise. It uses these exposure scenarios to construct the critical groups for the analysis. The doses to these critical groups, estimated by simulating the exposure scenario, dictate the level of radioactivity that is permitted in materials subject to regulation.

As an illustration of how critical groups are used, one critical group considered by the EPA is represented by an operator of an industrial lathe made with radioactively contaminated cast iron. This is a relatively high-dose scenario because of the time spent next to the radioactive object, as well as its size and proximity. The larger the object, given the same concentration of radioactive material, and the longer the time in proximity, the higher is the exposure (EPA, 1997a).

In most cases, as in the above example, the doses to the critical groups are constructed to provide the upper bound on what is permissible under the regulation. The method assumes that most of the public will be exposed to far lower levels of radiation than would members of the critical groups.

An important question that is frequently raised about such simulations is whether exposure from a number of different sources could lead to much higher levels of risk. Returning to the example of the lathe operator, multiple exposures would occur if this individual were exposed not only to radiation from the industrial lathe but also to radiation from cast iron cooking utensils and large home appliances. In theory, these multiple routes of exposure could raise the individual's exposure above the level that the applicable regulation is attempting to ensure is not exceeded.

Regulators work to account for the potential that multiple exposures will occur by using information on the volume of materials at issue, the materials' potential uses, the relative importance of different routes of exposure, and the circumstances under which the materials are used (EPA, 1997a). Using this information and a conservative set of assumptions, regulators attempt to assess the likelihood and importance of multiple exposures. For completeness, it is important to take into account the potential for such multiple exposures, even where the levels of contamination in the materials are very low, since multiple exposures can result in a higher dose to an individual than originally analyzed. Allowance for multiple exposures may be in the form of choosing a level for a standard that reflects the likelihood of multiple exposure. Thus, the standard for release of a

site may be a relatively large fraction of the public exposure safety limit, while the standard for release of material into commerce would be a much smaller fraction, even a de minimis level.

Uncertainty and Sensitivity of Analytical Assumptions

The inherent complexity of dose assessment analyses requires that numerous simplifying assumptions be made. For example, assumptions must be made about the length of time a person spends next to a contaminated object and at what distance, as well as whether the contaminated material is mixed with clean materials before being fabricated into a consumer product. These assumptions and the variability in the quality of information available mean that the exposure simulations on which the analysis depends are subject to significant uncertainties. These uncertainties are typically difficult to quantify. If overly conservative assumptions are used in the analysis, the assessment will err on the side of caution. Conversely, if simplifying assumptions minimize or underestimate potential risks, the assessment will err toward inadequate control to protect health and safety. If uncertainty distributions or ranges for the input assumptions are available, analysts can perform studies, using methods such as Monte Carlo simulations, to obtain estimates of the uncertainties in the dose calculations or other predictions from the analysis (see Chapter 5 for further discussion).

In addition to uncertainty, the difference that any given assumption makes to the overall analysis can be quantified by using a *sensitivity analysis*. The sensitivity of the final dose estimate to a particular input assumption or factor is measured by varying the value assumed for that assumption without varying any other factors.

Although Monte Carlo simulations and sensitivity analyses can be complicated by variables that are strongly dependent, they provide an important means by which analysts can gain a qualitative sense of the reliability, or variability, of their estimates and an understanding of what factors are most important. Regulators therefore have at their disposal an array of analytical methods that can be used to assess whether their judgments are reasonable.

Critical Uncertainties

Although the analytical methods employed by regulators in establishing standards have become increasingly sophisticated, uncertainty and judgment are unavoidable in assessing potential risks and deciding how much extra conservatism to embed in the regulations. In the present context, there are several particularly important uncertainties, which the committee discusses at several points in this report. Among these uncertainties are the following:

- The risk that radionuclides will concentrate in certain solid materials that

are unconditionally released into commerce;
- The limits on existing radiation monitoring equipment and survey methods;
- The significance of multiple potential exposure pathways for cumulative exposure to the public; and
- The reliability of conservative, or bounding, hypotheses in designating critical groups.

The consequences of these uncertainties for assessing risks associated with radionuclides are particularly complex because many radionuclides are long-lived and because monitoring for low levels of radioactivity requires sophisticated instrumentation and rigorous methods. In making conservative estimates, regulators must carefully take these factors into account. As discussed in Chapter 5, analysts attempt to incorporate these factors into their calculations and assess their significance, at least qualitatively.

HISTORICAL EVOLUTION OF THE REGULATORY FRAMEWORK FOR CONTROLLING RADIOACTIVELY CONTAMINATED SOLID MATERIALS

Under the Atomic Energy Act of 1946 as amended in 1954 (AEA), the Atomic Energy Commission (AEC) and its successor agency, the USNRC, were granted the authority to regulate radioactive materials associated with nuclear fission. These materials are categorized in the AEA as *source materials* (i.e., uranium and thorium), *special nuclear materials* (e.g., plutonium), and *byproduct materials* (e.g., most radioactive material including common radioactive wastes) (42 U.S.C. §§ 2073, 2091, 2111).[1] Byproduct material includes any radioactive material (except special nuclear material) yielded in or made radioactive by the process of nuclear fission. This process includes both fission fragments (fission products) and activation products (42 U.S.C. § 2014(e)).[2] Notably, the AEA does cover naturally radioactive source materials, but does not cover naturally occurring radioactive material (NORM) (e.g., radon gas), technologically enhanced

[1]References to the United States Code (U.S.C.) are given parenthetically using the conventional format with the title number first (Title 42 in this reference), followed by the initials U.S.C. and the section numbers within the title.

[2]The Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604) added a second category of byproduct materials at section 11(e)(2) of the AEA, defining them as the "tailings" or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material (i.e., uranium or thorium) content. This and other terms have been paraphrased from their original sources, the Atomic Energy Act and 10 CFR Part 20. These sources should be consulted with regard to the precise legal meaning and effect of these terms.

NORM (TENORM), or materials made radioactive from particle accelerator experiments.

In establishing the AEC's regulatory authority, the AEA delineated appropriate regulatory procedures in substantial detail (42 U.S.C. §§ 2073, 2091, 2111). It did not prescribe specific technical requirements, deferring instead to the AEC, and later the USNRC, to develop and promulgate requirements for specific activities. Accordingly, all activities that were to be licensed by the AEC originally required the applicant to submit technical justifications for the proposed practice and to undergo a case-by-case review for authorization. Over time, specific requirements have been established for recurring or routine license applications.

Regulatory Practices and Controls

Title 10 (Energy) of the Code of Federal Regulations establishes licensing requirements for all practices using nuclear materials under the jurisdiction of the USNRC and agreement states. Examples include 10 CFR Part 40 for source material, 10 CFR Part 50, et seq., for facilities that produce or utilize special nuclear material, and a series of regulations beginning with 10 CFR Part 30 for byproduct material. These regulations codify licensing requirements in a generically applicable way to the extent possible.

The USNRC issues two basic types of licenses, specific and general. A *specific license* is required for practices involving significant quantities of nuclear material that warrant licensee control employing at least one radiation control professional. Commercial nuclear power plants, for example, are operated under a specific license issued by the USNRC. A *general license* may be issued if the quantity of nuclear material is significant but adequately protected through design and administrative controls (e.g., an industrial gauge that uses a strong radiation source). General licensees are not required to have radiation control professionals but are required to use a generally licensed device under the specified controls. The design and administrative controls are imposed through the specific licensee who makes and distributes a generally licensed device, as well as the end user of the device.

Certain radioactive materials may be deemed exempt from regulation if the amount of radioactive material involved is small enough or adequately protected by design. Examples include ionization smoke detectors and the small quantities and concentrations listed as exempt in 10 CFR §§ 30.70, 30.71.

Extensive regulations govern the disposal of radioactive wastes generated by or from licensed facilities. The regulations for high-level radioactive waste, 10 CFR Part 60 and Part 63, define high-level radioactive waste by its origin, not its radioactive content, and delineate detailed requirements for its licensed disposal. The disposal requirements for the three classes of low-level radioactive waste (LLRW) are contained in 10 CFR Part 61. Although these regulations impose upper bounds on the radioactive content for Class A, B, and C low-level waste,

they do not specify a floor or threshold content of radioactivity below which material may be treated as nonradioactive waste. Accordingly, under existing regulations there is no generally applicable criterion for determining that the radioactive content in solid waste is de minimis.[3]

Formal USNRC regulations are augmented by a series of guidance documents, referred to as "Regulatory Guides," that establish preferred or acceptable methods for regulatory compliance purposes. Regulatory Guides are developed and proposed by committees of technical experts in a specific area, such as radiation monitoring or facility engineering requirements. If the USNRC endorses a proposed practice, it is formally published as a Regulatory Guide. Licensees who adopt a Regulatory Guide by incorporating it by reference in their license application are subject to inspection and enforcement of its requirements. A license applicant may choose instead to propose different practices for special reasons. However, doing so can lead to substantial delays in licensing decisions.

One such guidance document, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors* (AEC, 1974), is of particular interest to the study committee's task (see Box 2-2). Issued in June 1974, this guide was released in the midst of the transition from the former AEC to the newly established USNRC. This was also the time when the first generation of demonstration power reactors was decommissioned. Unlike the typical document in this series, Regulatory Guide 1.86 was not developed by an expert committee; it was promulgated as a placeholder to enable reactor decommissioning to proceed. Thus, it enumerates licensing administrative requirements and different approaches to reactor decommissioning and specifies, in its fourth and final section, a systematic approach for license termination and release of equipment and the site.

Regulatory Guide 1.86 includes a table, Table I, of acceptable surface contamination levels. This AEC guidance for permitting clearance of radioactive materials dates back more than 25 years, to the initial preparation of Regulatory Guide 1.86. The Table I guidance had been in informal use for some time before 1974 and apparently was based on the detection limits of the instruments available at that time, not on an assessment of risk.[4] Table I contains guidance on clearance standards for surfaces such as floors, walls, structural materials, and equipment; it contains no standards for volume contamination. The table, which became the USNRC's de facto standard for clearance of solid materials with residual surface contamination, has been widely used for decades.

Selecting a clearance level requires that specific implementing protocols be developed. Office of Inspection and Enforcement (IE) Circular No. 81-07, *Con-*

[3]For two radionuclides only, in solid materials, and in one specific application, section 2005(a)(2) of 10 CFR Part 20 does contain release criteria. These criteria allow disposal of volume-contaminated animal tissue containing less than 1.85 kBq/g of ^{3}H or ^{14}C as if it were not radioactive.

[4]The committee was not able to uncover substantial evidence that this early work was based on an assessment of risk.

trol of Radioactively Contaminated Material, provides guidance on radiation control programs, including material clearance protocols (USNRC, 1981). It contains guidance for implementing the surface contamination standards in Table I, such as data on radiation detection instrumentation, as well as radiation control systems required generally of licensees. Like Regulatory Guide 1.86, this guidance is not specific to volume-contaminated materials.

Authorized Releases of Radioactive Materials from Regulatory Control—Existing and Proposed Standards

The USNRC's general radiation protection regulations in 10 CFR Part 20 prescribe acceptable radiation exposures for workers and the public, as well as permissible levels of radioactivity in gaseous or liquid emissions from licensed facilities. Section 2002 of Part 20 provides for a case-by-case review to obtain approval to dispose of radioactive materials in unlicensed facilities when procedures are not specifically prescribed by existing regulations. (The USNRC received approximately 15 such requests over the past 5 years [USNRC, 2001b]. As the committee understands it, these requests cover only proposed disposals that are different from standard practices.)

In addition to the requirements specified in Part 20, the USNRC frequently incorporates directly into a facility's license specific requirements for release of certain radioactively contaminated solid materials. Except for the exemption tables in 10 CFR Part 30, general standards for the unrestricted release of volume-contaminated solid materials have not been promulgated.

First in 1986 and again in 1990, the USNRC proposed to formalize and update the existing guidance and other regulations by establishing policies on radiation levels that would be considered "below regulatory concern" (BRC). These proposals were meant to establish a threshold for residual levels of radioactivity, below which the solid material could be cleared from further regulatory control. Section 10 of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (42 U.S.C. § 2021j) specifically addresses low-level waste. Consistent with this statute, the proposed BRC policy attempted to set general criteria for allowable individual dose and collective dose[5] resulting from authorized releases of radioactively contaminated materials from licensed activities.

The BRC proposal was intended to be an overarching approach that would establish specific quantitative standards for site releases at license termination, unrestricted release of waste materials, and consumer or industrial product uses of radioactive materials, as well as other standards. In some quarters, however, this proposal was perceived as a subterfuge to reclassify a large part of the low-level waste from commercial reactors as nonradioactive waste, thereby allowing

[5]Collective dose is the sum of the individual doses received, in a given period of time by a specified population, from exposure to a specified source of radiation.

licensees to avoid the costs of disposal at a licensed LLRW facility (USNRC, 1991a). Many comments from the general public, the states, and Congress rejected the BRC approach for releasing radioactively contaminated materials for unrestricted reuse or disposal. In response to these criticisms, the USNRC placed a moratorium on the proposed BRC policy while it attempted to build public consensus for it. That effort failed, and Congress formally revoked the BRC policy in the Energy Policy Act of 1992. The USNRC rescinded its proposed BRC policy statement soon afterward.

In response to the USNRC's deregulation efforts, at least 16 states subsequently passed regulations or laws that were stricter than the federally proposed allowable releases. The intent evident in most of these new restrictions was to continue regulatory control if the federal government allowed deregulation. Major concerns voiced by the public included the uncertain risks, a lack of confidence in the USNRC and the Department of Energy (DOE), and general concerns about the release of radioactive materials into consumer products (USNRC, 1991a, 1991b). Chapter 8 provides further details on public reactions to the BRC proposal.

The committee has been asked to address questions related to a proposal that may be considered another attempt by the USNRC to establish uniform standards for the unrestricted release of SRSM. In 1998 the Commission directed the USNRC staff to consider a rulemaking for establishing a dose-based standard for release of SRSM (USNRC, 1998a), and in January 1999 the USNRC initiated an enhanced participatory rulemaking directed at establishing a clearance standard (USNRC, 1999c). At the same time, the USNRC sponsored a draft technical report on the topic, NUREG-1640, *Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities* (USNRC, 1998b). This draft report was criticized severely when concerned parties learned that the contractor developing the draft, Science Applications International Corporation (SAIC), was concurrently also doing work for a company that stood to gain financially from the promulgation of a clearance standard.

The USNRC published an issues paper in the *Federal Register* (64 Federal Register 35090-35100; June 30, 1999) and held a series of public meetings from September through December 1999. Its proposal for rulemaking on release criteria aroused the same skepticism that had greeted its earlier BRC policy. Consumer and environmental groups were particularly incensed that in their view, the USNRC had predetermined the outcome before it started. These concerns led to a broad-based boycott of the first two 1999 public meetings. At the same time, the USNRC, through its contract with SAIC, was conducting a detailed technical analysis that would become NUREG-1640 to assess the risks associated with establishing a clearance standard. As discussed in the section "Stakeholder Involvement" below, significant concerns about public health and safety issues and negative economic impacts on certain industries were raised. A USNRC paper summarizing the public meetings, technical bases, and alternatives was issued on

March 23, 2000 (USNRC, 2000a). A final stakeholder briefing occurred on May 9, 2000. As part of its response to the concerns expressed at these meetings, the Commission requested that a study be undertaken by the National Academy of Sciences.

COMPARATIVE ASSESSMENT OF EXISTING REGULATIONS IN THE UNITED STATES

There are numerous regulations in the United States governing releases of radioactively contaminated materials and facilities. Three agencies—the USNRC, DOE, and EPA—have promulgated regulations and/or guidance according to their respective statutory authorities. The standards range from about 1 mrem/yr (USNRC's Regulatory Guide 1.86, as estimated in USNRC, 1998b), to 100 mrem/yr (10 CFR Part 20.1301, which limits the annual dose received by members of the public from a licensee), to 500 mrem (10 CFR Part 35.75, which allows a licensee to release a person who has received radiopharmaceuticals provided doses to *other* persons will not exceed 500 mrem). In radiation control the USNRC generally applies the standards as limits supplemented by explicit steps to maintain the exposures at levels that are as low as reasonably achievable (ALARA). The EPA generally applies specific limits to specific applications. While there is general agreement among the three agencies, differences persist with regard to standards for protection of groundwater and for an all-pathways dose. Even within one agency's regulations, there are apparent discrepancies. For instance, the cancer risks associated with EPA standards for water, air, and Superfund cleanup range over more than two orders of magnitude (NRC, 1999). In summary, the levels of protection afforded by federal regulation of radioactive materials vary widely.

USNRC Regulations

There are two sets of USNRC regulations for unrestricted release. One set pertains to the release of facilities from regulatory control; the other pertains to materials to be released on an unrestricted basis from regulated facilities. Each set of regulations provides for significant regulatory flexibility depending on the circumstances.

The USNRC's License Termination Rule: Release of Facilities

The USNRC's License Termination Rule, 10 CFR Part 20, Subpart E, governs unrestricted and restricted release of USNRC-licensed facilities from regulatory control. This rule establishes procedures and specific standards that must be met before regulatory oversight of a facility can be terminated. The rule's key requirements are as follows:

- Unrestricted release of a USNRC-licensed facility is permitted if the all-pathways dose, including groundwater, does not exceed 25 mrem/yr and radioactive residues have been reduced to levels that are ALARA.
- Restricted release of a USNRC-licensed facility is permitted if (1) the net public and environmental harm is comparable to compliance with the 25 mrem/yr limit for unrestricted release and the residue levels are ALARA; (2) institutional controls are adequately funded and legally enforceable; (3) requirements for restricted release have the advice of a broad cross section of the community interests; and (4) in the event that institutional controls fail, the maximum dose is ALARA and does not exceed 100 mrem/yr (or 500 mrem/yr under exceptional circumstances substantiated by detailed information).

Alternative criteria may be submitted by a licensee for review if they are supported by adequate plans and analyses prepared with community advice. The dose limits apply to the total effective dose equivalent for the average member of the critical group, calculated over the first 1,000 years after decommissioning.

The USNRC's Case-by-Case Approach: Release of Materials

Overview. As noted in Chapter 1, the USNRC's regulations under 10 CFR Part 20 limit the radiation dose that an individual can receive from the operation or decommissioning of a USNRC-licensed facility and also require that doses received are ALARA. Although Part 20 sets standards for releases of effluents (liquids or gases), it sets no specific standard for release of solid materials with surface or volume contamination.[6] The USNRC generally evaluates releases on a case-by-case basis using license conditions and existing regulatory guidance.

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[6]According to the USNRC (1999a):

> For most NRC licensees, solid materials have no contamination because these licensees use sealed sources in which the radioactive material is encapsulated. These include small research and development facilities and industrial use of various devices including gauges, measuring devices, and radiography.
>
> For other licensees (including nuclear reactors, manufacturing facilities, larger educational or health care facilities, including laboratories) materials generally fall into one of three groups based on its location or use in the facility:
>
> - Clean or unaffected areas of a facility, from which areas the solid materials would likely have no radioactive contamination;
> - Areas where licensed radioactive material is used or stored, from which areas materials can become contaminated although the levels would likely be low to none; and
> - Material used for radioactive service in the facility or located in contaminated areas or areas where contamination can occur, from which materials generally have levels of contamination that would not allow them to be candidates for release unless they are decontaminated.

In Section 2002 of Part 20, "Method for obtaining approval of proposed disposal procedures," the basis for the case-by-case review is virtually the same as that in the old Section 302 of Part 20. As noted above, neither version provides specific standards for exemption.[7] The pertinent portion of Part 20.2002 reads as follows:

> A Licensee or applicant for a license may apply to the Commission for approval of proposed procedures, not otherwise authorized in the regulations in this chapter, to dispose of licensed material generated in the licensee's activities. Each application shall include:
>
> a. A description of the waste containing licensed material to be disposed of, including the physical and chemical properties important to risk evaluation, and the proposed manner and conditions of waste disposal; and
> b. An analysis and evaluation of pertinent information on the nature of the environment; and
> c. The nature and location of other potentially affected licensed and unlicensed facilities; and
> d. Analyses and procedures to ensure that doses are maintained ALARA and within dose limits in this part.

Under the case-by-case approach, the USNRC does not consider most releases of solid materials to be "disposals" authorized under Part 20 or Part 61. Instead, these releases are frequently authorized by specific license conditions, that is, a specific provision contained in the facility's license.[8]

Categories of Release. USNRC guidance on release of SRSM falls into three categories: (1) release of solid materials with surface residual radioactivity at reactors, (2) release of surface-contaminated solid materials possessed by a materials licensee (i.e. nonreactor licensee), and (3) release of volume-contaminated solid materials possessed by reactor and materials licensees (USNRC, 2001b). The guidance for each category is summarized next.

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[7]The 1957 issue of Part 20 had a short section on waste disposal that included Part 20.302, "Method for obtaining approval of proposed disposal procedures," the basis for case-by-case review of disposal procedures not authorized by the two succeeding sections on disposal in sewerage systems or in soil. The original Part 20 gave general requirements for waste disposal of byproduct material. The 1957 standard did not include any criteria for a floor to the amount or concentration of controlled radionuclides, which criteria might be used as the basis for exemption of waste from regulatory control.

[8]It is not appropriate to apply the ALARA principle at or below the dose limits that are typically proposed for clearance calculations. These are not dose safety limits in the ordinary sense of the word, but are levels at which SRSM may be released from regulatory control. The dose limits of 0.1 to 10 mrem/yr are already orders of magnitude below natural background levels. Additionally, the variation in natural background dose is larger than the level of the selected dose limit. Since the proposed dose limits are already well below most established safety limits, it is not appropriate to apply the ALARA principle to the clearance dose limits as calculated in NUREG-1640.

Release of solid materials with surface residual radioactivity at reactors. Reactor licensees typically follow a policy established by IE Circular 81-07, *Control of Radioactively Contaminated Material*, and Information Notice 85-92, *Surveys of Wastes Before Disposal from Nuclear Reactor Facilities* (USNRC, 1981, 1985). Under this policy, reactor licensees must survey equipment and material before its release. If the survey indicates the presence of licensed AEA material above natural background levels, the equipment or material cannot be released (USNRC, 2001b). The IE Circular 81-07 and related guidance basically set the sensitivity required of survey instruments, a sensitivity similar to that used in applying Regulatory Guide 1.86.

Release of surface-contaminated solid materials possessed by a materials licensee (i.e., nonreactor licensee). For materials licensees, the USNRC usually authorizes the release of solid material through specific license conditions. Table I of Regulatory Guide 1.86 is used to evaluate surface contamination on solid materials before they are released (AEC, 1974). Similar guidance is found in Fuel Cycle Policy and Guidance Directive FC 83-23, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source or Special Nuclear Materials Licenses* (USNRC, 1983). Both documents contain a table of surface contamination criteria, which may be used by licensees as the basis for demonstrating that solid material with surface contamination can be released safely with no further regulatory control.

Release of volume-contaminated solid materials possessed by reactor and materials licensees. The USNRC has not provided guidance for volume-contaminated materials analogous to the guidance in Regulatory Guide 1.86 for surface contamination. Instead, the USNRC has decided these situations on a case-by-case basis by evaluating the doses associated with the proposed release of the material. Typically, the evaluation and decision is made in such a way as to ensure that the maximum doses are a small percentage of the Part 20 dose limit for members of the public of 100 mrem/yr.

The Role of States. Under the AEA, the USNRC has preemptive authority to license and regulate the ownership, possession, use, and transfer of AEA materials—source, byproduct, and special nuclear materials—and to set standards, as are necessary to protect public health, for the ownership, possession, use, and transfer of AEA materials. However, Section 274 of the AEA specifically authorizes the Commission to enter into agreements with states to transfer limited elements of that authority. These agreements constitute a discontinuance of USNRC's authority, not a delegation; a state assumes the USNRC's authority over selected radioactive materials (specifically, byproduct materials, source materials, or special nuclear materials in quantities not sufficient to form a critical mass). Once an agreement is signed, the USNRC continues to have an over-

sight responsibility to ensure that the state, called an "agreement state," has a program for the regulation of AEA material that is adequate to protect public health and safety and is compatible with USNRC regulations (USNRC, 1999b).

As of December 2001, 32 states had entered into agreements with the Commission, and four more states had applied for agreement state status. The USNRC has extensive arrangements and procedures for communicating and interacting with the agreement states, especially to ensure that agreement state regulations are compatible with USNRC regulations.

For some USNRC requirements, such as basic radiation protection standards or those that have significant implications for interstate commerce or related activity (sometimes referred to as "transboundary implications"), the agreement state must adopt essentially identical requirements, in order to be compatible with the USNRC. For other USNRC requirements, such as most licensing requirements, the agreement state has some flexibility to adopt its own requirement if the state's requirements meet the essential objective of the USNRC. States may also establish more restrictive requirements provided that they have an adequate supporting health and safety basis and the requirements do not preclude a practice that is in the national interest (USNRC, 1999b). Criteria that have been applied by states on a case-by-case basis include the use of radiation levels that are indistinguishable from background, the use of guidelines similar or equivalent to Regulatory Guide 1.86, and the use of dose-based analyses (USNRC, 1999b).

Cited Advantages and Disadvantages of the Case-by-Case Approach. The USNRC document *Control of Solid Materials: Results of Public Meetings, Status of Technical Analyses, and Recommendations for Proceeding* (USNRC, 2000a) discusses issues and concerns related to a set of alternatives for establishing control of solid materials. In particular, it summarizes the following broad advantages and disadvantages of the current case-by-case approach, an appraisal with which the committee generally agrees:

Advantages. The advantages of the case-by-case approach are the following (adapted from USNRC, 2000a):

- *It is a flexible tool that is currently in use and well understood.* The USNRC staff and licensees have developed a common understanding of the criteria involved.
- *It is protective of public health and safety.* The potential exposures received are a fraction of public health guidelines.
- *Leaving it in place would not involve additional rulemaking resources.* USNRC resources would be devoted to specific requests from licensees, which would bear the cost. The USNRC would not have to expend its resources on a rulemaking.

Disadvantages. The disadvantages of the case-by-case approach are the following (adapted from USNRC, 2000a):

- *The criteria are inconsistent and incomplete*. The absence of uniform criteria for controlling solid materials results in inconsistent release levels. Licensees also can have difficulty determining what information to provide for USNRC approval because the existing guidance and criteria may not be clear.
- *The criteria are not risk informed*. The current detection-based approach does not relate regulatory requirements to the potential risk that might be associated with the regulated activity.
- *Expenditures of time and resources are required to resolve specific cases*. Each review involves establishing and justifying criteria for that case.

DOE Standards on Clearance of Solid Materials

DOE's standards for surface contamination are set forth in Order DOE 5400.5,[9] which incorporates Table I, the surface-activity standards, from USNRC's Regulatory Guide 1.86. At about the same time as the issuance of Regulatory Guide 1.86, the regulatory staff at the AEC were asked to develop solid release standards for volume-contaminated materials from modification of the uranium enrichment plants (see Chapter 5 for a discussion of NUREG-0518). The development of that standard was set aside after publication of NUREG-0518 (USNRC, 1980). Since then, DOE has maintained a policy that generally precluded the release of radioactively contaminated materials for unrestricted use or disposal. Not until Assistant Secretary of Environmental Management Alvin Alm issued a policy statement in September 1996 promoting, on a provisional basis, the recycling of radioactively contaminated scrap steel did DOE formally alter its long-standing policy against unrestricted release of contaminated materials. DOE's release policy had initially focused narrowly on restricted end uses of recycled steel at DOE facilities. It was subsequently broadened, at least unofficially, to include recycling into industrial and consumer products generally.

The 1996 policy change was implemented on a conditional basis while DOE evaluated the safety and economics of recycling these materials. The first large-scale project involving the recycling of radioactively contaminated materials was initiated at the Oak Ridge Reservation's gaseous diffusion plants, which contain

[9]Order DOE 5400.5, *Radiation Protection of the Public and Environment*, Department of Energy, February 8, 1990, revised January 7, 1992. A DOE memorandum dated November 17, 1995, from R.F. Pelletier, provided field and program offices with additional guidance regarding control of residual radioactive material, including the relationship of DOE standards to similar standards set by the USNRC and the states.

more than 100,000 tons of contaminated metals (EPA, 1997a; NRC, 1996). The Oak Ridge project was intended to establish a precedent for a much broader reliance on reuse of radioactively contaminated materials throughout the nuclear weapons complex (NRC, 1996). Under current estimates, DOE facilities contain about 1 million tons of contaminated metals that could be recycled (EPA, 1997a).

Contrary to the recommendations of a prior National Research Council report (NRC, 1996), the Oak Ridge project proceeded with little public outreach, and it ultimately provoked significant opposition from the public and the metals recycling industry. In response to this strong opposition from both the private sector and the public, Secretary of Energy Bill Richardson halted further releases of volume-contaminated metals—but not surface-contaminated metals—from DOE facilities in January 2000. The moratorium was limited to volume-contaminated metals because no generally accepted regulatory standard or guidance existed. In July 2000, Secretary Richardson reaffirmed this moratorium on volume-contaminated materials and added a temporary suspension on unrestricted recycling of all scrap metal originating from within radiologically controlled areas. He proposed continuing the moratorium and suspension until the USNRC resolved whether to proceed with promulgating a standard governing the clearance of radioactively contaminated solid materials. DOE, however, recently initiated the process for drafting a programmatic environmental impact statement on alternatives for recycling surface-contaminated metals (DOE, 2001).

The EPA Role

Under the AEA and Reorganization Plan No. 3 of 1970, the EPA has responsibility for establishing radiation standards, with which USNRC's and DOE's standards must conform. EPA has used its AEA authority to promulgate standards such as 40 CFR Part 190, which sets limits on doses received by members of the public from nuclear power operations. Pursuant to other statutes, EPA has promulgated radiation standards for air emissions and safe drinking water levels. Under the Safe Drinking Water Act, the EPA established a 4 mrem/yr standard for the dose that an individual is permitted to receive from drinking water (40 CFR Parts 141-142). This standard is based on a single pathway of exposure, under which an individual consumes 2 liters of water per day from a single source of drinking water. Under the Clean Air Act, the EPA promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAP), which permits a 10 mrem/yr dose to the reasonably maximally exposed individual from airborne emission of radioactive materials (40 CFR Part 61). The basis for this standard includes multiple exposure pathways, including exposure from airborne plumes, inhalation, and ingestion of foods on which radioactive materials have been deposited.

In August 1997 the EPA issued guidance on residual levels of radionuclides permitted under the Comprehensive Environmental Response, Compensation,

and Liability Act (CERCLA) (EPA, 1997b). The agency premised its standard on the policy that remediation goals for radionuclides should be consistent with a lifetime risk ranging from 10^{-4} to 10^{-6}. According to EPA guidance, clearance levels for CERCLA sites cannot result in a dose that exceeds 15 mrem/yr, which EPA guidance states "equates to approximately 3×10^{-4} increased lifetime risk" (EPA, 1997b).

In the context of evaluating potential clearance, or de minimis, standards, the EPA has provided technical analyses in the form of two major studies. In 1997 it completed a draft technical support document, *Evaluation of the Potential for Recycling of Scrap Metals from Nuclear Facilities* (EPA, 1997a), and a cost-benefit analysis, *Radiation Protection Standards for Scrap Metal: Preliminary Cost-Benefit Analysis* (EPA, 1997c).

The focus of EPA standard setting for unrestricted release has been on promoting consistent international import-export controls for materials containing residual radioactivity. This issue has become increasingly important with the erosion of regulatory controls at nuclear facilities in the countries of the former Soviet Union. A number of incidents have occurred in the United States and elsewhere in which radioactive materials have been discovered in scrap metal loads at steel mills and, less frequently, have contaminated the metal used to fabricate consumer products as in the Ciudad Juarez, Mexico, incident in 1983 (Lubenau, 1998).

In 1998 the EPA began to work with the International Atomic Energy Agency (IAEA) on clearance issues and import-export standards. EPA personnel initially worked on technical issues in an effort to promote agreement between the parties on appropriate methodologies for estimating exposure levels.

Control of TENORM

Naturally occurring radionuclides are found throughout the United States, primarily in the form of elements such as uranium, thorium, radium, potassium, and radon gas (NRC, 1999). Industrial activities such as oil and gas extraction, water treatment, mining, fossil fuel processing, and aluminum production generate tens of billions of metric tons of TENORM, some of which contain high levels of radioactivity (NRC, 1999). However, TENORM is not subject to the AEA because it cannot be classified as a source material, special nuclear material, or byproduct material.

Federal regulation of TENORM has been largely absent. In 1986 the Radon Gas and Indoor Air Quality Act directed the EPA to study the dangers of TENORM, particularly radon gas. After completing this study, the EPA drafted proposed rules to regulate TENORM under the Toxic Substances Control Act, which gives EPA the authority to regulate chemical substances, including those that are naturally occurring, that may present an "unreasonable risk of injury to health or the environment" (EPA, 1989). The EPA's draft proposed rules were

stayed indefinitely. An exception to this void in regulating TENORM is Order DOE 5400.5, which DOE issued under its general responsibility to protect health and safety in conducting activities authorized under the AEA.

This regulatory gap persists despite the fact that many forms of TENORM can be substantially more radioactive than LLRW subject to regulation under the AEA (NRC, 1999). The existing state regulations that apply to TENORM have largely been limited to disposal and handling requirements enacted under the state's general radiation protection laws or under other authority, such as the Resource Conservation and Recovery Act. The Conference of Radiation Control Program Directors (CRCPD) has drafted model state regulations for TENORM, but these have been neither finalized nor adopted by any states. State regulations remain limited and vary greatly from state to state (CRCPD, 1997).

STAKEHOLDER INVOLVEMENT

As noted earlier, the current evaluation of clearance of solid materials by the USNRC is not the first time it has attempted to update and formalize guidance for unrestricted releases of SRSM. The most notable prior attempts were those in 1986 and 1990 (discussed above) to establish policy and guidance for solid materials whose residual radioactivity would be "below regulatory concern." These attempts and the subsequent stakeholder reactions provide invaluable insight into the current USNRC effort to establish uniform standards for release of SRSM.

After the 1990 BRC policy statement was published in the *Federal Register* (55 Federal Register 27522; July 3, 1990), the USNRC held public meetings in five cities (USNRC, 1991a). These meetings were contentious and well attended by representatives of a large number of stakeholder groups. The USNRC estimated that more than 900 people attended, and oral statements were taken from 215 people. The oral statements were supplemented by numerous written questions and comments. "The prevailing sentiment expressed at each of the meetings was one of opposition to the BRC policy and to its implementation" (USNRC, 1991a).

In 1991 the USNRC staff reported that three themes were common to the five public meetings. First, "extreme concern was expressed concerning the possibility of deregulation of nuclear power waste." Second, many attendees from the public (including a large number of environmental groups) stated their strong opposition to recycling of materials that could be used in unlabeled consumer products. Third, many attendees perceived that the policy would "permit a large number of deaths per year per practice despite the presence of collective dose criterion" (USNRC, 1991a). In short, stakeholders' concerns expressed at the meetings centered on whether the USNRC could adequately protect the public.

Many of these stakeholders also expressed the belief that low levels of radiation were much more harmful than the regulatory agencies had determined them

to be. This expressed fear was compounded by concerns that it would not be possible to monitor solid materials adequately for radioactivity when they were being surveyed before release. Many of the stakeholders also raised two closely related issues. First, many alleged that the regulatory system failed to take into account multiple exposures. Second, general standards for release would undermine individual rights to decide the nature and magnitude of the risks to which members of the public would be exposed. These issues continue to be central to stakeholder criticisms. Most of the stakeholder concerns still revolve around safety and protection of the public.

The nuclear industry strongly supported the 1990 BRC policy, as did a few other stakeholder groups, on the grounds of economic and resource efficiency. However, the sheer number of groups opposing the policy; the intensity of their viewpoints; and their consistency in raising issues of public health, safety, and welfare doomed this policy from the outset. After the policy was announced in 1990, the USNRC hired a consultant to begin a phased consensus-seeking process. This effort collapsed shortly after it started because public interest groups refused to engage in the process (USNRC, 1991b). As noted above, Congress formally nullified the BRC policy as part of the Energy Policy Act of 1992. Even before Congress acted, the USNRC issued a moratorium on the BRC policy in July 1991 (56 Federal Register 36068-36069; July 30, 1991); after the Energy Policy Act was signed into law, the USNRC rescinded the policy in August 1993.

The BRC policy was defeated largely by the efforts of these public interest groups, which successfully used the political arena to expand the controversy over the issue and to make the issue salient to a large number of stakeholder groups and other interested parties.

The lines that were drawn in 1991 over the BRC policy do not seem to have altered appreciably. Many of the public interest groups that the USNRC concluded were indispensable to any effort to promote a consensus-seeking process are adamantly opposed to the proposed USNRC rulemaking on SRSM. The only shifts that have occurred are in the positions of officials from several states, whose representatives had opposed the BRC policy solely because of concerns that it would abrogate the states' enforcement authority. However, even among the agreement states from which the committee has heard, there is no consensus on the proposed rule. Many of those who addressed the committee questioned whether such a rule is necessary at all. What lessons, if any, the USNRC has learned from the BRC controversy is a question that the committee addresses in Chapter 9.

FINDINGS

Finding 2.1. The USNRC does not have a clear, overarching policy statement for management and disposition of SRSM. However, SRSM has been released from licensed facilities into general commerce or landfill disposal for many years

pursuant to existing guidelines (e.g., Regulatory Guide 1.86) and/or following case-by-case reviews. The USNRC advised the committee of no database for these releases.

Finding 2.2. A dose-based clearance standard can be linked to the estimated risk to an individual in a critical group from the release of SRSM. The general regulatory trend is toward standards that are explicitly grounded in estimating risks.

Finding 2.3. For clearance of surface-contaminated solid materials, the clearance practices regulated by the USNRC and agreement states are based on the guidance document Regulatory Guide 1.86, which is technology based and has been used satisfactorily in the absence of a complete standard since 1974.

Finding 2.4. For clearance of volume-contaminated solid materials, the USNRC has no specific standards in guidance or regulations. Volume-contaminated SRSM is evaluated for clearance on a case-by-case basis. This case-by-case approach is flexible, but it is limited by outdated, incomplete guidance, which may lead to determinations that are inconsistent.

Finding 2.5. Industrial activities are generating very large quantities of technologically enhanced naturally occurring materials (TENORM). Federal regulation of TENORM has been largely absent. State regulations vary in breadth and depth.

3

Anticipated Inventories of Radioactive or Radioactively Contaminated Materials

This chapter summarizes current estimates of the quantities of slightly radioactive solid material (SRSM) expected to arise over the next 25 years from cleanup and decommissioning of licensed nuclear facilities and from other facilities that may contain SRSM. These estimated inventories include materials from U.S. Nuclear Regulatory Commission (USNRC)-licensed facilities, from facilities licensed by agreement states, and from U.S. Department of Energy (DOE) and Department of Defense (DoD) facilities that do not require a USNRC license. Radioactively contaminated materials known as naturally occurring radioactive material (NORM), naturally occurring and accelerator-produced radioactive material (NARM), or technologically enhanced NORM (TENORM) also arise from a variety of activities that are not subject to the Atomic Energy Act (AEA) and thus are not regulated by the USNRC. The latter materials are not federally regulated but are regulated by state agencies in some states or not regulated at all in other states. Thus, the USNRC needs to be aware that any new regulations regarding clearance of SRSM could also have impacts on the management of contaminated materials that are currently unregulated at the federal level. Some perspective is also provided in this chapter on the relative fraction of the annual amount of recycled commercial steel scrap that cleared SRSM could comprise if clearance for unrestricted recycle were to be approved.

The committee did not find readily available information on inventory and anticipated dates for disposition of radioactive materials. The information currently available covers some industries but not others. In some cases, inventories of radioactive materials have been developed based on what is currently being

generated from active licensed operations. Other inventories have been developed based on projections of future decommissionings.

Inventories for materials that fall outside the legal requirements for radioactive waste management are not as carefully developed. The unlicensed industry segments, such as many that produce NORM or TENORM, deal with radioactive material as an unwanted byproduct associated with industrial processes. Inventory information about NORM and TENORM tends to focus on the concentrations of radium, uranium, or thorium and daughter radionuclides that they contain, rather than on total inventories.

Therefore, one must often infer or estimate the amount of materials that may satisfy particular clearance criteria based on information created for a different purpose. This chapter relies heavily on a recent report *Inventory of Materials with Very Low Levels of Radioactivity Potentially Clearable from Various Types of Facilities*, which was prepared for the USNRC by Sanford Cohen & Associates, Inc. (SCA, 2001). Information from this source has been supplemented with information from various published and Internet sources and from materials presented to the study committee.

The characteristics and quantities of radioactive materials used or possessed by USNRC licensees are discussed in the following section. To provide the bases for the cost analysis given in Chapter 4, the emphasis in that section is on radioactive material streams arising from the decommissioning of licensed power reactors. To complete the picture of radioactive materials in the United States, summary information on the other licensed and unlicensed radioactive material streams is presented in the second section.

INVENTORIES OF CONTAMINATED MATERIALS ARISING FROM DECOMMISSIONING OF USNRC-LICENSED FACILITIES

The majority of USNRC-licensed facilities can be divided into four types, each of which produces a characteristic body of radioactive materials during operations and decommissioning: (1) nuclear reactors (electric power, materials testing, and research reactors); (2) fuel cycle facilities (uranium milling, UF_6 [uranium hexafluoride] conversion plants, and uranium fuel fabrication); (3) non-fuel-cycle facilities (radioactive material processing, research laboratories, medical treatment, radiography, etc.); and (4) independent spent fuel storage installations (ISFSIs), which store spent fuel from power reactor operations.

Because of the substantial number (more than 100) and large size of electric power reactors, they are the source of about 75 percent of the radioactive materials in the United States that require disposal in licensed low-level radioactive waste (LLRW) disposal sites. Power reactors also provide SRSM that is cleared from regulatory control. SRSM arising from the latter three types of facilities is examined in less detail in this report because the quantities of radioactive materi-

als arising during operation or during decommissioning are small compared to the quantities arising from power reactor decommissioning.

Power Reactors

Some data are available for estimating the types and annual quantities of radioactive materials arising from the operation of power reactor facilities that currently dispose of their LLRW at licensed LLRW disposal facilities. Additional data and various estimates are available to define the types and total quantities of radioactive materials resulting from decommissioning power reactor facilities. The decommissioning data and estimates presented in Table 3-1 are derived from two USNRC reports: NUREG/CR-5884 (Konzek et al., 1995) for a reference pressurized water reactor (PWR) and NUREG/CR-6174 (Smith et al., 1996) for a boiling water reactor (BWR). Also presented in the table are estimates of the sums of the quantities of these materials expected to arise from the total U.S. population of power reactors. These population estimates were scaled from the reference reactor quantities using multiplication factors derived from the SCA (2001) report on inventory using the following equations:

$$M_{\mathrm{Pop.P}} = M_{\mathrm{Ref.P}}\ \Sigma i\ (P_{\mathrm{Pi}}/P_{\mathrm{Ref.P}})^{2/3}$$

and

$$M_{\mathrm{Pop.B}} = M_{\mathrm{Ref.B}}\ \Sigma i\ (P_{\mathrm{Bi}}/P_{\mathrm{Ref.B}})^{2/3}$$

where $M_{\mathrm{Pop.P}}$ and $M_{\mathrm{Pop.B}}$ are the PWR and BWR population multipliers, respectively, $M_{\mathrm{Ref.P}}$ and $M_{\mathrm{Ref.B}}$ are the weights of radioactive materials postulated to arise from decommissioning the reference PWR and BWR, respectively; $P_{\mathrm{Ref.P}}$ and $P_{\mathrm{Ref.B}}$ are the rated power levels of the reference PWR and BWR, respectively, and $P_{\mathrm{P}i}$ and $P_{\mathrm{B}i}$ are the rated power levels of the individual PWRs and BWRs that make up the U.S. population of power reactors. In essence, the population multiplier for a PWR or BWR represents the number of reference PWRs or BWRs that would contain the same total amount of structural material as is contained within the total populations of PWRs and BWRs that exist currently in the United States. Because many of the reactors are smaller than the reference reactors, the population multipliers are smaller than the actual number of each type of reactor in the total population.

For this analysis, the total volume of potential LLRW estimated to arise from decommissioning a power reactor is divided into three categories: (1) activated materials,[1] including the reactor pressure vessel and internals and the activated portions of the biological shield; (2) nonreusable contaminated materials such as

[1]Materials made radioactive through irradiation of stable nuclides by neutrons, protons, electrons, or other particles or radiation.

TABLE 3-1 Volume of Materials Arising from Power Reactor Decommissioning (cubic meters)

Material Type	PWR Volumes[a]	BWR Volume[b]	Population Totals
Activated (LLRW)	547	889	60,900
Nonclearable (LLRW)	1,800	1,520	159,000
Metallic SRSM	5,830	12,700	743,000
Excluded (30%) as LLRW	1,750	3,820	233,000
Net SRSM	4,080	8,900	521,000
Concrete SRSM	69,500	99,700	7,360,000
Total volumes SRSM	73,600	109,000	7,880,000
Population multipliers[c]	63.76	29.23	

NOTE: All values are rounded to three significant figures.

[a]Konzek et al. (1995).
[b]Smith et al. (1996).
[c]Data derived from SCA (2001). Each multiplier represents the number of reference reactors of that type that would contain the same total amount of structural material as is contained within the total population of each reactor type.

ion-exchange resins, filters, plastics, contaminated equipment insulation, and removed contaminated concrete surfaces; and (3) metallic SRSM that might be uncontaminated but is from a radioactive work area or that might be only slightly contaminated. The metallic SRSM includes pool liners, piping, tanks, valves, pumps, heat exchangers, and similar items. Because of the complexity of their inner and outer surfaces, it is difficult to demonstrate that some of these items (such as heat exchangers, pumps, and valves) have been decontaminated sufficiently to permit release under a clearance standard. An examination of the tables of system components presented in Konzek et al. (1995) shows that roughly 30 percent of the volume of the metallic SRSM in those tables would probably be excluded on the basis of structural complexity. For this analysis, that 30 percent fraction has been excluded from the volume of SRSM and equipment when calculating the volumes in Table 3-1. The same fraction was assumed to be applicable to the metallic SRSM arising from decommissioning a BWR.

The structural concrete rubble arising from demolition of decontaminated facility structures (clearable concrete) represents the largest single component of the decommissioning wastes. The volumes presented in the table are, for the purposes of analysis, based on the assumption that after contaminated surfaces and activated concrete have been removed, the remaining concrete structures are essentially uncontaminated and may be suitable for clearance or conditional clearance (e.g., for reuse in highway construction or other uses, or for disposal in municipal waste Resource Conservation and Recovery Act [RCRA] Subtitle D landfills). The volumes of concrete SRSM rubble are larger than the combined

TABLE 3-2 Weights of Slightly Radioactive Solid Material from Power Reactors (metric tons)

Material Type	PWR Weights	BWR Weights	Population Totals
Metallic SRSM	7,860	18,700	1,050,000
Excluded as LLRW (30%)	2,360	5,610	315,000
Net metallic SRSM	5,500	13,100	735,000
SRSM concrete[a]	83,600	120,000	8,850,000
Total weight SRSM	89,100	133,000	9,590,000

NOTE: Values are rounded to three significant figures and were derived from Konzek et al. (1995) and Smith et al. (1996).

[a]From Table 3-1, by assuming that the density of concrete rubble is 1.2 metric tons per cubic meter.

volumes of all of the other SRSM by at least a factor of 10. Although it is assumed that beyond the surface, the remainder of the concrete is uncontaminated, determining what to do with the concrete is complicated by several factors. It can be difficult, in practice, to determine the quantities and levels of radionuclide contamination that have penetrated into the concrete. There are also sampling and analysis costs associated with demonstrating that material is clean, as discussed in Chapter 6 in Measurement Cost. Public perception and regulatory factors can affect choices a licensee makes on disposition of such material, such as whether concrete is left as on-site fill after the license of a site is terminated. The committee was informed that these difficulties with on-site disposal have been encountered with at least one decommissioning of a reactor site, Maine-Yankee.

Table 3-2 presents the weights of SRSM and clearable concrete estimated from the reference PWR and BWR. Population totals assume that the same population-scaling factors applied to material volumes in Table 3-1 also apply to material weights.

The time distribution of these decommissioning wastes is a significant consideration. The quantities of material arising from decommissioning nuclear power reactors will be distributed over an extended period because of the varying dates at which their licenses are scheduled to expire (SCA, 2001, Tables 2-26, 2-27). Figure 3-1 illustrates this time distribution for the weight of metallic and concrete SRSM, given the shutdown dates stated in SCA (2001). If licenses are extended for an additional 20 years, which seems probable for most facilities, the large quantities of material shown in the figure would be generated up to 20 years later, with little material resulting from decommissioning until after 2030.

With or without license extensions, the weights of decommissioning material requiring disposition (about 8 percent metals and 92 percent concrete) range from about 100,000 to more than 1 million metric tons per year during a 25-year

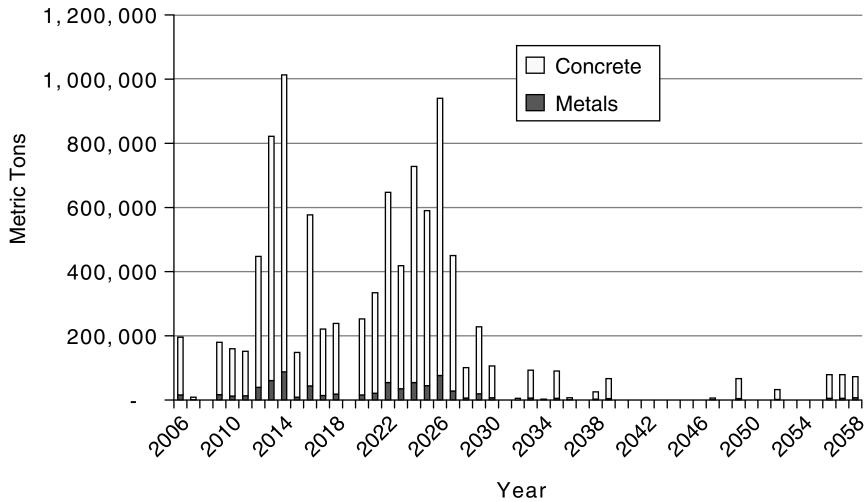

FIGURE 3-1 Time distribution for generation of slightly radioactive solid material from U.S. power reactor decommissionings. SOURCE: Adapted from SCA (2001).

period. The average is around 360,000 metric tons per year, or the equivalent of decommissioning four or five power reactor units per year. If most of the currently operating reactors do receive 20-year license extensions and if the reactors already in safe storage are decommissioned as assumed in SCA (2001), most of the weights shown in Figure 3-1 between 2006 and 2030 would move roughly 20 years into the future, to 2026 to 2050. Relatively small quantities of SRSM from power reactor decommissioning would be generated during the next three decades.

It is instructive to compare the amount of ferrous metals arising from decommissioning activities at commercial power reactors with the total amount of ferrous metal scrap currently being recycled commercially. The committee heard from a representative of a major scrap broker-processor[2] that the average amount of obsolete scrap recycled into commercial steelmaking in the years 1997-1999 was about 42 million metric tons per year. During the same period, U.S. production was about 98 million metric tons per year. The amount of nonactivated, steel SRSM arising from decommissioning the population of U.S. power reactors, as shown in Table 3-2, ranges from 0.74 million to 1.05 million metric tons (depending on the amount excluded as LLRW). Based on the distribution of current license expiration dates for U.S. power reactors over a 25-year period, the average amount of steel SRSM would be between 30,000 and 42,000 metric tons per

[2]Presentation to the committee by Ray Turner, David J. Joseph Company, June 13, 2001, Washington, D.C.

year. If the larger quantity (42,000 metric tons per year) was recycled, the potentially radioactive scrap would constitute only about 0.1 percent of the total steel scrap recycled each year. This small amount of metallic SRSM indicates that the effect on the available scrap metal resources is negligible if the metal is not recycled.

Nonpower Reactors

There are 46 USNRC-licensed research reactors in the United States, of which 36 are still operational (SCA, 2001, Table 2-79). Konzek et al. (1995) developed a decommissioning materials inventory for a reference research reactor that is presented again in SCA (2001). Also given in SCA (2001) are decommissioning data from four retired research reactors. The data from these four reactors were used in a least-squares analysis to develop a scaling factor for the weight of decommissioning material as a function of the licensed power rating of each research reactor relative to the reference research reactor (SCA, 2001, p. 2-138). The resulting equation for the scaling factor is $M_i/M_R = [P_i/P_R]^{1.0813}$, where M is the weight of material and P is the power rating, for the ith reactor and the reference reactor, respectively. The R^2 value for the fit of the data to the equation was 0.97.

The power ratings for the four research reactors used in the analysis ranged from 5 W to 20 MW, and the power rating of the reference research reactor was just 1.1 MW. Because a certain amount of facility structure is needed almost regardless of the power rating of the contained reactor, this scaling factor may underestimate the quantities of materials arising from research reactors having the much lower power ratings. Computing this factor for each of the 46 licensed research reactors and summing over that population yields the population scaling factor (65.79). Multiplying the weights of each category of materials (structural steel, concrete, system steel) from the reference research reactor by the population scaling factor yields the population weights for each material category from U.S. research reactors, as shown in Table 3-3. The weights of structural steel and concrete SRSM are assumed to all be clearable, without any exclusions for LLRW materials. The study committee also assumed that metallic SRSM from the system steel category would have the same 30 percent fraction that would have to be disposed of as LLRW as assumed in the previous section on power reactors. The inventory of steel and concrete from research reactors represents about 1.4 percent of the total weight of SRSM from the power reactors.

INVENTORIES OF RADIOACTIVE WASTE FROM OTHER LICENSED AND UNLICENSED SOURCES

Radioactive materials are generated in a number of industrial environments, where the sources range from dilute to concentrated and from small volumes to

TABLE 3-3 Decommissioning Materials Inventory from the Population of U.S. Research Reactors (metric tons)

Composite Reactor	Structural Steel	Concrete	System Steel
Activated	—	—	6.5
Nonclearable	—	11	2.0
SRSM	113	1,910	46.0
Excluded (30%)	—	—	13.8
Net SRSM	113	2,010	39.9
Population weight SRSM	7,400	125,000	2,100

NOTE: Values are rounded to three significant figures. Population scaling factor is 65.79.
SOURCE: Data derived from SCA (2001).

large volumes. The information presented here is intended to provide a broad view of the types and quantities of radioactive materials present in the United States. Some of these materials are under federal regulatory control, others are under the control of state agencies, and still others may not be under any regulatory control. The inventories include radioactive materials generated by (1) fuel cycle and (2) non-fuel cycle facilities, both categories of which are licensed, permitted, and regulated by the USNRC and agreement states; (3) facilities subject to the USNRC's Site Decommissioning Management Plan (SDMP); (4) DOE facilities; (5) DoD facilities; (6) facilities regulated by the Environmental Protection Agency (EPA Superfund sites) or state agencies; and (7) industries that produce NORM, NARM, or TENORM.

Steel and concrete SRSM arise from decommissioning activities at fuel-cycle and non-fuel-cycle facilities. The SRSM generated at these sites will include some or all of the following:

- Surface-contaminated equipment and material (i.e., concrete), and
- Materials that are not from controlled radioactive areas and may be designated as clearable, depending upon the type of facility.

In general, activated metals and concrete have been and will continue to be disposed at licensed LLRW disposal facilities. These activated materials are not considered candidates for clearance, except where the concentration of activation products is very minimal. The category of surface-contaminated equipment and material includes some materials that are unlikely to be clearable and some that might be clearable after application of an appropriate decontamination technology. The types and quantities of radioactive materials arising from decommissioning each type of facility are discussed briefly below.

USNRC-Licensed Fuel Cycle Facilities

There are basically four types of fuel cycle facilities licensed by the USNRC: uranium mills, uranium hexafluoride conversion plants, uranium oxide fuel fabrication plants, and ISFSIs.

Uranium Mills

The population of uranium mills consists of four conventional surface ore crushing and/or leaching facilities and up to seven (one is not yet operational) in situ leaching facilities. In the surface mills, the waste materials from decommissioning are generally disposed by adding them to the ore tailings piles. Little waste remains that would require disposal at an LLRW facility. The in situ leaching facilities produce some wastes for LLRW disposal, and some of their surface structures and equipment may be conditionally clearable. The contaminants present are primarily natural uranium (^{235}U and ^{238}U and their daughter products). No data are readily available on the volumes and weights of material and equipment that will arise from decommissioning in situ leaching facilities. However, because of the simplicity of these facilities, the committee expects that the quantities will be small.

Uranium Hexafluoride Conversion Plants

Decommissioning of the two existing uranium hexafluoride conversion plants is expected to be completed ultimately. One is currently operating; the other has been undergoing decommissioning for the past eight years. Although these two plants use different chemical processes, the SCA (2001) report assumes that they are sufficiently similar that a scaling factor of 2 is appropriate for calculating the size of the population waste inventory. The anticipated contaminants are primarily natural uranium (^{235}U and ^{238}U and their daughter products), with concentrations in the range of 10 to10,000 pCi/g. Table 3-4 gives the estimated weights of radioactive materials arising from decommissioning these facilities. For the uncleared equipment, the study committee accepted the assumption made by Elder (1981) that 40 percent is LLRW and 60 percent is SRSM. For the non-LLRW concrete and structural steel (including reinforcing bar in concrete, or rebar), Elder (1981) assumed that 40 percent is SRSM and 60 percent is clearable. Because there are only two of these facilities, the quantities requiring disposition are small.

Uranium Fuel Fabrication Facilities

There are seven uranium fuel fabrication plants presently licensed in the United States. Their licenses are currently scheduled to expire 2001 to 2009. At

TABLE 3-4 Decommissioning Materials Inventory from the Population of U.S. Uranium Hexafluoride Conversion Plants (metric ton)

Materials	Structural Steel	Concrete	Equipment
LLRW	—	161	928
SRSM	616	3,250	1,390
Clearable	922	4,870	271
Total clearable	1,540	8,120	1,660

NOTE: Values are rounded to three significant figures.
SOURCE: Data are derived from SCA (2001).

least four of these plants will probably have their licenses extended, in order to serve the U.S. nuclear power industry and the nuclear navy. Thus, the material inventories arising from decommissioning the population of uranium fuel fabrication plants, shown in Table 3-5, are likely to be distributed over the next 30 years or more.

The principal contaminants are low-enriched uranium (^{235}U and ^{238}U and their daughter products). The radioactivity levels on plant equipment could range from essentially zero up to 38,000 pCi/g.

For the committee's analysis, only six of the seven plants were considered; the naval reactors fuel plant was omitted. Table 3-5 uses a committee-derived population scaling factor, developed using the formula in SCA (2001), for estimating the weights of materials in other plants from the weights in a reference fuel fabrication plant (Wilmington, North Carolina), for which data were given in SCA (2001). For equipment, the same assumptions were used that were made for

TABLE 3-5 Decommissioning Materials Inventory from the Population of U.S. Fuel Fabrication Plants (metric tons)

Materials	Structural Steel	Concrete	Equipment
LLRW	347	2,010	
SRSM	6,500	21,000	3,020
Clearable	9,750	31,500	4,400
Total clearable	16,300	52,500	7,420

NOTE: The committee used a scaling factor of 3.88 applied to the reference plant value. Values are rounded to three significant figures.
SOURCE: Reference plant data are from SCA (2001).

the uranium hexafluoride plants. Namely, of the uncleared material, 40 percent would be disposed as LLRW and 60 percent is SRSM. For concrete and structural steel (including rebar), 40 percent is assumed to be SRSM and 60 percent is assumed clearable.

Independent Spent Fuel Storage Installations

An independent spent fuel storage installation (ISFSI) is a facility in which spent nuclear fuel from a nuclear power reactor is stored, primarily fuel that is in excess of the capacity of the spent fuel pool at the reactor. There are 15 ISFSI facilities in service in the United States employing five design concepts:

1. Vertical ventilated concrete casks (four sites),
2. Horizontal storage modules (eight sites),
3. Vertical metal casks (one site),
4. Modular vault dry storage (one site), and
5. Water-filled pool (one site).

Additional facilities are planned to be constructed in the coming decade to accommodate the excess spent fuel accumulating at reactors until a federal deep geologic repository begins receiving spent fuel for disposal.

The interior surfaces of the metal storage canisters in the dry storage concepts will undoubtedly be contaminated and might actually be activated to very low activity levels. However, the quantities of SRSM are not large and would accumulate slowly. The accumulation rate will be determined by the rate at which the geologic repository receives spent fuel. Thus, the committee has concluded that these materials will not contribute significantly to the total quantity of materials entering the disposal stream during any given year.

Non-Fuel-Cycle Licensees of the USNRC or Agreement States

There were roughly 21,000 radioactive materials licensees in the United States in 2000, consisting of roughly 5,000 USNRC licensees and nearly 16,000 agreement state licensees. Of the various types of licensees in this group, those involved in research and development, medical applications, nuclear pharmaceuticals, and the manufacture of sealed sources and radio-labeled compounds generate materials potentially subject to a clearance regulation. The estimates for radioactively contaminated materials generated by these licensees were calculated by multiplying the estimated weight of SRSM in a reference facility by the number of USNRC-licensed facilities of the same type. This result was then multiplied by 4 to account for the 75 percent of radioactive materials licenses issued by agreement states (SCA, 2001).

Hospitals

SRSM in hospitals consists of floors, walls, equipment (metal), and cabinets (wood). The total U.S. inventory is approximately 436,000 metric tons, of which an estimated 8,720 to 21,800 metric tons is disposed annually. Most of these materials are clearable. However, some small percentage contains fixed ^{3}H and ^{14}C contamination that must be disposed of as biomedical LLRW.

Research and Development Laboratories

The inventory of possibly radioactive materials in the reference research and development laboratory was estimated in SCA (2001) to be about 1 metric ton of equipment and about 2.5 metric tons of concrete. Hot cells and fume hoods were not included in the estimates, since they are expected to contain too much contamination to be considered for clearance. The total U.S. inventory for research and development laboratories was estimated by SCA (2001) to be about 2,058 and 5,145 metric tons of equipment and concrete, respectively.

Manufacturers of Sealed Sources and Radio-Labeled Compounds

Manufacturers of sealed sources and radio-labeled compounds use licensed radioactive materials in hot cell laboratories. Potentially clearable materials consist of approximately 1.7 metric tons of metal, concrete, and asphalt tiles in the reference facility, or about 107 metric tons for the 63 such facilities in the United States (SCA, 2001).

Biomedical Wastes

Biomedical radioactive waste is generated under either USNRC or agreement state licenses by institutions engaging in medical, biological, or academic research and in universities and hospitals where radioactive materials are used for research, diagnosis, or treatment of disease. Biomedical use of radioactive materials typically generates small volumes of LLRW with low content of radioactivity. Although short-lived radionuclides are most often used in biomedical research, longer-lived radionuclides such as tritium and ^{14}C are also used.[3] The longer-lived wastes are disposed at licensed LLRW facilities after pretreatment to reduce waste volume, which reduces disposal costs. Much of the short-lived waste can be managed by storage for decay, with subsequent disposal according to the nonradioactive constituents of the wastes (NRC, 2001).

[3]Criteria in 10 CFR Part 20 allow disposal of volume-contaminated animal tissue containing less than 1.85 kBq/g of ^{3}H or ^{14}C as if it were not radioactive.

Facilities Under the Site Decommissioning Management Plan

The USNRC is regulating the decommissioning of 28 facilities under the SDMP. Radioactive residues at these facilities consist primarily of ore or slag containing elevated concentrations of natural radioactivity (i.e., uranium and thorium and their daughter products). Approximately 4,100 cubic meters (9,840 metric tons) of concrete SRSM is expected to be produced. About 84,000 cubic meters of slag from previous processes may be recovered for reprocessing or other controlled uses.

DOE Facilities

Numerous DOE facilities have moved from production to decontamination and decommissioning. Assuming that 25 percent of the steel and iron present at these facilities cannot be recycled for economic or radiological reasons, recent studies estimate that about 1 million metric tons of metallic SRSM exist in current inventory or are expected to become available by 2035 (SCA, 2001). An estimated 60 percent of these metals will come from decommissioning the gaseous diffusion plants located at Oak Ridge, Tennessee (the K-25 plant); Piketon, Ohio ("Portsmouth"); and Paducah, Kentucky. The radionuclides of concern at the gaseous diffusion plants include ^{235}U, ^{238}U, ^{239}Pu, ^{237}Np, and ^{99}Tc. Concentrations tend to be dilute, with 78 percent of the ferrous metals estimated to contain less than 4,400 Bq/kg (120 pCi/g). (The significance of these concentrations depends on the scenarios whereby the radionuclides could expose humans to a radiation dose. This issue is covered in detail in Chapter 5.)

As discussed in the section on decommissioning power reactors, the amount of steel scrap recycled into commercial steelmaking is currently about 42 million metric tons per year. The projected 1 million metric tons of steel SRSM generated from DOE decommissioning and cleanup operations are expected to become available over about a 25-year period, or an average of about 40,000 metric tons per year. Thus, if recycled, this amount of slightly contaminated scrap would constitute only an additional 0.1 percent of the annual stream of recycled obsolete steel.

Available data are insufficient to characterize the inventory of concrete SRSM from the DOE complex. One DOE study (DOE, 1996) estimates that about 3.1 million cubic meters (~3.7 million metric tons) of rubble and debris will result from all decontamination and decommissioning operations through 2050. (Together with the estimate of steel SRSM given above, this data implies a mass ratio of concrete to metal of 3.7 to 1—an aggregate number that could vary widely by individual site and type of facility.) Another DOE study (DOE, 1999) has estimated the DOE concrete volume would be over 10 million cubic meters (greater than 12 million metric tons). These two estimates illustrate the kind of uncertainty that exists in the amount of potentially contaminated concrete present in the vast DOE complex.

Much of the concrete will probably be used as on-site fill material, after in situ removal of isolated areas of contamination with an appropriate decontamination technology. As shown in Table 3-6, the quantity of radioactively contaminated soil that may arise during cleanup efforts at DOE facilities could be as large as 76 million cubic meters.

DoD Facilities

Many DoD facilities are licensed by the USNRC, including hospitals, laboratories, proving grounds, some nuclear reactors, weapons facilities, and missile launch sites. The DoD holds approximately 600 licenses and/or radioactive materials permits, of which three-quarters are for sealed sources (and therefore generate no radioactive waste). Most of these licenses cover a spectrum of operations similar to those found in the civilian world. As noted, the USNRC does not license naval reactors and associated propulsion units. Overall, about 115,000 cubic feet of LLRW is generated annually from DoD facilities. Most of this waste (greater than 90 percent) is from cleanup efforts rather than operations.

TABLE 3-6 Sites Containing Radioactively Contaminated Soils

Authority	Location or Type	No. of Sites	Soil Volume (10^3 m^3)
DOE	Fernald	1	2,100
	Hanford	1	23,600
	Idaho	1	720
	Miamisburg	1	110
	Nevada Test Site	1	16,000
	Oak Ridge Reservation	1	133
	Paducah	1	990
	Portsmouth	1	25
	Rocky Flats	1	460
	Savannah River	1	19,000
	Weldon Springs	1	480
	Lawrence Livermore National Laboratory	2	2,212
	Los Alamos National Laboratory	1	9,900
	Sandia National Laboratories	2	221
USNRC or agreement states	Nuclear fuel cycle (active and inactive), including nuclear power plants	199	32
	Byproduct licensees	1,994	60
Other nonfederal	Rare-earth mill sites	17	120

SOURCE: Wolbarst (1999).

EPA-Regulated Superfund Sites

For more than a half century, radioactive materials have been produced and used in weapons production, power generation, and industrial and medical applications. Because these materials were frequently released into the environment, thousands of sites within the United States have become contaminated—some slightly, some heavily. Furthermore, other industrial activities not focused on using radioactive materials have resulted in the concentration of significant amounts of NORM at various sites. As reported by the EPA (63 Federal Register 51982-51888; September 29, 1998), there are about 1,200 sites on the National Priorities List (NPL) of facilities needing cleanup, of which about 150 are federal facilities. According to one estimate, at least 75 sites on the NPL are radioactively contaminated (Wolbarst, 1999). A current estimate by EPA places the number of sites on the NPL having radioactive contamination at approximately 60 (EPA, 2001).

Although DoD and DOE are responsible for the majority of these sites, more than 20 of them did not originate from federal agency activities. Table 3-6 illustrates the approximate inventory of sites containing soils contaminated with radioactivity, their locations, and the estimated volumes of contaminated soil associated with each site.

NORM, NARM, and TENORM

Several types of industrial activity coincidentally enhance the concentration of NORM in waste residues, resulting in the generation of TENORM. The typical radionuclides of concern in TENORM are members of the thorium and uranium decay series. The type of processing performed on natural materials and the time expired since processing determine the equilibrium status of the radionuclides present.

Industries associated with TENORM production may produce radioactively contaminated scrap metals, in addition to TENORM-containing waste residues. These industries include the following:

- Petroleum production,
- Uranium mining,
- Phosphate and phosphate fertilizer production,
- Fossil fuel combustion facilities (power plants),
- Drinking water treatment facilities,
- Metal mining and processing facilities, and
- Geothermal energy production facilities.

Currently, there are no federal statutes explicitly regulating TENORM, although some waste streams fall under the jurisdiction of various EPA regulations

or programs. Several agreement states regulate TENORM under their general rules governing possession of radioactive materials, and 11 states have promulgated regulations specifically addressing TENORM. Table 3-7 lists estimates of TENORM wastes generated annually, with associated ranges of uranium, thorium, and radium concentrations. Waste management practices or clearance of

TABLE 3-7 Sources, Quantities, and Concentrations of TENORM

		Concentration[a] (Bq/kg)		
Waste Source	Metric Tons per Year	Uranium	Thorium	Radium
Uranium overburden	3.8×10^4	1.8×10^3	990	920
Phosphate	5.0×10^4	Bkg-3.0×10^3	Bkg-1.8×10^3	400-3.7×10^6
Phosphogypsum	4.8×10^4	Bkg-500	Bkg-500	900-1.7×10^3
Slag	1.5×10^3	800-3.0×10^3	700-1.8×10^3	400-2.1×10^3
Scale	4.5×10^0	—	—	1.1×10^3-3.7×10^6
Phosphate fertilizers	4.8×10^3	740-2.2×10^3	37-180	180-740
Coal ash	6.1×10^4	100-600	30-300	100-1.2×10^3
Fly ash	4.4×10^4	—	—	—
Bottom ash	1.7×10^4	—	—	—
Petroleum production	2.6×10^2	—	—	bkg-3.7×10^6
Scale	2.5×10^1	—	—	bkg-3.7×10^6
Sludge	2.3×10^2	—	—	bkg-3.7×10^3
Petroleum processing	—	—	—	^{210}Pb and ^{210}Po
Refineries	—	—	—	>4.0×10^3
Petrochemicals	—	—	—	>4.0×10^3
Gas plants	—	—	—	^{210}Pb and ^{210}Po
Water treatment	3.0×10^2		—	100-1.5×10^6
Sludge	2.6×10^2	—	—	100-1.2×10^3
Resins	4.0×10^1	—	—	300-1.5×10^6
Mineral processing	1.0×10^6	6-1.3×10^5	8-9.0×10^5	<200-1.3×10^5
Rare earths	2.1×10^1	2.6×10^4-1.3×10^5	9.0×10^3-9.0×10^5	1.3×10^4–1.3×10^5
Zr, Hf, Ti, Sn	4.7×10^2	6-3.2×10^3	8-6.6×10^5	300-1.8×10^4
Alumina	2.8×10^3	400-600	500-1.2×10^3	300-500
Cu and Fe	1.0×10^6	<400	<400	<200
Geothermal waste	5.4×10^1	—	—	400-1.6×10^4
Paper mills	—	—	—	>3.7×10^3
Total	2.27×10^6	—	—	

[a]bkg = background radiation level.
SOURCE: USNRC (2001a).

materials from regulatory control depends on both the bulk quantity of the material involved and the concentrations of these key radionuclides in it.

As shown in Table 3-7, the amount of TENORM that could fall under USNRC waste disposal regulations would be about 2.3 million metric tons per year, on a continuing basis.

FINDINGS

Finding 3.1. Licensees may seek to clear about 740,000 metric tons of metallic SRSM that arise from decommissioning the current population of U.S. power reactors during the period 2006 to 2030 (about 30,000 to 42,000 metric tons per year). About 8,500 metric tons per year are expected to arise from decommissioning USNRC-licensed facilities other than power reactors during the same time period. The total quantity of metal from both power reactor and non-power reactor licensees, up to approximately 50,000 metric tons per year, represents about 0.1 percent of the total obsolete steel scrap that might be recycled during that same 25-year period.

Finding 3.2. If most of the licensees of currently operating reactors obtain 20-year license extensions, relatively little SRSM will arise from power plant decommissioning during the 2006-2030 period.

Finding 3.3. Because of the difficulty of determining the quantities and levels of contamination that have penetrated into the concrete, concrete SRSM is generally considered to be volume contaminated. Concrete SRSM constitutes more than 90 percent of the total SRSM arising from decommissioning the population of U.S. power reactors.

Finding 3.4. About 1 million metric tons of metallic SRSM and anywhere from about 3.7 million metric tons to greater than 12 million metric tons of concrete SRSM are projected to arise from cleanup and decommissioning of DOE facilities during the coming 25 years. This quantity of metallic SRSM is comparable in magnitude to the quantity of metallic SRSM estimated to arise from decommissioning the population of U.S. power reactors and corresponds to only an additional 0.1 percent of the total obsolete steel scrap recycled in the United States during the same 25-year period.

Finding 3.5. TENORM is generated in the United States at an annual rate of about 2.3 million metric tons per year. The quantity of TENORM SRSM predicted to arise over the coming 25-year period is nearly 16 times larger than the quantity of SRSM estimated to arise from decommissioning the population of U.S. power reactors.

4

Pathways and Estimated Costs for Disposition of Slightly Radioactive Material

For this discussion, the study committee has assumed that the following three possibilities are available for disposition of the inventories of suspected low-activity radioactive and/or slightly radioactive solid material (SRSM) arising from operating and decommissioning nuclear facilities:

- No release (i.e., disposal to a licensed low-level radioactive waste [LLRW] disposal facility);
- Conditional clearance (release for controlled reuse or disposal in a municipal or hazardous waste landfill); and
- Clearance (unrestricted reuse, recycle, or disposal).

Figure 4-1 illustrates the general decision pathway for disposition under these three possibilities. Under a no-release scenario, all of the materials are sent directly to LLRW disposal. All other disposition scenarios begin with an initial sorting of materials into two streams: cleared materials and materials needing further scrutiny. The materials not cleared are then divided into streams to undergo treatment or not. The uncleared-not treated stream is sorted into a stream for LLRW disposal and a stream of conditionally cleared materials. The post-treatment stream is sorted into three streams: LLRW disposal, conditionally cleared material, and cleared material.

Conditionally cleared material may be released for controlled reuse or disposal in a Resource Conservation and Recovery Act (RCRA) Subtitle D (or, less

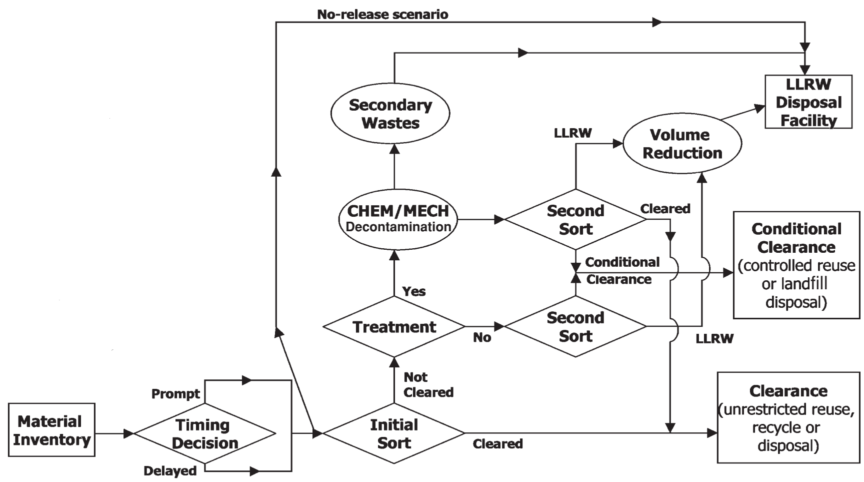

FIGURE 4-1 Decision points and disposition pathways.

frequently, Subtitle C) landfill.[1] Material cleared for disposal should be managed according to its nonradiological properties. In the remainder of this chapter, the committee discusses these pathways and the various decision points in the disposition system represented by Figure 4-1. The discussion includes estimates of the costs for disposing of metallic and concrete SRSM from the population of licensed power reactors in the United States via these three possibilities. Decontamination, segmentation, and transport costs are not included in the costs estimated in this report for disposition.

DISPOSITION SYSTEM DECISIONS

Many nuclear facilities today use waste brokers (firms licensed to receive, process, package, and transport suspected radioactive materials) to handle selected materials arising from their facility operations or decommissioning activities. Thus, an initial decision the waste generator makes is whether to handle its

[1]In addition to municipal solid waste landfills (MSWLF), which must meet minimum national criteria set forth by EPA at 40 CFR Part 258, two other types of Subtitle D landfills are commonly used: construction and demolition landfills, and industrial solid waste landfills. The latter two types of landfills are subject to state regulation with respect to liners, leachate collection, etc., requirements which can vary state to state; there were approximately 3,000 such facilities in the United States in the mid-1990s. There is frequent overlap between the types of waste received at the different types of facilities, e.g., regulations allow MSWLFs to receive industrial nonhazardous waste, and in some states construction and demolition waste are disposed of in MSWLFs.

waste disposal activities in-house or to contract with a waste broker. In either case, the decision points and pathways shown in Figure 4-1 remain the same.

The next decision is whether the SRSM could be stored for a sufficient time prior to disposal to allow decay of radionuclides to levels that might meet adopted clearance standards. For this purpose, materials could be stored at either the waste generator's site, a licensed storage facility, or a waste broker's site. Many factors can influence this decision, including the following:

- Will the radioactive isotopes present decay rapidly enough that a reasonably short storage period is possible?
- Is suitable storage capability available either on-site or at a licensed waste broker's site?
- Does the waste owner have the long-term financial stability to ensure safe and proper storage of the radioactive materials and future disposition of the residual material at the end of the storage period?
- Are the avoided immediate disposal costs and the projected future disposal costs and disposal capacities sufficiently well known to justify the risks of a longer-term financial commitment?
- Are the surrounding communities amenable to the long-term storage of these materials?

Some waste generators (particularly hospitals) already use a storage approach for wastes that contain short-lived radionuclides, such as those used in nuclear medicine for treatment or diagnosis. Generally, storage for less than a year is sufficient to permit disposal of these types of wastes subject only to other characteristics that might dictate disposal at hazardous waste (Subtitle C) or municipal waste (Subtitle D) landfills under existing guidance (i.e., Regulatory Guide 1.86). In these circumstances, storage is less costly than the expenses associated with packaging, transport, and disposal at an LLRW facility. In some locations, access to an LLRW disposal facility may be restricted by the compacts and the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLWPAA). Storage for decay may be the only choice.

Generators of SRSM containing radioactive species with half-lives in the range of one year or less may find the storage approach appealing. However, if the radioactive species have half-lives longer than a few years, the SRSM generator cannot solve the disposal problem with a storage approach.

In the conceptual framework, the next activity is to sort the waste stream into materials that presently can be cleared subject to the appropriate standards and those that cannot. The cleared material is then released for unrestricted use.

The next decision is whether treatment is available and will be used prior to disposition. The SRSM is sorted into two streams, one amenable to treatment and one for which treatment would not be beneficial. Materials to be treated are decontaminated using various chemical or mechanical methods to remove radio-

active contaminants from their surfaces. The SRSM that has been subject to treatment is then sorted into cleared, conditionally cleared, and LLRW streams (i.e., no release). The untreated materials are sorted into conditionally cleared and LLRW streams. The two streams of conditionally cleared materials can then be released for controlled reuse or for disposal in a Subtitle C or Subtitle D landfill. The LLRW materials may be reduced in volume before being delivered to an LLRW disposal facility. A secondary radioactive waste stream generated from the chemical or mechanical decontamination activities will also require disposal at an LLRW disposal facility.

RELATIVE COSTS FOR DISPOSITION ALTERNATIVES

Determining the costs for the pathways in this disposition system can be difficult, but some useful data are available. Components of disposal prices at Barnwell and U.S. Ecology are part of the public record. The disposal costs for special items such as reactor pressure vessels or steam generators are often negotiated privately between the waste owner and the disposal facility. In addition, many waste generators now use waste brokers to process and dispose of their wastes. These costs are based on negotiated contracts, which are generally not public record and are therefore not readily available. Many factors affect costs, and the committee was not able to make a detailed analysis of all these factors nor did it find that the U.S. Nuclear Regulatory Commission (USNRC) had prepared a detailed economic analysis. Factors affecting costs include volume, physical and chemical characteristics of the material, taxes and fees imposed by the various regulatory entities, and past relationship of the generator and disposal facility.

The disposal cost for LLRW from decommissioning can constitute a major share of the total cost of decommissioning a nuclear power plant (Konzek et al. 1995; Smith et al. 1996). The USNRC must ensure that utility owners deposit adequate monies into the decommissioning funds to cover the cost of decommissioning their nuclear power plants. Therefore, for the past decade the USNRC has issued a periodic report on LLRW disposal costs, *Report on Waste Burial Charges*, NUREG-1307. The latest revision of NUREG-1307 (USNRC, 2000b) lists the published year-2000 charge rates for LLRW disposal at licensed commercial disposal sites in Richland, Washington ("US Ecology"), and Barnwell, South Carolina ("Barnwell"). It also contains information on the escalation of LLRW disposal costs over recent years and a set of generic rates typically being charged by waste brokers for disposition of contaminated concrete rubble and contaminated metals. These generic rates come from a survey of licensed waste brokers. Thus, some data are available for use in estimating the disposition costs for contaminated materials. NUREG-1307 does not include data for Envirocare of Utah, which is not subject to the limitations of the LLWPAA and was designed specifically to receive high-volume, low-activity waste.

Disposal of commercially generated LLRW and SRSM, as defined in this report, is geographically controlled by the provisions of the LLWPAA. The LLWPAA established the framework for the creation of interstate compacts and granted the compacts the authority to exclude the importation of wastes from outside each compact. At the present time, three disposal facilities are operating in the United States and additional facilities are not likely to be developed in the near future. The US Ecology disposal facility on the Hanford Reservation in Washington takes LLRW and some technologically enhanced naturally occurring radioactive material (TENORM) from states in the Northwest Interstate Compact region (Washington, Oregon, Idaho, Utah, Montana, Wyoming, Alaska, and Hawaii) and, by agreement, the Rocky Mountain Compact region (Colorado, Nevada, and New Mexico). The Envirocare facility, located in Clive, Utah, takes some LLRW and SRSM from all over the country but, out of deference to the Northwest Compact, takes limited wastes from that region. The Chem Nuclear facility in Barnwell, South Carolina, currently takes LLRW from all other states, except North Carolina, although waste receipts at Barnwell will be further limited in the future. The South Carolina state Budget and Control Board has reported, "As you are probably aware, a South Carolina state law passed last year limits the annual volume of waste that can be accepted at the Barnwell site through our fiscal year 2008, which ends June 30, 2008. After that date, the site can only accept waste generated within the Atlantic Compact region. For the current fiscal year, July 1, 2001, through June 30, 2002, the site can accept 80,000 cubic feet, which is a 35 percent reduction from the volume received last fiscal year" (Newberry, 2001).

The following discussion of the estimated costs of disposal is provided for illustrative purposes and does not purport to represent the actual costs that any particular waste generator may incur. The projected dates for reactor decommissioning are too uncertain, as are the interest and discount rates appropriate to those dates, to permit any meaningful present value analyses. In addition, the cost of disposal of nuclear waste will in the future be subject to factors the committee is not able to foresee or take into account in these estimates. For example, the closing of Barnwell to receipt of waste from outside the Atlantic Compact after June 30, 2008, could have an effect on the prices charged by Envirocare of Utah and US Ecology for disposal services. However, the possibility cannot be ruled out that other compacts may open competing LLRW disposal facilities pursuant to the LLWPAA of 1985. Such facilities could accept SRSM generated within compact and, at their discretion, from other compacts. Historically, high disposal costs and lack of access to disposal sites have caused licensees to employ volume reduction (e.g., compaction) and other waste management strategies. This was observed, for example, during the closure of Barnwell to certain states during the 1990s (NRC, 2001). Finally, while the committee has considered the probable future market prices for disposal of waste in developing estimates for the costs of various disposition options, other input variables such as the costs of transporta-

TABLE 4-1 Approximate Costs for Disposal of Solid Material as Low-Level Radioactive Waste (dollars)

Site	Average Price per Cubic Meter	Average Price per Kilogram
Chem-Nuclear—Barnwell S.C.	16,800 (metal or concrete)	13.86
US Ecology—Hanford, Wash.	3,120 (metal or concrete)	2.64
Envirocare of Utah—Clive, Utah[a]	388 (concrete)	0.33

NOTES: The table does not include the cost of decontamination, waste processing, transportation, and handling. Taxes and government charges are included. Nominal waste density is 1,200 kg/m^3.

[a]Envirocare does not publish its rates. The committee was able to verify one set of rates for one customer for 11(e)(2) materials only and cannot state whether this rate is representative for disposal of SRSM in general.

tion, treatment, fees and tariffs, and so forth, have not been included in these estimates. The committee recognizes that the costs of treatment, transportation and handling fees can be substantial; however, since these costs are expected to be case dependent, it was decided not to include them in developing generic cost estimates for disposal.

To estimate the costs of LLRW disposal of metal at the US Ecology and Barnwell disposal facilities, the study committee applied the average costs for disposal at those sites to the inventory of net metallic SRSM (excluding concrete) for the population of U.S. power reactors, as shown in Table 3-1. The average cost for disposal of LLRW materials at the US Ecology disposal facility, adjusted to year-2000 dollars, was about $3,120 per cubic meter. The analogous cost for the Barnwell facility was $16,800 per cubic meter. Table 4-1 lists nominal rates for disposal of solid material used in this discussion. Not all licensees are authorized to dispose of materials at all LLRW facilities, due to the regulatory complexities of the waste compact provisions of the LLWPAA. Envirocare of Utah can accept certain types of high-volume low-activity Class A waste under 10 CFR Part 61, naturally occurring radioactive material (NORM), and 11(e)(2) wastes.[2] With respect to bulk scrap metals that would be generated by power reactor decommissioning, Envirocare's waste acceptance guidelines state that the facility can accept "bulk oversized debris in the form of large pieces of metal, boulders, equipment, etc." (Envirocare, 2001, p. 20). However, Envirocare does not publish prices for disposal of wastes, including large pieces of metal, at its facility. The committee has thus not made estimates of disposal of metals at Envirocare. The cost for disposal as LLRW wastes of net metallic SRSM from

[2]Charles Judd, President, Envirocare of Utah, presentation to the committee, March 26, 2001.

the total population of power reactors could range from about $1.6 billion for US Ecology disposal to about $8.8 billion for Barnwell disposal.

The committee estimated the costs for disposal of the same net metallic SRSM at a landfill. The unit costs range from about $30 per metric ton at a municipal waste (Subtitle D) landfill to about $110 per metric ton at a hazardous waste (Subtitle C) landfill. Based on the estimate in Table 3-2 for the weight of metallic SRSM from the population of power reactors, the cost for disposal as conditionally cleared metals would be about $22 million in a Subtitle D landfill or about $81 million in a Subtitle C landfill. The possible income (or cost) associated with clearance of the net metallic SRSM could range from an income of about $22 million (assuming a scrap recycle value of about $30 per ton) to a cost of about $22 million (assuming Subtitle D landfill disposal).

Similar cost estimates arise from consideration of disposition of the concrete SRSM from the population of U.S. power reactors. Envirocare can accept concrete debris for disposal, provided it is Class A waste under 10 CFR Part 61 (Envirocare, 2001, p. 19; see also footnote 2). Envirocare does not publically advertise disposal rates and negotiates disposal rates on a case-by-case basis (see p. 484, *Envirocare of Utah, Inc. v. U.S.*, 44 Fed.Cl. 474 (Fed.Cl., Jun 11, 1999) (NO. 99-76C)). In the absence of direct information, the committee has therefore estimated costs for disposing of concrete from power reactors by using the publicly available contract rate for debris (including concrete) used under contract with the U.S. Army Corps of Engineers (USACE) for disposal of 11(e)(2) wastes at Envirocare of $296.8 per cubic yard ($388 per cubic meter) (USACE, 1998). (The previous year, the contract rate for debris, which includes concrete debris, for the USACE was $427.5 per cubic yard—$559 per cubic meter—illustrating the case-by-case variability in the price of disposing of such wastes at Envirocare.) Disposal of all concrete rubble from U.S. power reactors at Envirocare would cost approximately $2.9 billion. Using the US Ecology and Barnwell disposal charge rates given previously, disposal costs for this concrete as LLRW would range from about $2.9 billion (Envirocare), as noted, to $23 billion (US Ecology), to $123 billion (Barnwell), if all of the concrete is disposed in one site. The text and Table 4-1 show a large difference in disposal costs at the three operating sites. Barnwell and US Ecology are regional disposal facilities under the LLWPAA and, as such, are subject to regional and state surcharges, taxes, and some rate regulation. Envirocare is not a regional disposal facility and is not similarly regulated. The committee cannot explain the differences in rates, nor does the committee know whether the quoted rate for 11(e)(2) disposal at Envirocare is representative of rates for other materials, volumes, or generators. Detailed analysis of the components of disposal costs (e.g., surcharges) is beyond the scope of the committee's task.

Disposal costs for this concrete as conditionally cleared material in a Subtitle D or Subtitle C landfill would range from $265 million to $975 million, depending on the type of landfill utilized. Clearance of this concrete for use in roadway

TABLE 4-2 Estimated Costs for Alternative Dispositions of Slightly Radioactive Solid Material[a] (billion dollars)

Disposal Location	SRSM Metals	SRSM Concrete
U.S. Ecology—Richland, Wash.	1.6	23
Chem-Nuclear—Barnwell, S.C.	8.8	123
Envirocare of Utah—Clive, Utah	Not calculated	2.9
Subtitle C landfill (generic)	0.081	0.98
Subtitle D landfill (generic)	0.022	0.27

[a]Values represent disposal of all material at a given disposal site, and do not reflect any credits that might arise from recycle or reuse of this material.

foundations or other similar unrestricted applications would reduce that portion of the disposition costs associated with disposal to nearly zero. Costs for these and other disposal options for concrete and metal are summarized in Table 4-2.

FINDING

Finding 4.1. Disposal of all slightly radioactive solid materials arising from decommissioning the population of U.S. power reactors into low-level radioactive waste disposal sites would be expensive (about $4.5 billion to $11.7 billion) at current disposal charge rates. Disposal in Subtitle D or Subtitle C landfills would be cheaper ($0.3 billion to $1 billion, respectively). Clearance of all of this material could reduce disposal costs to nearly zero (assumes 100 percent reuse or recycle) or might even result in some income (~$20 million) arising from the sale of scrap materials for recycle or reuse. Decontamination, segmentation, and transport costs are not included in the costs estimated in this report for disposition.

5

Review of Methodology for Dose Analysis

In the United States and internationally, there have been several attempts to provide technical guidance concerning the doses that might be associated with various clearance policies for slightly radioactive solid material (SRSM). As part of its charge, the study committee has reviewed the relevant public reports, as well as various commentaries and critiques of those reports. In addition, the committee met with knowledgeable experts involved in preparing the reports, to clarify specific issues, particularly the reasons why dose factors differ between reports.

Because one of the reports, the draft report NUREG-1640, *Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities* (USNRC, 1998b), was prepared for the U.S. Nuclear Regulatory Commission, the committee gave it particular attention. The committee has been able to delve sufficiently deeply into the report to form an overall judgment about its usefulness and to make recommendations for next steps.

Based on its review of technical documents from around the world, the committee has drawn a number of conclusions on technical issues. These findings are collected at the end of this chapter. The body of the chapter supports the findings.

Most of the technical material in this field falls under the rubric of risk assessment, which means it inherits both the strengths and the limitations of this discipline. In particular, although risk estimates can provide useful guidance, they do not substitute for policy decisions on what risks are acceptable. Furthermore, "although the conduct of a risk assessment involves research of a kind, it is

primarily a process of gathering and evaluating extant data and imposing science-policy choices" (NRC, 1994).

One of the science policy choices to be imposed involves setting boundaries on the scope of the analysis. In this case, the boundaries involve using radiation dose as a surrogate for health impacts and ignoring other consequences considered to be of lesser significance, such as psychological impacts. When it comes to assigning risk to dose, analysts generally accept standard estimates of dose-risk coefficients established by scientific bodies such as the Committee on Biological Effects of Ionizing Radiation (BEIR) of the National Research Council and the United Nations Scientific Committee on the Effects of Atomic Radiation (NRC, 1990; UNSCEAR, 1988). Nevertheless, the technical reports in this field can assist the USNRC and interested parties in making policy judgments about the clearance of SRSM, as long as the following three conditions are met: (1) the boundaries of the relevant risk assessments must be kept in mind; (2) policy decisions about acceptable risk must be separated from technical issues; and (3) the major limitations of the technical reports, as identified in this chapter, must be addressed. The flow chart in Figure 5-1 shows points at which technical information can inform decision makers about clearance of SRSM, if a rulemaking process one day advances to a decision point about clearance.

KEY TECHNICAL ASSESSMENTS OF ANNUAL DOSES ASSOCIATED WITH CLEARANCE OF SOLID MATERIALS

A great deal of effort in a number of countries over the last 20 years has gone into developing the numerical coefficients, also called *dose factors*, needed by policy makers to (1) understand the dose commitment implied by various clearance concentrations and (2) convert a primary dose standard into secondary activity standards that can be used by licensees to ensure compliance with the primary standard (see Box 5-1). The major compilations of these dose factors are listed in Table 5-1, along with the scientific bodies that have reviewed the underlying technical analyses. (See Appendix D for a summary of efforts here and abroad on SRSM clearance standards.)

All of the reports in Table 5-1 estimate doses to classes of persons, such as SRSM transport workers, or consumers, and focus on the group that is estimated to have the highest dose under all the scenarios considered (the *critical group*); see Figure 5-2. The principle is that if the most exposed group of individuals is identified correctly and the dose to that group is shown to fall below the primary standard, then the dose to any other member of the general public will fall below the standard as well. Thus, the dose to the critical group (for a unit release) determines the dose factor. Note that the critical group can differ for different radionuclides, which complicates implementation of any clearance standard that relies on dose factors. Also, the critical group, and thus the secondary standard, may change when the allowed clearance categories are restricted, as in condi-

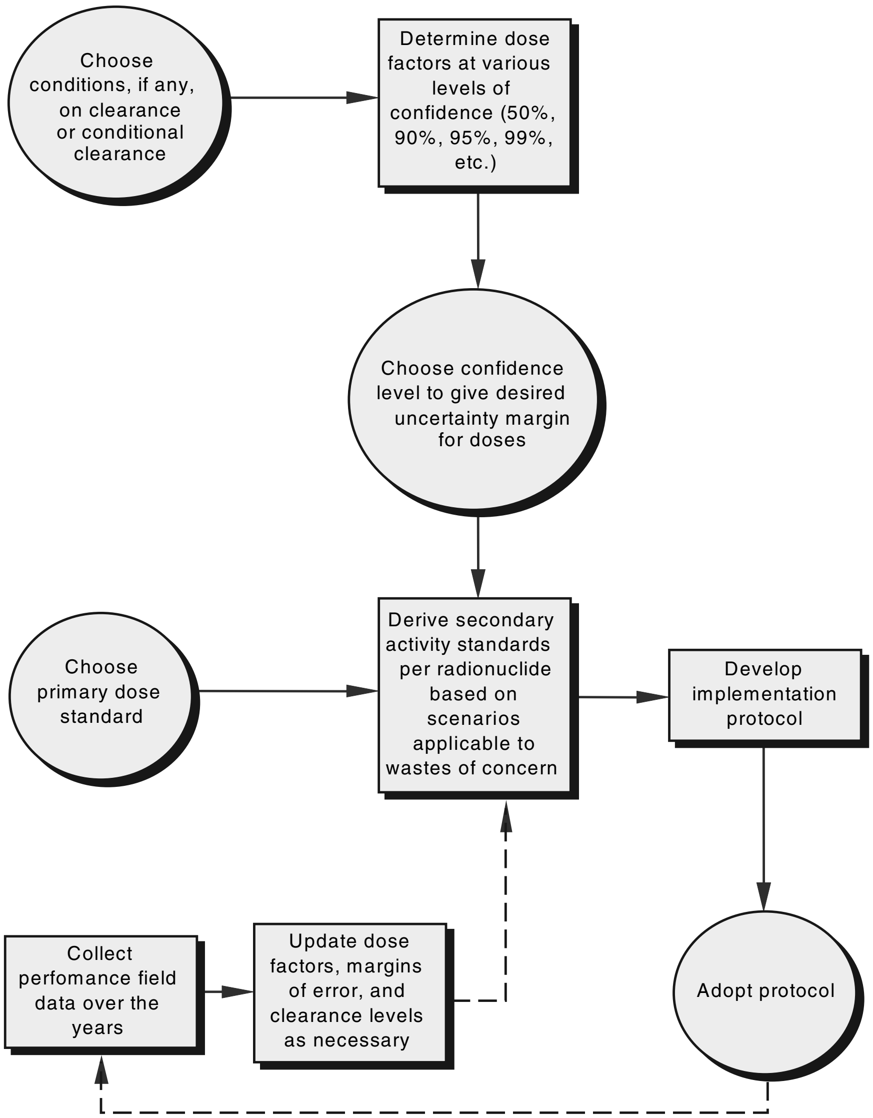

FIGURE 5-1 Points at which technical information and judgments can inform rulemaking decisions related to clearance of slightly radioactive solid material. NOTE: Circles indicate policy decisions. Rectangles indicate technical contributions.

tional clearance. To date, most of the attention to dose factors has assumed that they would be used in setting standards for (unconditional) clearance.

Because primary dose standards for clearance or disposition of solid materials are usually given in dose per year, the dose factors are generally expressed in

BOX 5-1
Primary and Secondary Clearance Standards and Dose Factors

A dose limit for an individual, such as 10 µSv/yr (1 mrem/yr), constitutes a *primary standard* for clearance of a radioactive or slightly radioactive solid material. *Secondary standards* or *derived activity standards* are derived from a primary standard. They apply to a licensee's material and specify the maximum activity in or on a solid material that has been estimated to be clearable while remaining below the primary dose standard. Derived activity standards are set using the results of risk analyses that determine the annual dose of radiation received for a given radionuclide concentration corresponding to a "critical" (most exposed) group of individuals. When developing regulations, analysts construct several groups of scenarios corresponding to different phases of the recycle and reuse of the slightly radioactive solid material during which there is the possibility that persons can be exposed to radiation. These include handling and processing scenarios, storage scenarios, product use scenarios (e.g., if steel is recycled to make a product), transport scenarios, disposal scenarios, and landfill resident scenarios. For a given radionuclide concentration (becquerels per gram), the annual dose to individuals in each of these scenarios (and the subgroupings within them, e.g., transport of scrap metal and transport of slag) is calculated. The critical group in draft NUREG-1640 for steel and cobalt-60, for example, is transport of scrap metal, meaning that the dose received in all other scenarios is lower. The dose factor for cobalt-60 is 250 microsieverts/yr per Bq/g, which is the mean of the distribution reported in NUREG-1640.

The derived activity standard for each radionuclide can be derived from its critical group dose factor by dividing the desired primary dose standard, e.g., 10 microsieverts, by the dose factor. This relationship can be shown by solving for the quantity *x* in the equation below to determine what quantity of Bq/g would cause a dose of 10 microsieverts per year, using the dose factor for cobalt-60 in the critical group just described for steel, as follows:

$$250\,\frac{\mu\mathrm{Sr\,/\,yr}}{\mathrm{Bq\,/\,g}} \times x\mathrm{Bq\,/\,g} = 10\mu\mathrm{Sv\,/\,y}r$$

In the case of cobalt-60 in steel, this yields a derived clearance standard of 0.04 Bq/g.

units of dose per year per unit of activity released.[1] Cumulative total doses can be obtained by multiplying the estimated dose by an assumed duration of exposure—for instance, a person's remaining years of life.

[1]Presumably, the total dose per year (i.e., the committed dose per year). In some cases, effective dose equivalent is used, which accounts for both the relative biological effectiveness of different types of radioactivity and the differing sensitivity of organs to cancer mortality. In some studies, only effective doses are used, without the weighting by cancer mortality that produces dose equivalents.

TABLE 5-1 Technical Analyses Supporting Numerical Coefficients for Deriving Secondary Activity Standards from Primary Dose Standards

Study	Status	Reviewer	Reference
USNRC			
NUREG-1640[a]	Draft	CNWRA	USNRC, 1998b
NUREG-0518	Draft		USNRC, 1980
EPA			
TSD 97[a]	Draft	NCRP	EPA, 1997a
TSD 99[b]	In progress		
ANSI/HPS			
N13.12-1999	Final		ANSI/HPS, 1999
IAEA			
Safety Practice No. 111-P-1.1	Final		IAEA, 1992
Technical Document 855	Interim		IAEA, 1996
European Commission			
Radiation Protection-89	Final		EC, 1998b
Radiation Protection-114	Final		EC, 2000

NOTE: ANSI/HPS = American National Standards Institute/Health Physics Society; CNWRA = Center for Nuclear Waste Regulatory Analyses; EC = European Commission; EPA = Environmental Protection Agency; IAEA = International Atomic Energy Agency; ICRP = International Commission on Radiological Protection; NCRP = National Council on Radiological Protection and Measurements; TSD = Technical Support Document.

[a]The coefficients given in the USNRC and EPA source documents have built into them, or the opportunity to use, an explicit margin to account for uncertainty. In EPA TSD 97 a margin was built into the dose coefficients. Specifically, the semiquantitative uncertainty analysis described in Chapter 10 showed that, depending on choice of input parameters, normalized doses could be higher by a factor of 5-50 or lower by a factor of 100-500, i.e., they favored more protective levels. The NUREG-1640 draft shows a distribution of dose factors based on Monte Carlo simulations of the aggregate uncertainty resulting from uncertainties in the component estimates. Both the mean values and the 95th percentile given in NUREG-1640 for the dose coefficients lie above the median, 50th percentile value. If either of these properties of the distribution were chosen to define the regulatory dose coefficients, a margin above the best estimate (median) would automatically be included.

[b]The study committee has seen the first EPA report, TSD 97. A new report, TSD 99, was prepared and given very limited distribution, presumably in 1999. Proposals were due to the EPA on April 13, 2001, for final revision of TSD 99, with submittal of the draft to the EPA by May 31, 2001. Both TSD 99 and this new revision will supplant Chapters 1-7 of TSD 97, using ICRP-68 guidance. By this revision the EPA will be reacting to comments from the NCRP review and others. The remaining chapters of TSD 97 after Chapter 7 will apparently stand without revision. (Information on status of TSD 99 and revision efforts was received in a personal communication from Debbie Kopsick, EPA, to Robert Bernero, Board on Radioactive Waste Management, National Research Council, April 11, 2001.)

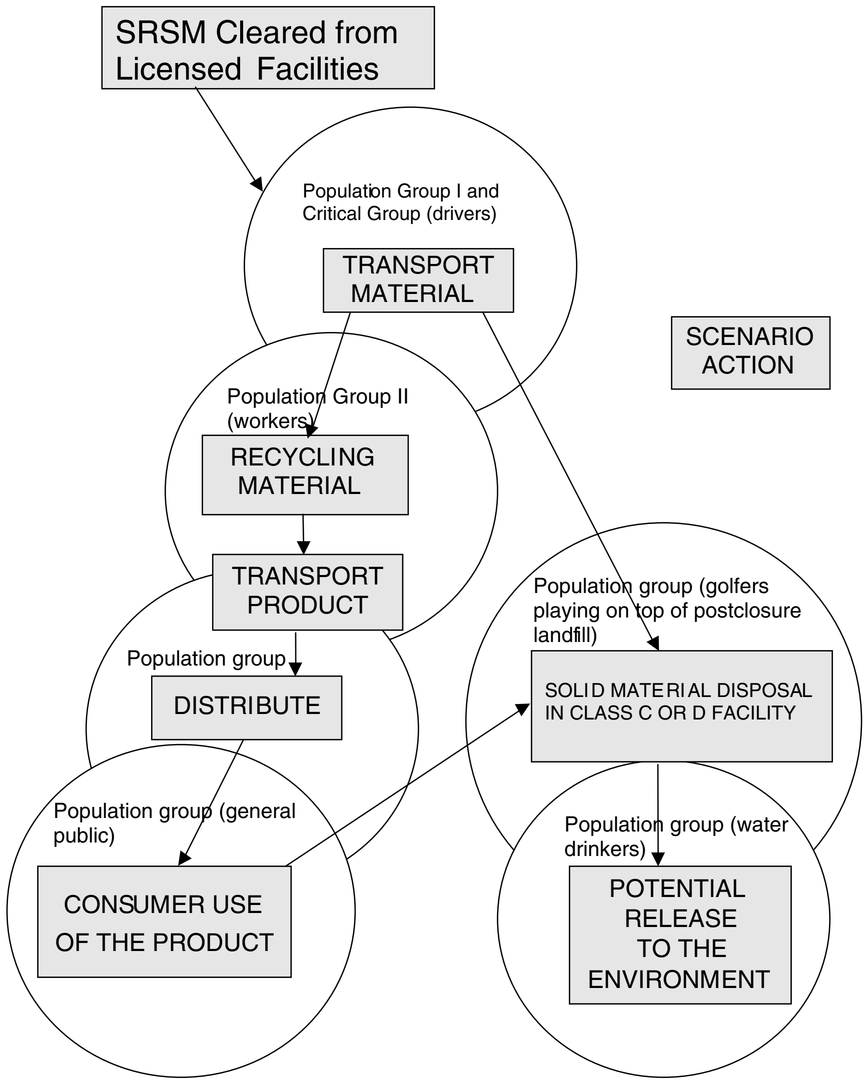

FIGURE 5-2 Illustration of scenario pathways following SRSM clearance and hypothetical affected critical groups.

The committee's assessments of the individual technical sources listed in Table 5-1 are presented in the next five sections. Then the committee compares the methodologies used across these studies, including comments on the usefulness and quality of the dose factors they contain, general limitations that should be corrected, and potential inconsistencies in the dose factors used by different countries. Before concluding with the summary statement of the findings for the chapter, the committee explores in further detail specific issues that should be addressed in subsequent work on the draft NUREG-1640.

USNRC STUDIES

The committee reviewed two technical documents on clearance standards developed for the USNRC. Draft NUREG-1640, which has been mentioned in earlier chapters of this report, is particularly relevant to the new rulemaking on clearance standards for SRSM, which the Commission is contemplating. The second document, NUREG-0518, represents an earlier effort at analysis to support clearance standards for SRSM.

Draft NUREG-1640

Draft NUREG-1640 (USNRC, 1998b) contains estimates of the *total effective dose equivalent* to an average individual in a critical group from direct reuse of equipment, recycling, or disposal of materials, for a wide range of radionuclides that may be present in solid materials from decommissioning of nuclear facilities. The risk assessment methodology is largely state of the art. Critical groups are chosen by assuming a policy of clearance, although information in the appendixes may be sufficient to allow choices of other critical groups to support derivation of dose factors for possible conditional clearance policies. The draft does not discuss implementation issues.

Although NUREG-1640 is a draft for review and comment, it is a sophisticated product and does many things well. The various scenarios considered for clearance of materials with surface or volume contamination are well documented and easy to understand. The major analytical effort is for recycling steel (31 scenarios), with less analysis for recycling copper (23 scenarios), aluminum (17 scenarios), and concrete (7 scenarios). There is an in-depth analysis of current recycling practices and how the inclusion of SRSM would show up as exposure to humans. In addition, the study does a good job of documenting the impact of equipment reuse.

The chemistry, metallurgy, geology, and physics used in the report seem reasonably sound. Considerable information is provided on the dose factors resulting from external exposure, inhalation, and ingestion of radioisotopes from recycled material, waste, and release of effluents to air or water. Most of the

critical groups turn out to be workers, not the public at large. The report does not discuss whether this pattern would change for conditional clearance.

The committee found the overall *conceptual* plan of draft NUREG-1640 to be the best of all of the studies that it reviewed. It is closest in spirit to recommendations on risk assessment that have been made by expert bodies, including committees of the National Research Council (NRC, 1994). For instance, the estimates in draft NUREG-1640 are traceable, and a formal uncertainty analysis has been performed for each dose factor.[2] The study presents the mean and the 5th, median, and 95th percentile values for each dose factor, derived from Monte Carlo uncertainty analyses. The authors of draft NUREG-1640 use the range from the 5th to the 95th percentile to define a "90 percent confidence interval" (about the median) (USNRC, 1998b, Tables 4.10 and 4.11).

The result of a Monte Carlo calculation, such as carried out by NUREG-1640, is a distribution of doses for each scenario delivered to the representative member of a critical group for a particular radionuclide. There is no single dose estimate to a critical group, and hence no single dose factor for that critical group. Nevertheless, a decision must be made, if NUREG-1640 is to be used to support clearance or conditional clearance, about which dose factor should be used to assign secondary activity standards. If one takes the median of the distribution, then 50 percent of the dose factors are below and 50 percent above. Choosing the median as the de minimis value for use in clearance or conditional clearance standards, however, would leave the decision maker without the higher degree of assurance that the dose to the critical group is below the ordinary dose standard as when higher percentile-valued dose factors are chosen (e.g., 90th percentile). This additional assurance is above and beyond the conservatism that applies to individuals within population groups that receive less exposure than the critical group.

Table 5-2 averages the uncertainty factors computed for NUREG-1640 across radionuclides. In this table, uncertainty is represented by the geometric standard deviation (GSD), which is appropriate for quantifying the spread in variables with large variations. Except for concrete recycle, the GSDs are small.[3]

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[2]For the uncertainty analysis, NUREG-1640 works with the individual steps involved in making a dose estimate. The analyst gathers data from the literature on the ranges that individual parameters required for the estimate might take and then propagates the individual uncertainties to the final coefficient using techniques such as Monte Carlo simulation (EPA, 1996). There is a subjective element in choosing the parameter distributions used to fit the literature data, but these choices are one or more steps removed from the final uncertainty estimate for the dose factor. Also, guidelines exist for selecting the functional form for a parameter distribution (Seiler and Alvarez, 1996).

[3]A sampling of papers published in *Health Physics* showed GSDs ranging from 1.7 to 20, with most in the range 2-4. Thus, values of GSD below 2 can be considered small, and values above 4 considered high (Breshears, 1989; Johnston, 1991; Till, 1995; Sheppard, 1997; Bolch, 2001).

TABLE 5-2 NUREG-1640 Uncertainty Factors Averaged Across Radionuclides

	Average Geometric Standard Deviation (GSD)[a]	
	Volume Contamination	Surface Contamination
Steel recycle[b]	1.8	2.0
Concrete recycle[c]	3.0[d]	3.4
Copper recycle[e]	1.5	1.6
Aluminum recycle[f]	1.4	1.7
Reuse of large piece of equipment[g]	NA[h]	1.9

[a]One standard deviation is equal to the product of the median times the GSD. Two standard deviations (~95th percentile limits) equal the square of the GSD. For the table, GSDs were approximated by computing the square root of the ratio of the 95th percentile dose factors to the 50th percentile results, as presented in tables in NUREG-1640 (USNRC, 1998b).

[b]From Tables 4.1, 4.2 (USNRC, 1998b).

[c]From Tables 7.2, 7.3 (USNRC 1998b).

[d]The distribution is bimodal, with one group of radionuclides having a GSD around 1 and another group having a GSD around 6.

[e]Tables 5.5, 5.6 (USNRC, 1998b).

[f]Tables 6.4, 6.5 (USNRC, 1998b).

[g]Tables 3.2, 3.3 (USNRC, 1998b).

[h]NA = not applicable.

Formal uncertainty analysis can be an important tool for building confidence in the use of dose estimates for policy decisions. It addresses the reported tendency of even experts in a field to underestimate uncertainty bands when professional judgment alone is used (Cooke, 1991). This tendency exists even in the physical sciences (Shlyakhter and Valverde, 1995). It is therefore not wise to rely on professional judgments of estimates of overall uncertainty because of the subjective bias found in such estimates. Of the studies listed in Table 5-1, only draft NUREG-1640 includes a formal uncertainty analysis that reduces the amount of professional judgment required in assigning uncertainty bands to dose factors. Excellent discussions of formal uncertainty analysis can be found in other USNRC documents (e.g., USNRC, 1995) and in Morgan and Henrion (1990).

The authors and planners of draft NUREG-1640 are to be commended for developing an excellent approach. The execution of draft NUREG-1640's conceptual plan, however, has been clouded by questions of contractor conflict of interest concerning the recycle option (see discussion in Chapter 2). One question is how the USNRC could have failed to identify the conflict of interest. These questions highlight the need to include the possibility of organizational failure when assessing overall system uncertainty. After the conflict of interest was

identified, the matter was investigated by USNRC counsel and the contract in question was terminated. The USNRC engaged another contractor to complete the work on draft NUREG-1640.

Meanwhile, the USNRC asked the Center for Nuclear Waste Regulatory Analyses (CNWRA) to perform an independent technical review of the draft NUREG-1640. The CNWRA, located at the Southwest Research Institute in San Antonio, Texas, is a dedicated contractor providing technical support to the USNRC on waste management matters. The committee has studied the CNWRA review (CNWRA, 2001), which is actually an audit of the mathematics and completeness of scenarios considered in draft NUREG-1640. CNWRA recommended that some additional scenarios be added to the mix considered in draft NUREG-1640 but otherwise found the mathematics to be correct. Although this CNWRA review is comforting and is confirmed by the committee's spot check of some of the scenarios, there has not yet been a similarly thorough review of the choice of parameters and parameter ranges, term by term, for the component estimates in deriving the dose factors. (The choice of parameters and parameter ranges are listed in Appendix B of draft NUREG-1640, Tables B.1, B.2, etc. Although the committee generally confirmed the reasonableness of many of these choices, it was able to review only a sample of the dose factors, given its full set of tasks.)

In addition to any lingering questions about the choice of parameters, whether due to a potential bias or for other reasons, there are a number of other limitations in draft NUREG-1640. These limitations have to be addressed before the document will be fully usable by the USNRC and interested parties in reaching valid conclusions about related SRSM policy issues. The limitations are discussed in the penultimate section of this chapter. One option for the USNRC, faced with any lingering concerns over charges of conflict of interest, is to start all over again. However, it is likely that any new contractor would simply repeat the work in NUREG-1640 as far as it goes and build upon it in the way the committee recommends. Therefore, from a scientific perspective, the committee does not believe it is cost-effective to repeat the work done in draft NUREG-1640.

The committee believes that once the remaining questions about and limitations in draft NUREG-1640 are addressed, either in the final version of the report or in follow-up reports, the USNRC and interested parties will have a sound technical basis for evaluating the health impacts, measurement issues, and implementability of various primary dose standards and the unavoidable uncertainties involved in risk estimates. However, the committee notes that the dose factors developed through the NUREG-1640 process cannot be adopted for use with Department of Energy (DOE) or other SRSM without further analysis. Changes are likely to be needed to some of the dose factors and/or their uncertainties because the quantity and types of DOE SRSM, as well as

some potential release scenarios, differ from wastes generated by USNRC-licensed facilities.[4]

NUREG-0518

Prior to NUREG-1640, the USNRC published a risk assessment in 1980 for the release of SRSM. In response to a 1974 amendment to the Atomic Energy Act (AEA), which authorized release of de minimis quantities of special nuclear material if justified, the Atomic Energy Commission (AEC) began developing a de minimis standard for enriched uranium and the attendant fission product technetium. The development side of the AEC (later the Energy Research and Development Administration, ERDA) requested guidance from the regulatory side of the AEC (later the USNRC). The ERDA developed data for the quantities of scrap steel, copper, and nickel that would become available from the 1976-1982 cascade improvements at the gaseous diffusion plants used for enriching uranium. (See also "DOE Facilities" in Chapter 3.) Data were provided on the extent of decontamination that could be achieved by smelting. These data showed that smelting could not be relied upon to reduce the contaminant content to less than 17.5 parts per million (ppm) uranium and 5 ppm technetium.

The USNRC staff prepared and issued NUREG-0518, *Draft Environmental Statement Concerning Proposed Exemption from Licensing Requirements for Smelted Alloys Containing Residual Technetium-99 and Low-Enriched Uranium* (USNRC, 1980). NUREG-0518 contained analyses of the expected scrap metal inventories from the gaseous diffusion plants and of scrap metal from other sources. Using several important assumptions, the study estimated both doses to an individual member and collective doses to the entire group for several critical groups. The most important assumption was that the proposed exemption from regulatory control would apply only to scrap metal ingots coming out of a licensed smelter, thus ensuring a radionuclide content in the scrap of no more than 17.5 ppm uranium and 5 ppm technetium. Conservative assumptions were ap-

[4]DOE may have disposition opportunities, and therefore clearance scenarios, that are not available to USNRC licensees. As for dose calculations, the committee notes that uncertainties about migration of transuranics have become important for DOE SRSM, whereas they are far less important for SRSM from USNRC licensees. For example, the transuranic radionuclides in the SRSM stream from USNRC-licensed facilities constitute a relatively minor component of the radioactive contaminants. USNRC analysts therefore do not need to delve too deeply into chemical and biological processes in landfills that might speed up migration of transuranic radionuclides, which are thought to migrate at a slow rate under usual subsurface conditions. By contrast, DOE has a great deal of material potentially contaminated with transuranics at substantially higher concentrations than occur in nuclear power plant wastes. An analysis by DOE to support conditional clearance standards for DOE SRSM may have to consider in some detail the chemical or biochemical processes in Subtitle C or other landfills.

plied to scenarios for possible uses of the ingots. For example, all of the steel scrap released was assumed to be used in a continuous 80-day run at the exempt steel plant and made into products of the reference content. Steel plate, iron tonic, and even a production run of 9 million cast iron frying pans, were considered as possible products from the steel. Jewelry, coins, and prostheses were considered as possible products from the other metals.

The estimated doses listed in NUREG-0518 include a 10 mrem/yr whole-body external dose for one exposed group (workers spending 1,000 hours per year in a steel vault), a 2 mrem total-body dose commitment for another group (1 year of iron tonic ingestion), and a 20 rem contact bone dose for a third group (prosthesis pins implanted for 50 years). The collective dose for the worst-case scenario was estimated to be 80 person-rem.

NUREG-0518 does not contain any uncertainty analysis as such. Instead, it invokes conservative bounding conditions to make the point estimates of dose usable for regulatory purposes.

In NUREG-0518 the USNRC staff concluded that the proposed exemption, as qualified, was acceptable for consideration by the Commission for amendment of its regulations. There was substantial negative public reaction to NUREG-0518, and the proposed exemption process was suspended (51 Federal Register 8842; March 14, 1986).

ENVIRONMENTAL PROTECTION AGENCY DOCUMENTS ON DOSE FACTORS

The Environmental Protection Agency (EPA) Technical Support Document (TSD) *Evaluation of the Potential for Recycling of Scrap Metals from Nuclear Facilities* ("TSD 97") contains numerous tables of background information on the sources and inventories of radioactively contaminated metal scrap from various government and commercial sources (EPA, 1997a). The document develops various normalized individual doses, collective doses, and collective risks, normalized to curie-per-gram concentrations in the scrap metal streams. It also contains valuable information, compiled in an insightful way, about detection limits for contamination as a function of various parameters and about various scrap metal processes, including how radionuclides partition in these processes. This is all useful information. The methodology employed and the handling of uncertainties helped the study committee understand the relevant issues.

TSD 97 also contains useful discussions about possible pathways from contaminated metal (sources) to humans (receptors). These pathways are sorted into a few important pathways and a much larger number that were judged to be less important. The basis for the sorting is explained well.

Another useful element is the discussion of an estimated "timetable," covering the next few decades, indicating when the waste streams might become available for potential commercial recycle (or other disposition alternatives).

This discussion, although inexact in detail because of some assumptions that cannot be verified, succeeds in putting the issues in context.

To assess the uncertainty associated with doses to the critical group, TSD 97 performed a semiquantitative uncertainty analysis that "evaluated the uncertainty/variability in the dose evaluation results due to uncertainty/variability in the calculational parameters and assumptions."[5] Although not a formal uncertainty analysis, the analysts used their inspection of these results and professional judgment to conclude that the dose factors they calculate represent a 90th percentile. (That is, in 90 percent of cases, use of the calculated dose factor will result in a dose to a member of the critical group that is at or below the primary dose standard.[6])

The National Council on Radiation Protection and Measurements (NCRP, 1998) has produced a detailed critique of TSD 97. Among its major findings and recommendations are the following (NCRP, 1998, pp. 9, 11):

1. The NCRP task group concluded that, "as it now stands, [TSD 97] overemphasizes the evaluation of a limited number of scenarios with data that are incomplete and/or unsupported."
2. The NCRP task group recommended "the use of a probabilistic risk assessment model, such as the Monte Carlo method (as recommended by [the EPA's] established policy relative to the conduct of [probabilistic risk assessments]), for analyzing the potential uncertainties and for identifying areas for improvements in the input data."
3. The NCRP task group recommended that the EPA evaluate the feasibility for implementation, stating, "Standard development cannot be devoid of information regarding implementation."

These comments from the NCRP task group are apparently being taken into account by the EPA as it works on a revision of TSD 97 (EPA, in progress). The committee has not seen the revision, which was still in progress when the various technical documents on dose factors were being reviewed for this report.

AMERICAN NATIONAL STANDARDS INSTITUTE AND HEALTH PHYSICS SOCIETY STANDARD N13.12-1999

The Health Physics Society (HPS) Standards Working Group developed this standard.[7] The document defines primary (dose) and secondary screening (activity level) criteria (ANSI/HPS, 1999). The primary dose standard is

[5]TSD 97 (EPA, 1997a, p ES-8, see also, Ch. 10, p. 12).
[6]TSD 97 (EPA, 1997a, Ch. 3, p 3).
[7]The standard was consensus balloted and approved by the ANSI-accredited HPS N13 Committee on October 19, 1998. It was approved by ANSI, Inc., on August 31, 1999.

10 μSv/yr (1 mrem/yr), which is consistent with international values. The document tabulates derived screening levels, above background, for the clearance of SRSM or items containing surface or volume activity concentrations of radioactive materials. These screening levels are derived by applying dose factors to the primary dose standard.

The ANSI/HPS document contains a great deal of useful information on uncertainties in dose factors. Furthermore, the working group took on the difficult task of developing an implementation protocol, which specifies areas over which measurement averages should be taken. It also groups radionuclides based on similarity of dose factors and assigns group-level screening levels ranging from 0.1 to 100 Bq/cm^2 or Bq/g, depending on the group considered. The dose factors chosen are quite similar to the International Atomic Energy Agency (IAEA) values.

To derive dose factors, the working group reviewed a range of dose estimates produced by different analysts for different activities, such as landfill disposal and steel recycling. It also used reports that examined exposures for different forms of contamination (either volume or surface contamination). In contrast to other reports the committee has reviewed, the working group did not use the range of dose estimates across categories to define a critical group in a documented manner. As a result, the method for deriving the screening levels is not traceable by independent reviewers.[8] Although the ANSI/HPS working group was composed of analysts of great skill and experience, only a traceable approach could be judged and ranked by the committee.

INTERNATIONAL ATOMIC ENERGY AGENCY DOCUMENTS

The committee reviewed two documents developed by the International Atomic Energy Agency: Safety Practice No. 111-P-1.1, *Application of Exemption Principles to the Recycle and Reuse of Materials from Nuclear Facilities* (IAEA, 1992), and a more recent interim document, IAEA-TECDOC-855, *Clear-*

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[8]Based on a discussion with a working group member, it appears that the working group used professional judgment to discount or reduce dose values from scenarios if the group believed the value to be unreasonably conservative. It then picked the highest remaining value to use in setting screening levels (personal communications from William Kennedy, HPS Standards Working Group, to Jan Beyea, committee member, April 20, 2001). Had the working group included a table in the standard with the discounted factors, the methodology would have been traceable.

As part of the working group's analysis, it concluded that dose factors appeared to be similar for surface and volume contamination, when units were expressed in becquerel per gram or becquerel per centimeter squared. (IAEA, 1996, came to a similar conclusion.) Consequently, the group chose the same "derived screening levels" to apply to both surface and volume contamination in the implementation protocol. Again, no summary of the values from which the group drew its conclusions was included in the report, making its analysis untraceable. The study committee recognizes that a volunteer group, such as the HPS Standards Working Group, can include only a limited amount of detail in its reports.

ance Levels for Radionuclides in Solid Materials: Applications of Exemption Principles (IAEA, 1996). Comments on each document are presented below.

Safety Practice No. 111-P-1.1

In Safety Series No. 89, *Principles for the Exemption of Radiation Sources and Practices from Regulatory Control*, the IAEA established the principles that underlie its technical estimates of dose factors (IAEA, 1988). The USNRC has produced no similar generic document. The IAEA dose factors are contained in Safety Practice No. 111-P-1.1, *Application of Exemption Principles to the Recycle and Reuse of Materials from Nuclear Facilities* (IAEA, 1992). Two of the IAEA recommendations from these documents may differ from the concept of clearance of SRSM under discussion in the United States:

1. "The dose to the individual of the critical groups(s) and the dose to the whole population exposed by the practice should not be significantly affected by other similar (or identical) practices (e.g., several waste disposal sites in the same region)" (IAEA, 1988, p. 6).
2. "The formulation of an exemption should not allow the circumvention of controls that would otherwise be applicable, by such means as deliberate dilution of material or fractionation of the practice" (IAEA, 1992, p. 4).

The technical calculations for Safety Practice No. 111-P-1.1 were completed in 1993. The authors considered recycle of steel, aluminum, and concrete. They also analyzed reuse of surface-contaminated rooms in buildings and reuse of tools and equipment. The report contains no uncertainty analysis. Instead, a conservative approach was taken to deterministic calculations. Parameters were assigned values from the upper end of their observed or expected ranges. This approach produces results that "are likely to overpredict doses which will be received in practice (if they are received); however, it is difficult to say by how much they are higher than the 'real' values" (IAEA, 1992, p. 49).

A Monte Carlo analysis was carried out for ^{60}Co in asphalt, which confirmed that the base case estimate produced an overestimate of exposure (IAEA, 1992, pp. 104-105). In addition, a limited sensitivity analysis was undertaken for steel recycling to study the effects of three basic assumptions on the partition, dilution, and quantity of contaminated steel (IAEA, 1992, p. 49).

A limitation in the report is the use of values for some parameters without citing sources,[9] which makes it difficult for independent reviewers to trace the analysis.

[9] See, for example, Appendix II, p. 97, of IAEA (1992), where values for a resuspension factor, the fraction of surface contamination available for resuspension, the rate of secondary ingestion of removable surface contamination, and the transfer factor for secondary ingestion are given without citation.

Interim Report IAEA-TECDOC-855

In 1996 the IAEA prepared an interim report *Clearance Levels for Radionuclides in Solid Materials: Application of Exemption Principles*, in which it reviewed a set of studies, including its own, to pick a set of dose factors to use in deriving secondary activity standards for clearance (IAEA, 1996). The secondary standards are derived by dividing the primary standard recommended by the IAEA (10 mSv/yr) by the dose factor that the authors decided on for each radionuclide. A similar approach was later used by the HPS Standards Working Group to prepare the ANSI/HPS clearance standard. However, unlike ANSI/HPS, the IAEA study includes the steps the authors took to discount various studies, so the work is traceable. To simplify implementation, the authors grouped radioncuclides with similar clearance levels by rounding values. No uncertainty analysis is presented in the report.

EUROPEAN COMMISSION DOCUMENTS

The European Commission (EC) has produced a number of technical and policy documents that deal with clearance issues. The two main technical reports are EC-RP-89, *Recommended Radiological Protection Criteria for the Recycling of Metals from the Dismantling of Nuclear Facilities* (EC, 1998b), and EC-RP-114, *Definition of Clearance Levels for the Release of Radioactively Contaminated Buildings and Building Rubble* (EC, 2000). These reports address metals recycling, equipment and building reuse, and building demolition.

For buildings and building rubble, the analysts used a few scenarios that are assumed to be representative of the many others that have been studied by other analysts. An analysis assuming homogeneous volume contamination produced "nuclide specific clearance levels" (i.e., secondary standards) that were prohibitively restrictive for large buildings, so the authors took into account the likelihood of inhomogeneous contamination and other factors to reduce the clearance levels by a factor of 10 (EC, 2000). An explicit assumption in the EC analyses, which is built into the EC recommendations, is that it is forbidden to mix highly contaminated surfaces or rubble with the uncontaminated bulk of the structure.

Apparently, no uncertainty analysis was carried out.[10] Presumably the underlying doses were calculated with a tendency to choose individual parameters that produced an overestimate in dose, but no statement to that effect is included in the reports. However, the study committee has not reviewed the full consultant's report for EC-RP-114, only what is included in the report itself.

In deriving nuclide specific clearance levels, the EC reports use a collective dose standard of 1 person-sievert (person-Sv) per year and a derived dose stan-

[10]The authors did consider what they called "pessimistic" assessments in developing dose factors and clearance values.

dard for individuals of either 10 μSv/yr (1 mrem/yr) or a skin dose of 50 mSv/yr (5 rem/yr) (EC, 1998b, p. 4). If the collective dose exceeds the 1 person-Sv/yr standard, a decision must be made on whether the activity has been optimally reduced, (i.e., is as low as reasonably achievable [ALARA]).

This approach suggests a refinement that the USNRC should consider as it deliberates over clearance standards. Suppose that the variations in contaminant levels of a material were so large that the highest values surveyed exceeded the allowed dose to a member of the public, even though the average value was at or below the USNRC clearance standard. It might be desirable to require reduction of the activity level to the point that the dose standard was not exceeded by the highest survey reading.

COMPARISON OF CLEARANCE STUDIES

Table 5-3 compares specific features of the general methodologies used in the studies reviewed by the committee. Not surprisingly, the studies do not always agree on the numerical values for best estimate. To capture the rough magnitude of these differences, Table 5-4 shows the average of the ratios of the NUREG-1640 dose factors to the dose factors presented in other studies. Note that Table 5-4 uses the *mean* NUREG-1640 dose factor coefficient, which lies somewhere between the 50th and 95th percentile values for the dose factor, depending on the radionuclide.

On average, the dose factors for metals in the draft NUREG-1640 and the EPA study are in relatively good agreement. Using the computation explained in Table 5-4, the NUREG-1640 values are lower but on average are within a factor of two of the EPA values. With respect to the dose factors selected in the IAEA and EC reports however, the NUREG-1640 values are on average about 5 to 14 times higher and hence would allow less activity to be released on average given the same primary dose standard. For particular radionuclides and particular critical groups, the disagreement between the U.S. dose factors (NUREG-1640 or EPA TSD 97) and those from the EC studies can be much greater than a factor of 10. For instance, the draft NUREG-1640 dose factor for ^{60}Co is 200 times more restrictive than the EC value for clearing surface-contaminated metals (USNRC, 1998b, Table 2.5).

One reason that dose factors computed for different studies vary is that different simplifying approximations are used. Another reason is that different critical groups and different exposure scenarios for those groups are selected to model doses. In some cases, heterogeneity of contamination was assumed, from which one could derive a lower dose in a given exposure scenario than if uniform contamination were assumed, and therefore increase the activity level allowed for clearance. For example, the EC studies estimate that "the mass specific activity averaged over the total quantity of building rubble (10^5 metric tons) will be around one order of magnitude less than the clearance level" (EC, 2000).

Similar assumptions, which have the effect of reducing the dose factor (and therefore allowing a higher secondary standard [see Box 5-1]) have not been introduced into the analyses from which either the EPA or the USNRC dose factors were estimated. These and other differences in methodology explain some of the difference between the European dose factors and those from the EPA or USNRC studies. Finally, different degrees of conservatism may have been built into the estimates. Large differences do not necessarily imply that one approach or the other is objectively mistaken, although that is possible.

Another way to look at the uncertainty in dose factors other than simply computing ratios of dose factors is to look at the variability around the ratios. To this end, we use the geometric standard deviation as a measure of variability, which can provide an estimate of the confidence that can be placed in any particular coefficient. The GSD of the ratios between draft NUREG-1640 and other studies amounts to a factor of 6 to 12,[11] which is a much larger range than the GSDs computed by draft NUREG-1640 based on its internal analysis of uncertainty (see Table 5-2). Although some difference would be expected, such a large discrepancy raises questions as to whether or not draft NUREG-1640's uncertainty bands are sufficiently wide to incorporate the range in which experts may reasonably disagree and therefore the bands might need rechecking. At the very least, the USNRC should understand and be able to explain the reasons for the discrepancy.

Given the complexity of the scenarios, the committee believes that an order of magnitude difference in dose estimates is reasonable for risk estimates of this type. With so much effort having gone into these studies over the past 20 years, it seems unlikely that additional, reasonable effort will be able to reduce dramatically the uncertainty in the coefficients that differ by less than a factor of 10—at least until there is real-world experience that can be used for benchmarking purposes. On the other hand, for the dose factors that show unusually large differences it would make sense to mount an international benchmarking exercise, with the goal of trying to understand the technical reasons for the major disagreements.

On average, the dose factors in draft NUREG-1640 and EPA TSD 97 will yield more restrictive secondary standards (i.e., the derived allowable activity level for release of a contaminated material will be lower) for the same primary dose standard than will the dose factors from the IAEA and EC studies. In other

[11]For instance, the committee looked at the GSD of the ratio of NUREG mean dose factors to those computed by the EPA and the EC (volume-contaminated metals), using data combined from Table 2.4 and Table 2.5 of NUREG-1640. The GSD was 6. A similar analysis was done for the ratio of NUREG-1640's mean dose factors to those computed by the IAEA (all materials), this time using Table 2.6 of NUREG-1640. The GSD was 8 for volume contamination and 12 for surface contamination. Note that 1 standard deviation is equal to the product of the median times the GSD; 2 standard deviations (~95th percentile for a log-normal distribution) equal the square of the GSD.

TABLE 5-3 Comparison of Dose Factor Estimates Made to Support Clearance Proposals

Category	USNRC NUREG-1640	EPA TSD 97	EC-89, EC
Nuclides	85	40	104
Scenarios	79	37	Limiting p
Approach	Generic geometries	Specific situations	Specific si
Materials	Fe, Al, Cu metals; concrete, equipment	Fe, Al metals (copper in preparation)	Metals for or rubble, equipment
Dose criteria	None established, estimates included for 10 µSv/yr when comparing results of other studies	None established	10 ∝Sv/yr collective if higher, (ALARA); 50 µSv/yr
Exposed population	Member of critical group	Reasonable maximally exposed individual	Member o
Conversion coefficients	Traceable	Traceable	Traceable
Collective dose considered	No	Yes	Yes
Comparison to fluxes from NORM or NARM, case-by-case clearance[c]	No	No	No
Dose uncertainty	Monte Carlo, traceable	Sensitivity studies and judgment	Not forma
Level of conservatism in dose calculations[d]	Can be determined by policy maker	Implicit, thought to represent 90th percentile (e.g., 90% of members of critical group get lower doses)	Implicit
Measurement uncertainty	Not considered	Considered in part	Not consid
Human error	Not considered[e]	Not considered	Not consid
Sensitivity studies	None	To determine which parameters contribute most to uncertainty	None
Benchmarking or validation	None	None	None

NOTE: NA = not applicable; NARM = naturally occurring and accelerator-produced radioactive material; NORM = naturally occurring radioactive material.

[a]IAEA (1988, p. 10).
[b]IAEA (1996, p. 47).
[c]To provide perspective.

learance

	EC-89, EC-113, EC-114	IAEA TECDOC-855	ANSI/HPS
	104	56	52
	Limiting pathway	NA	NA
	Specific situations	Most conservative of dose factors from range of studies considered reasonable	Most conservative of dose factors from range of studies considered reasonable
per in	Metals for recycle, buildings or rubble, all solids, equipment reuse	All solids	All solids
	10 ∝Sv/yr; 1 person-Sv collective dose per year or, if higher, optimization (ALARA); skin dose of 50 μSv/yr	10 μSv/yr; 1 person-Sv per year or optimization (ALARA)[a]	10 μSv/yr; higher on a case-by-case basis.
nally l	Member of critical group	Member of critical group	Unspecified
	Traceable	Traceable for volume-contamination factors	Not traceable
	Yes	Yes[b]	Qualitative discussion
	No	In part	No
and	Not formally analyzed	None	Assessed on an overall basis, not nuclide by nuclide
o represent g., 90% of l group	Implicit	Implicit	Implicit
	Not considered	Not considered	Not considered
	Not considered	Not considered	Not considered
ch oute most	None	None	None
	None	None	None

[d]Dose calculations that result in higher percentile-valued dose factors are more conservative. NUREG-1640 reports a distribution of values and hence the selection is at the discretion of the policy maker.

[e]The USNRC has commissioned a separate study dealing with accidents.

TABLE 5-4 Ratio of NUREG-1640 Dose Factors to Other Estimates, Averaged Across Radionuclides

	"Mean" Ratio[a]	
	Volume Contamination	Surface Contamination
EPA metals[b]	0.64[c]	NA[d]
EC metals[e]	5.4[c]	10[f]
IAEA all materials[g]	14[h]	4.5[c]

[a]Computed as the exponential of the average of logarithms of ratios. The values from NUREG-1640 are all mean values that lie between the 50th and the 95th percentiles for all radionuclides.

[b]Derived from Table 2.4, draft NUREG-1640.

[c]±~26 percent. Standard deviation for an individual radionuclide, however, is approximately a factor of 5.

[d]Not applicable.

[e]Derived from Table 2.5, draft NUREG-1640.

[f]±37 percent. Standard deviation for an individual radionuclide is a factor of 12.

[g]Derived from Table 2.6, draft NUREG-1640.

[h]±36 percent. Standard deviation for an individual radionuclide is a factor of 8.

words, the draft NUREG-1640 and EPA dose factors are more protective. The committee has not been able to determine the precise reason for the differences from other estimates. The question of whether the total uncertainty could be greater on average than a factor of 10 is discussed in the next section.

Usefulness and Quality of Dose Factors

The committee's review of the studies listed in Table 5-1 found that some of the dose factors estimated in these studies, particularly those for radionuclides causing external gamma radiation doses to workers, can easily be shown to be reliable. Other dose factors require the use of parameters that are highly uncertain. One way to compensate for uncertainty in setting a protective standard is to set the dose factor for each radionuclide at a fixed margin above the best estimate for the dose factor. This allows the decision maker to compensate for the lack of complete knowledge in the dose analysis and thus increase confidence that the dose to the critical group will be below the primary dose standard. For example, the value for the dose factor can be set to the 95th percentile in the distribution of values for that dose factor rather than the median. Taking the *mean* value of the distribution, in almost all complex dose analyses (i.e., for right-skewed distributions), will increase the value of the dose factor over the *median* or 50th percentile result of the Monte Carlo calculation. The mean value has the property, in most calculations of this type, that its distance above the median automatically increases when uncertainty is large and decreases when uncertainty is small. (Although NUREG-1640 gives explicit values for the 5th, 50th, and 95th percentiles, it would be possible for the authors to extract other values—e.g., the 85th

percentile—from the computed Monte Carlo distributions that would exceed the median by varying amounts.) However, the choice of any percentile level (and its corresponding dose factor), like the choice of a primary dose standard, is a matter of policy that cannot be decided by scientists through analysis or facts alone. For instance, policy makers could decide to choose dose factors closer to the median of the distribution of dose factors—forgoing the additional margin of protection afforded when a higher percentile-valued dose factor is selected—because they consider a 1 mrem/yr dose to be too far below background to be of concern. Conversely, they could pick a higher percentile-valued dose factor (e.g., the 95th) to assure the public that doses are very unlikely to exceed 1 mrem/yr.

If this additional margin of protection (which is implicit in the choice of higher percentiles) is not used in setting a dose factor, one must either pay close attention to the uncertainty in the estimate for each dose factor or fall back on assurances that analysts tended to be protective of public health (i.e., they picked parameter values—e.g., landfill leaching rates, resuspension coefficients—from the range of uncertain values that would end up being restrictive on the amounts of radioactivity that could be released to produce a given dose). However, the committee is reluctant to recommend reliance on statements by experts about the protectiveness of calculations. This is just the area in which experts have been found to perform poorly (Cooke, 1991; Shlyakhter and Valverde, 1995).

Although picking the percentile value appropriate for selection of dose factors is a policy choice, decision makers need to be informed about the quality of the supporting information. Over time, risk analysts have devised ingenious ways to reduce what at first glance appear to be unavoidable uncertainties in an analysis. For instance, it is often not necessary to know the *amount* of radioactivity released by a licensee in order to make use of a dose factor; often knowing the *mass concentration* is enough (i.e., the activity per gram). Analysts often simply consider releases that are large enough to saturate the doses to members of a candidate critical group, such as an entire truckload or industry-wide totals.[12] In general, bounding assumptions are made to eliminate the need to consider the total quantity of material released. Although this tends to overestimate dose factors and reduce allowed release concentrations, such as when concentrations are kinetically limited, it simplifies regulatory considerations. However, there are exceptions,[13] and some residual assumptions may still be necessary, such as the amount of mixing that takes place with nonradioactive material; see Box 5-2 for

[12]For example, once the volume of cleared material exceeds a truckload, the dose to the truck driver during one trip cannot go higher, which allows the number of trips one driver can make before receiving the allowed dose to be computed. The number of drivers needed to move the cleared material will increase as the quantity of cleared material increases, but this affects only the number of drivers who receive the dose. The collective dose increases, but not the dose to an individual driver.

[13]Exposure of workers in a steel plant may depend on the total quantity recycled (IAEA, 1992, p. 54), although even there, the dependence is limited. In the IAEA study, a hundredfold increase in the total amount of contaminated steel being handled produced an eightfold increase in individual dose (IAEA, 1992, p. 58).

BOX 5-2
Computing Doses to Critical Groups After Conditional Clearance for Landfill Disposal

Suppose a secondary standard for conditional clearance of volume-contaminated materials for a single radionuclide (assume ^{137}Cs as an example) is set at 40 Bq/g and the conditions for release allow for landfill disposal. Draft NUREG-1640 assumes that mixing of the released material at the landfill with nonradioactive wastes is such that the released material constitutes only 0.15 percent of the volume in the landfill. Doses from gamma radiation exposure to persons living near the facility or playing golf on top of the landfill after it is closed can be computed from these starting assumptions. If one also assumes (or estimates from data) the rate at which the radioactive component is leached from the material into subsurface moisture, the partition coefficients and flow rates for transport of the radionuclide plume through the unsaturated zone to groundwater, and the direction and rate of groundwater flow, maximal doses can be estimated for persons drinking water from wells in the vicinity of the landfill or from surface waters fed by the groundwater.

These estimated doses to persons affected by the landfill can be compared with the computed dose to truck drivers who transport released material to the landfill. By comparing the doses to individuals from each exposure scenario (a materials truck driver, a golfer, a local resident drinking well water, a city resident drinking water from a downstream reservoir), an analyst can determine which category constitutes the critical group. This comparison among exposed groups to identify the critical group depends only on the concentration of the radionuclide in the material, the dilution factor, and possibly the size of the landfill, not on the total amount of radionuclide in the landfill. Nevertheless, despite this insensitivity to total amounts of radioactivity, considerable uncertainties may remain when it comes to estimating water contamination. Leach rates and the parameters for subsurface transport can vary enormously from default values.

an illustration. In contrast to individual doses, collective doses under a clearance standard are directly related to the total amount of radioactivity released. Despite the use of bounding assumptions, considerable uncertainty remains in some scenarios, particularly when it comes to predicting the behavior of radioactive materials leaching from landfills.

Analysts often add margins of protection to components of a dose factor calculation because information about a parameter is lacking or because the analyst is seeking greater generality for the analysis. Because different analysts may not use the same margins in their computation, the various studies listed in Table 5-1 are difficult to compare. The numbers are neither pure "best estimates" (i.e., estimates of central tendency) nor pure bounding estimates (estimates of the upper and lower bounds of a percentile range). It is particularly difficult to estimate how the dose factor calculated for one study would change if an assumed margin of protection were changed to improve its agreement with other studies.

Until a clearance system is implemented and concentrations of radioactivity in key scenarios are measured, one cannot be certain that assumptions made to provide margins of protection or other safety-enhancing factors have been adequate or are unrealistically restrictive. One way to deal with hypothetical model error is to adopt a policy of "adaptive management" in which real-world performance is monitored through validation that is possible only after implementation, or through retrospective analysis of selected case studies.

For example, leachate can be sampled from representative landfills, or concentrations of radioactivity in sample pieces of recycled steel can be checked, to ensure that the model assumed in calculating dose factors reasonably represents reality, with an adequate margin of protection. The model, and the dose factors calculated from it, should be updated if the primary dose standard is being exceeded or even if key assumptions in the model are clearly inadequate.[14] The IAEA encourages this type of retrospective review, including the "testing of radioactive consumer products on the market" (IAEA, 1988, p. 14). Reaching most of the limiting conditions that were assumed in estimating dose factors, such as truck drivers handling slightly contaminated truckloads every work day or concentrations in landfills reaching the maximum capacity, will sometimes take considerable time (typically, years of activity after clearance standards are implemented). If a validation program is in place soon after a standard is implemented, there will be sufficient time to adjust dose factors (and the clearance standards derived from them) if corrections are needed.

Based on Table 3-7, it seems unlikely that SRSM from USNRC-licensed facilities cleared under a dose-based standard will come close to matching the

[14]A validation program might also include measuring the distribution of radioactivity, or limits on the amount of radioactivity, that arrives at monitored landfills. Even data from portal monitors placed at both the sending and the receiving facility would be useful, particularly in assessing how often human error leads to gross errors in maintaining transport constraints. Other ideas for useful data collection can be gleaned from the EC guidelines, which require licensees to track the total amount of material cleared for disposition (EC, 2001). If the amount of material per shipment was recorded, as well as the activity measurements made to check compliance with the secondary standard, then uncertainty margins relative to the assumption of clearance at the activity level of the secondary standard could be computed. This analysis would also aid in determining if significant mixing of waste was occurring.

The USNRC may not find it justifiable to require this degree of data gathering and reporting by licensees, but it might fund a program of research-oriented activities. During the 1980s, when the Low-Level Radioactive Waste Policy Amendments Act was passed, the USNRC considered including a requirement in 10 CFR Part 61 for reporting data on the radioactive content of low-level radioactive waste shipments to disposal sites. This requirement was not included in the rule. It was believed that the data would be useful only as a broad check of assumptions made in the environmental impact analysis for disposal, not for material balance. For some years, such data were obtained by contract for such a broad check (personal communication from Robert Bernero, Board on Radioactive Waste Management, National Research Council, July 17, 2001). However a detailed material balance would not be necessary for the validation activities discussed.

concentration and total amounts of naturally occurring and radioactive material (NORM), naturally occurring and accelerator-produced radioactive material (NARM), and comparable materials that are cleared today under a case-by-case approach. Consequently, field data will probably prove useful only in assessing how well the clearance models have bounded the concentrations and thus estimated the doses. Nevertheless, a modest monitoring effort would boost confidence in the dose factors, particularly for those who are skeptical of the models being used. It may also provide useful incidental information on where NORM and NARM are ending up.

General Limitations of the Reviewed Studies

Failure to Consider Uncertainties Associated with Implementation of a Primary Dose Standard

Dose factors as estimated to date are useful theoretical tools. However, they have practical value only within a specific implementation protocol, where such a protocol can introduce uncertainties into dose estimates tied to primary dose standards. Only a few studies (e.g., EPA, 1997a) appear to have explicitly considered any implementation issues in assigning uncertainties to the estimated dose factors. Among these sources of added uncertainty are averaging error, sampling error, rounding error, and treatment of multiple radionuclides:

- *Averaging error*. The area or volume over which one averages radioactivity can introduce errors (EC, 2000, p. 20). This will increase the uncertainty associated with dose estimates.
- *Sampling error*. Guidance for a volume contamination standard would probably include acceptable sampling and modeling methods, which would allow some level of sampling error. Sampling error, in turn, could add to overall dose uncertainty. To a degree, any error incurred from a finite number of samples might be offset by the fact that not all of the cleared material will have an activity level exactly matched to the secondary standard. On the other hand, there is also the possibility that hot spots may have been missed.
- *Rounding error*. For practical reasons, regulatory authorities may decide to round secondary activity standards to a few convenient values—for instance, 0.1, 1, 10, and 100 Bq/g, and so forth. This can result in an error of a factor of three or so in dose factors. This practice, which has been adopted by the European Union (EC 2001, Table 1) and is used in the ANSI/HPS standard (ANSI/HPS, 1999), is equivalent in effect to choosing higher or lower percentile-valued dose factors. The possibility of rounding the derived secondary standards to integral powers of 10 should be considered when assessing uncertainties and selecting the percentile

value corresponding to the dose factors. The percentile level implicit in a rounded activity standard should be roughly the same as the percentile level sought in a dose factor that will not be subject to rounding. For example, if the policy choice for selecting dose factors is to maintain a 95 percentile level, then the implicit percentile level of a rounded activity standard should be at least 95 percent. Alternatively, information such as the implied confidence level after rounding should be presented with the proposed activity standards so that policy makers understand the implications of adopting a policy of rounding the activity standards.

- *Multiple radionuclides.* If a dose-based clearance standard was chosen, a decision would have to be made on whether its implementation for multiple radionuclides should apply a sum-of-the-fractions[15] computation or apply the individual clearance levels for any nuclides detected. The sum-of-the-fractions method is used routinely for control of radioactive effluents (10 CFR Part 20, Appendix B) and is recommended by the EC for clearing solid material (EC, 2001, p. 14). For a given protocol, an analyst can estimate the uncertainty that may result from using it with contamination from multiple radionuclides and include the estimated uncertainty in the dose factors. Without the specification of a protocol for treating multiple nuclides, it is difficult to assess whether any changes need be made, up or down, to the uncertainty estimates for dose factors.

Lack of Validation of Model Estimates

Validation against field data provides the best way to check for model error, as well as unexpected problems with parameter assignments. As noted in the previous section, a validation program should be used to correct and refine a system of dose-based clearance standards, given the inevitable uncertainties in the process of estimating dose factors. Furthermore, the confidence of policy makers, licensees, the public, and skeptics in the predictions from risk assessments can be increased by undertaking validation exercises. The committee heard only one presentation about a study in which clearance model estimates have been field-tested.[16] In that case, an international group led by the Swedish Radiation Protection Institute attempted to check predictions of model estimates against

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[15] A sum-of-the-fractions computation is used when the governing standard sets the amount of each isotope that, if alone, would reach the dose limit of the standard. When materials containing many isotopes are analyzed for compliance with the dose-based standard, a fraction is calculated for each isotope present (the amount detected divided by the dose limit amount set for that isotope). The sum of all these fractions must be less than or equal to 1 if compliance with the dose limit is to be ensured.

[16] Shankar Menon, program co-ordinator, OECD/NEA Co-operative Program on Decommissioning, presentation to the committee, June 13, 2001.

results of actual recycling of SRSM. The committee did not review this work but wishes to encourage that such studies be undertaken.

Lack of Inclusion of Accidents and Human Errors in the Dose Factors

The IAEA recommends consideration of accidents in estimating exposures of the public from disposal exemptions (EC, 2000, p. 20). Examples of human error that can initiate or contribute to accidents involving error in clearance of materials at a nuclear power plant include failure to monitor properly, failure to properly handle and contain loose contamination, and delivery of material to the wrong recipient. Specifically, a facility that was routinely required to screen all scrap material for radioactivity, but rarely encountered any contamination, might disable the radiation alarms, fail to keep them in working order, and/or ignore them when they actually went off. Human error was not explicitly addressed in the analyses supporting dose factor estimates in any of the studies reviewed. However, the USNRC has carried out an (as yet unpublished) analysis of one form of human error (accidents), which suggests that this type of human error is not likely to have a significant impact on dose factor estimates. USNRC staff were not able to provide the study committee with the frequency at which exit monitors at licensed facilities were triggered by shipments on their way to final disposition, following clearance based on Regulatory Guide 1.86, a license provision, or approved by case-by-case review. However, a health physicist from the steel recycling industry told the committee that shipments from USNRC-licensed facilities have been sent back from recycling facilities because the shipments triggered portal monitors. Although alarm events could be false alarms since the portal monitors are set as close as possible to background radioactivity levels, they may also indicate that human errors were made in the release of material from the source facility. Consequently, it must be presumed at this time that some shipments will leave licensed facilities with contamination in excess of a clearance threshold level. Clearance coefficients that are estimated using a probabilistic approach, such as draft NUREG-1640, can account for this possibility.[17]

Human error may have only limited impacts on dose factor estimates, especially for those coefficients where simplifying methods have been used to make

[17]If human error is not correctly accounted for in the dose rate coefficients themselves, other methods can be used to handle it in the system itself. For instance, portal monitors can be placed not just at the exit of licensed facilities, but at recipient sites, such as landfills or recycling facilities, if release to these facilities is allowed under the standard adopted. In many cases, steel mills have such portal monitors (and, in some cases, monitors in other portions of the facility), as do landfills and licensees that generate wastes. Pennsylvania already has a requirement that all landfills be outfitted with portal monitors to catch orphan sources, along with a formal plan for dealing with radiation sources that trigger the monitors. As one example: if landfill disposition of SRSM were restricted to landfills that installed portal monitors, one protection against human errors made at licensed facilities might be institutionalized.

estimation easier and more robust. However, human error can also be embedded in the larger framework of system failure, which includes the following interrelated sources of failure: (1) hardware, (2) software, (3) organizational, and (4) human (Haimes, 1991). A follow-up study might take such a systems approach.

Potential Inconsistencies in Dose Factors Between Countries

As noted above, analysts from different countries have estimated different dose factors. These differences can lead to inconsistencies between clearance policies adopted in different countries. However, in discussing transnational consistency of dose factors and derived secondary clearance standards, two types of consistency must be distinguished. If countries agree on the same primary dose standard, they have agreed on the level of risk that sets the ceiling on clearable SRSM. For instance, there is widespread agreement on a 10 mSv/yr primary dose standard in the European Union. If countries disagree on which sets of dose factors are appropriate—the second type of inconsistency—they are differing over technical calculations, possibly differing only over degrees of conservatism that are needed to simplify the estimates.

Consistency of clearance standards across national boundaries is clearly desirable, particularly for materials that might find their way into international commerce. However, it would be inappropriate for one country to change its view of the supporting scientific evidence simply to achieve consistency with the standards in effect in other countries. Such an approach would not be conducive to building confidence in the scientific and engineering foundations for clearance standards.

Even the appearance of making changes in technical documents to make policy choices easier could undermine public confidence in the overall results. If rationalization of standards across borders becomes paramount, after attempts at technical rationalization have failed, the effort should be separated from the scientific deliberations by which dose factors are estimated. The decisions to rationalize for reasons beyond those supported by technical studies should be made as a clear policy choice (e.g., accepting more or less conservatism in the adopted dose factors).

DETAILED COMMENTS ON NUREG-1640

As noted, the committee paid particular attention to the draft NUREG-1640 because it was prepared for the USNRC in preparation for reconsideration of clearance standards. The discussions in this section supplement the earlier general discussion of analytical limitations in the draft document. Many of the issues raised here may have been considered intuitively by the analysts and staff that prepared the draft and judged to be of little consequence. Some may be currently under study at the USNRC. In any case, the committee believes that all of the

following issues have to be considered explicitly, at some point, in the technical support process.

Issue 1: Landfill Disposal Scenarios

Landfill issues in the draft NUREG-1640 were difficult to understand. They require clarification and justification. The following are examples:

- *Fraction of material that goes to landfill.* The justification for the assumed 0.15 percent fraction of volume of material that ends up in a landfill is weak (USNRC, 1998b, p. 4-98). The ±50 percent uncertainty assigned to the fraction seems small.
- *Alternative economic models for landfill deposits.* Draft NUREG-1640 does not consider the situation in which only a small number of facilities are willing to take cleared material. Neither does the EPA, although TSD 97 does mention this possibility. If the postclearance landfill industry splits this way, the net result would be to increase the fraction of released material in the few facilities that would take contaminated material, thereby increasing the dose to landfill workers and nearby residents. This possibility is sufficiently realistic that it deserves assessment. It can probably be handled in draft NUREG-1640 by changing the uncertainty distribution currently assigned to landfill clearance calculations.
- *Uncertainties.* Landfill scenarios in draft NUREG-1640 did not have defined critical groups, so they did not get the consideration they might have if conditional clearance had been under consideration. Leaching rates, liner failure, and long-range transport are possible issues that should be addressed more carefully as part of the technical support process.

Issue 2: Incineration Pathway

Once material is released into general commerce, it may one day enter the municipal waste stream. Since a certain percentage of trash is incinerated to reduce volume, one possible immediate or delayed-clearance pathway would be incineration; yet this pathway was not addressed. Even though this pathway is unlikely to be significant, it should be explicitly considered.

Issue 3: Sensitivity Analysis

The uncertainty analysis was reasonable, but since the study uses a Monte Carlo analysis, the committee wondered why a set of sensitivity analyses was not carried out. Sensitivity analyses can be misconstrued as uncertainty ranges, but the committee believes that they can be constructive. Sensitivity studies yield important information about the significance of an input parameter's value to the

output value predicted by the model. In this case, such a study would allow a better assessment of the effect of the parameter's uncertainty on the calculated dose factors. (See also discussion of resuspension of contamination below.)

Issue 4: Validation

There is no benchmarking or validation provided in the appendix material to draft NUREG-1640. Benchmarking or validation exercises would be appropriate to demonstrate the validity of the modeling technique.

Issue 5: Sample Calculations

There was a dearth of sample calculations that could have provided clarity for readers as to the overall method.

Issue 6: Multiple Pathways

The draft report does not consider multiple pathways. The committee notes that when exemption from regulatory control is considered, the IAEA (1988) recommended as follows: "The dose to the individuals of the critical groups(s) and the dose to the whole population exposed by the practice should not be significantly affected by other *similar* (or identical) practices (e.g. several waste disposal sites in the same region)."

Issue 7: Resuspension of Contamination

The draft document has only limited consideration of resuspension of surface contamination into the air. Of all the factors that can play a role in exposure to toxic substances, resuspension is probably the most difficult to address (IAEA 1992, p. 66; USNRC, 1998b, p. 3-8). Even after loose material is removed during cleaning, some residual radioactive material can be available for resuspension over a longer time. Resuspension rates, which generally affect only inhalation exposures, can span many orders of magnitude, as the authors of draft NUREG-1640 acknowledge: "The resuspension factor, RF_{sc}, is the most poorly known parameter in the inhalation pathway analysis . . ." (USNRC, 1998b, p. 3-8).

The method of uncertainty analysis adopted by NUREG-1640, which the committee applauds, can nevertheless be disconcerting when applied to parameters with large uncertainty ranges. The 95th percentile can end up being many times greater than the highest value measured to date. There is a tendency for analysts to disbelieve such numbers and make some form of downward adjustment. This is a potential form of downward bias that bears watching, given the known problem of expert overconfidence (Cooke, 1991), which leads to underestimation of uncertainty ranges when subjective judgments are made.

For example, in estimating doses to workers in reused trucks, the draft NUREG-1640 analysts selected the bottom of the range of resuspension values available to represent the median of the distribution, with little justification. The choice of geometric standard deviation was also made with little justification.

With measured resuspension rates varying by many orders of magnitude, it is difficult to determine how to handle this problem. At a minimum, a sensitivity analysis should be performed to inform readers as to how the dose factor would vary with a change in the resuspension coefficient.

A sufficient technical basis may not yet exist for assigning a credible uncertainty factor to certain types of releases that are sensitive to resuspension. If so, such clearance categories could be excluded by regulation until a sufficient technical basis is developed.

Issue 8: Collective Dose

Draft NUREG-1640 has no consideration of collective dose. The EC and the IAEA have a two-part primary dose standard, 10 μSv/yr for an individual and 1 person-Sv/yr for the collective dose to the population. Specifically, IAEA recommends that regulatory authorities conduct a generic study in the early stages of regulatory development to determine whether the annual dose from exempt practices will exceed one man-Sv. If not, then further optimization of the regulatory option being proposed is not needed (IAEA, 1988, pp. 10-11). Unlike practices from which individual doses may vary over a wide range and be a significant fraction of background radiation, doses from activities that result in low individual doses result in doses and therefore risks that are individually and collectively very small both in absolute value and in comparison to natural background and man made exposures—levels at which the significance of collective dose has been controversial. (To exceed the collective dose requirement, more than 100,000 persons would have to receive the allowed individual dose.) The EPA has also examined collective dose (EPA, 1997a). However, technical analysis by the USNRC has focused only on the individual dose. Although the dose to an individual in a critical group, and thus the secondary activity standard, does not ultimately depend on the total radioactivity released, the collective dose does increase with total radioactivity. For example, if more than one truckload of material is shipped at a given concentration from a licensed facility using different drivers for each truck, the dose to an individual driver from a full load does not increase, only the number of exposed truck drivers increases. Even if the same driver makes multiple trips, the dose will be limited by the total number of trips that can be made in one year.

Consequently, it may be of interest in shaping policy to have some idea of collective dose, recognizing that such estimates may carry much greater uncertainty than will the dose to an individual in the critical group. Given a collective primary dose standard in the range of 1 person-Sv/yr, the individual dose estimate

for material from USNRC-licensed facilities is likely to be more restrictive than the collective dose (Clarke, 2001).

Issue 9: Size of Critical Groups

The draft NUREG-1640 does not discuss the total number of people exposed in any critical group. Although most critical groups will include a relatively small number of persons, other critical groups may include greater numbers of people. When groups are large, it is easy to think of smaller subgroups that could get higher doses. For instance, iron workers, train conductors, and elevator operators could receive higher doses from slightly radioactive steel than would users of common consumer objects. Knowledge of the approximate size of critical groups assists in building confidence that a more important subgroup has not been overlooked.

Issue 10: Total Activity Buildup and Mass Balance

The draft NUREG-1640 contains limited information on total activity buildup and mass balance. The methodology chosen to estimate doses for draft NUREG-1640 largely eliminates the need to know the total inventory of curies released. The authors consider (justifiably) that the total amount of curies released and stored affects the estimation of cumulative doses more than the estimates of critical doses (i.e., the individual doses on which dose factor selection is based). Nevertheless, the committee is uncomfortable with the lack of activity balance estimates.

Given that a material flow model has already been developed for the analyses, it should be straightforward to account for approximately how much of the radioactivity released each year is removed from the commerce “pool” as it enters landfills, how much will build up in the steel content, and how much would end up stored in structures. Since 85 percent of the steel cleared from USNRC facilities is likely to end up in landfills, steel made from cleared scrap will constitute only a tiny fraction of the total recycle in the United States. With radioactive decay, the committee does not believe that the buildup is likely to be significant, but without supporting estimates there is no explicit basis for this position.[18]

[18]It would also be useful to compare the amount of radioactivity in material projected to enter commerce and landfills from various proposed clearance policies with the amounts entering now from both the USNRC’s case-by-case clearance policy and NORM or NARM sources. To aid in estimating the quantities entering commerce and landfills now from USNRC-licensed facilities, analysts could collect a random sample of case-by-case decisions from each USNRC region and analyze the dose implications using NUREG-1640 coefficients.

Issue 11: Accounting for Human Error

Accounting for human error is good risk assessment practice. Draft NUREG-1640 does not consider human error and specifically assumes that there is none. Although USNRC staff has already taken steps to analyze the impacts of accidents on dose factor estimates, more of this type of analysis should have been done in the draft document.

For instance, in one case, the analysis assumes that loose surface contamination is always removed according to good health physics practice (USNRC, 1998b, p. 3-2).[19] Yet inclusion of a modest human error rate could end up dominating the dose estimate. It is inconceivable that all loose surface contamination will always be removed prior to clearance. The probability that loose material may be overlooked may be low, but the downstream dose from loose contamination could in principle be sufficiently high to overcome the low probability that an error will occur.

Issue 12: Uncertainty in Conversion between Intake and Dose

The authors of draft NUREG-1640 did not consider uncertainties in the coefficients that convert inhalation and ingestion to dose,[20] relying instead on coefficients developed by the EPA. Although the uncertainty in these coefficients may not be significant compared to other uncertainties that enter the estimate of dose factors, especially for USNRC-licensed facilities,[21] this contribution to uncertainty should be explicitly considered.

FINDINGS

Finding 5.1. Analytical work in the United States and abroad over the past two decades is useful in understanding the likely doses associated with exposure scenarios that might occur under various clearance standards. Much of the technical analysis in this field has the objective of understanding "dose factors," which to date have been analyzed in depth only for (unconditional) clearance scenarios. A dose factor is used to convert a concentration of radioactivity that is about to be released, whether it be confined to a surface or contained within a volume, to a primary dose level (measured in microsieverts per year or millirems per year). With such a dose factor in hand, a primary dose standard can be converted to obtain a secondary clearance standard in terms of radionuclide activity, which

[19]"Based on assumed good health physics practices at NRC licensed facilities, removable surface contamination has been removed during decontamination procedures prior to final survey and clearance" (USNRC, 1998b, p. 3-2).

[20]Constant values taken by draft NUREG-1640 included "the dose equivalent due to radionuclide intake."

[21]The radionuclides of significance at USNRC-licensed facilities are generally not transuranics.

could then be used at USNRC-licensed facilities. A dose factor can be used with any choice of primary dose standard.

Finding 5.2. Selecting a primary dose standard is a policy choice, albeit one informed by scientific estimates of the health risk associated with various doses. For instance, as shown in Table 1-2, a lifetime dose rate of 10 μSv/yr (1 mrem/yr) equates to an estimated increased lifetime cancer risk of 5×10^{-5}, which falls within the range of acceptable lifetime risks of 5×10^{-4} to 10^{-6} used in developing health-based radiation standards other than radon in the United States (NRC, 1995, p. 50). When setting primary dose standards, regulators can make a policy decision to include a level of conservatism such that the final standard is in excess of the best-estimate dose factor and in this way account for uncertainty (e.g., selecting the 90th, 95th, or other percentile in the distribution for the dose factor, instead of the best-estimate value).

Finding 5.3. The uncertainty in dose factor estimates is a key technical issue. When an uncertainty has been estimated, a quantitative determination can be made of the likelihood that the dose to an individual in the critical group will be below the primary dose standard. Quantitative uncertainty estimates can also assist regulators in assigning a level of conservatism to dose factors in excess of the best estimate. Dose factors developed by analysts from different countries show wide variation, which highlights the need for careful consideration of uncertainties.

Finding 5.4. The committee concludes from its review that of the various reports, draft NUREG-1640 (USNRC, 1998b) provides a *conceptual framework* that best represents the current state of the art in risk assessment, particularly with regard to its incorporation of formal uncertainty, as judged using recommendations of this committee and other committees of the National Research Council. Once the limitations in draft NUREG-1640 have been resolved (see Findings 5.5 and 5.6) and the results are used in conjunction with appropriate dose-risk estimates—in the final version of the report or in follow-up reports—the USNRC will have a sound basis for considering the risks associated with any proposed clearance standards and for assessing the uncertainty attached to these dose estimates.

Finding 5.5. The development of the NUREG-1640 draft has been clouded by questions of contractor conflict of interest. The mathematics and completeness of scenarios considered in draft NUREG-1640 have been verified through an audit carried out by another USNRC contractor. The committee also carried out its own review that generally confirmed the reasonableness of several dose factor analyses. However, a thorough review of the choice of parameters and parameter ranges, term by term, is needed to complete the reassessment of draft NUREG-1640.

Finding 5.6. Draft NUREG-1640 did not consider human error and its possible effect on dose factor predictions, nor did it consider scenarios involving multiple exposure pathways. In addition, draft NUREG-1640 does not provide a sufficient basis to analyze conditional clearance options, such as disposal in a Subtitle D landfill.

Finding 5.7. The dose factors developed in draft NUREG-1640 should not be used to derive clearance standards for categories of SRSM other than those considered in the draft NUREG-1640, without first assessing the appropriateness of the underlying scenarios. Some of the dose factors developed in draft NUREG-1640 are likely to require modification when applied to other mixtures of radionuclides (e.g., mixtures in which transuranics dominate) and other clearance scenarios, such as may be relevant to DOE material and technologically enhanced naturally occurring radioactive material (TENORM).

6

Measurement Issues

The quantitative determination of the identity and activity of radionuclides present in a sample is a process that ranges from straightforward to complex, depending on the radionuclides, their distribution on or within the sample, the instrumentation available, the material matrix, and the pattern of radionuclide distribution within the matrix. Many radionuclides that emit gamma photons are relatively easy to identify and quantify. Most radionuclides that decay only by particle emission can be detected if they are on the surface of a solid material, but identification of the specific radionuclides present is often difficult or complex. Further, when particle-emitting radionuclides are distributed through the volume of a solid material, determining the amount of a radionuclide(s) present can require sophisticated technology beyond simple survey instruments.

Dose cannot be measured directly. Instead, the dose received is estimated by first determining activities for the radionuclides to be released (identity and quantity of each radionuclide) then using a factor to convert from activity to dose. Specifically, a screening level of activity is set by two quantities, the primary dose standard and the dose factor that relates the secondary activity standard (or screening level) to the primary dose standard, as discussed in Box 5-1. The dose factors, which are derived by modeling, vary by radionuclide and by the expert group that computed them. The relationship between source concentration and dose is affected by many factors, including but not limited to the following:

- The magnitudes of the dose factors chosen to derive screening levels from the primary dose standards;
- The specific instrumentation used in measuring radioactive material concentrations in a source;

- The counting conditions, including background radiation levels;
- The sample's physical and chemical characteristics;
- The inventory (identity and quantity) of the radionuclides present; and
- The nonradioactive material present.

NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (USNRC, 1997) discusses each of these factors in detail, including the factor's impact on the minimum detectable concentration (MDC). The MDC is defined in NUREG-1507 as "the minimum activity concentration on a surface or within a material volume, that an instrument is expected to detect (e.g., activity expected to be detected with 95% confidence)" (USNRC, 1997, p. 3-1).

This discussion assumes that (1) the concentration of any radionuclides in samples to be measured is low relative to licensed levels and (2) the dose received by individuals from contact with these materials after their release is a small fraction of the natural background doses. As the activity in the sample increases, detecting, identifying, and quantifying the radiation source or sources become easier.[1]

When clearance for materials is considered, the process starts with an assay of a sample having an unknown inventory of radionuclides. The instrument selected to perform the assay will depend on the type of radiation that may be present. The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (EPA et al., 2000) specifies a methodology, which is discussed later in this chapter, for accomplishing a statistically valid assay of radioactivity in potentially clearable material. It also provides guidance on instrument selection. NUREG-1507 provides detailed information on instrument capabilities (USNRC, 1997).

Instrument selection is straightforward when it is known which radionuclides could be present. An example would be a medical licensee that uses only three radionuclides. However, if the licensee operates a reactor where a large number of radionuclides are present and neutron activation of materials is a possibility, instrument selection may be more complex. A series of measurements may be required, using different instruments, each of which can detect a different radiation type. Each measurement will yield a number of counts obtained in a counting period. The counts per unit time are converted to units of radioactivity, using the known properties of the detector and the geometry of the configuration for counting (see Appendix E).

An important issue is whether one or more radionuclides may be present. Each radionuclide has its own activity, which in most circumstances will differ from the activities of other radionuclides present in the sample. However, as the

[1]Appendix E of this report provides tutorial-level information on radiation, radioactivity, and radiation detection.

number of radionuclides present increases, it becomes increasingly likely that the radiation from one will mask (be sufficiently close in energy to) the radiation from another, complicating the process of identifying and quantifying them.

Detection limits for both field survey instruments and laboratory instruments play a critical role in selecting the instrumentation and measurement procedures used in the analysis. Background radiation from naturally occurring radionuclides and cosmic radiation influence the sensitivity of the measurement process. As discussed in Appendix E and NUREG-1507, a detection limit in effect represents a practical trade-off between the acceptable statistical chances of obtaining a false positive or a false negative indication of the presence of radioactive material.

LEVELS OF DETECTABILITY

A reasonable question to ask is whether a radionuclide can be measured at the concentrations corresponding to (i.e., derived from) proposed primary standards.

The Environmental Protection Agency's (EPA's) Technical Support Document 97 ("TSD 97") presents MDC data derived from 24 laboratories (EPA, 1997a). The authors of TSD 97 recognized that increasing the count time or sample size could lower the reported MDC, but they concluded that the values reported represented the state of the art at the time (1995) for practical measurements. For most radionuclides, the background count rates were less than one count per minute and the lower limits of the detectors were less than 0.037 Bq/g (1 pCi/g). A variety of instruments were used, depending on the radionuclide. Count times ranged from 20 to 1,000 minutes. Sample masses ranged from 0.1 to 750 grams.

A review of the dose factor data illustrates the wide range of screening levels for volume contamination (picocuries per gram) obtained from different reports for the same radionuclide. Table 6-1 presents the screening levels for selected radionuclides from three reports, based on a 1 mrem/yr primary dose standard. In the two right-hand columns are the volumetric MDCs from TSD 97. Despite the variations, these derived (secondary) screening levels[2] are all greater than the lower MDC from TSD 97, except for the ^{129}I dose factor for NUREG-1640. Even this screening level could probably be detected if longer counting times were used to lower the MDC. Thus, under practical measurement conditions, existing measurement capabilities are sufficiently sensitive to meet almost all of the de-

[2]Derived (secondary) screening levels (i.e., secondary dose standards) can be derived by dividing the primary standard (in units of microsieverts per year) by the highest dose, from the most critical scenario, per year per becquerel per gram for volume sources, or by the highest dose per year per becquerel per square centimeter for surface-contaminated sources (see Box 5-1).

TABLE 6-1 Comparison of Derived Screening Levels and Laboratory Minimum Detectable Concentrations (MDCs) for Selected Radionuclides (pCi/g)[a]

	Derived Screening Level				MDC	
		USNRC Values	IAEA TECDOC 855 Table 1.6[b]		EPA TSD 97 Table 8-9[b]	
Radionuclide	ANSI/HPS 13.12-1999	NUREG-1640 Table 2.6	Low	High	Low	High
^{137}Cs	30	1	5.4	2,432	0.007	0.3
^{60}Co	30	1	13.5	2,432	0.01	0.3
^{63}Ni	3,000	27,000	2.15×10^5	2.7×10^7	1	100
^{129}I	300	0.1	270	21,000	0.4	2
^{14}C	3,000	17	2,700	1.9×10^5	0.2	37
^{239}Pu	3	1.2	2.16	18,000	0.02	0.4
^{99}Tc	3,000	2.3	1,100	1.6×10^6	0.3	15
^{230}Th	3	1.2	2.7	216	0.05	0.5

NOTE: ANSI/HPS = American National Standards Institute and Health Physics Society; IAEA = International Atomic Energy Agency; USNRC = U.S. Nuclear Regulatory Commission.

[a] Based on 1 mrem/yr.
[b] Low and high indicate the extremes of the screening level range presented in the reference.

rived (secondary) screening levels for volume contamination derived in the technical analyses reviewed by the committee.

TSD 97 also evaluated the detectability of surface contamination and reached a similar conclusion. Namely, existing measurement capabilities for surface contamination are sufficiently sensitive to reach the screening levels for surface contamination derived in these same technical analyses. Although the Health Physics Society (HPS) Standards Working Group evaluated a different set of instruments and measurement procedures for the American National Standards Institute (ANSI)-Health Physics Society Standard N13.12-1999, the conclusion about detectability at the derived activity levels was the same (ANSI/HPS, 1999, Sections B.4 and B.5):

> . . . in most cases the minimum detectable activities were significantly lower than the derived screening levels. These results indicate that, with a careful selection of alpha and gamma spectroscopy instruments and methods, it should be possible to attain a minimum detectable activity lower than the screening levels for most groups of radionuclides identified in this standard.

The ANSI/HPS report uses the term "minimum detectable activity" instead of MDC.

TABLE 6-2 Detectability of Selected Radionuclides by Laboratory Analysis Relative to Derived Screening Level (DSL) from TSD 97 (pCi/g)[a]

	MDC		DSL			Detectable at All
Radionuclide	Low	High	15 mrem/yr	1 mrem/yr	0.1 mrem/yr	Levels?
^{137}Cs	0.007	0.3	170	11	1.1	Yes
^{60}Co	0.01	0.3	17	1.1	0.11	Yes
^{63}Ni	1	100	1.4×10^6	93,000	9,300	Yes
^{129}I	0.4	2	19	1.3	0.13	No
^{14}C	0.2	37	17,000	1,200	12	Yes
^{239}Pu	0.02	0.4	21	1.4	0.14	Yes
^{99}Tc	0.3	15	700,000	46,000	4,600	Yes
^{230}Th	0.05	0.5	23	1.6	0.16	Yes

[a]Low and high represent the extremes of the derived screen levels in this reference.
SOURCE: EPA (1997a, Table 8.9).

Table 6-2 compares the MDCs from TSD 97 with the derived screening levels from TSD97 for volumetric contamination corresponding to primary dose standards of 15 mrem/yr, 1 mrem/yr, and 0.1 mrem/yr. The scenario used to derive the screening levels was the normalized dose to individuals exposed to radiation as the result of recycling scrap metal from nuclear facilities. Again, the MDCs are lower than the screening levels in all cases except for ^{129}I at the 0.1 mrem/yr primary dose limit.

TSD 97 reports similar results for surface-contaminated materials, when large-area detectors are used for surface scans (EPA, 1997a, Table 8-6). For large-area detectors used in the scan mode with a distributed source, the TSD 97 analysis concludes that in the laboratory, all 40 radionuclides considered would be detectable at the surface contamination screening levels (in units of disintegrations per minute per 100 cm^2) derived from a primary dose limit of 1 mrem/yr. These results assume a scanning rate of one-third of the detector width per second for beta and alpha detection and 15 cm/s for gamma detection.

For small-area detectors, which TSD 97 assumes would be used in field conditions, detectability becomes more difficult when factors such as human error, small nonhomogeneous contamination areas, realistic distances from source to detector, the condition of the material's surface, and surface coating are included. The fraction of radionuclides detectable under field conditions at the derived screening levels decreases from 39 of 40 for a primary dose limit of 15 mrem/yr to 31 of 40 for 1 mrem/yr and only 11 of 40 for 0.1 mrem/yr.

Whenever the potential exists for the presence of radionuclides that are not detectable with the detection method being used for the survey, it is necessary to

change or modify the method to increase the sensitivity of the measurement by lowering the scan rate, changing to a larger area detector, or changing from a field measurement to a laboratory measurement. The conclusion of TSD 97 is that at levels corresponding to the screening levels utilized in that study of 15 mrem/yr and 1 mrem/yr, "100% of the radionuclides evaluated can be detected." Even at screening levels corresponding to 0.1 mrem/yr, "85% of the radionuclides are detectable" (EPA, 1997a, p. ES-17).

Thus, for both volume-contaminated and surface-contaminated solid materials, measurement of radionuclide activity concentrations at levels being considered for dose-based standards is not the limiting factor if the primary dose standard is at or above 1 mrem/yr in both laboratory and field measurements.

MEASUREMENT COST

The cost of measuring activities at these levels depends on the difficulty of analysis. The instrumentation to perform alpha, beta, and gamma spectroscopy is similar in cost to the most sophisticated systems for chemical analysis. Alpha and beta spectrometers cost approximately $50,000 each, but many systems can be adapted to analyze either particle by changing the detector. Gamma spectroscopy systems range from $50,000 to $200,000. A reasonable cost to set up a state-of-the-practice radionuclide analysis laboratory would be less than half a million dollars. The major operating expense is for the trained personnel needed to perform the sample preparation analyses correctly, especially on difficult samples. The TSD 97 authors referenced an article by Cox and Guenther (1995) that presented a range of MDCs as reported by 24 commercial and governmental laboratories. Table 8-5 of TSD 97 presents detection costs in 1995 dollars per sample that range from $40 to $375, depending on the radionuclide. There is some increase in per-sample cost as the required sensitivity increases: activities in the 10 pCi/g range, cost $40 to $250 per sample; in the 1 pCi/g range, $75 to $300 per sample; and in the 0.1 pCi/g range, $100 to $375 per sample. However, the increase is not as large as would be expected if most laboratories offering detection services were not already working with instruments and measurement procedures adequate to detect activities at the 0.1 pCi/g level.

If clearance is an option, the tradeoff between the cost of clearance and the cost of disposal as low-level radioactive waste (LLRW) will ultimately determine which option a licensee chooses. Chapter 4 estimates that costs for LLRW disposal will range from $3,120 to $16,800 per cubic meter. LLRW densities in the United States are usually between 50 and 120 pounds per cubic foot (0.8 to 1.92 metric tons/m^3). If a nominal density of 75 pounds per cubic foot, disposal costs of $30 per metric ton and $110 per metric ton at Subtitle D and C landfills, respectively, and a fixed sampling cost of $20 per sample (collection and preparation) are assumed, one can estimate the number of samples that can be taken at the break-even cost relative to LLRW disposal. Table 6-3 presents the results of

TABLE 6-3 Estimated Number of Analyzed Samples per Metric Ton of Waste at Breakeven Between Clearance and Low-Level Radioactive Waste Disposal

	LLRW Disposal ($2,590 per metric ton) Number of Samples Analyzed at		LLRW Disposal ($13,950 per metric ton) Number of Samples Analyzed at	
Alternative Disposal Site	$40 per sample	$375 per sample	$40 per sample	$375 per sample
Subtitle D at $30 per metric ton	42	6	232	35
Subtitle C at $110 per metric ton	41	6	232	35

NOTE: Calculation assumes no difference in transportation costs and constant sampling costs of $20 per sample.

this estimation.[3] The number of samples required to characterize the waste stream adequately will depend on the degree of certainty that the waste is homogeneous. However, at the higher LLRW cost, the number of samples that could be taken for the same cost ranges from 35 to 232, which is large enough to characterize a homogenous ton of waste. If the lower cost of LLRW disposal and the high sample analysis cost are used in the estimation, the six samples at equivalent cost are probably too small for adequate sampling, unless the waste is known to be homogeneous. Depending on the waste stream and the sampling protocol, it may be possible to aggregate samples and resample. This approach would reduce the typical number of samples to be analyzed per ton of waste.

Thus, the cost of sampling and analysis by itself does not appear to be a limiting factor when selecting a primary dose standard at or above 0.1 mrem/yr. (However, as noted above, at screening levels corresponding to a primary dose standard of 0.1 mrem/yr, the detection capability of field instruments is such that only 11 of 40 key radioncuclides can be detected.) This conclusion on costs is confirmed by the operation of a commercial waste management service, Duratek, Inc., which uses the derived screening levels from ANSI/HPS Standard N13.12 (see Table 6-1) to make decisions on waste disposition. Duratek, Inc. provided

[3]For example, if you had one ton of waste and access to LLRW disposal at $2,590 per ton, one option is to send that ton of waste to such an LLRW disposal facility. On the other hand, to send the same ton of waste to a Subtitle D facility, you would have to sample sufficiently to show it meets clearance levels and do so within a budget of $2,590-$30 = $2,560, the amount left after $30 tipping fee per ton. At $40 per sample characterization plus $20 per sample for sampling, this allows 42 samples to be taken within the break-even budget. If more samples are needed to show the waste meets clearance criteria, it is cheaper to send it to LLRW disposal.

the committee with information on its process and procedures, as discussed in the next section.

CURRENT MEASUREMENT PRACTICES OF A WASTE BROKER

Radioactive waste is generated daily from hospitals, research laboratories, and nuclear power plants. Licensees that generate controlled materials during operations currently survey all potentially contaminated waste materials prior to shipment. Those that are determined to have no licensee-generated radioactive material present are treated as nonradioactive waste. Materials that have surface contamination are either treated as LLRW or cleared using the criteria in Regulatory Guide 1.86 (AEC, 1974), license conditions, or approval obtained on a case-by-case basis from either the USNRC or the agreement state regulator. During decommissioning, potentially radioactive materials are typically cleared on a case-by-case basis or sent to a waste processor for clearance. Known radioactive materials are disposed as appropriate for their radioactive waste classification.

In 2000, about 30,000 tons of LLRW were processed in the United States. Waste brokers and processors handle a significant fraction of this waste. Waste brokers provide services to direct the disposition of LLRW and to prevent the release of contaminated materials into general commerce. A broker may transport, collect, or consolidate shipments or process radioactive waste. The survey of the incoming waste stream is an essential step in a waste processor's management of customer materials. The incoming shipment is scanned with handheld counters as an initial screen. (The licensee shipping the material has already certified that the waste has a low activity level and can be evaluated for clearance.) The material is then examined in either a box or a drum assay system. At the facilities of the waste broker Duratek, Inc., high-purity germanium (HPGe) detectors are employed for gamma spectroscopy, sodium iodide detectors are used for micro-dose rate determinations, and the records for each assay are stored digitally. If the material is clean (no activity at or above detectable limits), it is shipped to a Subtitle D landfill. As a further check, portal monitors at the facility exits are used to ensure that "clean" material shipped to the local Subtitle D landfill will not trigger portal monitors upon arrival there. If the material is contaminated at levels above those that would allow landfill disposal, it is either returned to the generator or, at the direction of the generator, disposed of as LLRW. Prior to disposal as LLRW, material is processed by melting, compaction, incineration, or a combination of these processes, to reduce its volume (which reduces disposal costs).

THE MARSSIM METHODOLOGY

Determination of an appropriate sampling program is a major consideration in the measurement process. MARSSIM methodology could be a valuable tool

for licensees in demonstrating compliance with the type of dose-based standards under consideration for releasing SRSM. The MARSSIM includes a statistical sampling methodology suitable for release of land and buildings potentially containing residual radioactive material in surface soil or on building surfaces. At some licensed facilities, potentially clearable building materials may contain volume-distributed sources of radioactivity, in addition to surface sources. The MARSSIM methodology could also be expanded to be used as a decision tool in evaluating these solid materials.

The number of measurements or samples needed in each survey unit for statistical testing of residual radioactive material against a release level depends on the expected variability in concentration of the radioactive material and the level of acceptable error. If a licensee is in doubt, MARSSIM encourages assuming a larger, rather than smaller, variability in the material. This conservative approach (presumption of less homogeneity) drives a MARSSIM-guided assessment toward taking a larger number of measurements or samples.

A plethora of radiation detection instruments is available to scan surfaces and make direct measurements of residual radioactivity. The radionuclide(s) present and the magnitude of the release level are key factors in determining the appropriate instrument for a particular slightly radioactive solid material to be assessed. Several references, including MARSSIM (EPA et al., 2000), and NUREG 1507 (USNRC, 1997), provide MDCs for various types of radiation detection instruments under different sets of circumstances. The characteristics of the detector (probe area, detection efficiency, background response, etc.) enable the licensee to relate the release level to a corresponding instrument response, which MARSSIM calls the Derived Concentration Guideline Level (DCGL). The instrument selected should have sensitivity as far below the DCGL as possible. MARSSIM recommends that the MDC should be less than 10 percent of the DCGL, although it is acceptable for the MDC to be as much as 50 percent of the DCGL.

Having selected appropriate instrumentation, the licensee must next develop an integrated survey design combining some degree of scanning surveys with static measurements or sample collection. MARSSIM strongly recommends that the effort expended be weighted toward those survey units[4] more likely to contain elevated levels of residual radioactive material.

[4]A geographical area consisting of structures or land areas of specified size and shape at a remediated site for which a separate decision will be made whether the unit attains the site-specific reference-based cleanup standard for the designated pollution parameter. Survey units are generally formed by grouping contiguous site areas with a similar use history and the same classification of contamination potential. Survey units are established to facilitate the survey process and the statistical analysis of survey data (EPA et al., 2000).

The assessment phase, which follows collection of the survey data, includes data validation as well as a reassessment of the quantity of data. For example, the number of measurements taken was based, in part, on an assumption about the variability of radionuclide concentration in the material. This assumption should be verified. If the variability was underestimated, more data should be collected to ensure that the desired statistical significance is attained. For survey units that are likely to contain elevated levels of radioactivity, MARSSIM also requires that an elevated measurement comparison (EMC) test be performed to demonstrate compliance for small areas with elevated activity concentrations.

FINDINGS

Finding 6.1. The concentration of radioactive material in released solids directly affects radiation detection requirements and costs. Measurement of the amount of radioactive material in a solid matrix is a complex task that involves a combination of instrument characteristics, background radiation levels, and source characteristics. No single measurement method would be appropriate or adequate for all radionuclides.

Finding 6.2. The overall measurement costs, including sampling (collection and preparation) and analysis and material disposition choices, affect clearance decisions. If the measurement costs are too high, it may be more cost-effective to dispose of the material as low-level radioactive waste.

Finding 6.3. For a 1 mrem/yr or higher standard (and the corresponding derived secondary screening levels), the majority of radionuclides can be detected at reasonable costs in a laboratory setting, under most practical conditions. For a 0.1 mrem/yr standard, the measurement capability falls below the upper bound of minimum detectable concentrations for some radionuclides in some laboratories, although 85 percent of radionuclides are still detectable. Using field measurements, a more rapid fall-off of detectability is observed at more stringent radiation protection levels, with 31 of 40 key radionuclides detectable at 1 mrem/yr and 11 of 40 detectable at 0.1 mrem/yr.

7

International Approaches to Clearance

THE GLOBAL CONTEXT

Import-export activities involving recycled materials have increased greatly with the growth of international trade over the past several decades. This is particularly true for metals such as steel in which recycled material constitutes a significant fraction of the total production. It is also true for metals with high intrinsic value such as aluminum, copper, and nickel. Scrap metal is actively traded worldwide, and the amounts in international trade are measured in millions of metric tons per year. The United States imports about 3 million metric tons of scrap steel per year. Both the European Union (EU) and the United States are concerned about imports of steel scrap containing radioactive material (see Box 7-1). The amount of scrap steel employed in making steel varies markedly with the process, but on the average, scrap represents a significant component of the charge for a furnace. The percentage of recycled material is also significant for some other metals such as aluminum, copper, and nickel. These high percentages reflect both the inherent potential for metals to be recycled repeatedly at a cost competitive with producing metal from raw materials, which is higher than for most other materials, and the actual practice in metals production worldwide.

Appendix D summarizes the work on slightly radioactive solid material (SRSM) clearance standards by various entities within the United States, as well as major international efforts. Specifically, Appendix D discusses the following documents developed by international organizations: (1) IAEA Safety Series 89; (2) EC Radiation Protection 89; (3) International Commission on Radiological Protection Publication 60; (4) reports of the United Nations Scientific Committee

BOX 7-1
Sealed Radioactive Sources in Scrap Metal

One of the steelmakers' concerns is contamination of recycled materials due to the inclusion, whether accidental or deliberate, of sealed high-radioactivity sources in metal scrap for recycling. This possibility is a different issue from the introduction of slightly radioactive solid material cleared from licensed facilities. Cleared SRSM has presumably been properly evaluated and released according to approved criteria. Sealed sources that are either intentionally or inadvertently introduced into scrap offered for processing present a greater and typically unknown source of contamination. The management of such "orphaned sources" is beyond the scope of this report. It is mentioned here because the introduction of these sources typically dominates the discussion of recycle of radioactive materials into steel. These "orphaned sources" in metal scrap can contaminate a processing plant. Such contamination may raise questions regarding worker health in subsequent handling or processing of the scrap, as well as exposures to members of the general public during transport and any subsequent use of the contaminated metal.

on the Effects of Atomic Radiation; and (5) European Union Basic Safety Standards.

National and international concerns about potential problems of radioactive contamination associated with recycled metal have increased during the past decade. Several international agencies are addressing the problem, including the International Atomic Energy Agency (IAEA), the United Nations Economic Commission for Europe, and the European Commission (EC). At present, no international or national registries of missing radioactive sources are available to the recycling industry to indicate when such sources are lost or stolen and where they may enter the recycling chain. To address concerns about the import-export of metal scrap with undetected levels of radioactivity above clearance limits, the Team of Specialists on Radioactive Contaminated Scrap Metal, United Nations Economic Commission for Europe, has proposed the following (UNECE, 2001):

- The regulatory framework associated with the clearance of material should include provisions for prior notification to the receivers of the material of the origin of this material and the regulatory framework under which it is released.
- When materials contaminated with naturally occurring radioactive materials (NORM) are released according to a national regulatory framework, such information should also be forwarded.
- As part of the "contractual" provisions, this information should be conveyed with the released material to the successive suppliers and buyers of the metal scrap.

The European Union has been establishing standards and methods of control for SRSM within Europe. Many EU countries possess nuclear power reactors and nuclear fuel cycle facilities. As these facilities are decommissioned, scrap metals and concrete are cleared from regulatory control. Some of these materials are released for restricted uses, but others are released to general commerce. The amount of potentially clearable metal from all categories of EU facilities is estimated at 12,700 metric tons per year, although this estimate increases to about 40,000 metric tons by 2020 from commercial power plants alone (EC, 1998b).

Different clearance procedures for the release of SRSM metals are currently in use among EU countries. Delayed release and dilution have been standard practice in some. For example, 14,000 metric tons of contaminated steel scrap has been melted at a dedicated melting facility operated by Siempelkamp (Krefeld, Germany). Although most of this recycled scrap metal has been used in restricted applications, 2,000 metric tons has been released for unrestricted use. The contamination limits in Germany for unrestricted reuse are expressed in becquerels per gram for each radionuclide (e.g., cobalt-60 is 0.1 Bq/g).

The EU member nations are in various stages of developing detailed regulations to implement the controlling directive from the EU Council (EU,1996), as discussed in the next section. Japan is developing similar regulations and has ongoing discussions among government organizations. Table 7-1 summarizes international activities and the status of clearance standards for SRSM in a number of countries for which the committee was able to obtain information. Activities of the Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (USNRC) are included in Table 7-1 for comparison.

Generation of radioactive material outside the United States is not limited to EU member states or to commercial nuclear power operations and decommissioning. Nuclear weapons development has occurred in many countries over the past 60 years. China, India, and Pakistan are known to have developed and tested weapons. Clearly, radioactive materials containing significant quantities of long-lived radionuclides are located around the world.

Documentation regarding radioactive material contamination exists for republics of the former Soviet Union, which produced 55,000 nuclear warheads during the Cold War. The Soviet Union, and later Russia, produced uranium and plutonium for nuclear weapons at three closed atomic cities—Ozersk, Seversk, and Zheleznogorsk—which were founded to produce weapons-grade material and reprocess civilian nuclear fuel. Some of these materials may enter commerce as SRSM if cleared from one or all of these countries involved in the development of nuclear weapons, nuclear power, and other uses of radioactive materials in industry, medicine, and research.

For general information on radioactive waste management activities, the International Nuclear Societies Council (INSC) recently published an overview of radioactive waste management activities in countries with INSC member soci-

TABLE 7-1 International Clearance Status as of May 2001

Country	Surface Clearance Level(s) (Bq/cm^2)	Volume Clearance Level(s) (Bq/g)	Basis for C
Belgium	Case-by-case	Case-by-case	IAEA TEC used as
France	Nuclear power industry: moratorium on generic levels; case-by-case allowed Nonnuclear power industry: case-by-case	Nuclear power industry: moratorium on generic levels; case-by-case allowed Nonnuclear power industry: case-by-case	Waste stre quality a study, p public, s authoriz
Germany	Nuclide specific, based on 10 μSv to a person in a year.	Nuclide specific, based on 10 μSv to a person in a year (e.g., 0.1 Bq/g ^{60}Co)	SSK (Com Radiolog recomme
Japan	No general criteria	No general criteria	Ongoing d governm

s)	Basis for Clearance	Situation	Remarks
	IAEA TECDOC-855[a] levels used as reference levels	General regulations are under review for update to Directive 96/29/Euratom[b]	IAEA TECDOC-855 dose criteria are 10 μSv to a person in a year, plus collective dose of 1 person-Sv or optimization
c levels; try:	Waste stream analysis, quality assurance, impact study, presentation to public, specific authorization	Incorporation of Directive 96/29/ Euratom[b] for both power and non-power industries is in preparation, planned for mid-2001	Ministerial order issued Dec. 31, 1991, requested nuclear industry to implement waste stream analysis Authorized release is possible, though rarely used Generic clearance levels may be required for non-nuclear power very low level waste
on 10 μSv e.g.,	SSK (Commission on Radiological Protection) recommendations.	Incorporation of Directive 96/29/Euratom[b] is in preparation Some debate on whether to replace SSK recommended levels with EC RP 122[c] clearance levels	Updated regulations targeted for fall 2001 Authorized release is possible (e.g., 4 Bq/g ^{60}Co for landfill or incineration; 0.6 Bq/g ^{60}Co for metals to be melted) Clearance of sites based on 10 μSv/yr. individual dose
	Ongoing discussions among government organizations	Legislation targeted for 2001	Nuclear Safety Commission based clearance calculations on 10 μSv criterion. These agree well with IAEA TECDOC-855[a] with a few exceptions

continues

TABLE 7-1 continued

Country	Surface Clearance Level(s) (Bq/cm^2)	Volume Clearance Level(s) (Bq/g)	Basis for C
United Kingdom	Case-by-case basis	0.4 Bq/g for non-naturally occurring radionuclides Naturally occurring radionuclides range from 0.37 to 11.1 Bq/g, depending on the nuclide	Implement 96/29/ E incorpor regulatio disposal expected
United States	DOE suspension of scrap metal for recycling	DOE moratorium on metals	January 19 memora Secretar (a) Metals within D (b) Morato suspensi (c) Enviror Statemer regulatio (d) Reuse products
	USNRC: consistent with average of 0.017 Bq/cm^2 for transuranics, ^{226}Ra, and others to 0.83 Bq/cm^2 for most β-γ emitters	USNRC: no general criteria	Table I of 1.86[f] for radioact

[a]IAEA (1996).
[b]EU (1996).
[c]EC (2001).

eties.[1] Although the summary information gives an interesting snapshot of radioactive waste management practices, the document contains no information on procedures for clearing or exempting materials from regulatory control.

The committee's statement of work specifically requested a review of EU activities. The EU offers important comparisons with U.S. practices and regula-

[1]The INSC document is available on the Internet at <http://www2s.biglobe.ne.jp/~INSC/INSCAP/Radwaste.html>.

s)

	Basis for Clearance	Situation	Remarks
ly s onuclides 1 Bq/g, ide	Implementation of Directive 96/29/ Euratom[b] by incorporation of existing regulations, except disposal of waste is expected in a few months		Basis for clearance is 10 μSv criterion Exemption orders exist that allow less restrictive clearance levels for naturally occurring radionuclides
als	January 19, 2001; memorandum from DOE Secretary (a) Metals recycle only within DOE (b) Moratorium and suspension remain (c) Environmental Impact Statement needed before regulations are revised (d) Reuse of lead and lead products	Pending the improved release criteria and information management recycle of scrap metals Pending USNRC decision to establish national volumetric standards	Other materials and equipment are released under DOE Order 5400.5,[d] which bases case-by-case approval on criteria of a small fraction of 1 μSv in a year and ALARA[e]
eria	Table I of Regulatory Guide 1.86[f] for surface radioactivity	Ongoing USNRC study	Authorized release for disposal is possible on case-by-case basis

[d] DOE (1993a).
[e] ALARA = as low as reasonably achievable.
[f] AEC (1974).

SOURCE: USNRC (2001b).

tory trends, and it is a major trading partner of the United States for recycled materials, particularly metals.

CLEARANCE STANDARDS IN THE EUROPEAN UNION

Clearance practices in the EU are subject to a directive of the Council of the European Union, Directive Number 96/29/Euratom of May 13, 1996 (EU, 1996). The subject of this directive is ". . . laying down basic safety standards for the protection of the health of workers and the general public against the dangers

arising from ionising radiation." Article 3, Section (2), defines the following exemptions to practices for the control of radioactive material if specified quantities or concentration limits are not exceeded (EU, 1996, p. 6):

> No reporting need be required for practices involving the following:
>
> (a) radioactive substances where the quantities involved do not exceed in total the exemption values set out in Column 2 of Table A to Annex I or in exceptional circumstances in an individual Member State different values authorized by the competent authorities that nevertheless satisfy the basic criteria set out in Annex I; or
> (b) radioactive substances where the concentration[s] of activity per unit mass do not exceed the exemption values set out in Column 3 of Table A to Annex I or in
> (c) exceptional circumstances in an individual Member State different values authorized by the competent authorities that nevertheless satisfy the basic criteria set out in Annex I; or
> (d) . . . [this item deals with sealed sources in devices that exceed the exemption limits but are devices that are approved by a Member State of the EU]; or
> (e) . . . [this item deals with electrical apparatus that can produce ionizing radiation]; or
> (f) . . . [this deals specifically with cathode ray tubes in x-ray equipment]; or
> (g) material contaminated with radioactive substances resulting from authorized releases which competent authorities have declared not to be subject to further controls.

Table A to Annex I, which lists limits by nuclide, is reproduced in Appendix D of this report (see Table D-1). Annex I contains "Criteria to Be Considered for the Application of Article 3" in exempting a practice from regulatory control. For comparison, tables have been generated using the NUREG-1640 methodology discussed in Chapter 5 of this report assuming a dose level of 10 μSv/yr (1 mrem/yr) total effective dose equivalent (TEDE). These dose factors are given in Appendix D (see Table D-2) as information for the reader. The relationship between EU values, NUREG-1640 values, and other calculations of dose factors is discussed in Chapter 5.

The EU criterion of particular relevance to dose-based clearance standards is Paragraph 3, which allows member states to substitute their own limit values for those shown in Table A of Annex I, provided that both an individual dose limit and a condition on collective dose are met. The exact language of this "exemption" paragraph is included in Box 7-2.

BOX 7-2
Annex I (from Council Directive 96/29/EURATOM): Criteria to Be Considered for the Application of Article 3

1. A practice may be exempted from the requirement to report without further consideration, in compliance with Article 3 (2) (a) or (b) respectively, if either the quantity or the activity concentration, as appropriate, of the relevant radionuclides does not exceed the values in column 2 or 3 of Table A.
2. The basic criteria for the calculation of the values in Table A, for the application of exemptions for practices, are as follows:
   (a) the radiological risks to individuals caused by the exempted practice are sufficiently low as to be of no regulatory concern; and
   (b) the collective radiological impact of the exempted practice is sufficiently low as to be of no regulatory concern under the prevailing circumstances; and
   (c) the exempted practice is inherently without radiological significance, with no appreciable likelihood of scenarios that could lead to a failure to meet the criteria in (a) and (b).
3. Exceptionally, as provided in Article 3, individual Member States may decide that a practice may be exempted where appropriate without further consideration, in accordance with the basic criteria, even if the relevant radionuclides deviate from the values in Table A, provided that the following criteria are met in all feasible circumstances:
   (a) the effective dose expected to be incurred by any member of the public due to the exempted practice is of the order of 10 μSv or less in a year; and
   (b) either the collective effective dose committed during one year of performance of the practice is no more than about 1 man-Sv or an assessment of the optimization of protection shows that exemption is the optimum option.
4. For radionuclides not listed in Table A, the competent authority shall assign appropriate values for the quantities and concentrations of activity per unit mass where the need arises. Values thus assigned shall be complementary to those in Table A.
5. The values laid down in Table A apply to the total inventory of radioactive substances held by a person or undertaking as part of a specific practice at any point in time.
6. Nuclides carrying the suffix "+" or "sec" in Table A represent parent nuclides in equilibrium with their correspondent daughter nuclides as listed in Table B. In this case the values given in Table A refer to the parent nuclide alone, but already take account of the daughter nuclide(s) present.
7. In all other cases of mixtures of more than one nuclide, the requirement for reporting may be waived if the sum of the ratios for each nuclide of the total amount present divided by the value listed in Table A is less than or equal to 1. This summation rule also applies to activity concentrations where the various nuclides concerned are contained in the same matrix.

SOURCE: EU (1996, Annex I).

In short, two mechanisms exist in the EU for clearing SRSM materials from regulatory control:

1. Materials can be released from regulatory control if the quantities and concentrations of activity per unit mass do not exceed the concentration limits listed in Column 3 of Table A in Annex I.
2. Competent regulatory authorities may use their own assessment process, conforming to the general approach used to derive the Table A values, to decide that a proposed exempting practice is within the principal individual and collective dose limits.

The EC has issued *Communication from the Commission concerning the implementation of Council Directive 96/29/Euratom* (EC, 1998a) describing how to implement Council Directive 96/29/Euratom (EU, 1996). With respect to Article 3 of the Directive 96/29/Euratom, the communication states:

> Article (3)(2) and Annex I specify the circumstances under which competent authorities may decide that reporting is not required. Member States are allowed to deviate from the values in Table A of Annex I in exceptional circumstances and subject to specified conditions.

This EC communication also contains information on how the values in Table A of Annex I were calculated:

> The exemption levels, which apply to practices, are worked out using scenarios, pathways and formulae presented in the report published by the Commission. (Radiation Protection No. 65, Principles and methods for establishing concentration and quantities [exemption values] below which reporting is not required in the European Directive, Luxembourg, 1993.)

A related EU directive on shipments of radioactive waste is officially titled *Council Directive 92/3/Euratom on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community (OJ L 35, 12.2.92)* (EU, 1992). This directive controls the shipment of radioactive materials that have not been exempted or cleared from regulatory control. In addition, the Environmental Directorate of the EC has published the guidance document *Radiation Protection 89: Recommended Radiological Protection Criteria for the Recycling of Metals from the Dismantling of Nuclear Installations* (EC, 1998b), which provides activity standards for both surface and volume contamination of solid materials. These standards have been applied at several facilities in the EU. As indicated in Table 7-1, EU member nations are in various stages of developing detailed regulations to implement Directive 96/29/Euratom. There is a lack of uniformity of views regarding standards for materials that are candidates for release from further regulatory control, as described in the paper "Management of Slightly Contaminated Materials: Status and Issues" (Pescatore, 2001).

FINDINGS

Finding 7.1. The EU and the IAEA have each established a dose-based standard of 10 μSv/yr (1 mrem/yr) for the clearance of materials from regulatory control. A collective dose standard is also included, expressed as a committed dose equivalent of 1 man-Sv per year of exposure of the affected group (100 man-rem total effective dose equivalent per year).[2]

Finding 7.2. The EU has derived tables using a scenario assessment process against which radioactive solid materials can be evaluated for clearance.

Finding 7.3. A body of science, policy, and literature supports the development of the EU safety directives related to radioactive solid material clearance. In particular, the IAEA has developed policy guidance found in *Principles for the Exemption of Radiation Sources and Practices from Regulatory Control* (IAEA, 1988).

[2]Provisions exist in the EU safety directives for competent authorities in member states to develop alternative clearance guidance for special or specific circumstances.

8

Stakeholder Reactions and Involvement

PAST USNRC EFFORTS AT STAKEHOLDER INVOLVEMENT

This chapter reviews recent past and current efforts by the U.S. Nuclear Regulatory Commission (USNRC) to involve stakeholders in decision-making processes relevant to clearance standards for slightly radioactive solid material (SRSM). Three efforts by the USNRC to promote public involvement are particularly important and are discussed next: (1) the below regulatory concern (BRC) policy in the early 1990s, (2) the License Termination Rule (1992-1997), and (3) the 1999 issues paper that initiated a regulatory process for release of SRSM. The chapter then presents basic principles that the USNRC can follow to avoid past mistakes and involve its stakeholders more effectively.

The Below Regulatory Concern Effort

The BRC policy was intended to cover four basic clearance standards: (1) clearance of licensed facilities containing residual radioactivity after license termination; (2) distribution of consumer products containing small amounts of radioactivity; (3) disposal of solid wastes containing very low levels of radioactivity; and (4) recycling or reuse of solid materials containing very low levels of radioactivity (USNRC, 1991b). As noted in Chapter 2, promulgation of the BRC policy began in 1990 with a series of public meetings in which comments were obtained from various stakeholders (USNRC, 1991a). However, this public involvement process polarized as it progressed. Four of eight environmental and consumer groups that had been actively involved in the initial meetings refused to

discuss entering a consensus-building process because of the conditions set forth for entering into the process. These four organizations had been among the stakeholder groups most actively engaged in BRC issues.

Strong stakeholder opposition ultimately prompted the USNRC to defer action on petitions submitted by licensees for BRC exemptions (56 Federal Register 21631; May 10, 1991). The USNRC began an open, consensus-building process to clarify differences among affected parties and to work toward resolution of issues. However, the USNRC imposed two critical conditions on groups participating in the process. First, representatives from *all* parties who previously had a major interest in the BRC policy—as determined by the USNRC—were required to participate in a "core group." Second, all parties were required to agree to defer action on other avenues of relief (legislative, legal, or administrative) (USNRC, 1991d). These conditions and the general distrust engendered by the process resulted in continued boycott by certain groups. A letter from the Natural Resources Defense Council declining to participate was particularly persuasive in terminating the BRC process (NRDC, 1991).

The License Termination Rule

Following the withdrawal of the BRC policy, the USNRC decided to focus on issuing—in conjunction with an enhanced public participation process—a rule governing the clearance of facilities containing residual radioactivity (USNRC, 1992). The agency solicited input through a series of public workshops designed to identify issues, areas of concern, and disagreement. In addition, the normal notice and comment process was initiated. An initial draft rule was circulated by the USNRC staff along with public comments from the workshops on February 2, 1994 (59 Federal Register 4868). The additional comments on this initial rule were considered in the report to the Commission recommending a proposed rule for publication (USNRC, 1994). The Commission was to hear the final rule after another round of public comment in early May of 1995.

The report to the Commission gave special attention to three categories of comments critical of the initial draft proposed rule (USNRC, 1994):

- Comments that questioned the technical basis of the draft rule's 3 mrem/yr goal and 15 mrem/yr limit for individual dose;
- Suggestions by several licensees, industry groups, and the Environmental Protection Agency (EPA) that the 3 mrem/yr goal be dropped because it would become a de facto limit; and
- Comments indicating a need for greater guidance on demonstrating compliance with the rule's provisions.

The proposed rule (59 Federal Register 43200-43232; August 22, 1994) was published by the USNRC after considering the outcome of the workshops, the

National Environmental Policy Act (NEPA) scoping results, and the comments on the initial draft rule. The proposed rule dropped the 3 mrem/yr goal and retained the 15 mrem/yr standard. It retained the site-specific advisory boards that had been in the draft and endorsed the need for additional guidance on how the rule should be applied and enforced.

With publication of the proposed rule, the USNRC should have been able to conclude a successful public participation process. However, subsequent USNRC actions fundamentally undercut the consensus that had been achieved, further alienating many of those who had participated. The USNRC had announced an extension of the comment period for the proposed rule to January 20, 1995 (59 Federal Register 63733; December 9, 1994). Then on August 7, 1995, the USNRC announced (60 Federal Register 40117) an extension of the schedule for the final rule until early 1996 "to allow the NRC to more fully consider public comments received on the technical basis." That announcement of schedule extension noted the USNRC's intention to hold a public meeting in September 1995 to address specific issues and included the separate views of one commissioner questioning the adequacy of the technical basis for selecting a dose criterion of 15 mrem in contrast to 25 or 30 mrem. A letter dated September 25, 1995, from 10 environmental and consumer organizations objected to the "Commission's current move to hold a single workshop in Washington, D.C., to discuss a [new] proposal, . . . a possible 35 mr/yr clean-up standard [that] would substantially relax the final rule and is contrary to all of the remarks and comments [from the 1993 workshops]." The letter also charged that among other issues, "public comments in those sessions were a mandate for the most radiologically protective standard possible." The letter's authors asserted that the proposed rule was no longer adequate (Mariotte et al., 1995). Separately, the EPA objected to raising the standard from 15 mrem/yr to 25 or 30 mrem/yr because the higher limits would not adequately protect public health and the environment (EPA, 1997d).

Contrary to the consensus that had emerged from the extensive public process, the final rule (62 Federal Register 39058-39092; July 17, 1997) contained a 25 mrem/yr cleanup standard. It dropped the requirement for establishing site-specific advisory boards, substituting only broad performance criteria for obtaining such advice.

The 1999 Issues Paper and Current Stakeholder Involvement Efforts

The stated intention of the USNRC's June 1999 *Federal Register* notice (64 Federal Register 35090-35100; June 30, 1999) entitled "Release of Solid Materials at Licensed Facilities: Issues Paper, Scoping Process for Environmental Issues and Notice of Public Meetings" (the "1999 issues paper") was to initiate another "enhanced participatory process" for a proposed rule on clearance of SRSM (USNRC, 2000a). The 1999 issues paper established essentially three alternative actions (USNRC, 2000d, Attachment 1):

1. Do not conduct a rulemaking and proceed by continuing with current case-by-case practices.
2. Do not conduct a rulemaking and proceed by exploring options for updating existing guidance to improve consistency of criteria.
3. Conduct a rulemaking to develop a proposed rule.

If the third alternative, to proceed with rulemaking, were to be adopted, three technical approaches would be explored:

1. Permit release of solid material for unrestricted use if doses to the public from releases are less than a specified level.
2. Restrict release of materials to only certain authorized uses.
3. Prohibit release of material from areas where radioactive material has been stored—otherwise allow clearance.

As in previous efforts, the process centered around a series of public meetings. At these meetings, the USNRC once again asked environmental and consumer groups and other stakeholders to participate in a process that many of them had severely criticized and still doubted had been adequately reformed. This skepticism led some national environmental and consumer advocacy groups to boycott the public meetings intended to consider the issue of clearance of SRSM from USNRC-licensed facilities. Nevertheless, the USNRC received more than 900 comment letters.

The significant public concern expressed in these comments, combined with the boycott of the meetings, prompted the USNRC to hold an additional public meeting, conducted by the Commission and attended by representatives of a variety of stakeholder groups, including some that had boycotted earlier meetings (USNRC, 2000c).

Summaries of the stakeholder comments and oral statements from meetings on the 1999 issues paper are contained in a staff report to the USNRC (USNRC, 2000c) and in a consultant's report (USNRC, 2000d). Both sources provide the reader with some sense of the range of views expressed on the 1999 issues paper. However, they contain little detail about the number of comments in each category, the number of comments received that do not fall into the categories, or the intensity of the views expressed. The following analysis is the committee's attempt to fill in some of these details and fathom the extent and depth of reactions to the proposed alternatives. This analysis illustrates some key themes that the committee found in the diverse, sometimes conflicting, views of various stakeholders. It does not cover all of the groups that expressed opinions at the meetings, nor does it cover all possible opinions and options. For more detailed coverage, see Appendix F to this report, as well as the consultant's report on the meetings (USNRC, 2000d).

The positions expressed by stakeholder groups regarding the 1999 issues

paper typically were similar to the positions articulated by the same groups during the BRC policy debate. Some of the strongly critical groups expressed views that certain policy options contained in the 1999 issues paper presented even greater risks than did the BRC policy. Their concern was that the Department of Energy (DOE), which they perceived as having large volumes of SRSM, was likely to handle that material in accordance with the USNRC approach to SRSM clearance.

Table 8-1 indicates the preferred alternatives for a number of stakeholder groups. The range of positions articulated is illustrated by the following list of stated views:

- Preclude any release of contaminated materials from regulatory control.
- Continue the USNRC's case-by-case process.
- Promulgate a conditional clearance standard (e.g., landfill disposal).
- Promulgate a clearance standard.
- Delay decision until a process is established for arriving at a consensus.

The alternatives presented in the issues paper—represented in Table 8-1 by the "Do Not Conduct a Rulemaking" and "Conduct a Rulemaking" columns—do not capture the full spectrum of alternatives favored by stakeholder groups. For example, many of the environmental and consumer groups that expressed an opinion criticized the USNRC for failure to include a "no release" alternative (see columns for "Other" in Table 8-1).

Three major themes emerged from the committee's analysis of the complete range of stakeholder views expressed in response to the 1999 issues paper:

- *Theme 1. There is little support from stakeholder groups for a clearance standard for SRSM.* Although agreement states and the nuclear industry favor some form of clearance standard, many consumer and environmental groups and certain affected industry organizations do not. Environmental groups expressed concern about risks to human health from clearance. The metals and concrete industries expressed concern that the presence of radioactive materials in their products would negatively affect their sales due to public fear. The metals industry also feared an economic impact if public confidence were decreased in the safety of steel products.
- *Theme 2. There is a legacy of institutional distrust of the USNRC by some of its stakeholder groups, particularly the environmental and consumer advocacy groups.* The three regulatory events described above have contributed to this distrust of USNRC by certain stakeholder groups. Other reasons, based on stakeholders' perceptions that may or may not have a basis in fact, are evident in the public comments received by the USNRC

and this committee. Among the factors that undermine trust are the following:

—The USNRC and the DOE are perceived as not having fully disclosed the risks and uncertainties associated with establishing a clearance standard.

—The perception is that the true purpose of establishing a clearance standard is to provide regulatory cover for DOE's efforts to recycle radioactive materials.[1]

—The USNRC is perceived to have focused almost exclusively on economic benefits rather than protecting human health and the environment.

—The perception that the USNRC lacks the capacity to regulate the implementation of a clearance standard effectively.

—The perception that USNRC's public participation process is implemented mechanically, with little or no commitment to comprehending and addressing stakeholder concerns.

Appendix F illustrates several of these perceptions in depth, categorizing them with respect to the views of particular groups.

- *Theme 3. Numerous stakeholders are unclear about the meaning or import of certain technical terms and issues.* Among the sources of confusion are the panoply of radiation control units of measure (e.g., sieverts, rems, becquerels) and technical distinctions such as those between surface contamination and volume (or volumetric) contamination, between (unconditional) clearance and conditional clearance, or between exclusions and exemptions.

Summary of Stakeholder Views

In summary, the committee's review of the record on the BRC policy, the License Termination Rule, and the 1999 issues paper found that many stakeholders distrust the USNRC and remain confused about important technical questions. There are misperceptions about intentions on both sides, and the USNRC has not been effective in its risk communication. There is also no consensus evident among stakeholder groups about the options for regulating disposal of SRSM. The USNRC must overcome serious levels of distrust, generated by its actions during the BRC policy and License Termination Rule efforts, before the

[1]For a brief account of circumstances cited by some groups to support this strongly negative perception, see the section below on "DOE Recycling of SRSM: The Oak Ridge Project."

TABLE 8-1 Matrix of Stakeholder Perspectives

	Do Not Conduct a Rulemaking	Conduct a Rulemaking	
Stakeholder	Continue Case by Case	Release for Unrestricted Use (Clearance)	Restrict Re Certain Au Uses (Con Clearance)
Nuclear Information and Resource Service			
Public Citizen			
New England Coalition on Nuclear Pollution			
Allied Industrial Chemical and Energy Workers Union			
Natural Resources Defense Council			
Steel Manufacturers Association			X
American Iron and Steel Institute			X
National Ready- Mixed Concrete Association			X
Metals Industry Recycling Coalition			X
Association of Radioactive Metal Recyclers			X
Association of State and Territorial Solid Waste Management Officials			
Illinois Department of Nuclear Safety, representing 49 States[b]	X[c]		
Health Physics Society		X[d]	
American Nuclear Society		X[d]	
Nuclear Energy Institute		X[d]	
Conference of Radiation Control Program Directors		X[d]	

[a]Authorized use includes both licensed (nuclear) use and unlicensed use (landfills, bridge supports).

[b]More specifically, representing the Conference of Radiation Control Program Directors and the Organization of Agreement States.

[c]These groups want to continue case by case but with uniform national criteria.

[d]Group expressed view that some special exceptions might apply, i.e., for metals industry.

ct a aking		Other		
e for ricted Use nce)	Restrict Release to Certain Authorized Uses (Conditional Clearance)[a]	No Release (No Option Specified, But Want the Solid Waste Isolated from General Commerce)	Cannot Engage in Dialogue Because Dialogue Process Is Tainted	Recommend Delaying Decision on a Rule Until Stakeholder Views Are Integrated with USNRC Decision Framework
		X		
		X	X	
		X		
			X	
				X
	X			
	X			
	X			
	X			
	X			X
				X

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expanded public participation process associated with the 1999 issues paper is likely to succeed.

RISK COMMUNICATION AND ITS ROLE IN THE RULEMAKING PROCESS

Approaches for effective risk communication have become highly sophisticated over the past 10 to 15 years. A study committee of the National Research Council has defined risk communication as follows (NRC, 1989, p. 21):

> [A]n interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management.

According to this definition, risk communication is a reciprocal process, not an attempt by an agency to "sell" its program to the public. If decisions are not negotiable, then the agency should not waste stakeholders' time (Omenn, 1997, p. 18). The approach must embody the principle, articulated by Thomas Jefferson, that there is "no safe depository of the ultimate powers of society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion" (Jefferson, 1820). Risk communication succeeds when it promotes a deeper understanding of the issues and satisfies individuals involved that they are adequately informed within the limits of available knowledge and that their views have been fairly considered.

Further, the concept of risk communication is consistent with federal laws on open government, which were meant to promote public participation in agency decision making. Among these laws are the Administrative Procedures Act, the Federal Advisory Committee Act, the Government in the Sunshine Act, the National Environmental Policy Act, and the Freedom of Information Act.

Communicating the risks and benefits of a clearance standard to the public is challenging because of both the fears associated with radiation and the technical nature of the issues. The USNRC has successfully engaged in risk communication in limited contexts, such as the initial public participation process during development of the License Termination Rule. The USNRC's inability to follow through on the 1994 consensus is an equally compelling example of poor risk management and communication. The results of these errors and others during the BRC policy effort have included a stalemate on SRSM clearance and disposal issues, as well as increased distrust of the USNRC.

The USNRC through a series of studies it commissioned and finished in 1999, has been made fully aware of the "state of the art" in using risk communication with both the public and decision makers. If the USNRC implements the

information contained in the reports, their efforts will be better informed than past work that employed, but did not follow through with, participatory processes and risk communication. Interestingly, the commissioned studies view sharing power and empowering the public in decision-making processes as a critical function of risk communication with the public and a crucial step in building trust or credibility, deeming it the "ultimate solution to situations of [existing] distrust" (Bier, 1999a, 1999b).

Stakeholders' Distrust and Deficiencies in the USNRC Process

The USNRC's request for stakeholder input should, in principle, be acceptable as an honest effort to respect and consider all stakeholder views. For a variety of reasons discussed above, many stakeholder groups do not view it this way. Many of the stakeholder groups that boycotted the initial workshops on the most recent reconsideration of the SRSM issue expressed skepticism that the USNRC was substantively considering and responding to their views and expressed concern that USNRC had not solicited their input prior to publishing the 1999 issues paper. These concerns are not directed toward scientific or technical issues but to issues of *process*.

The USNRC maintains the final responsibility for any rule or change in policy, but within its statutory limitations there is a great deal of latitude for involving stakeholders. Legitimacy can be achieved only through fostering trust in the agency's integrity, fairness, honesty, and competence (Pijawka and Mushkatel, 1992). If the process appears to be biased, if the communications are one-sided and technically obscure, or if uncertainties are disregarded, many stakeholders will view both the process and the outcome as illegitimate. When this occurs, groups seek other avenues, such as the courts or Congress, through which to be heard.

DOE Recycling of SRSM: The Oak Ridge Project

Stakeholders' concerns on the clearance issue have been influenced by their experience with DOE projects, as well as by their experience directly with the USNRC. A DOE plan to recycle approximately 100,000 tons of nickel and steel removed from the K-25 gaseous diffusion plant at Oak Ridge, Tennessee, resulted in the erosion of stakeholder trust. DOE proposed to remove and recycle the metals without completing an environmental impact statement—despite the size and novelty of the project. Moreover, a report by a National Research Council committee had previously recommended that public participation and support were critical to any such effort (NRC, 1996). Yet, the DOE project was initiated with essentially no public review or involvement, and regulatory approval to clear radioactively contaminated materials through an agreement state-licensed facility was conducted with no public process.

Environmental groups' concerns were confirmed when a contractor for the project, BNFL, was found to have an inadequate training program for employees, a deficient procurement system, problems in laboratory quality control, and several important violations of Occupational Safety and Health Administration standards. The DOE Inspector General confirmed these problems in a September 2000 report (DOE, 2000). The Inspector General also found that BNFL's surveys of contaminated materials were not conducted accurately, that employees were not adequately supervised, and that these problems posed an increased risk to the public (DOE, 2000, p. 2).

One of BNFL's partners on the Oak Ridge project was Science Applications International Corporation (SAIC), with whom the USNRC had also contracted to perform the technical analysis for NUREG-1640. In November 1999, the Paper, Allied-Industrial, Chemical, and Energy Workers International Union, which represents hourly workers at Oak Ridge National Laboratory, charged that the SAIC contract violated federal conflict-of-interest regulations precluding contractors from conducting work for the government that could benefit a private-sector client. In December 1999 the USNRC issued a stop-work order to SAIC, and in March 2000 it terminated the SAIC contract.

In July 2001, DOE announced plans to perform a Programmatic Environmental Impact Statement on scrap metal disposition, recycling, and clearance across its complex. SAIC was the contractor initially selected to undertake this work (Inside NRC, 2001). DOE canceled the SAIC contract on July 25, 2001, after environmental groups and an influential member of Congress raised concerns about possible bias stemming from SAIC's earlier involvement as a subcontractor to BNFL in the nickel recycling project (Zuckerbrod, 2001).

Hence, DOE's approach to the K-25 metals recycling, the subsequent problems with one DOE contractor for that project, and the links between that contractor and a second DOE contractor have further undermined the USNRC's credibility with some stakeholders. These stakeholders suggest that the two agencies are collaborating behind the scenes (i.e., "conspiring") to establish standards allowing clearance of SRSM.

The Importance of Trust

In the literature on public involvement, institutional trust is widely viewed as the single most important factor influencing the acceptance of controversial government policies (Raynor and Cantor, 1987; Flynn et al., 1992; Pijawka and Mushkatel, 1992). Trust is often characterized as a collection of attributes, such as honesty, fairness, integrity, competence, and consistency (DOE, 1993b). Research studies indicate that individuals accept higher levels of risk, or perceive risk as being lower, if they trust the agency setting the policy. The agency, however, must be perceived as honestly presenting the level of risk associated with the policy and as having the competence to evaluate the risks.

When an agency does not address issues consistently or is shown to have misinformed the public, stakeholder mistrust develops. By contrast, the more transparent a decision-making process is, the more likely are stakeholders to perceive the agency as having nothing to hide. The USNRC has lost the trust and confidence of some of its important stakeholder groups. It now must either work to regain their trust or continue to contend with an increasingly adversarial relationship. Some encouragement can be gleaned from studies showing that although trust is easy to lose and difficult to regain, it can be rebuilt through a concerted and sustained effort (Kasperson et al., 1988). The USNRC will have regained trust when it has significant participation by a broad base of stakeholders in its rulemaking process.

STAKEHOLDER INVOLVEMENT: METHODS AND SUCCESSES

The USNRC has had limited success in obtaining meaningful stakeholder involvement. Even so, determining the proper strategy or process to increase effective public participation and rebuild the trust of stakeholder groups will be difficult. Various types of dispute resolution techniques that may be appropriate at steps along the way include unassisted procedures or third-party assistance, including facilitation, mediation, fact finding, and nonbinding arbitration. Some authorities have found partnering techniques to be successful in avoiding disputes (Creighton and Priscoli, 1996).

Formalized public involvement, such as the workshops that the USNRC has conducted recently, is designed to give stakeholders an opportunity to be heard prior to a decision and to involve them in the framing of problems and solutions. Approaches such as facilitation, fact finding, mediation, and nonbinding arbitration allow stakeholders to participate in the evaluation of alternatives, impacts, and proposed decisions (see Figure 8-1). Some forms of dispute resolution are designed to require stakeholders' approval before a final decision is made (Creighton and Priscoli, 1996).

Some determinations must be made before selecting and moving forward with any of these methods or techniques for public participation. In particular, it is critically important that the agency and the stakeholders both believe that they can benefit from the process whether it is a public consensus-building process or an alternative dispute resolution approach. That is, the entities must believe that the outcome is more likely to be favorable to them if they participate in the joint process rather than remain outside it.[2] When this belief is lacking on either side, these processes are not appropriate. If the agency is bound legally to one option or if the agency does not believe that stakeholder involvement is important and worthwhile, these methods should not be employed.

[2]Janesse Brewer, the Keystone Center, presentation to the committee, June 27, 2001.

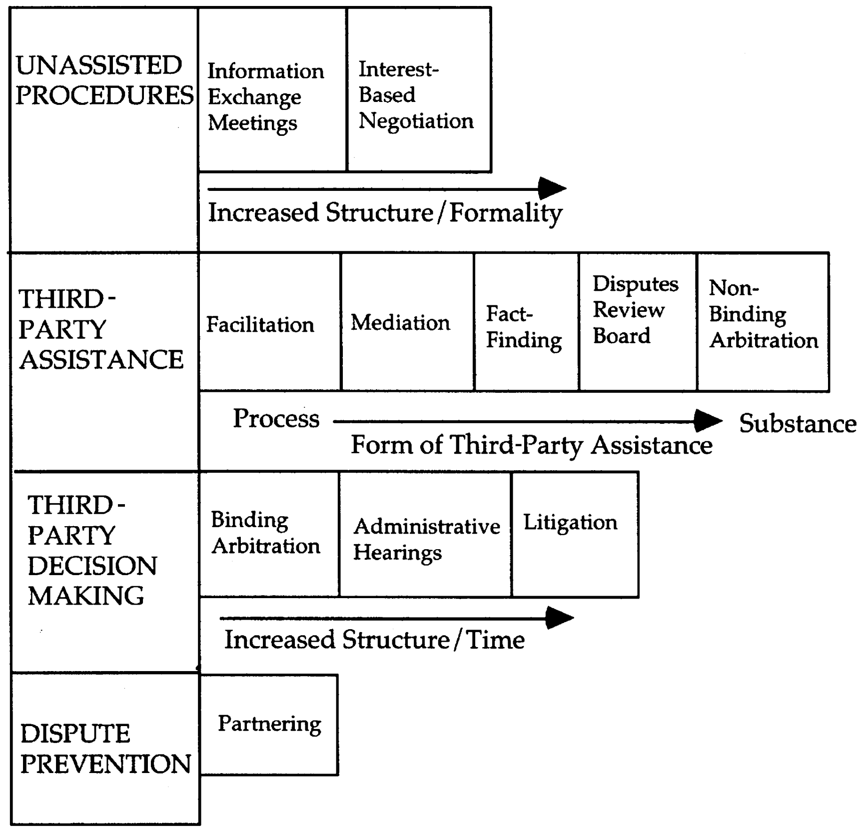

FIGURE 8-1 Dispute resolution techniques. SOURCE: Creighton and Priscoli (1996, p. 24).

An agency can gain several benefits from using public involvement strategies appropriately. These benefits include not only building legitimacy for decisions but also gaining new information and perspectives. The affected public may gain new information and perspectives as well, and the process can keep all constituencies better informed. However, if parties on either side are not acting in good faith, such methods may do more harm than good.

Both the EPA and the U.S. Army Corps of Engineers (USACE) have extensive alternative dispute resolution programs that have received widespread attention (Creighton and Priscoli, 1996). The EPA has published for review a draft plan for public involvement (EPA, 2000). The U.S. Army has successfully used a dialogue process designed by the Keystone Center to gain public acceptance of an alternative technology for the destruction of chemical weapons. The USACE and the Department of Defense are using partnering approaches extensively to

minimize disputes. The DOE, which has used site-specific advisory boards extensively, has recently retained a public involvement consulting firm (Creighton and Creighton) to design materials for its public involvement processes. The U.S. Bureau of Reclamation has conducted an extensive review of its public involvement programs and is revising them.

No single approach is best for all situations or for all agencies. Much depends on an agency's true goals. If the USNRC truly believes that it is *important and worthwhile* to involve stakeholders, then it should assess the willingness of stakeholder groups to begin a dialogue. This dialogue will have to address not only items contained in the 1999 issues paper but also issues that some stakeholder groups claim have been omitted. The assessment should address stakeholder views about desirable and feasible mechanisms for obtaining sustained stakeholder input into (1) how issues should be framed and (2) how decision processes can be made transparent and open. This assessment should be viewed as *just the first step* toward rebuilding the credibility of the agency and beginning to reestablish trust by stakeholders. In addition, it is critical that the dialogue clearly spells out *up front* what flexibility the USNRC has in responding to specific stakeholder concerns and where it feels it is statutorily precluded from taking action. This delineation of where action is feasible will allow stakeholders both to know they can have some influence and to determine if this amount of influence on the outcome is sufficient to justify their participation in the process. In order to increase the belief of stakeholder groups that their input matters, it is vital that the USNRC provide ongoing feedback as to how the agency is utilizing the input from the dialogue group. Feedback should include both the identification of when and how input affected decisions and the reasons input did not have an effect.

The USNRC, like many other federal agencies, has tended to rely on a small and closed circle of contractors for certain services. Although a tight circle of support contractors may simplify procurement of specialized technical services, it fosters negative perceptions, by those outside the circle, of the openness and fairness of the process. These perceptions often underlie and reinforce beliefs that USNRC contractors are not adequately trained, have not exercised credible efforts to meet safety and quality standards, and often represent too closely the interests and perspectives of the regulated industry.

As noted, other agencies have adopted innovative and far-reaching approaches to public involvement, alternative dispute resolution, and consensus building. The USNRC should reach out to the contractors that have been involved in these programs for the EPA, the Army (including the USACE[3] and the chemical weapons demilitarization programs), and other agencies.

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[3]The alternative dispute resolution handbook developed for the USACE (Creighton and Priscoli, 1996).

FINDINGS

Finding 8.1. The USNRC involved stakeholders in the processes for the BRC policy and the License Termination Rule for decommissioning, as well as in the initial stages of considering standards for release of SRSM. Despite these efforts, environmental and consumer advocacy groups remain concerned with radiation effects, and industrial groups continue to be concerned with the potential economic consequences of the clearance of SRSM.

Finding 8.2. Most of the issues of concern to those stakeholder groups that oppose the USNRC's recent efforts to establish a rule for the release of SRSM are the same issues expressed by these groups 10 years ago during the effort to establish the BRC policy. The committee's review of the record on the BRC policy, the License Termination Rule, and the 1999 issues paper found that stakeholders distrust the USNRC and remain confused about important technical questions. There are misperceptions about intentions on both sides, and the USNRC has not been effective in its risk communication.

Finding 8.3. Stakeholder groups differed in their viewpoints on regulating disposition of SRSM. Generally, professional societies associated with the nuclear industry supported clearance, industrial groups endorsed conditional clearance, and environmental groups opposed any type of clearance. However, much of the opposition to a clearance standard was associated with recycling metal SRSM into general commerce.

Finding 8.4. A legacy of distrust of the USNRC has developed among most of the environmental stakeholder groups. This distrust results from their experience with the BRC policy, the License Termination Rule, and the 1999 issues paper on the release of SRSM. Reestablishing trust will require concerted and sustained effort by the USNRC, premised on a belief that stakeholder involvement will be important and worthwhile, as well as a prerequisite for making progress.

9

A Framework and Process for Decision Making

PROBLEMS WITH THE CURRENT APPROACH

The current approach for releasing radioactive materials from facilities licensed by the U.S. Nuclear Regulatory Commission (USNRC) is based on Regulatory Guide 1.86 (AEC, 1974), USNRC guidance memoranda, and the case-by-case application of section 2002 of 10 CFR Part 20 by USNRC and its agreement states. Several problems with this approach were pointed out in presentations to the study committee (see details in Chapters 2 and 8). From an administrative perspective, the major concerns expressed were that this approach does not handle volume contamination generically and that the case-by-case approach may lead to inconsistent determinations from one case to another. Another point made was that this approach and the acceptable surface contamination levels in Table I of Regulatory Guide 1.86 are 27 years old; they have not kept up with international developments of release standards, many of which are risk based (see Chapter 7). Also, the regulatory guidance was not adopted through rulemaking and hence was not submitted for public comment or review. The case-by-case applications for release produce additional workload and costs for the USNRC, but this burden appears manageable for the foreseeable future.

From the licensees' perspective, the major concerns expressed to the committee were that this approach is unpredictable and costly, and creates undesirable operational impacts. Licensees also expressed concern about future liabilities if materials released under Regulatory Guide 1.86 are later suspected to have caused harm.

From the perspective of environmental groups and some members of the public, a major concern with the current case-by-case approach is that it allows unrestricted uses of slightly radioactive solid material (SRSM) once it clears the surface contamination limits. However, representatives of this perspective typically do not favor dose-based standards as a remedy; they prefer a no-release approach. In addition, environmental groups criticized the current approach as being largely administrative and precluding the possibility of public scrutiny or external review.

For the above reasons and more, various stakeholders, including licensees, and other interested parties have argued for modifying or replacing the current approach. Their proposals for an alternative approach differ widely, ranging from a strict no-release policy favored by some to a dose-based standard for unconditional release favored by others. Given these different and strongly held views, the development, evaluation, and implementation of a regulatory approach will likely create substantial controversy and debate. It will take significant time and effort to develop an acceptable solution.

The committee recognizes that there are problems with the current approach and that a new approach is needed for many of the reasons stated by the stakeholders. However, the committee has not found any evidence that the problems with the current approach cause significant health effects or amount to an immediate crisis. The committee therefore concludes that it is possible for the USNRC to conduct, with deliberate speed, a thorough analysis and evaluation of several alternative approaches to the disposition of SRSM including a broad-based stakeholder involvement process.

THE DECISION-MAKING PROCESS

The USNRC has two important choices when considering a decision on the disposition of SRSM. The first choice is what kind of decision process to use—for example, a regular rulemaking process or an enhanced participatory process. The second choice is which alternatives for the disposition of SRSM it should study and evaluate. This section discusses process options. The next section describes a systematic framework for developing, analyzing, and evaluating disposition alternatives within this process.

The USNRC has various process options for making the decision about the disposition of SRSM. One possibility is to follow a variation of the National Environmental Policy Act (NEPA) process. NEPA provides a widely accepted structure for the announcement of a proposal by an agency, for solicitation of public input as to the appropriate range of alternatives and impacts to analyze through a scoping process, and for subsequent review of environmental analyses with public input. In addition, the NEPA concept of tiering will allow the USNRC to obtain input on issues of broad scope first and later move to NEPA review of increasingly specific options.

The USNRC used a scoping NEPA process in parallel with its enhanced participatory rulemaking process during 1992-1997, while developing its License Termination Rule, 10 CFR Part 20, Subpart E. The USNRC might reconsider that experience, and the experience with the below regulatory concern (BRC) policy statement that preceded it, to evaluate a tiered NEPA approach overall. The BRC process did not use an enhanced open approach and had severe difficulties. The enhanced participatory process for the License Termination Rule was an open NEPA approach and appeared to have achieved consensus until the USNRC's process changed, following the issuance of the proposed rule.

As explained in Chapter 2, the BRC policy statement was required of USNRC in response to Section 10 of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLWPAA; 42 U.S.C. §2021j), which was specifically directed at defining a release standard for radioactive material that was at such a low level that it would be "below regulatory concern." The BRC policy statement addressed this statutory provision with an overarching dose-based or risk-based policy. The policy would have provided guidance for setting BRC standards for radioactive waste, residues at license termination, exemption of radioactivity in consumer products, and general release of materials for recycle or reuse.

If a tiered NEPA process had been followed, the USNRC might have begun by developing a draft policy statement, with full public input and participation. Then it would have proceeded with separate NEPA processes for each of the subsequent decisions. Instead of this tiered NEPA process, the USNRC developed and published the BRC policy statement in 1990 but turned to public consensus building only after receiving severe negative reactions to the policy. Public acceptance was not built step by step, nor was the policy developed in an iterative manner. The consensus process failed, and the BRC policy was first put on hold (56 Federal Register 36068; July 30, 1991) and then rescinded (58 Federal Register 44610; August 24, 1993). Since that failure to establish a broad policy, the lack of a top tier—an overarching policy—appears to have significantly hindered progress with the subsequent License Termination Rule and the development of standards for release of SRSM.

The USNRC decision processes can be improved by including a broad range of affected groups and individuals. Administrative appeals processes and administrative guidelines may have to be altered to ensure greater access to the USNRC's decision-making process by a broader range of affected individuals, industries, and interested parties. The goal should be to develop a process that solicits input broadly, while remaining flexible, open, transparent, and fair.

In addition, compared to some of the more recent national health and safety legislation (such as the Resource Conservation and Recovery Act [RCRA]; the Comprehensive Environmental Response Compensation and Liability Act [CERCLA]; the Clean Air Act, and the Clean Water Act) the USNRC's fundamental legislation, the Atomic Energy Act (AEA) provides a somewhat less extensive legal basis for citizens' suit challenges or public review. However, the

legal basis is fully adequate if used properly. Whatever the AEA's shortcomings might be in this regard, the USNRC can and must employ the appropriate mechanisms to reach out to develop stakeholder participation, acceptance, and (eventually) support.

It is vital that any decision process for developing policies on clearance of SRSM begins from a broad set of alternatives. Among the alternatives could be options beyond just clearance of materials from licensed sites. In particular, the committee believes that it would be useful to consider alternatives beyond a clearance standard by looking at issues concerning the broader range of low-activity radioactive materials. For example, a broad-based scoping process could also include consideration of whether the USNRC should regulate naturally occurring and accelerator-produced radioactive material (NARM) and naturally occurring radioactive material (NORM) by some national standards rather than continuing with state-only regulation of these categories of radioactive materials.

The USNRC might consider supplementing its decision process with enhanced and expanded use of public advisory committees. Many federal agencies include members of the broader public—not just highly technical experts—on their advisory committees. The result of using NEPA, a broad scoping process, more iterative development of proposals, and broader participation on advisory committees would be greater and broader public participation in the USNRC decision-making process.

As the regulatory body, the Commission holds the statutory decision-making authority. Some concerned groups perceive the Commission and USNRC staff as nonresponsive to public input. In addition, many observers perceive the Commission and staff as not operating cohesively. Unless confidence and trust in the USNRC increase, acceptance by the public and Congress of a clearance or conditional clearance standard is unlikely.

Any process to develop a release standard might be enhanced by using professional facilitators. During the BRC process, the Commission called on one of the USNRC staff to lead the attempt at building consensus for BRC. The staff then recruited a professional facilitator, who worked on BRC and other matters. For the enhanced participatory rulemaking effort, the USNRC engaged the services of the Keystone Center, a group of professional facilitators. In the long run, the USNRC might benefit from further pursuit of facilitated participation processes to increase the likelihood of productive public involvement.

A SYSTEMATIC DECISION FRAMEWORK

Several alternatives exist for the disposition of SRSM: the current case-by-case approach, a no-release (from regulatory control) alternative, clearance, and conditional clearance. In addition, there are many combinations, types, and levels of possible standards and several possible clearance conditions worth consider-

ing. Impacts to be considered include public health, costs and benefits, consistency with existing national and international analysis and regulations, and public perceptions and acceptance. This section first defines a logical set of alternatives for disposition of SRSM, ending with the finding that for practical purposes, only a few alternatives merit further consideration. It then develops a list of impacts that should be examined when evaluating these alternatives.

Alternatives

In its statement of work (see Appendix C), the study committee was asked to consider the following alternatives for the disposition of SRSM from USNRC-licensed facilities:

1. Continue the current system of case-by-case decision;
2. Establish a national standard by rulemaking or other approaches; and
3. Consider other alternative approaches.

After gathering information and deliberating on the range of possible approaches, the committee decided to address two "other" approaches in some detail:

1. A no-release policy, and
2. Establishment of a national standard with conditions on the uses of released materials.

At the general level, there are thus four policy alternatives to address:

1. Case-by-case approach (the USNRC or an agreement state approves specific license conditions in accordance with Regulatory Guide 1.86 or modifications);
2. Clearance standard (unrestricted release of materials that meet the standard);
3. Conditional clearance standard (restricted release of materials that meet the standard); and
4. No releases of licensed material.

There are many possible variants for some of these alternatives. Box 9-1 illustrates some of these variants.

Not all of the alternatives in Box 9-1 merit detailed consideration here. For example, the committee found little support for minor modifications of the current approach. One such modification would be to develop additional criteria for volume contamination, based on a dose assessment, and apply these criteria on a case-by-case basis. As a second example, stakeholders who prefer a national

BOX 9-1
Policy Alternatives for Releasing Slightly Radioactive Solid Materials

Case-by-Case Approach

- Current approach: USNRC or agreement state approves specific license conditions
- Additional criteria for volume contamination
- Restrictions on reuse (see examples below, under conditional clearance)

Clearance Standard

- Dose based (based on risk to an individual or population caused by exposure to radiation)
- Source based (based on surface or volume radioactivity concentration of the contaminated solid material)

Conditional Clearance Standard

- Dose based (based on risk to an individual or population caused by exposure to radiation)
  —Beneficial reuse in controlled environments (e.g., metal for shield blocks in USNRC licensed or Department of Energy [DOE] facilities)
  —Limited reuse for low-exposure scenarios (e.g., concrete rubble base for roads)
  —Landfill disposal
- Source based (based on surface or volume radioactivity concentration of the contaminated solid material)
  —Beneficial reuse in controlled environments (e.g., metal for shield blocks in USNRC licensed or DOE facilities)
  —Limited reuse for low-exposure scenarios (e.g., concrete rubble base for roads)
  —Landfill disposal

No Release

- All slightly radioactive solid materials are disposed of at licensed LLRW sites.

standard (for unconditional or conditional clearance) typically argue for a dose-based standard rather than a source-based standard. Therefore, source-based variants for clearance standards are not addressed further herein.

Based on these and similar observations from its information gathering efforts, the committee focused on the following six policy alternatives and variants:

1. Case-by-case approach (pursuant to Section 2002 of 10 CFR Part 20 or possible modifications);
2. Dose-based clearance standard (unrestricted reuse, including commercial recycling);
3. Dose-based conditional clearance standard (beneficial reuse in controlled environments, e.g., shield blocks at Department of Energy [DOE] facilities);
4. Dose-based conditional clearance standard (commercial reuse for low-exposure scenarios, e.g., concrete rubble base for roads);
5. Dose-based conditional clearance standard (landfill disposal); and
6. No release (all SRSM is disposed of at licensed low-level radioactive waste [LLRW] sites).

The current case-by-case approach can be improved by developing additional criteria for volume contamination, possibly based on a dose assessment, using coefficients similar to those currently under development for the draft NUREG-1640.

Several possible dose limits for use in a dose-based standard have been discussed, including annual doses of 1 μSv (0.1 mrem), 10 μSv (1 mrem), or 100 μSv (10 mrem). Placing conditions on clearance has the effect of limiting the potential exposure scenarios. For example, suppose SRSM is cleared under a dose-based standard of 10 μSv/yr (1 mrem/yr) for landfill disposal only. If the same secondary activity standard were kept, the maximum individual dose would be lowered for most radionuclides, because the highest doses without the landfill restrictions apply to transport and factory workers, who would no longer be exposed on the job.[1] On the other hand, if the secondary activity standard is adjusted upward under a landfill restriction to allow the primary dose standard to be reached in the new critical group, then it would be possible to release SRSM with higher concentration under a conditional clearance standard than it would under an (unconditional) clearance standard.

The following discussion provides a few examples of the range and type of policy alternatives that the committee recommends to the USNRC. It may even be reasonable to consider alternative dose standards for different conditional clearance conditions. For example, if the restriction is beneficial reuse in controlled environments, a dose standard of 100 μSv/yr (10 mrem/yr) may be reasonable since exposure limits for nuclear workers are typically much higher (50,000 μSv/yr or 5,000 mrem/yr).

[1]The committee notes that modeling of exposed groups in draft NUREG-1640 (USNRC, 1998b) specifically rules out residential use of postclosure property. Had such a restriction not been made, landfills would become the critical group for some radionuclides and hence would already represent the maximum dose for these radionuclides.

Impacts of Alternative Regulatory Approaches

Many participants in the study committee's information-gathering meetings expressed concerns, issues, preferred outcomes, and objections in response to some of the alternatives discussed above. As discussed in Chapter 8, the USNRC has not gained widespread public trust in its recent rulemakings. For example, environmental groups objected to any standard that allowed the release of SRSM into commerce. They argued that this would create an unnecessary health risk with unknown cumulative effects. Some licensee representatives expressed concerns about liability risks and economic costs of regulation. Representatives from the steel and concrete industries worried about the possible stigmatization of their products if it became known that some of their materials might include radioactive contamination, no matter how slight.

The committee drew on these comments, together with the numerous statements of issues and concerns submitted in response to USNRC's June 1999 *Federal Register* notice (64 Federal Register 35090-35100; June 30, 1999) entitled "Release of Solid Materials at Licensed Facilities: Issues Paper, Scoping Process for Environmental Issues and Notice of Public Meetings" and public hearings in the fall of 1999 (see Appendix F), to create a generic list of impacts for consideration when evaluating alternatives for disposing of SRSM. This list is shown in Box 9-2 and discussed below.

Health Impacts

The primary objective of any alternative for the disposition of SRSM is to ensure that there are minimal health impacts for any individual and the public at large. Much of the work on dose-based standards (e.g., draft NUREG-1640) has focused on specific scenarios for individuals with the potentially highest doses from released materials. However, the committee also heard concerns about the potential for multiple exposures and collective doses, especially cumulative doses from multiple commercial products containing SRSM. To address these concerns, risk assessments must consider not only maximally exposed individuals and direct health impacts from a single source, but also the potentially exposed population and cumulative impacts from multiple sources.

There may also be indirect and unintended impacts from implementing alternative approaches. For example, under the current approach, radioactive materials must be shipped over long distances, usually by truck. One waste broker (Duratek, Inc.) estimated that its trucks drive about 6 million miles per year. With increased decommissioning activities, these shipment miles will increase substantially, thus increasing the probability of accidents, however low the probability per mile might be.

The conditional clearance option, by allowing disposal of SRSM in Subtitle C or D landfills, would reduce both the transportation miles and the associated

BOX 9-2
Possible Impacts of Alternatives for Slightly Radioactive Solid Materials from USNRC-Licensed Facilities

Health Impacts

- Dose to maximum exposed individuals
- Collective dose
- Cumulative impacts from multiple exposures
- Indirect and unintended health impacts

Environmental Impacts

- Transportation
- Disposal

Direct Costs

- Licensee waste management cost
- USNRC regulatory cost
- Other agencies' regulatory cost

Indirect Costs

- Licensee potential liabilities
- Product stigmatization (steel and concrete)

Direct Benefits

- Licensee benefits from resale of materials
- Reduction of operational expenses

Consistency with Existing Regulations

- International
- National (U.S. Environmental Protection Agency, other USNRC regulations)
- State and local

Implementation and Enforcement

- Ability to track the chain of custody of released materials
- Ability to detect violations
- Ability to enforce sanctions for violations
- Ability to detect, measure and monitor low levels of radioactivity

Public Perception

- Public trust and acceptability
- Public fears and concerns

transportation risks. The greater number of such landfills in the United States, relative to the three LLRW disposal facilities, means a much greater likelihood of a landfill being in close proximity to the power reactor that is undergoing decommissioning.

Environmental Impacts

Alternative approaches to the disposition of SRSM will have different environmental impacts. For example, if conditional clearance is chosen, the use of landfill disposal at sites near nuclear power plants will reduce transportation and associated vehicle emissions. These impacts may be small relative to the potential radiation-related impacts on health and the economic impacts, but they must be examined to ensure that any regulation does not produce worse environmental impacts as an unintended consequence.

Direct Costs

The main direct cost impact of alternative approaches is likely to be the licensees' disposal costs for SRSM. A no-release policy means, in practice, that all low-level radioactive materials would have to be sent to a site licensed to accept LLRW for disposal. If conditional clearance is chosen, the cost of disposal of metals at a landfill site, even a Subtitle C hazardous waste landfill, is substantially lower than the cost at LLRW sites. The committee's preliminary calculations (Chapter 4) indicate that disposal of decommissioning wastes under a strict no-release policy would cost *billions* of dollars, whereas Subtitle D landfill disposal would cost a few hundred *million* dollars.

The committee reviewed available cost data but found only limited information. The current cost estimates of disposal vary widely, both among LLRW sites and between LLRW sites and landfill disposal options. Because cost will be a major factor in selecting an approach for disposing of SRSM, it is very important that the USNRC conduct a thorough cost analysis that accounts for the differences among disposal options and the uncertainties in cost estimates caused by regulations and by supply and demand.

Other waste management costs will include transportation and operational (e.g., material preparation and sample analysis) costs. These are likely to be much lower than disposal costs. Regulatory costs also have to be considered. These include the cost of staff at the USNRC and in agreement states to manage whichever regulatory approach is taken.

Indirect Costs

Indirect costs of alternative approaches include the potential liabilities of licensees and other waste handlers. Although the study committee has not heard

of any cases where such liabilities were invoked, some industry representatives clearly expressed concerns about this possibility. However an approach is fashioned, it must consider the liability of generators in a variety of circumstances, including continuing liability, erroneous free release, and unapproved reuse.

As noted above, representatives from the steel and concrete industries have expressed particular concern about the impact of releasing slightly radioactive steel and concrete into commerce. They believe that the presence of released material in their feed streams could stigmatize their products, reducing sales and revenue. Representatives of these industries made it quite clear that their policy is to reject any materials identified as radioactive by detection equipment at their gates when the material arrives at their facilities. They emphasized that their companies will continue to exercise vigilance in this area.

Direct Benefits

Alternatives allowing clearance would create opportunities for commercial benefits—for example, through the sale of SRSM. One example is the sale being contemplated by the DOE of $30 million worth of slightly radioactive nickel on the commercial market. The committee did not hear much evidence for potential direct benefits (other than the nickel example), but it would be useful to determine the net value associated with releasing these materials into commerce. These net value calculations should consider both the market value of the materials and the cost of processing and shipping them. Another direct benefit is the reduction of licensees' operational expenses. For example, licensees expressed concern about the paperwork and cost of releasing equipment to be moved from one controlled site to another, but they did not comment on additional potential labor costs associated with further categorization of waste materials.

Consistency with Existing Regulations

Consistency with international, national, state, and local regulations is desirable, even though it should not be the main reason for selecting an alternative. In Chapter 7, the committee discusses the efforts under way in the European Union (EU) to establish consistent standards for free release of SRSM. There may be economic advantage to the United States in establishing a clearance standard for SRSM, particularly if it were consistent with international standards. Consistency would make import-export and control of materials easier and, if monitored properly, of no consequence to public health. An international agreement on such trade not only must include the levels of residual radioactivity allowable for clearance for shipment, but also must specify standard methodologies of measurement at both the point of export and the point of import. Standard measurement methods are particularly important for ensuring detection, and preventing the shipment, of materials in which orphan sources are present.

The committee believes that the USNRC may wish to evaluate the various technical considerations employed by the EU and other countries in reaching clearance standards. However, as stated elsewhere in this report, the committee believes that many other factors should be considered in any U.S. approach.

Consistency with other federal regulations is also important. For example, the rulemaking process employed by the Environmental Protection Agency (EPA) results in lengthy explanation of all comments in the preamble to the *Federal Register* announcement of the rule. Under RCRA, the EPA establishes acceptable risk levels and then develops compound-by-compound standards through detailed calculations for each chemical and environmental medium. The EPA approach results in a detailed explanation of regulatory decisions, aspires to consistent application of risk, and elicits extensive public participation. It also includes extensive responses and analyses of public comments in *Federal Register* announcements as well as in administrative records.

Similarly, if the USNRC were to choose a dose-based approach to setting a national standard, consistency with the regulation of other radioactive materials would be important. For example, the committee is concerned about inconsistencies with the current regulatory approaches to NORM, technologically enhanced naturally occurring radioactive material (TENORM), and NARM wastes. The issue of consistency within USNRC guidelines and regulations should be addressed as well.

Implementation and Enforcement

To be effective, any approach to clearance of SRSM must be implementable and enforceable. Of special relevance in this case is the ability to detect, measure, and monitor very small amounts of radiation with few false alarms. Another concern is the ability to track the chain of custody of conditionally cleared materials, especially if the uses of these materials are restricted by conditions on their release. Hence, to establish confidence in any approach to clearance of SRSM, there must be adequate procedural guidance, oversight, and reporting requirements.

Enforceability is crucial for ensuring broad-based compliance with a standard. Both enforceability and a standardized, accessible measurement methodology are crucial for uniform implementation. Enforceability requires penalties (such as fines) for failure to meet the standard or failure to implement the standard properly. Enforcement by regulatory agencies is an integral part of gaining public trust as well.

Public Perception

The USNRC faces perhaps no greater challenge than winning widespread public acceptance of any regulation for release of SRSM. As discussed in the next

section of this chapter, there are many challenges, opportunities, and options for the USNRC in seeking public acceptance. Acceptance does not equate directly with consensus or unanimous agreement. Rather, the likelihood of acceptance is increased first by adhering faithfully to an announced process that engages all responsible stakeholder representatives and viewpoints. Second, this process must be perceived by participants as fair and open. Third, the process should bring out all advantages and disadvantages of the alternative approaches in an even-handed way. Fourth, participation throughout the process by informed and knowledgeable persons, as well as openness to a broad and creative range of alternatives, will increase public acceptance.

The USNRC could use many mechanisms to attain public acceptance. The committee believes that the degree of trust (or mistrust) of the USNRC has been and will remain a major factor in the public's response to issues involving SRSM. The USNRC should consider substantial changes that would open its decision-making process (for details, see "Stakeholder Involvement" in Chapter 2 and all of Chapter 8).

Decision Impact Matrix

Figure 9-1 shows, in the form of a two-dimensional matrix, the committee's view of how alternative approaches and their possible impacts should be analyzed and evaluated. A thorough and systematic analysis and evaluation of these approaches would address each cell of this matrix. Additional columns and rows might emerge from a thorough stakeholder involvement process.

Most of the work to date on evaluating alternatives has focused on health impacts. Although this is an important issue when setting a standard, other impacts may be significant as well. The committee has done some preliminary work on some of these other impacts. For example, the relative costs for a conditional clearance standard and a no-release alternative are discussed in Chapter 4. However, there clearly is much more work to be done to provide a satisfactory assessment for all of the alternatives and impacts represented in Figure 9-1.

FINDINGS

Finding 9.1. The committee found no evidence that the problems with the current approach to clearance decisions require its immediate replacement. The committee concludes that there is sufficient time to conduct a thorough and systematic analysis and evaluation, including a sound process of stakeholder participation and involvement, of alternative approaches to the disposal of SRSM.

Finding 9.2. Although there are many possible alternatives for the disposal of SRSM from USNRC-licensed facilities, the committee heard substantial support

	Case-by-Case Approach	Clearance Standard	Conditional Clearance Standard			No Releases
	RG 1.86 or modification	No restrictions on reuse	Beneficial reuse in controlled environments	Reuse for low-exposure scenarios	Landfill disposal	LLRW disposal
Health Impacts						
Environmental Impacts						
Direct Costs						
Indirect Costs						
Direct Benefits						
Consistency with Existing Regulations						
Implementation and Enforcement						
Public Perception						

FIGURE 9-1 Decision impact matrix. This matrix represents impacts to be assessed in evaluating alternatives for the disposition of SRSM from USNRC-licensed facilities. The alternatives shown as the column headings are preliminary selections by the study committee for this report; a different set might emerge from a thorough approach to public involvement at all levels of the decision process. NOTE: RG = Regulatory Guide.

from stakeholders for only a few. In general terms, the supported alternatives are a dose-based clearance standard, a dose-based conditional clearance standard, and a no-release policy. Different stakeholders expressed preferences for different conditions for a dose-based conditional clearance standard: beneficial reuse in controlled environments, commercial reuse in low-exposure scenarios, or landfill disposal. Source-based standards and minor modifications of the existing case-by-case approach received limited support.

Finding 9.3. There are many possible impacts of the approaches that the USNRC might select for the clearance of SRSM. Potentially important impacts include the degree of public protection against exposure from radioactive materials, environmental impacts, direct costs (e.g., for disposal), indirect costs (e.g., through product stigmatization), consistency with existing regulations, implementation and enforcement, and public perception. To date, the USNRC has focused its analyses of alternative approaches fairly narrowly on protecting the public from exposure to SRSM. The USNRC has done very little analysis of the other important impacts on this list.

10

Findings and Recommendations

The U.S. Nuclear Regulatory Commission's (USNRC's) regulations on protection against radiation, 10 CFR Part 20, do not contain predetermined concentrations, amounts, or quantities of radionuclides in solid materials below which these materials can be released from further regulatory control. Solid materials potentially available for release from regulatory control include metals, building concrete, on-site soils, equipment, and furniture used in routine operation of licensed nuclear facilities. Most of this material will have no radioactive contamination, but some of it may have surface or volume contamination. Licensees continue to request permission from the USNRC and agreement states to release such solid materials when the materials are no longer useful, pursuant to Section 2002 of 10 CFR Part 20 or compatible state regulations, or when the licensed facility is decommissioned. The USNRC does use a guidance document issued by the Atomic Energy Commission in 1974, Regulatory Guide 1.86, which contains limits applicable to surface contamination and allows clearance of solid materials, usually by incorporation into license technical specifications.

The USNRC allows licensees to release solid material according to preestablished criteria. For reactors, if surveys for surface residual radioactivity performed by the licensee on equipment or materials indicate the presence of radioactivity above natural background levels then release is not permissible.[1] If no such surface activity is detected, then the solid material in question need not be treated as waste under 10 CFR Part 20. This approach sometimes leads to prob-

[1]Reactor licensees can apply to USNRC for approval for clearance of solid materials with small but detectable levels of radioactivity pursuant to Section 2002 of 10 CFR Part 20 on a case-by-case basis.

lems when detectors of greater sensitivity than were used in the initial survey detect radioactivity above the threshold in previously released material (USNRC, 2001b). For surface-contaminated solid materials possessed by a materials licensee, the USNRC usually authorizes the release through specific license conditions (USNRC, 2001b). In the case of volume-contaminated materials held by reactor and materials licensees, the USNRC has not provided guidance similar to that found in Regulatory Guide 1.86 for surface contamination. These situations are instead decided on an individual basis by evaluating the doses likely to be associated with the proposed disposition of the material.

The USNRC has attempted to update and formalize its policies on disposition of slightly radioactive solid material (SRSM). In 1990, the USNRC issued a policy as directed by the Low Level Radioactive Waste Policy Amendments Act of 1985 (LLWPAA) that declared materials with low concentrations of radioactivity contamination to be "below regulatory concern" (BRC) and hence deregulated (55 Federal Register 27522; July 3, 1990). However, Congress intervened to set aside the BRC policy in the Energy Policy Act of 1992 after the USNRC's own suspension of the policy (56 Federal Register 36068; July 30, 1991). In 1999, the USNRC again examined the issue of disposition of SRSM and published a *Federal Register* notice examining several policy options (64 Federal Register 35090-35100; June 30, 1999). In neither case was the USNRC able to convince consumer and environmental groups that clearance of SRSM could be done safely or to convince some industry groups that clearance is desirable.

In August 2000, the USNRC asked the National Research Council to form a committee to provide advice in a written report. The committee addresses its tasks in Chapters 2 through 9 of the report, each of which contains a set of findings, a subset of which is presented. The reader is encouraged to review all of the findings as well as the supporting documentation in each chapter. The major findings and recommendations follow.

MAJOR FINDINGS

Regulatory Framework (Chapter 2)

Finding 2.1. The USNRC does not have a clear, overarching policy statement for management and disposition of SRSM. However, SRSM has been released from licensed facilities into general commerce or landfill disposal for many years pursuant to existing guidelines (e.g., Regulatory Guide 1.86) and/or following case-by-case reviews. The USNRC advised the committee of no database for these releases.

Finding 2.2. A dose-based clearance standard can be linked to the estimated risk to an individual in a critical group from the release of SRSM. The general regulatory trend is toward standards that are explicitly grounded in estimating risks.

Finding 2.3. For clearance of surface-contaminated solid materials, the clearance practices regulated by the USNRC and agreement states are based on the guidance document Regulatory Guide 1.86, which is technology based and has been used satisfactorily in the absence of a complete standard since 1974.

Finding 2.4. For clearance of volume-contaminated solid materials, the USNRC has no specific standards in guidance or regulations. Volume-contaminated SRSM is evaluated for clearance on a case-by-case basis. This case-by-case approach is flexible, but it is limited by outdated, incomplete guidance, which may lead to determinations that are inconsistent.

Finding 2.5. Industrial activities are generating very large quantities of technologically enhanced naturally occurring materials (TENORM). Federal regulation of TENORM has been largely absent. State regulations vary in breadth and depth.

Anticipated Inventories of Radioactive or Contaminated Materials (Chapter 3)

Finding 3.1. Licensees may seek to clear about 740,000 metric tons of metallic SRSM that arise from decommissioning the current population of U.S. power reactors during the period 2006 to 2030 (about 30,000 to 42,000 metric tons per year). About 8,500 metric tons per year are expected to arise from decommissioning USNRC-licensed facilities other than power reactors during the same time period. The total quantity of metal from both power reactor and non-power reactor licensees, up to approximately 50,000 metric tons per year, represents about 0.1 percent of the total obsolete steel scrap that might be recycled during that same 25-year period.

Finding 3.2. If most of the licensees of currently operating reactors obtain 20-year license extensions, relatively little SRSM will arise from power plant decommissioning during the 2006-2030 period.

Finding 3.3. Because of the difficulty of determining the quantities and levels of contamination that have penetrated into the concrete, concrete SRSM is generally considered to be volume contaminated. Concrete SRSM constitutes more than 90 percent of the total SRSM arising from decommissioning the population of U.S. power reactors.

Pathways and Estimated Costs for Disposition of Slightly Radioactive Solid Materials (Chapter 4)

Finding 4.1. Disposal of all slightly radioactive solid materials arising from decommissioning the population of U.S. power reactors into low-level radioac-

tive waste disposal sites would be expensive (about $4.5 billion to $11.7 billion) at current disposal charge rates. Disposal in Subtitle D or Subtitle C landfills would be cheaper ($0.3 billion to $1 billion, respectively). Clearance of all of this material could reduce disposal costs to nearly zero (assumes 100 percent reuse or recycle) or might even result in some income (~$20 million) arising from the sale of scrap materials for recycle or reuse. Decontamination, segmentation, and transport costs are not included in the costs estimated in this report for disposition.

Review of Methodology for Dose Analysis (Chapter 5)

Finding 5.1. Analytical work in the United States and abroad over the past two decades is useful in understanding the likely doses associated with exposure scenarios that might occur under various clearance standards. Much of the technical analysis in this field has the objective of understanding "dose factors," which to date have been analyzed in depth only for (unconditional) clearance scenarios. A dose factor is used to convert a concentration of radioactivity that is about to be released, whether it be confined to a surface or contained within a volume, to a primary dose level (measured in microsieverts per year or millirems per year). With such a dose factor in hand, a primary dose standard can be converted to obtain a secondary clearance standard in terms of radionuclide activity, which could then be used at USNRC-licensed facilities. A dose factor can be used with any choice of primary dose standard.

Finding 5.2. Selecting a primary dose standard is a policy choice, albeit one informed by scientific estimates of the health risk associated with various doses. For instance, as shown in Table 1-2, a lifetime dose rate of 10 μSv/yr (1 mrem/yr) equates to an estimated increased lifetime cancer risk of 5×10^{-5}, which falls within the range of acceptable lifetime risks of 5×10^{-4} to 10^{-6} used in developing health-based radiation standards other than radon in the United States (NRC, 1995, p. 50). When setting primary dose standards, regulators can make a policy decision to include a level of conservatism such that the final standard is in excess of the best-estimate dose factor and in this way account for uncertainty (e.g., selecting the 90th, 95th, or other percentile in the distribution for the dose factor, instead of the best-estimate value).

Finding 5.3. The uncertainty in dose factor estimates is a key technical issue. When an uncertainty has been estimated, a quantitative determination can be made of the likelihood that the dose to an individual in the critical group will be below the primary dose standard. Quantitative uncertainty estimates can also assist regulators in assigning a level of conservatism to dose factors in excess of the best estimate. Dose factors developed by analysts from different countries show wide variation, which highlights the need for careful consideration of uncertainties.

Finding 5.4. The committee concludes from its review that of the various reports, draft NUREG-1640 (USNRC, 1998b) provides a *conceptual framework* that best represents the current state of the art in risk assessment, particularly with regard to its incorporation of formal uncertainty, as judged using recommendations of this committee and other committees of the National Research Council. Once the limitations in draft NUREG-1640 have been resolved (see Findings 5.5 and 5.6 [see Chapter 5]) and the results are used in conjunction with appropriate dose-risk estimates—in the final version of the report or in follow-up reports—the USNRC will have a sound basis for considering the risks associated with any proposed clearance standards and for assessing the uncertainty attached to these dose estimates.

Finding 5.7. The dose factors developed in draft NUREG-1640 should not be used to derive clearance standards for categories of SRSM other than those considered in the draft NUREG-1640, without first assessing the appropriateness of the underlying scenarios. Some of the dose factors developed in draft NUREG-1640 are likely to require modification when applied to other mixtures of radionuclides (e.g., mixtures in which transuranics dominate) and other clearance scenarios, such as may be relevant to DOE material and technologically enhanced naturally occurring radioactive material (TENORM).

Measurement Issues (Chapter 6)

Finding 6.3. For a 1 mrem/yr or higher standard (and the corresponding derived secondary screening levels), the majority of radionuclides can be detected at reasonable costs in a laboratory setting, under most practical conditions. For a 0.1 mrem/yr standard, the measurement capability falls below the upper bound of minimum detectable concentrations for some radionuclides in some laboratories, although 85 percent of radionuclides are still detectable. Using field measurements, a more rapid fall-off of detectability is observed at more stringent radiation protection levels, with 31 of 40 key radionuclides detectable at 1 mrem/yr and 11 of 40 detectable at 0.1 mrem/yr.

International Approaches to Clearance (Chapter 7)

Finding 7.1. The EU and the IAEA have each established a dose-based standard of 10 μSv/yr (1 mrem/yr) for the clearance of materials from regulatory control. A collective dose standard is also included, expressed as a committed dose equivalent of 1 man-Sv per year of exposure of the affected group (100 man-rem total effective dose equivalent per year).[2]

[2]Provisions exist in the EU safety directives for competent authorities in member states to develop alternative clearance guidance for special or specific circumstances.

Finding 7.3. A body of science, policy, and literature supports the development of the EU safety directives related to radioactive solid material clearance. In particular, the IAEA has developed policy guidance found in *Principles for the Exemption of Radiation Sources and Practices from Regulatory Control* (IAEA, 1988).

Stakeholder Reactions and Involvement (Chapter 8)

Finding 8.1. The USNRC involved stakeholders in the processes for the BRC policy and the License Termination Rule for decommissioning, as well as in the initial stages of considering standards for release of SRSM. Despite these efforts, environmental and consumer advocacy groups remain concerned with radiation effects, and industrial groups continue to be concerned with the potential economic consequences of the clearance of SRSM.

Finding 8.3. Stakeholder groups differed in their viewpoints on regulating disposition of SRSM. Generally, professional societies associated with the nuclear industry supported clearance, industrial groups endorsed conditional clearance, and environmental groups opposed any type of clearance. However, much of the opposition to a clearance standard was associated with recycling metal SRSM into general commerce.

Finding 8.4. A legacy of distrust of the USNRC has developed among most of the environmental stakeholder groups. This distrust results from their experience with the BRC policy, the License Termination Rule, and the 1999 issues paper on the release of SRSM. Reestablishing trust will require concerted and sustained effort by the USNRC, premised on a belief that stakeholder involvement will be important and worthwhile, as well as a prerequisite for making progress.

Framework and Process for Decision Making (Chapter 9)

Finding 9.1. The committee found no evidence that the problems with the current approach to clearance decisions require its immediate replacement. The committee concludes that there is sufficient time to conduct a thorough and systematic analysis and evaluation, including a sound process of stakeholder participation and involvement, of alternative approaches to the disposal of SRSM.

RECOMMENDATIONS

In developing its recommendations the committee was guided by two overarching, compelling findings:

1. The current approach to clearance decisions is workable and is sufficiently protective of public health that it does not need immediate re-

vamping. However, the current approach, among other shortcomings, is inconsistently applied, is not explicitly risk based, and has no specific standards in guidance or regulations for clearance of volume-contaminated slightly radioactive solid material. Therefore, the committee believes that the USNRC should move ahead without delay and start a process of evaluating alternatives to the current system and its shortcomings.

2. Broad stakeholder involvement and participation in the USNRC's decision-making process on the range of alternative approaches is critical as the USNRC moves forward. The likelihood of acceptance of a USNRC decision greatly increases when the process (1) engages all responsible stakeholder representatives and viewpoints, (2) is perceived by participants as fair and open, (3) addresses all the advantages and disadvantages of the alternative approaches in an even-handed way, and (4) is open to a broad and creative range of alternatives. Thus, it is essential that the USNRC focus on the process and not prescribe an outcome. The outcome, an approach to disposition of slightly radioactive solid material, must evolve from the process.

While the committee did not want to prescribe the outcome of the decision process, it has made several specific recommendations, conditional on the process arriving at certain decision points. For example, if the USNRC contemplates clearance or conditional clearance standards, the committee recommends that these standards be dose based. The committee also recognized that significant national and international efforts have been completed, or are near completion, that provide a solid foundation for the USNRC to move forward. The committee has recommended the foundation from which to begin the process. Thus, the USNRC should be able to proceed expeditiously with a broad-based stakeholder participatory decision making process.

Recommendation 1. The USNRC should devise a new decision framework that would develop, analyze, and evaluate a broader range of alternative approaches to the disposition of slightly radioactive solid material. At a minimum, these alternatives should include the current case-by-case approach, clearance, conditional clearance, and no release.

Recommendation 2. The USNRC's decision-making process on the range of alternative approaches to the disposition of slightly radioactive solid material should be integrated with a broad-based stakeholder participatory decision-making process. Elements of this process should include the following:

- The willingness and commitment of the USNRC to establish and main-

tain a meaningful and open dialogue with a wide range of stakeholders regarding the disposition of slightly radioactive solid material;

- An ad hoc broad-based advisory board that would advise the USNRC in its consideration of approaches to the disposition of slightly radioactive solid material. The advisory board would also suggest additional stakeholder involvement mechanisms that the USNRC could use in the decision process (for example, establishing a National Environmental Policy Act process; alternative dispute resolution; and partnering, arbitration, mediation, or a combination of such methods); and
- Assistance obtained by the USNRC as needed from outside experts in order to (1) assist its efforts to establish the ad hoc stakeholder advisory board and to facilitate dialogue among the USNRC and stakeholder participants in the decision-making process and (2) assess, evaluate, and perhaps conduct portions of the USNRC stakeholder involvement program and make recommendations as appropriate.

Recommendation 3. The USNRC should adopt an overarching policy statement describing the principles governing the management and disposition of slightly radioactive solid material. A review and discussion of the IAEA policy statement *Principles for the Exemption of Radiation Sources and Practices from Regulatory Control* (Safety Series No. 89, IAEA Safety Guidelines, Vienna, 1988) with a broad-based stakeholder group would provide a good starting point in developing a policy statement that would provide a foundation for evaluation of alternative approaches to disposition of slightly radioactive solid material.

Recommendation 4. When considering either clearance or conditional clearance, a dose-based standard should be employed as the primary standard. To employ a dose-based standard, it is necessary to consider a wide range of scenarios that encompass the people likely to be exposed to slightly radioactive solid material. From these people, a critical group is selected and secondary standards (based on dose factors) are derived. These secondary standards are used to limit the radioactivity in materials being considered for release or conditional release.

The USNRC should also consider the pros and cons of the establishment of a separate collective dose standard.

Recommendation 5. An individual dose standard of 10 μSv/yr (1 mrem/yr) provides a reasonable starting point for the process of considering options for a dose-based standard for clearance or conditional clearance of slightly radioactive solid material. This starting point is appropriate for the following reasons:

- A dose of 10 μSv/yr (1 mrem/yr) is a small fraction (less than 0.5 percent) of the radiation received per year from natural background sources.

- A dose of 10 μSv/yr (1 mrem/yr) is significantly less than the amount of radiation that we receive from our own body due to radioactive potassium (one contributor to background radiation) and other elements and to routine medical procedures that involve ionizing radiation.
- A dose of 10 μSv/yr (1 mrem/yr) over a 70-year lifetime equates to an estimated increase of 3.5×10^{-5} in the lifetime cancer risk, which falls within the range of acceptable lifetime risks of 5×10^{-4} to 10^{-6} used in developing health-based standards for exposure to radiation (other than for radon) in the United States.
- Radiation measurement technologies are available at a reasonable cost to detect radioactivity at concentrations derived from this dose standard.
- This dose standard is widely accepted by recognized national and international organizations.

The final selection of an individual dose standard should nonetheless be a policy choice, albeit one informed by the above considerations.

Recommendation 6. For any dose-based alternative approach to disposition of slightly radioactive solid materials, the USNRC should use the *conceptual framework* of draft NUREG-1640 to assess dose implications. To use the actual results of NUREG-1640 in the decision framework discussed in Recommendations 1 and 2, the USNRC must first establish confidence in the numerical values, expand the scope of applicability, and overcome certain limitations in draft NUREG-1640. At a minimum, the following specific actions are required:

- Review the choice of parameter distributions used in the dose modeling, as well as the characteristic values chosen for each parameter distribution.
- Develop complete scenarios and dose factors for conditional clearance options.
- Provide sufficient information to enable calculation of collective doses to support Recommendation 4.
- Expand the current set of scenarios used to compute dose factors to include (1) human error and (2) multiple exposure pathways.

The USNRC should use an independent group of experts to provide peer review of these activities.

Recommendation 7. The USNRC should continue to review, assess, and participate in the ongoing international effort to manage the disposition of slightly radioactive solid material. The USNRC should also develop a rationale for consistency between secondary dose standards that may be adopted by the United States and other countries. However, the USNRC should ensure that the technical basis for secondary dose standards is not adjusted for consistency unless these adjustments are supported by scientific evidence.

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Appendixes

A

Biographical Sketches of Committee Members

Richard S. Magee, chair, is currently vice president, Carmagen Engineering, Inc., and technical director, New Jersey Corporation for Advanced Technology. His previous positions include associate provost for research and development and executive director, Otto H. York Center for Environmental Engineering and Science, New Jersey Institute of Technology (NJIT); professor in the Department of Mechanical Engineering and the Department of Chemical Engineering, Chemistry, and Environmental Science, NJIT; associate director, Environmental Protection Agency (EPA) Center for Airborne Organics, Massachusetts Institute of Technology (MIT); director, Northeast Hazardous Substance Research Center, NJIT; and director, Stevens Institute of Technology Energy Center. He has chaired numerous groups and committees including a number of National Research Council (NRC) committees. His NRC service includes chair and member of the NRC Evaluation Panel for the National Bureau of Standards Center for Fire Research; member of the Board of Assessment of the National Engineering Laboratories; chair and member of the Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program; chair and member of the Panel on Review and Evaluation of Alternative Chemical Disposal Technologies; and chair and member of the Committee on Review of the U.S. Department of Energy Office of Fossil Energy's Research Plan for Fine Particulates. He is a fellow of the American Society of Mechanical Engineers and a National Associate of the National Academies. He has also provided service to the North Atlantic Treaty Organization Science Committee as a member of the Priority Area Panel on Disarmament Technologies and as a member of the Advisory Panel on Security-related Civil Science and Technology. He has extensive experience in environmental science

and engineering, including expertise in combustion, incineration, emissions, hazardous waste, and energy technologies. He has a B.E., an M.S., and an Sc.D. from Stevens Institute of Technology.

David E. Adelman is an associate professor at the University of Arizona's James E. Rogers College of Law. His work focuses on the myriad interfaces between law and science, with particular emphasis on evaluating environmental and regulatory issues relating to new or controversial technologies as well as assessing the impacts of intellectual property regimes on scientific research in the United States. He is a member of the U.S. Department of Energy's (DOE's) Environmental Management Advisory Board, as well as a member of the National Academies' Committee on Building a Long-term Environmental Quality Research and Development Plan in the U.S. Department of Energy, which evaluated DOE's Environmental Management science program. From July 1998 to September 2001, he was a senior attorney with the Natural Resources Defense Council's (NRDC) Nuclear and Public Health programs in Washington, D.C., where he monitored and litigated issues pertaining to the environmental cleanup of the nuclear weapons complex and developed proposals for appropriate regulatory mechanisms for agricultural biotechnology. Prior to his position at NRDC, he was an associate at the law firm of Covington & Burling in Washington, D.C., where he litigated patent disputes and provided counsel on environmental regulatory issues. He received a B.A. in chemistry and physics from Reed College in 1988, a Ph.D. in chemical physics from Stanford University in 1993, and a J.D. from Stanford Law School in 1996.

Jan Beyea is a senior scientist with Consulting in the Public Interest and a consultant to the National Audubon Society and the Epidemiology Department of the Mount Sinai Medical School. He consults on nuclear physics and other energy and environmental topics for numerous local, national, and international organizations. He has been chief scientist and vice president, National Audubon Society, and has held positions at the Center for Energy and Environmental Studies, Princeton University, Holy Cross College, and Columbia University. He has served on numerous advisory committees and panels including as a member of the NRC's Board on Energy and Environmental Systems, Energy Engineering Board; Committee on Alternative Energy R&D Strategies; and Committee to Review DOE's Fine Particulates Research Plan. He has served on the Secretary of Energy's Advisory Board, Task Force on Economic Modeling and the policy committee of the Recycling Advisory Council. He served as an advisor to various Office of Technology Assessment studies. He has expertise in energy technologies and associated environmental and health concerns and has written numerous articles on environment and energy. He received a B.A. from Amherst College and a Ph.D. in physics from Columbia University.

Jack S. Brenizer, Jr., is a professor in the Department of Mechanical and Nuclear Engineering and chairman of the Nuclear Engineering Program at the Pennsylvania State University. His previous positions include associate professor, School of Engineering and Applied Science, University of Virginia, Charlottesville, and engineering technician, AMP Incorporated. His research and teaching interests cover a wide range of expertise related to nuclear science and engineering, nuclear measurements, radiation detection, reactor operations and systems, and effects of radiation. He is a recipient of the American Society for Testing and Materials (ASTM) E7 Charles W. Briggs Award and a Board Member of the International Society for Neutron Radiography. He is a member of the American Nuclear Society, the Health Physics Society, Sigma Xi, the American Society for Nondestructive Testing, the ASTM, the International Society for Neutron Radiography, and the International Society for Optical Engineering. He has a B.S. in physics from Shippensburg State College and an M.E. (engineering science) and a Ph.D. (nuclear engineering) from the Pennsylvania State University.

Lynda L. Brothers is a partner with Sonnenschein Nath & Rosenthal. Her previous positions include partner, Davis Wright Tremaine (1990-2000); executive vice president, Raytheon Hanford, Inc. (1996); assistant director, Hazardous, Solid and Radioactive Waste and Air Quality, Department of Ecology, State of Washington (1983-1985); deputy assistant secretary for environment, U.S. Department of Energy (1979-1981); and counsel, Subcommittee on Environment and Atmosphere, Committee on Science and Technology, U.S. House of Representatives (1978-1979). She has extensive experience in environmental and radioactive waste issues that cut across many agencies and jurisdictions and addresses regulatory issues related to defense wastes and commercial low-level radioactive waste. She has served on a number of advisory boards and committees including the NRC's Board on Radioactive Waste Management (1989-1996); Committee on Classification of Documents at the Department of Energy; Committee to Review New York State's Siting and Methodology Selection for Low Level Radioactive Waste Disposal. She has also served on the Advisory Board, Virginia Mason Center for Women's Health; the Northwest Citizens' Forum on High Level Nuclear Waste at Hanford; and the Board of Trustees, Washington Environmental Foundation. She served as chair of the Northwest Interstate Compact Commission on Low Level Radioactive Waste from 1983-1985. Until spring of 2000, she was counsel to the board of directors of Envirocare of Utah, and she currently serves on the board of directors, American Birding Association. She has a J.D. from the Golden State University, an M.S. in biology from the University of Virginia, and a B.S. in genetics from the University of California, Berkeley.

Robert J. Budnitz is president of Future Resources Associates, Inc., in Berkeley, California. Previously, he served as deputy director and director of the U.S.

Nuclear Regulatory Commission's (USNRC's) Office of Nuclear Regulatory Research and also held several management positions at the Lawrence Berkeley Laboratory of the University of California. His professional interests are in environmental impacts, hazards, and safety analysis, particularly of the nuclear fuel cycle. He has been prominent in the field of nuclear reactor safety assessment and waste repository performance assessment, including probabilistic risk assessment. Dr. Budnitz has served on numerous investigative and advisory panels of scientific societies, government agencies, and the National Research Council. His most recent NRC committee service was with the Board on Radioactive Waste Management, Committee on Buried and Tank Wastes and Committee on Technical Bases for Yucca Mountain Standards. He is a member of the Board of Directors of the Cal Rad Forum, an association of public and private institutions and corporations that generate low-level radioactive waste in the Southwestern Low-Level Waste Disposal Compact, which supports the prompt development of the Ward Valley site in California. He received a B.A. from Yale University and a Ph.D. in physics from Harvard University.

Gregory R. Choppin is currently the R.O. Lawton Distinguished Professor of Chemistry at Florida State University. His research interests involve the chemistry of the f-elements, the separation science of the f-elements, and the physical chemistry of concentrated electrolyte solutions. During a postdoctoral period at the Lawrence Radiation Laboratory, University of California, Berkeley, he participated in the discovery of mendelevium, element 101. His research and educational activities have been recognized by the American Chemical Society's Award in Nuclear Chemistry, the Southern Chemist Award of the American Chemical Society, the Manufacturing Chemist Award in Chemical Education, the Chemical Pioneer Award of the American Institute of Chemistry, a Presidential Citation Award of the American Nuclear Society, and honorary D.Sc. degrees from Loyola University and the Chalmers University of Technology (Sweden). Dr. Choppin has served as member, chair, or vice chair of numerous NRC committees and is currently a member of the Board on Radioactive Waste Management and chair of the Committee on Building a Long-term Environmental Quality Research and Development Program in the U.S. Department of Energy. Dr. Choppin received a B.S. in chemistry from Loyola University, New Orleans, and a Ph.D. from the University of Texas, Austin.

Michael Corradini (National Academy of Engineering [NAE]) is a professor in the Department of Engineering Physics at the University of Wisconsin, Madison, and associate dean of the College of Engineering. Dr. Corradini's research focus is nuclear engineering and multiphase flow with specific interests that include light-water reactor safety, fusion reactor design and safety, waste management and disposal, vapor explosions research and molten core concrete interaction research, and energy policy analysis. He is a member of the American Institute of

Chemical Engineers, the American Society of Engineering Education, and the American Society of Mechanical Engineers, and a fellow of the American Nuclear Society. Dr. Corradini has received numerous awards including the National Science Foundation's Presidential Young Investigators Award, the American Nuclear Society's reactor safety best paper award, and the University of Wisconsin, Madison campus, teaching award. He is the author of more than 100 technical papers and has served on various technical review committees, including the research review panel of the USNRC and the direct heating review group. He is currently a member of the NRC's Electric Power/Energy Systems Engineering Peer Committee and chair of the Frontiers of Engineering Organizing Committee. Dr. Corradini was elected to the NAE in 1998. He received his B.S. in mechanical engineering from Marquette University and his M.S. and Ph.D. in nuclear engineering from the Massachusetts Institute of Technology.

James W. Dally (NAE) is Glenn L. Martin Institute Professor of Engineering Emeritus, University of Maryland, College Park. Dr. Dally has had a distinguished career in industry, government, and academia and is the former dean of the College of Engineering at the University of Rhode Island. His former positions include senior research engineer, Armour Research Foundation; assistant director of research, Illinois Institute of Technology Research Institute; assistant professor, Cornell University; professor, Illinois Institute of Technology; and senior engineer, International Business Machines Corporation. He is also an independent consultant. Dr. Dally is a mechanical engineer and the author or coauthor of six books, including engineering textbooks on experimental stress analysis, engineering design, instrumentation, and the packaging of electronic systems, and has published approximately 200 research papers. He has served on a number of NRC committees and is currently on the Committee on the Future Environments for the National Institute for Standards and Technology and the Committee on Review of Federal Motor Carrier Safety Administration's Truck Crash Causation Study. He has a B.S. and an M.S. from the Carnegie Institute of Technology, and a Ph.D. from the Illinois Institute of Technology.

Edward R. Epp is professor of radiation oncology, emeritus, Harvard University. He has served as physicist, Department of Radiology, Montreal General Hospital; has worked at the Sloan-Kettering Institute for Cancer Research where he served as member and professor of biophysics at Cornell University in the Graduate School of Medical Sciences; was professor of radiation oncology, Harvard Medical School; and served as head of the Division of Radiation Biophysics in the Department of Radiation Oncology at Massachusetts General Hospital. Dr. Epp is a fellow of the American Physical Society and the American Association of Physicists in Medicine. He has served as president of the Radiation Research Society and on a number of committees of the National Academy of Sciences. He has also been a member of the National Institute of Health

Radiation Study Section and the National Cancer Institute Clinical Program Project Committee. In 2000, he was the Failla Memorial Lecturer for the Greater New York Chapter of the Health Physics Society in association with the Radiation and Medical Physics Society of New York. His research interests include radiation physics and dosimetry, radiation biophysics, and mechanisms of radiation action in cells. His specific research on mechanism aspects has dealt with the biological effects of ultrahigh-intensity pulsed radiation in the presence of oxygen and other chemical sensitizers. He obtained his B.A. and M.A. degrees from the University of Saskatchewan and his Ph.D. in nuclear physics from McGill University.

Alvin Mushkatel is currently a professor in the School of Planning and Landscape Architecture at Arizona State University (ASU). Previous positions at ASU include professor, School of Public Affairs; director of the Doctor of Public Administration Program; and director of the Office of Hazards Studies. He has held positions in political science at the University of Denver; University of Missouri, St. Louis; and St. John's University in Minnesota. He has conducted numerous studies and published widely in a number of areas including risk perception, siting of hazardous waste facilities, public and stakeholder involvement in policy making, and nuclear waste policy. He has served on numerous advisory bodies and committees including the U.S. Department of Energy Headquarters Public Participation Seminar Series Panel on public trust and confidence, and on the following NRC committees: Earthquake Engineering and a number of its subpanels; Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program; Committee to Assess the Policies and Practices of the Department of Energy to Design, Manage, and Procure Environmental Restoration, Waste Management, and Other Construction Projects; and Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities. Dr. Mushkatel received his Ph.D. in political science from the University of Oregon.

Rebecca R. Rubin is a partner in the BAHR Environmental Company, in which she leads and performs environmental studies and evaluations for clients in the federal and commercial sectors. She has held a number of positions in the environmental field including director, Army Environmental Policy Institute, managing the research, analysis, and development of progressive environmental policies and strategies for the U.S. Army; and manager, project leader, and analyst, Environmental Program, Institute for Defense Analyses, where she managed the environmental studies program and conducted studies for the Department of Defense and other government agencies. Her experience in the environmental area covers a broad range of subjects including the integration of environmental, safety, and health considerations with defense acquisition; evaluation of site contamination, developmental testing of environmental technologies; and poli-

cies and strategies for environmental cleanup and compliance. She has a B.A. from Harvard College and an M.A. from Columbia University.

Michael T. Ryan is an associate professor, Department of Health Administration and Policy, Medical University of South Carolina (MUSC). He earned his B.S. in radiological health physics from Lowell Technological Institute in 1974. In 1976, he earned his M.S. in radiological sciences and protection from the University of Lowell. Dr. Ryan received a Ph.D. in 1982 from the Georgia Institute of Technology, where he was recently inducted into the Academy of Distinguished Alumni. Dr. Ryan is an editor in chief of *Health Physics Journal*. Over the past 10 years, he has served on the Technical Advisory Radiation Control Council for the State of South Carolina. He is a member of the National Council of Radiation Protection and Measurements (NCRP) scientific vice president for Radioactive and Mixed Waste Management and chair of Scientific Committee 87; and a member of the board of directors. He is also a member of NCRP's scientific committee 87-4 on Management of Waste Metals Containing Radioactivity. Dr. Ryan is certified in the comprehensive practice of health physics by the American Board of Health Physics. Dr. Ryan holds adjunct appointments at Georgia Tech and at the University of South Carolina and the College of Charleston where he has taught radiation protection courses at the graduate level. He is currently serving on the Scientific Review Group appointed by the Assistant Secretary of Energy to review the ongoing research in health effects at the former weapons complex at Mayak in the Southern Urals of the former Soviet Union. Prior to his appointment at MUSC, Dr. Ryan was most recently vice president of Barnwell Operations for Chem-Nuclear Systems, Inc., and previously served as vice president of regulatory affairs, having responsibility for developing and implementing the company's policies and programs to comply with state and federal regulations. Before joining Chem-Nuclear Systems, Inc., as director of the Environmental and Dosimetry Laboratory in 1983, Dr. Ryan spent seven years in environmental health physics research at Oak Ridge National Laboratory.

Richard I. Smith retired from Pacific Northwest National Laboratory in 1996 after nearly 40 years of scientific activities on the Hanford Site, where he was a staff engineer in the Systems and Risk Management Department. He has extensive experience related to decontamination and decommissioning (D&D) of licensed nuclear facilities, including cost analyses and environmental impact analyses. His studies on the decommissioning of power and test reactors, fuel cycle facilities, and non-fuel cycle nuclear facilities, which focus on estimating the costs and occupational radiation dose for D&D of nuclear facilities, are known and used throughout the world. He has participated in the development of several reports for the International Atomic Energy Agency (IAEA) on the D&D of nuclear facilities, dealing with the status of technology decontamination, disas-

sembly, and waste management, and he served as a member of an IAEA working group considering the planning for decommissioning of WWER-440 reactors throughout the former Eastern bloc countries. He has also recently contributed to the International Nuclear Safety Program in the area of planning for decommissioning the three undamaged reactors at the Chernobyl Nuclear Power Station in Ukraine. He has led studies in the storage, packaging, and transport of spent fuel and greater than Class C waste. He has served on the NRC Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities, and the Committee to Assess the Policies and Practices of the DOE to Design, Manage and Procure Environmental Restoration, Waste Management, and Other Construction Projects. He has a B.S. in physics from Washington State University and an M.S. in applied physics from the University of California at Los Angeles; he is a professional engineer in nuclear engineering, licensed in the states of Washington and California.

Dale Stein (NAE) is president emeritus of Michigan Technological University and retired professor of materials science. He has held positions at Michigan Technological University, the University of Minnesota, and the General Electric Research Laboratory. He is a recipient of the Hardy Gold Medal of the American Institute of Mining, Metallurgical and Petroleum Engineers and the Geisler Award of the American Society of Metals (Eastern New York Chapter), and he has been an elected fellow of the American Society of Metals and the American Association for the Advancement of Science. He has served on numerous NRC committees: he is currently a member of the Committee on Review of DOE's Office of Heavy Vehicle Technologies; Committee on Review of National Transportation Science and Technology Strategy; and Research and Technology Coordinating Committee of the Transportation Research Board; he was chair of the Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities. He previously was a member of the U.S. Department of Energy's Energy Research Advisory Board. He is currently chairman of the Advisory Committee for the Center for Nuclear Waste Regulatory Analyses (CNWRA), which is concerned primarily with advising the USNRC on the granting of a license for a repository for high-level nuclear waste; CNWRA is affiliated with the Southwest Research Institute, a contractor to the USNRC. He is also a member of the NAE and is an internationally known authority on the mechanical properties of engineering materials. He received his Ph.D. in metallurgy from Rensselaer Polytechnic Institute.

Detlof von Winterfeldt is a professor of public policy and management at the University of Southern California and director of its Institute for Civic Enterprise. He also is the president of Decision Insights, Inc., a management consulting firm specializing in decision and risk analysis. His research interests are in the foundation and practice of decision and risk analysis as applied to technology and

environmental management problems. He is the coauthor of two books and author or coauthor of more than 100 articles and reports on these topics. He has served on several committees and panels of the National Science Foundation (NSF) and the National Research Council, including the NSF's Advisory Panel for its Decision and Risk Management Science Program and the NRC's Committee on Risk Perception and Risk Communication.

B

Presentations and Committee Activities

1. **Committee Meeting, National Academy of Sciences, Washington, D.C., January 3-5, 2001**

   Controlling the Release of Solid Materials
   Richard A. Meserve, Chairman, U.S. Nuclear Regulatory Commission

   EPA's Clean Materials Program
   Craig Conklin, Office of Air and Radiation, U.S. Environmental Protection Agency

   Revision of DOE Requirements for Control of the Release of Materials for Re-use and Recycle
   Andrew Wallo, Office of Environmental Safety and Health, U.S. Department of Energy

   Controlling Release of Solid Materials—Current Approach
   Anthony Huffert, U.S. Nuclear Regulatory Commission

   Controlling Release of Solid Materials—Public Input
   Frank Cardile, U.S. Nuclear Regulatory Commission

   Controlling Release of Solid Materials—International Status
   Robert Meck, U.S. Nuclear Regulatory Commission

   Controlling Release of Solid Materials—Technical Bases
   Robert Meck, U.S. Nuclear Regulatory Commission

2. Committee Meeting, National Academy of Sciences, Washington, D.C., March 26-28, 2001

Radiological Clearance: An Industry Perspective
Paul Genoa, Nuclear Energy Institute

NAS—Release of Radioactive Material
George Vanderheyden, Exelon

Maine Yankee Atomic Power Company: Decommissioning Update
William O'Dell, Entergy Corporation

Big Rock Point Restoration Project
Kurt Haas, Consumers Energy

Release of Solid Materials
Ellen Heath, Duke Engineering

Envirocare of Utah, Inc.: The Safe Alternative
Charles Judd, Envirocare

Vehicle Radiation Monitoring Systems
Jas Devgun, American Nuclear Society

Presentation to National Research Council Committee on Alternatives for Controlling the Release of Solid Materials from NRC-Licensed Facilities
Gary Visscher, American Iron and Steel Institute

Radiation and Steel
Anthony LaMastra, Health Physics Associates

Restricted Recycling of Metals
Gordon Geiger, University of Arizona

National Academy of Sciences Presentation
Eric Stuart, Steel Manufacturers Association

Washington State's Perspective on Controlling the Release of Solid Materials from Nuclear Facilities
John Erickson, State of Washington, Division of Radiation Protection

Presentation to National Academy of Sciences
Henry Porter, S.C. Department of Health and Environmental Control

Comments on Clearance Rules
John Erickson, Organization of Agreement States

Position Statement of CRCPD
Kathleen McAllister, Conference of Radiation Control Program Directors

Radioactivity in Solid Waste
David Allard, State of Pennsylvania Bureau of Radiation Protection

Federal Solid Waste Disposal Regulations
Bob Dellinger, US Environmental Protection Agency, Office of Solid Waste

Radioactive Materials Found in Municipal Waste and Recycle Materials
Greg Smith, Radiation Service Organization

Statement to the Committee
Dan Guttman, Attorney-at-law

Committee Must Safeguard Public Health and Allow More Public Interest Input
David Ritter, Public Citizen

Radioactive Waste and Materials Release and Recycling
Diane D'Arrigo, Nuclear Information and Resource Service

Presentation to Committee on Alternatives for Controlling the Release of Solid Materials from NRC-Licensed Facilities
Jens Hovgaard, Exploranium G.S. Ltd.

Radioactive Waste Management at Stanford Linear Accelerator
Steven Frey, Stanford Linear Accelerator Center

Brokering, Assaying, and Releasing "Potentially Clean" Waste
Al Johnson, Duratek, Inc.

Demolition Waste and Metals Recycling
Al Johnson, Duratek, Inc.

Comments of the National Ready Mixed Concrete Association
Robert Garbini, National Ready Mixed Concrete Association

3. Committee Subgroup Site Visit to ATG, Richland, Washington, April 16, 2001

4. Committee Subgroup Site Visit to Duratek Inc., Oak Ridge, Tennessee, June 1, 2001

5. Committee Meeting, National Academy of Sciences, Washington, D.C., June 12-15, 2001

Discussion of EPA Technical Support Document
Robert Anigstein, Sanford Cohen & Associates

Discussion of NUREG-1640
Robert Meck, U.S. Nuclear Regulatory Commission

Recyclable Metallurgical Scrap Metal for the Steel Industry
Ray Turner, Health Physicist, David J. Joseph Company

Scope of International Regulations
Gordon Linsley, Waste Safety Section, International Atomic Energy Agency

Application of the Concepts of Clearance in the European Union
Augustin Janssens, Environment Directorate-General, European Commission

A Nuclear Decommissioner's Views on Clearance Levels
Shankar Menon, OECD/NEA Cooperative Programme on Decommissioning

Stakeholder Involvement Strategies for Highly Technical and Controversial Issues
Janesse Brewer, Senior Facilitator, The Keystone Center

SAIC Organizational Conflict of Interest
Dan Guttman, Attorney-at-Law

A Historical Perspective on the NRC Public Participation Process After the BRC Policy
Francis Cameron, Special Counsel for Public Liaison, U.S. Nuclear Regulatory Commission

6. **Committee Subgroup Meeting, National Academy of Sciences, Washington, D.C., July 16-18, 2001**

7. **Committee Subgroup Meeting, National Academy of Sciences, Washington, D.C., July 30-August 1, 2001**

8. **Committee Meeting, Woods Hole, Massachusetts, August 29-31, 2001**

9. **Committee Meeting, National Academy of Sciences, Washington, D.C., November 19-20, 2001**

C

Statement of Work

The National Research Council committee formed to undertake this study will address the following tasks:

(1) As part of its data gathering and understanding the technical basis for the Nuclear Regulatory Commission's (USNRC's) analyses of various alternatives for managing solid materials from USNRC-licensed facilities, the committee shall review the technical bases and policies and precedents derived therefrom set by the USNRC and other Federal agencies, by States, other nations and international agencies, and other standard setting bodies including the following. The review of the following will be contingent on the USNRC staff providing summaries with the salient issues of each document to the Research Council staff and committee, as well as copies of the documents, soon after project funds are received and before the first committee meeting.

- The USNRC technical bases development, including ongoing and planned staff activities, to include the assessment of potential scenarios and pathways for radiation exposure, survey and detection methodology, and an evaluation of the environmental impacts for a variety of solid materials.
- The 1997 Environmental Protection Agency Preliminary Technical Support Document for its clean metals program and other studies on the environmental impacts of clearance of materials, exemption of materials containing naturally occurring radioactive material (e.g., coal ash), and development of guidelines for screening materials imported into the U.S. that contain radioactivity.
- The 1980 Department of Energy (DOE) petition to establish exemptions

for small concentrations of technetium-99 and/or low enriched uranium as residual contamination in smelted alloys and the public comment on the proposed DOE rule.
- The 1990 USNRC Below Regulatory Concern (BRC) Policy setting a standard for release of solid materials for recycle. In 1991 the USNRC instituted a moratorium on the BRC Policy to allow more extensive public involvement, and the BRC policy was revoked by Congress in the Energy Policy Act of 1992.
- DOE criteria (e.g., DOE Order 5400.5) for release of solid materials and handbooks for controlling release of property containing residual radioactive material. DOE has established a task force to review its policies on release of materials for re-use and recycling that could have implications for USNRC licensees.
- Conference of Radiation Control Program Directors recommendations or policies on the control of solid materials from licensed facilities.
- Experience of individual states promulgating release criteria for solid materials in the absence of federal standards. For example, one state prohibits the disposal of radioactive material in municipal landfills and another state authorizes unrestricted release of volumetrically contaminated materials. Methodologies states are using to survey and detect slightly contaminated materials. Basis and criteria states are using for approving the release of these materials. Approaches states are using for similar levels of naturally occurring radioactive materials.
- International Atomic Energy Agency and European Union experience, directives, recommendations or standards, especially as they pertain to international adoption of guidelines and criteria on international trade and import standards.
- Recommendations of the International Commission on Radiological Protection (e.g., ICRP Report 60) and the National Council on Radiation Protection and Measurements (e.g., NCRP Report 116) and on-going activities evaluating clearance and criteria for release of slightly radioactive materials.
- American National Standards Institute Standard N13.12, "Surface and Volume Radioactivity Standards for Clearance." This standard contains criteria for unrestricted release of solid materials from nuclear facilities. Also, review of the National Technology Transfer and Advancement Act of 1995 and its implications for developing and implementing alternative release criteria.

(2) The committee will review public comments and reactions received so far on current and former USNRC proposals to develop alternatives for control of solid materials. Again, this review will be contingent on the USNRC staff providing the committee both with the comments and summaries of the public com-

ments and reactions received. The committee will explicitly consider how to address public perception of risks associated with the direct reuse, recycle, or disposal of solid materials released from USNRC-licensed facilities. The committee should provide recommendations for USNRC consideration on how comments and concerns of stakeholders can be integrated into an acceptable approach for proceeding to address the release of solid materials.

(3) The committee shall determine whether there are sufficient technical bases to establish criteria for controlling the release of slightly contaminated solid materials. This should include an evaluation of methods to identify the critical groups, exposure pathway(s), assessment of individual and collective dose, exposure scenarios, and the validation and verification of exposure criteria for regulatory purposes (i.e., decision making and compliance). As part of this determination, it should judge whether there is adequate, affordable measurement technology for USNRC-licensees to verify and demonstrate compliance with a release criteria. What, if any, additional analyses or technical bases are needed before release criteria can be established?

(4) Based on its evaluation and its review, the committee shall recommend whether USNRC: (1) continue the current system of case-by-case decisions on control of material using existing, revised, or new (to address volumetrically contaminated materials) regulatory guidance, (2) establish a national standard by rulemaking, to establish generic criteria for controlling the release of solid materials, or (3) consider another alternative approach(es).

If the committee recommends continuation of the current system of case-by-case decisions, the committee shall provide recommendations on if and how the current system of authorizing the release of solid materials should be revised.

If the committee recommends that USNRC promulgate a national standard for the release of solid material, the committee shall: (1) recommend an approach, (2) set the basis for release criteria (e.g., dose, activity, or detectability-based), and (3) suggest a basis for establishing a numerical limit(s) with regard to the release criteria or, if it deems appropriate, propose a numerical limit.

(5) The committee shall make recommendations on how the USNRC might consider international clearance (i.e., solid material release) standards in its implementation of the recommended technical approach.

D

Standards (Limits) Proposed by Other Organizations

AMERICAN NATIONAL STANDARDS INSTITUTE AND HEALTH PHYSICS SOCIETY

ANSI/HPS N13.12-1999 Surface and Volume Radioactivity Standards for Clearance

The Health Physics Society (HPS) Standards Working Group developed this standard. The standard was consensus balloted[1] and approved by the American National Standards Institute (ANSI) accredited HPS N13 Committee on October 19, 1998. Furthermore, ANSI, Inc., itself approved the standard on August 31, 1999. The standard defines primary (dose) and secondary screening (derived) criteria.

Primary Dose Criterion

The primary criterion of this standard is to provide for the public health and safety of an average member of a critical group such that the dose shall be limited to 10 μSv/yr (1.0 mrem/yr) total effective dose equivalent (TEDE), above background, for clearance of materials from regulatory control. When justified on a case-by-case basis, clearance shall be permitted at higher dose levels when it can be ensured that exposures to multiple sources will be maintained as low as rea-

[1]A listing of the organizations and government agencies represented on the N13 Committee is listed in an Appendix to the ANSI/HPS standard.

sonably achievable (ALARA) and will provide an adequate margin of safety below the public dose limit of 1 mSv/yr (100 mrem/yr) TEDE.

Derived Screening Levels

Derived screening levels, above background, for the clearance of solid materials or items containing surface or volume activity concentrations of radioactive materials are tabulated in the standard. In that table the radionuclides have been divided into four groups based on similarity of exposure scenario results, with screening levels ranging from 0.1 to 100 Bq/cm^2 (or Bq/g), depending on the group considered.[2] A generic ALARA process was employed in developing the derived screening levels. However, based on a detailed ALARA evaluation, it shall be permissible to derive less restrictive screening levels on a case-by-case basis using the primary dose criterion.

The standard includes a discussion of the collective dose in relation to the screening levels. In reality, concentrations in cleared materials will likely average about an order of magnitude less than the screening levels, which are intended to define upper bounds. From the qualitative evaluation it is concluded that on the average, individuals will likely receive no more than the 10 μSv/yr (1.0 mrem/yr) primary dose criterion because of conservative modeling and assumed maximum concentrations. Assuming an average U.S. background level of 3.0 mSv/yr (300 mrem/yr), the collective doses to the critical group resulting from clearance of items using the criterion from this standard will be no more than 0.3 percent of the dose the same population would receive from natural background radiation in any one year. The magnitude of the potential collective doses to the critical group associated with the items in accordance with this standard is so low that additional ALARA evaluations or analyses, or further reductions in the primary dose standard, are not deemed necessary.

INTERNATIONAL ATOMIC ENERGY AGENCY

Safety Series No. 89: Principles for the Exemption of Radioactive Sources and Practices from Regulatory Control

This document was jointly sponsored by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency of the Organization for Economic Cooperation and Development and was published in 1988. It is based on two principles for exemption:

[2] *Surface and Volume Radioactivity Standards for Clearance: An American National Standard*, Health Physics Society Report, ANSI/HPS N13.12-1999.

1. Individual risk must be sufficiently low as not to warrant regulatory concern.
2. Radiation protection, including the cost of regulatory control, must be optimized.

Two approaches were followed in determining if the level of risk or dose is trivial;[3] first, choose a level of risk and the corresponding dose that is of no significance to individuals; second, use the exposure to natural radiation, to the extent that it is normal and unavoidable, as a relevant reference level.

Risk-Based Considerations

It is widely recognized that values of individual risk that can be treated as insignificant correspond to a level at which individuals, aware of these risks, would not commit significant resources of their own to reduce them. It is believed that few people would commit their own resources to reduce an annual risk of death of 10^{-5} and that even fewer would take action at an annual level of 10^{-6}. By considering a rounded risk factor of 10^{-2} Sv^{-1} (10^{-4} rem^{-1}) for whole-body exposure as a broad average over age and gender, the level of trivial individual effective dose equivalent would be in the range of 10 to 100 mSv/yr (1 to 10 mrem/yr).[4]

Natural Background Radiation Considerations

The natural background radiation has been estimated to give an average individual dose of about 2.4 mSv/yr (240 mrem/yr).[5] This average conceals a wide variation due to different concentrations of radioactive materials in the ground and in building materials, different altitudes, and different habits of people. About half of this dose is due to radon exposure, which may be controlled. The other half comes from cosmic rays, terrestrial gamma rays, and radionuclides in the body for which control is not practical. Individuals do not usually consider variation in exposure to natural background radiation when considering moving

[3]The word trivial is used extensively by the IAEA in Vienna and the European Commission in their safety guides when describing an individual effective dose equivalent in the range of 10 to 100 mSv/yr (1 to 10 mrem/yr).

[4]*Principles for the Exemption of Radiation Sources and Practices from Regulatory Control*, Safety Series No. 89, International Atomic Energy Agency, Vienna, 1988.

[5]The background radiation varies significantly from country to country and from one location to another within a country. There are several regions in the world where natural background radiation gives doses that exceed the normal ranges by factors of 4 to 6. It is reported that no adverse health effects have been discerned from doses arising from these high natural levels. See, BEIR V, National Academy Press, Washington, D.C., 1990.

from one location to another or when going on a holiday. IAEA believes it can therefore be judged that a dose level that is small in comparison with the variation in natural background radiation can be considered trivial. A figure of whole-body or effective dose equivalent of the order of one to a few percent of the natural background, 20 to 100 mSv/yr (2 to 10 mrem/yr), has been suggested.

Conclusion on Individual Related Risk

The IAEA concluded that an individual radiation dose, regardless of its origin, is likely to be trivial if it is of the order of some tens of microsieverts per year (some millirems per year). It is noted that this dose corresponds to a few percent of the annual dose limit for members of the public recommended by the International Commission on Radiological Protection (ICRP) in 1977 and is much lower than any upper bound set by competent authorities for practices subject to regulatory control.

EUROPEAN COMMISSION

Radiation Protection 89: Recommended Radiological Protection Criteria for the Recycling of Metals from the Dismantling of Nuclear Installations

This document provides recommended radiological protection criteria for the recycling of metal arising from dismantling nuclear installations. The document prepared by the Group of Experts established under the terms of Article 31 of the Euratom Treaty confirms and extends its previous recommendations, made in IAEA Safety Series 89 of 1988. It has been demonstrated that metals below the clearance levels specified can be released from regulatory control with negligible risk, from a radiation point of view, for workers in the metals industry and for the population at large.

Radiological Protection Criteria

The document references the IAEA recommendation in Safety Series 89 that an individual dose of some tens of microsieverts is considered trivial and therefore the basis for exemption. The Working Group adopted radiation protection levels of 10 μSv/yr (1 mrem/yr) and 1 man-Sv/yr (100 man-rem/yr) of practice collective dose criteria. In addition, the skin dose was limited to 50 mSv/yr (5 rem/yr).

Relating the dose received by individuals to a practice, and to the levels of radioactivity involved in a practice, is difficult because the clearance criteria must be defined for a largely hypothetical environment. The Working Group constructed a set of exposure scenarios, which relate the activity content of the

recycled metals to an individual dose. The proposed clearance levels are derived radioactivity levels from the most critical scenario.

Tables are provided that specify clearance levels for metal scrap recycling for the radionuclides encountered in decommissioning. A similar table is provided specifying the more stringent clearance levels for direct reuse of the metal.

AMERICAN NUCLEAR SOCIETY

The American Nuclear Society (ANS) Special Committee on Site Cleanup and Restoration Standards is responsible for reviewing draft regulations from federal organizations related to the decommissioning of nuclear facilities and providing ANS input to the rulemaking process.

The ANS is not in the business of writing standards, although it does write position papers and makes comments after reviewing rules. As of this date, the ANS has not endorsed ANSI N13.12. However, in a letter of December 4, 2000, ANS made the following comments regarding the Department of Energy's (DOE's) standard:

- ANS considers the 1 mrem/yr standard to be unreasonably low and without a firm scientific justification.
- Scientific evidence would seem to support a dose limit several times larger than the proposed 1 mrem/yr.

The ANS is currently working on a draft position paper on the standard for clearance and expects it to be released in 2002.

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Publication 60

The ICRP recommends that the maximum permissible dose for occupational exposure should be 20 mSv/yr (2,000 mrem/yr), averaged over five years (i.e., 100 mSv total) with a maximum of 50 mSv in any one year. For public exposure, 1 mSv/yr (100 mrem/yr), averaged over 5 years, is the limit. In both categories, the figures are over and above background levels and exclude medical exposure.

The ICRP proposed apportionment of the total allowable dose from all anthropogenic sources of radiation (excluding medical exposures). Hence for radioactive waste management, authorities could allocate a fraction of the 1 mSv/yr (100 mrem/yr), to establish an exposure limit for low-level radioactive waste (LLRW). For example, the Environmental Protection Agency (EPA) in 40 CFR Part 191 imposed a limit of 0.15 mSv/yr (15 mrem/yr), which is consistent with the ICRP's concept of apportionment.

THE EUROPEAN UNION

Basic Safety Standards

The scope of the Basic Safety Standards (BSS) adopted by the European Union (EU) is defined in terms of practices and only indirectly in terms of radioactive substances. Justification of any practice involving radioactivity is required, i.e., determining whether the benefits to individuals and to society from introducing or continuing the practice outweigh the harm (including radiation detriment) resulting from the practice. If such practice is deemed justifiable, a decision is made as to whether it should be placed under the system of reporting and prior authorization as described by the BSS. Exempt practices are those that do not fall under this system. Practices thought to involve appreciable potential risks are put under the regulatory system without exception, including all of the practices associated with the nuclear fuel cycle. However, practices can be exempt from control if the associated risks are sufficiently low. Exemption levels have been derived for the BSS that apply to radionuclide levels and activities per unit mass from which the risks are regarded as trivial.

All associated activities and material movements are regulated after a practice has been placed within the regulatory system. Regulatory control can be relinquished only by proceeding through the system of reporting and prior authorization set out by the BSS. An ad hoc case-by-case procedure is followed for the possible release of materials for recycling, reuse, and disposal, and implementation of this procedure is the responsibility of the competent national authorities. Clearance is defined as the removal from regulatory control of a substance that has radionuclide levels below the recommended specific limits. Cleared substances are automatically exempt from the requirements of reporting and authorization.

The radiological protection criteria that have been adopted for clearance are 10 μSv/yr (1 mrem/yr), with a collective dose for the practice of 1 man-Sv/yr (100 man-rem/yr).[6] Additionally, the skin dose is limited to 50 μSv/yr.

European Union Directive 96/29/EURATOM allows clearance of "radioactive substances where the concentration of activity per unit mass do not exceed the exemption values set out in Column 3 of Table A to Annex I." Annex I is reproduced at the end of this appendix (see Table D-1), as is a table of derived clearance levels based on a primary dose standard of 10 μSv/yr from NUREG-1640 (Table D-2).

[6]European Union Directive 96/29/EURATOM further provides that collective dose can exceed 1 man-sievert, provided that "an assessment of an optimization of protection shows that exemption is the optimum option" (EU, 1996, p. 19).

UNITED NATIONS

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

Consistent with the current understanding of the related consequences, the ICRP, National Council on Radiation Protection and Measurements (NCRP), IAEA, and UNSCEAR have recommended that radiation doses above background levels to members of the public not exceed 1 mSv/yr (100 mrem/yr), for continuous or frequent exposure from radiation sources other than medial exposures.

Most countries imposing limits on radiation from anthropogenic sources have endorsed the principle of apportionment of the total allowable dose. Many countries are in the process of endorsing a dose limit of 10 μSv/yr (1 mrem/yr) for LLRW that is 1 percent of the total allowable dose.

MULTIAGENCY RADIATION SURVEY AND SITE INVESTIGATION MANUAL

The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) provides a nationally consistent consensus approach to conducting radiation surveys and investigations at potentially contaminated sites. This approach is intended to be both scientifically rigorous and flexible enough to be applied to a diversity of site cleanup conditions. MARSSIM's title includes the term "survey" because it provides information on planning and conducting surveys and the term "site investigation" because the process outlined in the manual allows one to begin by investigating any site that may involve radioactive contamination.

The decommissioning that follows remediation requires a demonstration to the responsible federal or state agency that the cleanup effort was successful and that the release criterion (a specific regulatory limit) was met. This manual assists site personnel or others in performing or assessing such a demonstration. The demonstration of compliance involves three interrelated steps:

1. Translating the cleanup or release criterion (e.g., millisieverts per year, millirem per year, specific risk) into a corresponding derived contaminant concentration level (e.g., becquerels per kilogram or picocuries per gram in soil) through the use of environmental pathway modeling;
2. Acquiring scientifically sound and defensible site-specific data on the levels and distribution of residual contamination, as well as levels and distribution of radionuclides present as background, by employing suitable measurement techniques; and

3. Determining that the data obtained from sampling support the claim that the site meets the release criterion, within an acceptable degree of uncertainty, by applying a statistically based decision rule.

MARSSIM provides standardized and consistent approaches for planning, conducting, evaluating, and documenting environmental radiological surveys, with a specific focus on the final status surveys that are carried out to demonstrate compliance with cleanup regulations.

TABLE D-1 Exempt Quantities Established by Council Directive 96/29/EURATOM

Nuclide	Quantity (Bq)	Concentration (kBq/kg)	Nuclide	Quantity (Bq)	Concentration (kBq/kg)
H-3	10^9	10^6	Ga-72	10^5	10
Be-7	10^7	10^3	Ge-71	10^8	10^4
C-14	10^7	10^4	As-73	10^7	10^3
O-15	10^9	10^2	As-74	10^6	10
F-18	10^6	10	As-76	10^5	10^2
Na-22	10^5	10	As-77	10^6	10^3
Na-24	10^5	10	Se-75	10^6	10^2
Si-31	10^6	10^3	Br-82	10^6	10
P-32	10^5	10^3	Kr-74	10^9	10^2
P-33	10^8	10^5	Kr-76	10^9	10^2
S-35	10^8	10^5	Kr-77	10^9	10^2
Cl-36	10^6	10^4	Kr-79	10^5	10^3
Cl-38	10^5	10	Kr-81	10^7	10^4
Ar-37	10^8	10^6	Kr-83m	10^{12}	10^5
Ar-41	10^9	10^2	Kr-85	10^4	10^5
K-40	10^6	10^2	Kr-85m	10^{10}	10^3
K-42	10^6	10^2	Kr-87	10^9	10^2
K-43	10^6	10	Kr-88	10^9	10^2
Ca-45	10^7	10^4	Rb-86	10^5	10^2
Ca-47	10^6	10	Sr-85	10^6	10^2
Sc-46	10^6	10	Sr-85m	10^7	10^2
Sc-47	10^6	10^2	Sr-87m	10^6	10^2
Sc-48	10^5	10	Sr-89	10^6	10^3
V-48	10^5	10	Sr-90+	10^4	10^2
Cr-51	10^7	10^3	Sr-91	10^5	10
Mn-51	10^5	10	Sr-92	10^6	10
Mn-52	10^5	10	Y-90	10^5	10^3
Mn-52m	10^5	10	Y-91	10^6	10^3
Mn-53	10^9	10^4	Y-91m	10^6	10^2
Mn-54	10^6	10	Y-92	10^5	10^2
Mn-56	10^5	10	Y-93	10^5	10^2
Fe-52	10^6	10	Zr-93+	10^7	10^3
Fe-55	10^6	10^4	Zr-95	10^6	10

TABLE D-1 continued

Nuclide	Quantity (Bq)	Concentration (kBq/kg)	Nuclide	Quantity (Bq)	Concentration (kBq/kg)
Fe-59	10^6	10	Zr-97+	10^5	10
Co-55	10^6	10	Nb-93m	10^7	10^4
Co-56	10^5	10	Nb-94	10^6	10
Co-57	10^5	10^2	Nb-95	10^6	10
Co-58	10^6	10	Nb-97	10^6	10
Co-58m	10^7	10^4	Nb-98	10^5	10
Co-60	10^5	10	Mo-90	10^6	10
Co-60m	10^6	10^3	Mo-93	10^8	10^3
Co-61	10^6	10^2	Mo-99	10^6	10^2
Co-62m	10^5	10	Mo-101	10^6	10
Ni-59	10^8	10^4	Tc-96	10^6	10
Ni-63	10^8	10^5	Tc-96m	10^7	10^3
Ni-65	10^6	10	Tc-97	10^8	10^3
Cu-64	10^6	10^2	Tc-97m	10^7	10^3
Zn-65	10^6	10	Tc-99	10^7	10^4
Zn-69	10^6	10^4	Tc-99m	10^7	10^2
Zn-69m	10^6	10^2	Ru-97	10^7	10^2
Ru-103	10^6	10^2	Cs-134	10^4	10
Ru-105	10^6	10	Cs-134	10^7	10^4
Ru-106+	10^5	10^2	Cs-136	10^5	10
Rh-103m	10^8	10^4	Cs-137+	10^4	10
Rh-105	10^7	10^2	Cs-138	10^4	10
Pd-103	10^8	10^3	Ba-131	10^6	10^2
Pd-109	10^6	10^3	Ba-140+	10^5	10
Ag-105	10^6	10^2	La-140	10^5	10
Ag-108m+	10^6	10	Ce-139	10^6	10^2
Ag-110m	10^6	10	Ce-141	10^7	10^2
Ag-111	10^6	10^3	Ce-143	10^6	10^2
Cd-109	10^6	10^4	Ce-144+	10^5	10^2
Cd-115	10^6	10^2	Pr-142	10^5	10^2
Cd-115m	10^6	10^3	Pr-143	10^6	10^4
In-111	10^6	10^2	Nd-147	10^6	10^2
In-113m	10^6	10^2	Pm-147	10^7	10^4
In-114m	10^6	10^2	Pm-149	10^6	10^3
In-115m	10^6	10^2	Sm-151	10^8	10^2
Sn-113	10^7	10^3	Sm-153	10^6	10^2
Sn-125	10^6	10^2	Eu-152	10^6	10
Sb-124	10^6	10	Eu-152m	10^6	10^2
Sb-125	10^6	10^2	Eu-154	10^6	10
Te-123m	10^7	10^2	Eu-155	10^7	10^2
Te-125m	10^7	10^3	Gd-153	10^7	10^2
Te-127	10^6	10^3	Gd-159	10^6	10^3
Te-127m	10^7	10^3	Tb-160	10^6	10
Te-129	10^6	10^2	Dy-166	10^6	10^3

continues

TABLE D-1 continued

Nuclide	Quantity (Bq)	Concentration (kBq/kg)	Nuclide	Quantity (Bq)	Concentration (kBq/kg)
Te-129m	10^6	10^3	Ho-166	10^5	10^3
Te-131	10^5	10^2	Er-169	10^7	10^4
Te-131m	10^6	10	Er-171	10^6	10^2
Te-132	10^7	10^2	Tm-170	10^6	10^3
Te-133	10^5	10	Tm-171	10^8	10^4
Te-133m	10^5	10	Yb-175	10^7	10^3
Te-134	10^6	10	Lu-177	10^7	10^3
I-123	10^7	10	Hf-181	10^6	10
I-125	10^6	10	Ta-182	10^4	10
I-126	10^6	10^2	W-181	10^7	10^3
I-129	10^5	10^2	W-185	10^7	10^4
I-130	10^6	10	W-187	10^6	10^2
I-131	10^6	10^2	Re-186	10^6	10^3
I-132	10^5	10	Re-188	10^5	10^2
I-133	10^6	10	Os-185	10^6	10
I-135	10^6	10	Os-191	10^7	10^2
Xe-131m	10^4	10^4	Os-191m	10^7	10^3
Xe-133	10^4	10^3	Os-193	10^6	10^2
Xe-135	10^{10}	10^3	Ir-190	10^6	10
Cs-129	10^5	10^2	Ir-192	10^4	10
Cs-131	10^6	10^3	Ir-194	10^5	10^2
Cs-132	10^5	10	Pt-191	10^6	10^2
Cs-134m	10^5	10^3	Pt-193m	10^6	10^3
Pt-197	10^6	10^3	U-235+	10^4	10
Pt-197m	10^6	10^2	U-236	10^4	10^4
Au-198	10^6	10^2	U-237	10^6	10^2
Au-199	10^6	10^2	U-238+	10^4	10
Hg-197	10^7	10^2	U-238sec	10^3	1
Hg-197m	10^6	10^2	U-239	10^6	10^2
Hg-203	10^5	10^2	U-240	10^7	10^3
Tl-200	10^6	10	U-240+	10^6	10
Tl-201	10^6	10^2	Np-237+	10^3	1
Tl-202	10^6	10^2	Np-239	10^7	10^2
Tl-204	10^4	10^4	Np-240	10^6	10
Pb-203	10^6	10^2	Pu-234	10^7	10^2
Pb-210+	10^4	10	Pu-235	10^4	10^2
Pb-212+	10^5	10	Pu-236	10^4	10
Bi-206	10^5	10	Pu-237	10^7	10^3
Bi-207	10^6	10	Pu-238	10^4	1
Bi-210	10^6	10^3	Pu-239	10^4	1
Bi-212+	10^5	10	Pu-240	10^3	1
Po-203	10^6	10	Pu-241	10^5	10^2
Po-205	10^6	10	Pu-242	10^4	1
Po-207	10^6	10	Pu-243	10^7	10^3
Po-210	10^4	10	Pu-244	10^4	1
At-211	10^7	10^3	Am-241	10^4	10^3

TABLE D-1 continued

Nuclide	Quantity (Bq)	Concentration (kBq/kg)	Nuclide	Quantity (Bq)	Concentration (kBq/kg)
Rn-220+	10^7	10^4	Am-242	10^6	10^3
Rn-222+	10^8	10	Am-242m+	10^4	1
Rn-223+	10^5	10^2	Am-243+	10^3	1
Rn-224+	10^5	10	Cm-242	10^5	10^2
Rn-225	10^5	10^2	Cm-243	10^4	1
Rn-226+	10^4	10	Cm-244	10	10
Rn-227	10^6	10^2	Cm-245	10^4	1
Rn-228+	10^5	10	Cm-246	10^3	1
Ac-228	10^6	10	Cm-247	10^4	1
Th-226+	10^7	10^3	Cm-248	10^4	1
Th-227	10^4	10	Bk-249	10^6	10^3
Th-228+	10^4	1	Cf-246	10^6	10^3
Th-229+	10^3	1	Cf-248	10^4	10
Th-230	10^4	1	Cf-249	10^3	1
Th-231	10^7	10^3	Cf-250	10^4	10
Th-232sec	10^3	1	Cf-251	10^3	1
Th-234+	10^5	10^3	Cf-252	10^4	10
Pa-230	10^6	10	Cf-253	10^5	10^2
Pa-231	10^3	1	Cf-254	10^3	1
Pa-233	10^7	10^2	Es-253	10^5	10^2
U-230+	10^5	10	Es-254	10^4	10
U-231	10^7	10^2	Es-254m	10^4	10
U-232+	10^3	1	Fm-254	10^7	10^4
U-233	10^4	10	Fm-255	10^6	10^3
U-234	10^4	10			

SOURCE: EU (1996).

TABLE D-2 Derived USNRC Clearance Levels Assuming a 10 μSv/yr Primary Dose Standard (All Metals)

Mass Clearance Levels		Surficial Clearance Levels	
Radionuclide	NRC (Bq/g)	Radionuclide	NRC (Bq/cm^2)
H-3	2.E+04	H-3	2.E+04
C-14	6.E+02	C-14	7.E+02
Na-22	2.E–02	Na-22	3.E–02
P-32	8.E+01	P-32	9.E+01
S-35	1.E+03	S-35	2.E+03
Cl-36	4.E+00	Cl-36	5.E+00
K-40	2.E–01	K-40	3.E–01
Ca-41	8.E+01	Ca-41	1.E+02
Ca-45	1.E+02	Ca-45	2.E+02
Cr-51	4.E+00	Cr-51	5.E+00
Mn-54	1.E–01	Mn-54	1.E–01
Fe-55	1.E+04	Fe-55	1.E+04
Co-57	3.E+00	Co-57	3.E+00
Co-58	1.E–01	Co-58	1.E–01
Fe-59	9.E–02	Fe-59	1.E–01
Ni-59	2.E+04	Ni-59	3.E+04
Co-60	4.E–02	Co-60	5.E–02
Ni-63	8.E+03	Ni-63	1.E+04
Zn-65	5.E–02	Zn-65	6.E–02
Cu-67	5.E+00	Cu-67	6.E+00
Se-75	3.E–01	Se-75	4.E–01
Sr-85	2.E–01	Sr-85	2.E–01
Sr-89	9.E+01	Sr-89	1.E+02
Sr-90	1.E+00	Sr-90	1.E+00
Y-91	3.E+01	Y-91	3.E+01
Mo-93	7.E+02	Mo-93	9.E+02
Nb-93m	1.E+03	Nb-93m	2.E+03
Nb-94	6.E–02	Nb-94	7.E–02
Nb-95	1.E–01	Nb-95	2.E–01
Zr-95	1.E–01	Zr-95	2.E–01
Tc-99	5.E+01	Tc-99	7.E+01
Ru-103	2.E–01	Ru-103	3.E–01
Ru-106	5.E–01	Ru-106	6.E–01
Ag-108m	6.E–02	Ag-108m	7.E–02
Cd-109	2.E+01	Cd-109	3.E+01
Ag-110m	4.E–02	Ag-110m	4.E–02
Sb-124	6.E–02	Sb-124	6.E–02
I-125	4.E+00	I-125	5.E+00
Sb-125	2.E–01	Sb-125	3.E–01
I-129	2.E–01	I-129	2.E–01
I-131	4.E–01	I-131	5.E–01
Ba-133	4.E–01	Ba-133	4.E–01
Cs-134	2.E–02	Cs-134	2.E–02
Cs-137	4.E–02	Cs-137	5.E–02

TABLE D-2 continued

Mass Clearance Levels		Surficial Clearance Levels	
Radionuclide	NRC (Bq/g)	Radionuclide	NRC (Bq/cm^2)
Ce-141	4.E+00	Ce-141	4.E+00
Ce-144	3.E+00	Ce-144	4.E+00
Pm-147	9.E+02	Pm-147	1.E+03
Eu-152	9.E–02	Eu-152	1.E–01
Eu-154	8.E–02	Eu-154	1.E–01
Eu-155	9.E+00	Eu-155	1.E+01
Re-186	4.E+01	Re-186	5.E+01
Ir-192	8.E–02	Ir-192	1.E–01
Pb-210	7.E–02	Pb-210	9.E–02
Po-210	2.E–01	Po-210	2.E–01
Bi-210	3.E+02	Bi-210	4.E+02
Rn-222	1.E–01	Rn-222	1.E–01
Ra-223	6.E–01	Ra-223	6.E–01
Ra-224	2.E–01	Ra-224	2.E–01
Ac-225	7.E–01	Ac-225	8.E–01
Ra-225	6.E+00	Ra-225	7.E+00
Ra-226	6.E–02	Ra-226	7.E–02
Ac-227	3.E–02	Ac-227	4.E–02
Th-227	2.E+00	Th-227	2.E+00
Th-228	8.E–02	Th-228	9.E–02
Ra-228	1.E–01	Ra-228	1.E–01
Th-229	2.E–02	Th-229	3.E–02
Th-230	2.E–01	Th-230	2.E–01

E

Radiation Measurement

This appendix provides tutorial information about radioactivity, radiation, and their detection. It is important to understand the basic concepts of ionizing radiation, its interaction with matter, and its detection to be able to address many issues associated with the release of slightly radioactive solid material (SRSM) from regulatory control. Note that the levels of radioactive material concentration under consideration for release are very low relative to most licensed sources. In fact, these levels are close to those of the natural background radiation. As the concentration or amount of radioactive material decreases, detection and identification of the source or sources become more difficult.

First, consider some elementary but important aspects of matter. Atoms are composed of electrons that orbit around a nucleus. It is the number of electrons surrounding the nucleus that determines the chemical properties of the atom, and in an atom, the number of orbital electrons is equal to the number of protons in the nucleus, since protons are positively charged and electrons are negatively charged. Atoms gain electrons (to become anions), lose electrons (to become cations), or share electrons to form molecules. Neutrally charged particles—neutrons—also exist in the nucleus. The relative numbers of protons and neutrons play a key role in determining the stability of an atom's nucleus. Nuclei with the same number of protons but different numbers of neutrons are called isotopes.

Unstable nuclides—radionuclides—radiate particles and electromagnetic radiation when they transform to a more stable configuration. All isotopes of an element will behave the same chemically. For example, radioactive ^{60}Co will act just like stable ^{59}Co when steel is melted.

Radioactive material can be either naturally occurring or created by man. Radioactive decay is a random process. The half-life of a radionuclide is the

average time it takes for a sample of that radionuclide to reduce in quantity by one-half. The activity of a collection of radionuclides is a measure of the number of nuclear transformations per unit time occurring in a sample in units of becquerels (Bq) and curies (Ci). One becquerel is defined as one disintegrating nucleus per second. The curie is a customary unit that is equal to 3.7×10^{10} Bq. In any radiation measurement, there is a small statistical uncertainty resulting from the radioactive decay process.

It is the emitted radiation and its subsequent interaction with matter that can be detected. The type, energy, half-life, and frequency of detected radiation can be used to determine the amount of each radionuclide present in a sample. By comparing the quantity of each radionuclide present in a sample with the activity limits established from a dose standard, a determination can be made of whether the sample meets release criteria.

THE MEASUREMENT PROCESS

The method used to detect the radiation emitted from radioactive material plays an important role in determining the presence and quantity of a specific radionuclide or collection of radionuclides that are present. Two general approaches can be applied, each giving different levels of information. One method is to attempt to survey 100 percent of the material entering or leaving a facility. An example of this is the use of portal detectors to survey scrap metal entering a steel production site. The truck with a load of scrap pulls between two large detectors and slows or stops briefly while the load is "counted"; then, based on the number of counts obtained during the counting period, an essentially immediate determination is made of whether the load contains radioactive material. No attempt is made to identify or quantify the specific radionuclides that are present. An alternative method is to survey each piece of scrap metal individually, using a more sensitive detector capable of determining the identity and quantity of each of the radionuclides in the material by determining radiation type, energy, and activity. The first method has the clear advantage of being capable of a large throughput. Its major disadvantage is the inability to detect small quantities of radioactive material and its insensitivity to radiation that is easily stopped in matter. The second approach gives a very accurate and complete assessment of the radionuclide inventory (i.e., identity and quantity), but the process is tedious, leading to high personnel costs (more skilled personnel required) and low throughput. Thus, the measurement process selected will vary depending on the goal.

RADIATION TYPES AND INTERACTIONS

There are unique types and combinations of radiation emitted by individual radionuclides as they decay. This uniqueness permits identification of the radio-

nuclide that decayed from its detected radiations. The most common types of radiation are alpha particles, beta particles, and gamma rays (or photons).

An alpha particle is a helium-4 nucleus with two protons, two neutrons, and a +2 charge. Alpha particles travel only a short distance before coming to a stop, having transferred all their kinetic energy to the target material. An alpha particle can usually be stopped by 2 to 3 cm of air or one sheet of paper. After the alpha particle stops, it simply picks up two free electrons and becomes a helium atom. Alpha particles are easy to shield and, thus, are of little hazard to humans when outside the body. Conversely, when alpha particles are emitted from radionuclides within the body, all of their kinetic energy is deposited in a small amount of tissue, resulting in a large, highly localized absorbed dose.

Beta particles originate in the nucleus when a neutron transforms to a proton. Beta particles are electrons that have been given this special name to differentiate them from the atomic orbital electrons. Like alpha particles, beta particles take energy away from the nucleus. Beta particles travel a longer distance through matter than alpha particles. A typical range of a beta particle is 1 to 3 meters in air or 0.1 to 1 cm in solids and liquids.

Radionuclides emit a third type of radiation, gamma rays, which are zero-mass, zero-charge photons. Usually, gamma photons are emitted in conjunction with particle decay to rid the nucleus of the remaining excess energy. Gamma photons also interact with a target material's orbital electrons, but with very low frequency compared to the interaction frequency of charged particles. This means that gamma photons are the most penetrating of the common types of radiation. The attenuation of photon radiation is described by an exponential relationship.

The interaction of radiation with matter is extremely important in the overall assessment of the radioactive material content of an unknown sample. To successfully measure the radioactive material in a sample, radiation emitted from the decaying nuclei must be able to penetrate everything between its point of emission and the detector. The radiation must then interact within the active volume of the detector.

Some radionuclides are difficult to measure because the radiation is not very penetrating. Radionuclides emitting only alpha or beta particles fall within this category. Special procedures must be used to quantify the radioactive material content of solid materials containing alpha- and beta-particle emitters. The difficulty in assaying materials contaminated with radionuclides that emit only particle radiation is getting the radiation to the detector.

Many radionuclides that decay by emission of alpha or beta radiation also simultaneously emit one or more gamma photons. Gamma photons are very penetrating relative to particles, with the exception of low-energy photons. For radioactive materials emitting gamma photons, different detectors (from those used for alpha and beta particles) are employed depending on the purpose of the measurement.

If it were necessary to determine only whether radiation is present, a detector that responds to alpha, beta, and gamma radiation would be preferred. An example of such a detector is the Geiger-Müller (GM) detector. A GM detector is a gas-filled chamber that is coupled to an electronic circuit to detect the pulses generated by a radiation interaction within the detector's active volume. These devices are portable and inexpensive. GM instruments are often used for initial surveys, since they register detected radiation events as "counts." By knowing the details of how the measurement was made and the sample characteristics, the radioactive material concentration in the sample can be estimated.

There are many other types of radiation detectors, including ion chambers, scintillation detectors, and solid-state detectors. Ionization chambers are air-filled detectors operated in the current mode. Ion chambers are insensitive at radiation intensities associated with the proposed clearance levels. Scintillation detectors are based on detection of the small light flashes produced by radiation interactions within a scintillation material. Scintillators can be manufactured in liquid, crystal, or plastic form. Because scintillators are usually designed to respond to one type of radiation, it is possible to eliminate some radionuclides from consideration when assaying an unknown sample. Additionally, the intensity of the flash is proportional to the energy; thus, scintillation detectors can be used to gain some information on the radiation's energy.

Solid-state detectors utilizing silicon or germanium are preferred for radiation spectroscopy because of the high-energy resolution possible from these devices. Solid-state detectors are available for particle and photon measurement. When coupled with a computer and spectral analysis software, these detectors provide a powerful tool for quantifying both the activity level and the radionuclide inventory in a sample.

It is perhaps easier to illustrate radiation detection and measurement procedures using two examples. The first example is the decision process made on scrap steel entering a steel plant. The objective of the measurement is to determine whether or not the shipment contains radioactive materials. A truckload of scrap is pulled between two detectors. If activity is detected, the shipment is rejected. Usually no attempt is made to sort the scrap or investigate the cause of the radiation alarm. Since the material is scrap metal contained in a truck, any particle radiation would be shielded from the detectors by the truck wall, the other scrap metal, and the air between the truck and the detectors. If sufficient quantities of radioactive materials that emit gamma rays are present, the detectors will respond accordingly.

This example illustrates several important points. The goal in many cases is to determine the presence or absence of radioactivity in a large amount of material. In order to maximize the probability of detection of the radiation from any radioactive materials present, the measurement system must be optimized, usually by the use of large gamma scintillation detectors. The go/no go type of

system gives no information about the radionuclide inventory in the shipment, since the detectors used are not capable of providing sufficient data for radionuclide identification and the parameters necessary to convert from counts per unit time to activity are unknown.

A second hypothetical example is a U.S. Nuclear Regulatory Commission (USNRC) licensee who has a quantity of concrete for disposal that is probably not radioactive. However, the licensee is aware of the possibility that the concrete may have been irradiated with neutrons that would have created some radionuclides. External measurements with a survey instrument indicate that the activity, if present at all, is about at the background level. Thus, the problem is to determine whether the concrete contains neutron-produced radionuclides or only naturally occurring radionuclides. Since it would be reasonable to assume that neutrons could penetrate deeply into the concrete, it would follow that radionuclides could have been produced within the concrete, not just on its surface. An additional assumption would be that a wide variety of radionuclides could have been produced.

A solution would be to perform a measurement of the concrete in a laboratory. This requires collection of a statistically representative group of samples from the batch of concrete. Each sample would be analyzed carefully using standard methods to determine the radionuclides present and their respective activities. One method would be to crush the concrete to a fine powder and then count small volumes of the powder to eliminate source self-shielding, making it possible to determine if alpha or beta radiation is present. Spectroscopy could then be utilized to gather the data to determine the energies and intensities of each radiation type. Analysis of the data would yield a complete radionuclide inventory and determine whether any of the detected radionuclides were produced by neutron activation or whether they were naturally occurring.

This second example illustrates the difficulty with a quantitative assay of volumetrically contaminated or irradiated materials. Although exact activity inventory determinations are possible (and routinely performed), they utilize specialized, nonportable instrumentation in a laboratory environment. Such an analysis may take several weeks to complete at a fairly high cost (relative to simple scanning of materials). Thus, it is not realistic to anticipate that this type of analysis would be performed in most high-volume, high-throughput manufacturing processes.

BACKGROUND RADIATION

Background radiation is present in every counting situation. It results from several different sources, including naturally occurring radioactive materials, cosmic radiation, and man-made radionuclides from weapons tests. Some naturally occurring radionuclides have long half-lives, often more than a billion years. These are residual isotopes that were once present in much larger abundances but

have slowly decayed with time. Examples of these include ^{40}K, ^{147}Sm, and ^{235}U. Other naturally occurring radionuclides are produced by activation by cosmic-ray bombardment of stable isotopes. An example of this is the production of radioactive ^{14}C from stable ^{14}N. Table E-1 gives some specific examples of background and man-made source activities. Since the distribution of radionuclides varies around the world depending on the geology of the area, some of these activities represent typical numbers. All detection systems must account for and subtract background levels to obtain true sample radioactive material concentrations.

TABLE E-1 Radiation Sources and Their Activities

Radiation Source	Radioactivity (Bq)
70 kg adult human (male) ^{40}K[a]	~5,000
1 kg of fresh vegetables[a]	10
1 kg of super phosphate fertilizer[b]	5,000
Air inside 2000 ft^2 home (radon) (593 m^3)[a]	36,000
Household smoke detector[b]	3,700-110,000
Radionuclide for medical diagnosis[c]	11-740 $\times 10^6$
Radionuclide source for medical therapy[d]	3.7×10^{14}
1 kg natural uranium[a]	24×10^6
1 kg low-level radioactive waste (Class A, ^{137}Cs)[e]	4×10^7
1 kg of coal fly ash[b]	150-410
1 kg of granite (U, Th, K)[b]	72

[a]National Council on Radiation Protection and Measurements (NCRP) Report No. 94 (NCRP, 1987b).
[b]NCRP Report No. 95 (NCRP, 1987d).
[c]NCRP Report No. 100 (NCRP, 1989a).
[d]NCRP Report No. 105 (NCRP, 1989b).
[e]10 CFR Part 61.55

F

Stakeholder Reactions to the USNRC Issues Paper

This appendix describes alternative points of view expressed by a range of stakeholders responding to the U.S. Nuclear Regulatory Commission's (USNRC's) issues paper (64 Federal Register 35090-35100; June 30, 1999). The appendix is illustrative: it does not cover all groups with an opinion, nor does it cover all possible opinions (for this one should consult NUREG/CR-6682; USNRC, 2000d). In general, the committee found that positions taken by stakeholder groups on the alternatives presented in the USNRC's issues paper were often similar to those expressed when the below regulatory concern (BRC) policy was discussed 10 years earlier.

USNRC EFFORTS AT STAKEHOLDER INVOLVEMENT

Background

As the initial step in this process, the USNRC solicited comment on its June 30, 1999, issues paper (64 Federal Register 35090-35100; "Release of Solid Materials at Licensed Facilities: Issues Paper, Scoping Process for Environmental Issues and Notice of Public Meetings"), noting that it was the initial step in an

NOTE: Some of the displayed quotes in this appendix were recorded at the Rockville public meeting on May 9, 2000; others were from oral or written statements to the committee on March 26 and 27, 2001.

"enhanced participatory process" in which the USNRC would seek public input into its decision-making process (USNRC, 2000a). The envisioned participatory process would consist of various forums, invited written comments on the paper, and a Web site that contained the issues paper and other materials and invited public comment. The cornerstone of the enhanced process was four public meetings to provide stakeholder groups and the public an opportunity to learn about the USNRC's issues paper effort and respond to it.

The four sites for the meetings, held in 1999, included San Francisco, California (September 15-16); Atlanta, Georgia (October 5-6); Rockville, Maryland (November 1-2); and Chicago, Illinois (December 7-8). Despite numerous other attendees, public interest groups (such as environmental advocacy groups) did not attend the first two meetings. These groups provided a letter explaining why they would not attend. The last two meetings were attended by only a few of these interest group representatives; the others continued to boycott the public meetings. Although the USNRC had obtained more than 800 comment letters by December 2000, efforts by some groups to extend the comment period were denied by the USNRC (USNRC, 2000a). A public meeting in Rockville, Maryland, on May 9, 2000, was attended by a variety of public interest groups, including some that had boycotted earlier meetings with the USNRC (USNRC, 2000c). The May 2000 Rockville meeting between the USNRC and stakeholder groups was designed to "provide an opportunity to deal with a range of different people who have – reflect the diversity of views on this issue" (USNRC, 2000c, p. 2). Three panels were headed by the chairman of the USNRC and were conducted with some opportunity for presenters to enter a dialogue with commissioners. The summary of the public meetings and written comments (USNRC, 2000d) and the proceedings from the Rockville stakeholder-Commission meeting (USNRC, 2000c) form two of four databases for this appendix. The other two include the summary of public comments at the four public meetings, NUREG/CR-6682 (USNRC, 2000d), just prior to the May 9, 2000, Rockville dialogue and various presentations made to this committee by different stakeholder groups including nuclear industry groups, agreement states, environmental interest groups, and others from the metals and concrete industries.

The USNRC (2000a) staff report, SECY-00-0070, and the ICF Kaiser report (USNRC, 2000d) are the two major summaries of all 900 (written) comments as well as additional oral comments. Both efforts adequately provide the reader with the range of responses to the issues paper categories, but they do not offer a sense of the intensity of the views expressed. In addition, both SECY-00-0070 and the ICF Kaiser report tie comments and analyses back to the preexisting issues paper categories (process alternatives and technical approach categories). The difficulty of adequately summarizing and analyzing these comments (without some sort of weighting, content analysis, and/or statistical analysis) is clearly evident in the documents.

Approach

The approach adopted in this report deviates from these two prior efforts in that it identifies stakeholder opinions without deliberate attempt to tie the opinions back to categories identified in the issues paper. As a result, some opinions correlate well with issues paper categories and some do not. The rationale for this approach is to avoid the misperception that all comments made correlate perfectly with categories identified in the issues paper; clearly, some stakeholders' opinions contravene issues-paper-defined categories, while others embody categories not originally envisioned by the issues paper (for a review of the stakeholder positions relative to issues paper categories, refer to Chapter 8, Table 8-1).

The approach utilized is a qualitative analysis of data obtained from presentations made directly to the study committee (see Appendix B for a complete list of presenters) and from the Rockville meeting. The perspectives that developed from the committee's analysis were then confirmed by reviewing both the ICF summary report and the USNRC staff report to the commissioners summarizing the input from all of the hearings.

The committee's approach was to extract remarks and aggregate them into categories that demonstrate gradations of opinion. These gradations ranged from no clearance to support for a specific release standard. The gradations identified are the following:

- Cannot support release (clearance) for recycle or disposal;
- Cannot engage in a dialogue with the USNRC because the dialogue process is itself tainted;
- Recommend delaying a decision on whether to conduct a rulemaking until public comments can be integrated into the USNRC's decision framework;
- Recommend restricted release (conditional clearance);
- Recommend continuing case-by-case, but with uniform national dose-based criteria; and
- Recommend setting a specific clearance standard, but with some exceptions for special groups such as the metals recycling industry.

Each of these gradations is discussed further below. In addition, options are discussed that fall outside those originally envisioned by the USNRC, which nonetheless need to be identified and considered.

Stakeholder Positions

Cannot Support Release for Recycle or Disposal

Illustrative stakeholders in this category consisted of environmental public interest groups (Nuclear Information and Resource Service, Public Citizen, New

England Coalition on Nuclear Pollution), which generally believe that the solid materials should be "regulated, monitored, and isolated from general commerce."[1] These stakeholders tended to share the following perceptions:

- The U.S. Nuclear Regulatory Commission already has a position (i.e., a free release standard that it hopes to promulgate), and the public involvement process is just that—a process, not a meaningful dialogue.
- Multiple and synergistic effects are possible from a release that is recycled into numerous sources for public use, and these effects have not been well characterized by the USNRC or any scientific body.
- The USNRC consistently uses so-called scientific evidence to justify the bases for its decisions, even though reasonable people might (and often do) disagree as to whether these bases can be substantiated.
- Releases of radioactive materials cannot be tracked or otherwise controlled, thereby raising doubts about the role they could play in the stream of commerce not only during their initial use but also during any subsequent uses.
- The USNRC role in developing a standard is self-perpetuating in that the USNRC is attempting to justify its position by "punting"[2] to an international standard that the USNRC itself had a role in creating.
- The fact that some radioactive materials already exist in the stream of commerce (whether natural or man-made) is not sufficient to justify additional releases.
- The USNRC's true intent is economic, that is, to enable recycling of large amounts of contaminated material, which will benefit no one but the nuclear industry.
- The USNRC should seriously consider a "no-release" option; however, no group stated a specific, preferred process or technical alternative for how the materials should be treated, other than to request development of a scenario by which the materials would not be released.

Two observations are offered based on these comments:

- Stakeholder viewpoints reflect an overall lack of trust in the USNRC.
- Since most stakeholders assumed that the USNRC's true objective is to recycle the material, they were taken aback when asked whether removing recycling from the equation would make a difference. Most indicated that it would, in fact, make a significant difference in the degree of their opposition to the proposed rulemaking.

[1]Oral testimony of Dianne D'Arrigo, Nuclear Information and Resource Service, Rockville public meeting. May 9, 2000.
[2]Oral testimony of Wenonah Hauter, Public Citizen, Rockville public meeting. November, 1999.

"Your job is to prevent exposures to the public and the environment—not convince us that it's a trivial amount." —*Wenonah Hauter, Public Citizen*

"Informed and concerned citizens may choose to remove themselves from the vicinity of nuclear facilities. No such information and no such choice exists when contaminated materials are free-released for recycle."

—*New England Coalition on Nuclear Power*

Cannot Engage in a Dialogue with the USNRC Because the Dialogue Process Is Itself Tainted

Illustrative stakeholders in this category consisted of a public interest group, Public Citizen, and the Allied Industrial Chemical and Energy Workers Union. These stakeholders shared most or all of the concerns noted above and additionally rejected the process and technical framework set forth by the USNRC. These stakeholders tended to perceive the following:

- The USNRC is asking the wrong question and may thus be avoiding discussion of all possible options and alternatives. To these stakeholders, the question is not, Should we conduct a rulemaking—why or why not? Rather, it is, Can we have an honest dialogue that would enable consideration of all the options and alternatives—even those options and alternatives that the USNRC dislikes?
- The USNRC and the National Academy of Sciences (NAS) through the National Research Council both mistakenly believe the primary issues to be technical issues involving formulation, in the abstract, of some notional dose that ensures public health and safety, whereas the real issue is that the USNRC has an "empirical record of institutional incompetence"[3] that shows a startling incapacity to technically abide by public protection standards."[4]
- The real task is for the NAS to undertake a thorough public review of whether the Department of Energy (DOE) and its contractors cannot reasonably be relied on by the public to abide by whatever radiation protection standards might, in the abstract, appear reasonable.
- Although the USNRC does not regulate DOE facilities, any standard adopted by the USNRC would in fact be implemented by DOE, since DOE is perceived to be the prime promoter of the unrestricted release of contaminated metals.[5]

[3]Oral remarks by Dan Guttman to the committee, March 27, 2001.
[4]Written testimony of Dan Guttman, presented to the committee March 27, 2001, p. 3.
[5]Ibid, p. 17. This theme was also reflected in testimonies to the committee by other public interest groups.

Two observations emerge from these comments:

1. The groups in this category do not believe that it is possible to engage in a dialogue until other issues of whether or not the USNRC can reliably protect public health and safety are resolved.
2. Again, since most stakeholders assumed that the USNRC's true objective is to recycle the material, they were taken aback when asked whether removing recycling from the equation would make a difference. Most indicated that it would, in fact, make a significant difference in the degree of their opposition to the proposed rulemaking.

"Why did the NAS—an entity with essential responsibility for vouchsafing the integrity of scientific advice to the nation—accept without any evident question a framework for its work which it knew, or should have known, effectively excluded from inquiry most important facts bearing on the protection of the public?"

—*Dan Guttman*

Recommend Delaying a Decision on Whether to Conduct a Rulemaking Until Public Comments Can Be Integrated into the USNRC's Decision Framework

Illustrative stakeholders in this category include groups as diverse as the scrap recycling industry, the Natural Resources Defense Council (NRDC), the Association of Radioactive Metals Recyclers (ARMR), and the Association of State and Territorial Solid Waste Management Officials (ASTWMO). They believe that the question of whether to conduct a rulemaking should be delayed in order to obtain substantive representation from all the affected stakeholders—that is, to incorporate the stakeholders' viewpoints into the decision framework. Stakeholders in this category generally tended to perceive the following:

- While it is possible to arrive at a defensible, scientific standard, the thought of radioactive materials entering the recycling stream elicits strong fears and concerns on the part of the public.
- The USNRC's investigation should focus not only on the technical issues but also on understanding and integrating public concerns into the overall process.
- As the NRDC suggested, the USNRC is unwilling or unable to explain the basis for its position, and fundamental questions should be answered as to (1) why contaminated solid materials had to be recycled in the first place and (2) how the USNRC would propose to regulate these materials in a way that protects public health and safety.

Specific suggestions were also made, as follows:

- ASTWMO[6] suggested that the USNRC itself might not have explored all the consequences of a rulemaking such as the following:
  —Would rulemaking consume fewer resources than continuing to use case-by-case?
  —Would the increased credibility of the USNRC resulting from delaying the process be of more benefit than making a rule?
  —How important is the rule to licensees?
  —What are the economics of the problem?
- ARMR[6] suggested that a demonstration plan acceptable to both industry and the public should be developed; this plan should be the collaborative work of key stakeholders to gain their acceptance for determining impacts (e.g., to an industry).
- ARMR[6] suggested that the appropriate next step in the USNRC's process would be to convene a balanced stakeholder committee that would report to the USNRC and would provide it with criteria for acceptable release, recycle, and reuse.
- These comments suggest that the stakeholders generally felt that no step in the USNRC's public outreach process had thus far been able to represent and integrate stakeholder concerns into the decision framework.

"It's not that the public doesn't understand—it's just that they have a different perspective based on risk and government credibility.

—Jeff Deckler,Department of Human Health and Environment for the State of Colorado, representing ASTSWMO

"If you were going into end uses that were very clear and controlled, and we had confidence in how the material was being surveyed and how measurements were being made, what you're proposing is something we might consider."

—Natural Resources Defense Council

Recommend Restricted Release (Conditional Clearance)

Illustrative stakeholders in this category included the metals and concrete industries. Both expressed serious concerns about the potential economic damage to their markets from free release. Both support a restricted use concept, in which

[6]The only group on record that took this position.

solid waste re-use would be limited to selected purposes and subject to a high degree of control.

The concrete industry (National Ready Mixed Concrete Association) generally perceives the following:

- Unrestricted release would force both the ready-mixed concrete producer and the consumer to assume liability or cost for potentially contaminated materials.
- Unrestricted use of contaminated materials could put an extreme burden on unqualified handlers of radioactive materials, such as ready-mixed concrete producers.
- It would be difficult to conceive of unrestricted use of contaminated concrete, since recycled concrete—whether contaminated or not—does not have the best record in the construction industry.
- Unrestricted widespread use of any of the solid materials from licensed facilities is unacceptable.
- Restricted use should be defined to include only single point users where contact for exposure of the general population is minimal; examples could include non-water supply concrete dams for flood control, deep concrete foundations, or concrete containment facilities used as licensed storage facilities.
- Restricted use should entail licensing these facilities as low-level waste facilities.

Illustrative stakeholders in the metals industry included the Steel Manufacturers Association, the American Iron and Steel Institute, and the Metals Industry Recycling Coalition. They generally perceived the following:

- Radioactively contaminated scrap has no value and could in fact contribute to economic losses for scrap recyclers, since free release could damage the market for steel products by eroding public confidence in the safety of steel products.
- Free release could also add substantially to costs by forcing steel mills to go to extremes to protect against volumetrically contaminated materials that could cause a radioactive melt; recycling is viewed by the industry as a way for DOE to shift responsibility to the mills; and if sensor alarms go off too frequently, they may be ignored by employees—even if the alarm is truly warranted.
- No unrestricted release of any contaminated radioactive steel or other metals should be permitted from USNRC-licensed facilities, even if the steel meets dose-based release levels that the committee might recommend and the USNRC adopt.

- Material should be reused by DOE, stored or disposed on-site at the licensed facility, or disposed of off-site.
- Products from a licensed facility that are to be used for their original purpose off-site could be released without special restrictions if they meet a dose-based standard; those not used for their original purpose could be released to landfills or for dedicated nuclear-related uses such as at USNRC-licensed or DOE facilities.

The following observations were made by spokespeople for the metals and concrete industries: both industries made a useful distinction between recycling and disposal, and it is recycling that poses the perceived economic threat to them.

"The last thing the [metals] industry needs is to have a release standard that allows thousands or potentially millions of tons of steel that will meet the release standard but exceed our detectors coming into the mills. It will essentially shut down our ability to control for orphan sources."

—John Wittenborn, Metals Industry Recycling Coalition

"Faced with the challenges of closing licensed facilities and handling contaminated concrete, it is logical to conclude that a rule regarding release of contaminated materials from licensed sites should be made. It is not, however, an adequate conclusion in our opinion that these materials should be placed in unrestricted use or even restricted use without further definition. Concrete, as several other construction materials, is ubiquitous to our society. The concept of concrete framed buildings across the United States being made with radioactive materials housing millions of people exposing them to potential radioactive material greater than background exposure is contrary to the charter of the NRC."

—Robert A. Garbini, National Ready Mixed Concrete Association

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Recommend Continuing Case by Case, but with Uniform National Dose-Based Criteria

Several individual states and the Organization of Agreement States (OAS) gave the committee information regarding their views and activities related to clearance of slightly radioactive solid material (SRSM). The OAS recommended the development of standards that would apply nationally and felt that the standards should address "free release" of material for unrestricted use. It commented that the approach should be "similar to the USNRC's tiered approach for license termination." It was suggested that consideration be extended to radioactive materials generated from technologically enhanced naturally occurring radioactive

material (TENORM) and naturally occurring and accelerator-produced radioactive material (NARM) sources.

In general, states have been applying case-by-case decisions to radioactive materials that are considered for alternative disposal, reuse, recycle, or clearance from the regulatory process. They have done so under their agreement states' authority and existing regulations. It seemed clear to the committee that while this process has been ongoing, a more formal and uniform process would be desirable.

Illustrative stakeholders in this group were the Conference of Radiation Control Program Directors (CRCPD) and the Organization of Agreement States,[7] which suggested continuing the case-by-case approach but using uniform, national dose-based criteria. The CRCPD and OAS see the main limiting factor under the current case-by-case approach as licensees' using different survey equipment with different detection limits, leading to inconsistencies in the overall approach. The CRCPD and OAS position suggested that states want a more consistent application of criteria, as well as uniform criteria. They proposed that because a value of 1 mrem/yr is not only a trivial dose but also the basis for the American National Standards Institute (ANSI) standard, it readily suggests itself as an easy common denominator.

Recommend Setting a Specific Clearance Standard, but with Some Exceptions for Special Groups Such as the Metals Recycling Industry

Illustrative stakeholders in this category included the Health Physics Society, the Nuclear Energy Institute, the American Nuclear Society's Special Committee on Site Restoration and Cleanup Standards, and the CRCPD E-23 Committee on Resource Recovery and Radioactivity. These stakeholders generally shared in the following perceptions:

- Lack of a consistent acceptance criteria provides inconsistent public protection, undermines public confidence, wastes resources, and perpetuates liability.
- In the absence of a clearance standard, there may be some wastage of potentially recyclable materials.
- Regulatory Guide 1.86 (AEC, 1974) contains surface contamination guidelines only (no volumetric criteria) and is not dose based.
- Current regulations are inconsistently applied.
- Current regulations do not cover recycling.

[7]Testimony of Steve Collins, Illinois Department of Nuclear Safety, representing both organizations, at USNRC, May 9, 2000.

- Current regulations are inconsistent with the standards adopted by the international community.
- A national clearance standard should be developed through rulemaking and should embrace ANSI N13.12 because it is a consensus standard, uses the same dose criteria as the International Atomic Energy Agency, uses practical screening values, can be verified with available instruments, and would establish a "floor." To these ends, the standard should be expedited for direct reuse and direct disposal.
- The steel recycling industry deserves special consideration because orphaned sources are a risk to public health, steel workers, and the steel industry.[8]
- There is a need to distinguish "disposal" from "recycle."
- The following observation is based on the points above; even those stakeholders who essentially support the development of a specific clearance standard would argue for special consideration to be given to the metals industry.

"We continue to advocate for the eventual promulgation of clear, consistent and enforceable regulations based upon a one millirem annual dose criterion and nuclide specific concentration guidelines."

—*Kathleen McAllister, Committee on Resource Recovery and Radioactivity*

Options Beyond Those Originally Envisioned by the USNRC Have to Be Identified and Considered in Any Further Stakeholder Involvement Process.

As can be seen from the matrix in Table 8-1, all stakeholder opinions do not neatly line up with process and technical alternatives initially envisioned by the USNRC in its issues paper, notably the section of the matrix that refers to "other" alternatives. This category includes the following:

- Groups who felt strongly that there should be no release but were not prepared to formulate specific no-release scenarios;
- Groups who essentially supported a rulemaking but who felt that the rulemaking should be delayed until all public comments have been integrated into the USNRC's decision framework; and

[8]The special exception for metals recyclers (and others such as the concrete industry) was not uniformly shared. Written testimony of Kathleen McAllister, chair, CRCPD E-23 Committee on Resource Recovery and Radioctivity, to the committee on March 27, 2001: "Despite inconveniences caused to them. . . . [i]t is reasonable to assume that landfills and scrap recycling yards, as well as municipal public sewer facilities, and possibly concrete facilities will take it upon themselves to install radiation monitoring equipment . . . ." p. 3.

- Groups who were unwilling to engage in discussion of "new" issues surrounding the release of solid materials until the "old" issues involving lack of public trust and confidence in the USNRC's ability to protect the public can be resolved.

The USNRC had expected to receive comments on the issues paper that would offer new options and alternatives. In this light, the discussion of stakeholder views above and the matrix of options in Chapter 8 may be of some value in framing other options and alternatives.

G

Acronyms and Glossary

ACRONYMS

AEA	Atomic Energy Act of 1948, as amended in 1954
AEC	U.S. Atomic Energy Commission
ALARA	as low as is reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARMR	Association of Radioactive Metals Recyclers
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BEIR	Committee on the Biological Effects of Ionizing Radiation
BRC	below regulatory concern
BSS	Basic Safety Standards (EC)
BWR	boiling water reactor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	U.S. Code of Federal Regulations
CNWRA	Center for Nuclear Waste Regulatory Analyses
CRCPD	Conference of Radiation Control Program Directors
DCGL	derived concentration guideline level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
dpm	disintegrations per minute
DU	depleted uranium

EC	European Commission
EMC	elevated measurement comparison
EPA	U.S. Environmental Protection Agency
ERDA	U.S. Energy Research and Development Administration
EU	European Union
GM	Geiger-Müller
GSD	geometric standard deviation
HPGe	high-purity germanium
HPS	Health Physics Society
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IE	Office of Inspection and Enforcement (USNRC)
INSC	International Nuclear Societies Council
ISFSI	independent spent fuel storage installation
LLRW	low-level radioactive waste
LLWPAA	Low Level Radioactive Waste Policy Amendments Act of 1985
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
MDC	minimum detectable concentration
NARM	naturally occurring and accelerator-produced radioactive material
NAS	National Academy of Sciences (U.S.)
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NORM	naturally occurring radioactive material
NPL	National Priorities List
NRC	National Research Council
NRDC	Natural Resources Defense Council
OAS	Organization of Agreement States
ppm	part per million
PRA	probabilistic risk assessment
PWR	pressurized water reactor
RCRA	Resource Conservation and Recovery Act
SAIC	Science Applications International Corporation
SCA	Sanford Cohen & Associates, Inc.
SDMP	Site Decommissioning Management Plan
SI	international system of units
SRSM	slightly radioactive solid material

TEDE	total effective dose equivalent
TENORM	technologically enhanced naturally occurring radioactive materials
TSD	technical support document
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USACE	U.S. Army Corps of Engineers
USNRC	U.S. Nuclear Regulatory Commission

GLOSSARY

agreement state — Section 274 of the AEA authorizes the Commission to enter into an effective agreement with the governor of a state to allow that state to assume the USNRC's authority to regulate certain types of materials licensees only. Reactor licensees remain the exclusive domain of the USNRC. Today there are 32 agreement states, which have implemented state regulations that are equivalent and compatible with the USNRC's regulations, as required by section 274(d) of the AEA. The materials licensees that a state can regulate include those that use or possess source material, byproduct material or special nuclear material in quantities not sufficient to form a critical mass (less than 350 grams for uranium-235).

de minimis — Shortened form of *de minimis non curat lex*, which is Latin for the common law doctrine stating, in free translation, that "the law does not concern itself with trifles." A *de minimis* amount of something (e.g., a dose) is one at or below which statutory or regulatory controls on larger amounts would not apply.

11(e)2 materials — Materials defined in section 11(e)(2) of the Atomic Energy Act (AEA) of 1954, as amended to be the tailings or waste produced by the concentration or extraction of uranium or thorium ore processed primarily for its source content. This definition was added in a 1978 by section 201 of the Uranium Mill Tailings Radiation Control Act, which amended the AEA.

--H.R.776--

H.R.776

One Hundred Second Congress of the United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Friday, the third day of January,

one thousand nine hundred and ninety-two

An Act

To provide for improved energy efficiency.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE- This Act may be cited as the `Energy Policy Act of 1992'.

(b) TABLE OF CONTENTS-

TITLE IV--ALTERNATIVE FUELS--NON-FEDERAL PROGRAMS

TITLE V--AVAILABILITY AND USE OF REPLACEMENT FUELS, ALTERNATIVE FUELS, AND ALTERNATIVE FUELED PRIVATE VEHICLES

TITLE VII--ELECTRICITY

Subtitle A--Exempt Wholesale Generators

Subtitle B--Federal Power Act; Interstate Commerce in Electricity

Subtitle C--State and Local Authorities

TITLE VIII--HIGH-LEVEL RADIOACTIVE WASTE

TITLE XII--RENEWABLE ENERGY

TITLE XIII--COAL

Subtitle A--Research, Development, Demonstration, and Commercial Application

Subtitle B--Clean Coal Technology Program

Subtitle C--Other Coal Provisions

TITLE XIV--STRATEGIC PETROLEUM RESERVE

TITLE XV--OCTANE DISPLAY AND DISCLOSURE

TITLE XVI--GLOBAL CLIMATE CHANGE

TITLE XVII--ADDITIONAL FEDERAL POWER ACT PROVISIONS

TITLE XVIII--OIL PIPELINE REGULATORY REFORM

TITLE XX--GENERAL PROVISIONS; REDUCTION OF OIL VULNERABILITY

Subtitle A--Oil and Gas Supply Enhancement

Subtitle B--Oil and Gas Demand Reduction and Substitution

TITLE XXI--ENERGY AND ENVIRONMENT

Subtitle A--Improved Energy Efficiency

TITLE XXIII--POLICY AND ADMINISTRATIVE PROVISIONS

TITLE XXIV--NON-FEDERAL POWER ACT HYDROPOWER PROVISIONS

TITLE XXV--COAL, OIL, AND GAS

TITLE XXVI--INDIAN ENERGY RESOURCES

TITLE XXVII--INSULAR AREAS ENERGY SECURITY

TITLE XXVIII--NUCLEAR PLANT LICENSING

TITLE XXIX--ADDITIONAL NUCLEAR ENERGY PROVISIONS

TITLE XXX--MISCELLANEOUS

Subtitle A--General Provisions

Subtitle B--Other Miscellaneous Provisions

SEC. 2. DEFINITION.

For purposes of this Act, the term `Secretary' means the Secretary of Energy.

TITLE I--ENERGY EFFICIENCY

Subtitle A--Buildings

SEC. 101. BUILDING ENERGY EFFICIENCY STANDARDS.

(a) IN GENERAL- Title III of the Energy Conservation and Production Act (42 U.S.C. 6831 et seq.) is amended--

(1) in section 303--

(A) by striking paragraph (9);

(B) by redesignating paragraphs (10), (11), (12), and (13) as paragraphs (9), (10), (11), and (12), respectively; and

(C) by adding at the end the following new paragraphs--

`(13) The term `Federal building energy standards' means energy consumption objectives to be met without specification of the methods, materials, or equipment to be employed in achieving those objectives, but including statements of the requirements, criteria, and evaluation methods to be used, and any necessary commentary.

`(14) The term `voluntary building energy code' means a building energy code developed and updated through a consensus process among interested persons, such as that used by the Council of American Building Officials; the American Society of Heating, Refrigerating, and Air-Conditioning Engineers; or other appropriate organizations.

`(15) The term `CABO' means the Council of American Building Officials.

`(16) The term `ASHRAE' means the American Society of Heating, Refrigerating, and Air-Conditioning Engineers.'; and

(2) by striking sections 304, 306, 308, 309, 310, and 311 and inserting the following:

`SEC. 304. UPDATING STATE BUILDING ENERGY EFFICIENCY CODES.

`(a) CONSIDERATION AND DETERMINATION RESPECTING RESIDENTIAL BUILDING ENERGY CODES- (1) Not later than 2 years after the date of the enactment of the Energy Policy Act of 1992, each State shall certify to the Secretary that it has reviewed the provisions of its residential building code regarding energy efficiency and made a determination as to whether it is appropriate for such State to revise such residential building code provisions to meet or exceed CABO Model Energy Code, 1992.

`(2) The determination referred to in paragraph (1) shall be--

`(A) made after public notice and hearing;

`(B) in writing;

`(C) based upon findings included in such determination and upon the evidence presented at the hearing; and

`(D) available to the public.

`(3) Each State may, to the extent consistent with otherwise applicable State law, revise the provisions of its residential building code regarding energy efficiency to meet or exceed CABO Model Energy Code, 1992, or may decline to make such revisions.

`(4) If a State makes a determination under paragraph (1) that it is not appropriate for such State to revise its residential building code, such State shall submit to the Secretary, in writing, the reasons for such determination, and such statement shall be available to the public.

`(5)(A) Whenever CABO Model Energy Code, 1992, (or any successor of such code) is revised, the Secretary shall, not later than 12 months after such revision, determine whether such revision would improve energy efficiency in residential buildings. The Secretary shall publish notice of such determination in the Federal Register.

`(B) If the Secretary makes an affirmative determination under subparagraph (A), each State shall, not later than 2 years after the date of the publication of such determination, certify that it has reviewed the provisions of its residential building code regarding energy efficiency and made a determination as to whether it is appropriate for such State to revise such residential building code provisions to meet or exceed the revised code for which the Secretary made such determination.

`(C) Paragraphs (2), (3), and (4) shall apply to any determination made under subparagraph (B).

`(b) CERTIFICATION OF COMMERCIAL BUILDING ENERGY CODE UPDATES- (1) Not later than 2 years after the date of the enactment of the Energy Policy Act of 1992, each State shall certify to the Secretary that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency. Such certification shall include a demonstration that such State's code provisions meet or exceed the requirements of ASHRAE Standard 90.1-1989.

`(2)(A) Whenever the provisions of ASHRAE Standard 90.1-1989 (or any successor standard) regarding energy efficiency in commercial buildings are revised, the Secretary shall, not later than 12 months after the date of such revision, determine whether such revision will improve energy efficiency in commercial buildings. The Secretary shall publish a notice of such determination in the Federal Register.

`(B)(i) If the Secretary makes an affirmative determination under subparagraph (A), each State shall, not later than 2 years after the date of the publication of such determination, certify that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency in accordance with the revised standard for which such determination was made. Such certification shall include a demonstration that the provisions of such State's commercial building code regarding energy efficiency meet or exceed such revised standard.

`(ii) If the Secretary makes a determination under subparagraph (A) that such revised standard will not improve energy efficiency in commercial buildings, State commercial building code provisions

regarding energy efficiency shall meet or exceed ASHRAE Standard 90.1-1989, or if such standard has been revised, the last revised standard for which the Secretary has made an affirmative determination under subparagraph (A).

`(c) EXTENSIONS- The Secretary shall permit extensions of the deadlines for the certification requirements under subsections (a) and (b) if a State can demonstrate that it has made a good faith effort to comply with such requirements and that it has made significant progress in doing so.

`(d) TECHNICAL ASSISTANCE- The Secretary shall provide technical assistance to States to implement the requirements of this section, and to improve and implement State residential and commercial building energy efficiency codes or to otherwise promote the design and construction of energy efficient buildings.

`(e) AVAILABILITY OF INCENTIVE FUNDING- (1) The Secretary shall provide incentive funding to States to implement the requirements of this section, and to improve and implement State residential and commercial building energy efficiency codes. In determining whether, and in what amount, to provide incentive funding under this subsection, the Secretary shall consider the actions proposed by the State to implement the requirements of this section, to improve and implement residential and commercial building energy efficiency codes, and to promote building energy efficiency through the use of such codes.

`(2) There are authorized to be appropriated such sums as may be necessary to carry out this subsection.

`SEC. 305. FEDERAL BUILDING ENERGY EFFICIENCY STANDARDS.

`(a)(1) IN GENERAL- Not later than 2 years after the date of the enactment of the Energy Policy Act of 1992, the Secretary, after consulting with appropriate Federal agencies, CABO, ASHRAE, the National Association of Home Builders, the Illuminating Engineering Society, the American Institute of Architects, the National Conference of the States on Building Codes and Standards, and other appropriate persons, shall establish, by rule, Federal building energy standards that require in new Federal buildings those energy efficiency measures that are technologically feasible and economically justified. Such standards shall become effective no later than 1 year after such rule is issued.

`(2) The standards established under paragraph (1) shall--

`(A) contain energy saving and renewable energy specifications that meet or exceed the energy saving and renewable energy specifications of CABO Model Energy Code, 1992 (in the case of residential buildings) or ASHRAE Standard 90.1-1989 (in the case of commercial buildings);

`(B) to the extent practicable, use the same format as the appropriate voluntary building energy code; and

`(C) consider, in consultation with the Environmental Protection Agency and other Federal agencies, and where appropriate contain, measures with regard to radon and other indoor air pollutants.

`(b) REPORT ON COMPARATIVE STANDARDS- The Secretary shall identify and describe, in the report required under section 308, the basis for any substantive difference between the Federal building energy standards established under this section (including differences in treatment of energy efficiency and renewable energy) and the appropriate voluntary building energy code.

`(c) PERIODIC REVIEW- The Secretary shall periodically, but not less than once every 5 years, review the Federal building energy standards established under this section and shall, if significant energy savings would result, upgrade such standards to include all new energy efficiency and renewable energy measures that are technologically feasible and economically justified.

`(d) INTERIM STANDARDS- Interim energy performance standards for new Federal buildings issued by the Secretary under this title as it existed before the date of the enactment of the Energy Policy Act of 1992 shall remain in effect until the standards established under subsection (a) become effective.

`SEC. 306. FEDERAL COMPLIANCE.

`(a) PROCEDURES- (1) The head of each Federal agency shall adopt procedures necessary to assure that new Federal buildings meet or exceed the Federal building energy standards established under section 305.

`(2) The Federal building energy standards established under section 305 shall apply to new buildings under the jurisdiction of the Architect of the Capitol. The Architect shall adopt procedures necessary to assure that such buildings meet or exceed such standards.

`(b) CONSTRUCTION OF NEW BUILDINGS- The head of a Federal agency may expend Federal funds for the construction of a new Federal building only if the building meets or exceeds the appropriate Federal building energy standards established under section 305.

`SEC. 307. SUPPORT FOR VOLUNTARY BUILDING ENERGY CODES.

`(a) IN GENERAL- Not later than 1 year after the date of the enactment of the Energy Policy Act of 1992, the Secretary, after consulting with the Secretary of Housing and Urban Development, the Secretary of Veterans Affairs, other appropriate Federal agencies, CABO, ASHRAE, the National Conference of States on Building Codes and Standards, and any other appropriate building codes and standards organization, shall support the upgrading of voluntary building energy codes for new residential and commercial buildings. Such support shall include--

`(1) a compilation of data and other information regarding building energy efficiency standards and codes in the possession of the Federal Government, State and local governments, and industry organizations;

`(2) assistance in improving the technical basis for such standards and codes;

`(3) assistance in determining the cost-effectiveness and the technical feasibility of the energy efficiency measures included in such standards and codes; and

`(4) assistance in identifying appropriate measures with regard to radon and other indoor air pollutants.

`(b) REVIEW- The Secretary shall periodically review the technical and economic basis of voluntary building energy codes and, based upon ongoing research activities--

`(1) recommend amendments to such codes including measures with regard to radon and other indoor air pollutants;

`(2) seek adoption of all technologically feasible and economically justified energy efficiency measures; and

`(3) otherwise participate in any industry process for review and modification of such codes.

`SEC. 308. REPORTS.

`The Secretary, in consultation with the Secretary of Housing and Urban Development, the Secretary of Veterans Affairs, and other appropriate Federal agencies, shall report annually to the Congress on activities conducted pursuant to this title. Such report shall include--

`(1) recommendations made under section 307(b) regarding the prevailing voluntary building energy codes;

`(2) a State-by-State summary of actions taken under this title; and

`(3) recommendations to the Congress with respect to opportunities to further promote building energy efficiency and otherwise carry out the purposes of this title.'.

(b) CONFORMING AMENDMENT- The table of contents of such Act is amended by striking the items relating to sections 304, 306, 308, 309, 310 and 311, and inserting in lieu thereof the following--

`Sec. 304. Updating State building energy efficiency codes.

`Sec. 305. Federal building energy efficiency standards.

`Sec. 306. Federal compliance.

`Sec. 307. Support for voluntary building energy codes.

`Sec. 308. Reports.'.

`

(c) FEDERAL MORTGAGE REQUIREMENTS-

(1) AMENDMENT TO CRANSTON-GONZALEZ NATIONAL AFFORDABLE HOUSING ACT- Section 109 of the Cranston-Gonzalez National Affordable Housing Act (42 U.S.C. 12709) is amended to read as follows:

`SEC. 109. ENERGY EFFICIENCY STANDARDS.

`(a) ESTABLISHMENT-

`(1) IN GENERAL- The Secretary of Housing and Urban Development and the Secretary of Agriculture shall, not later than 1 year after the date of the enactment of the Energy Policy Act of 1992, jointly establish, by rule, energy efficiency standards for--

`(A) new construction of public and assisted housing and single family and multifamily

residential housing (other than manufactured homes) subject to mortgages insured under the National Housing Act; and

`(B) new construction of single family housing (other than manufactured homes) subject to mortgages insured, guaranteed, or made by the Secretary of Agriculture under title V of the Housing Act of 1949.

`(2) CONTENTS- Such standards shall meet or exceed the requirements of the Council of American Building Officials Model Energy Code, 1992 (hereafter in this section referred to as `CABO Model Energy Code, 1992'), or, in the case of multifamily high rises, the requirements of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers Standard 90.1-1989 (hereafter in this section referred to as `ASHRAE Standard 90.1-1989'), and shall be cost-effective with respect to construction and operating costs on a life-cycle cost basis. In developing such standards, the Secretaries shall consult with an advisory task force composed of homebuilders, national, State, and local housing agencies (including public housing agencies), energy agencies, building code organizations and agencies, energy efficiency organizations, utility organizations, low-income housing organizations, and other parties designated by the Secretaries.

`(b) MODEL ENERGY CODE- If the Secretaries have not, within 1 year after the date of the enactment of the Energy Policy Act of 1992, established energy efficiency standards under subsection (a), all new construction of housing specified in such subsection shall meet the requirements of CABO Model Energy Code, 1992, or, in the case of multifamily high rises, the requirements of ASHRAE Standard 90.1-1989.

`(c) REVISIONS OF MODEL ENERGY CODE- If the requirements of CABO Model Energy Code, 1992, or, in the case of multifamily high rises, ASHRAE Standard 90.1-1989, are revised at any time, the Secretaries shall, not later than 1 year after such revision, amend the standards established under subsection (a) to meet or exceed the requirements of such revised code or standard unless the Secretaries determine that compliance with such revised code or standard would not result in a significant increase in energy efficiency or would not be technologically feasible or economically justified.'.

(2) AMENDMENT TO TITLE 38, UNITED STATES CODE- Section 3704 of title 38, United States Code, is amended by adding at the end thereof the following new subsection:

`(g) A loan for the purchase or construction of new residential property, the construction of which began after the energy efficiency standards under section 109 of the Cranston-Gonzalez National Affordable Housing Act (42 U.S.C. 12709), as amended by section 101(c) of the Energy Policy Act of 1992, take effect, may not be financed through the assistance of this chapter unless the new residential property is constructed in compliance with such standards.'.

SEC. 102. RESIDENTIAL ENERGY EFFICIENCY RATINGS.

(a) RATINGS- Title II of the National Energy Conservation Policy Act (42 U.S.C. 8211 et seq.) is amended by adding at the end the following new part:

`PART 6--RESIDENTIAL ENERGY EFFICIENCY RATING GUIDELINES

`SEC. 271. VOLUNTARY RATING GUIDELINES.

`(a) IN GENERAL- Not later than 18 months after the date of the enactment of the Energy Policy Act of 1992, the Secretary, in consultation with the Secretary of Housing and Urban Development, the Secretary of Veterans Affairs, representatives of existing home energy rating programs, and other appropriate persons, shall, by rule, issue voluntary guidelines that may be used by State and local governments, utilities, builders, real estate agents, lenders, agencies in mortgage markets, and others, to enable and encourage the assignment of energy efficiency ratings to residential buildings.

`(b) CONTENTS OF GUIDELINES- The voluntary guidelines issued under subsection (a) shall--

`(1) encourage uniformity with regard to systems for rating the annual energy efficiency of residential buildings;

`(2) establish protocols and procedures for--

`(A) certification of the technical accuracy of building energy analysis tools used to determine energy efficiency ratings;

`(B) training of personnel conducting energy efficiency ratings;

`(C) data collection and reporting;

`(D) quality control; and

`(E) monitoring and evaluation;

`(3) encourage consistency with, and support for, the uniform plan for Federal energy efficient mortgages, including that developed under section 946 of the Cranston-Gonzalez National Affordable Housing Act (42 U.S.C. 12712 note) and pursuant to sections 105 and 106 of the Energy Policy Act of 1992;

`(4) provide that rating systems take into account local climate conditions and construction practices, solar energy collected on-site, and the benefits of peak load shifting construction practices, and not discriminate among fuel types; and

`(5) establish procedures to ensure that residential buildings can receive an energy efficiency rating at the time of sale and that such rating is communicated to potential buyers.

`SEC. 272. TECHNICAL ASSISTANCE.

`Not later than 2 years after the date of the enactment of the Energy Policy Act of 1992, the Secretary shall establish a program to provide technical assistance to State and local organizations to encourage the adoption of and use of residential energy efficiency rating systems consistent with the voluntary guidelines issued under section 271.

`SEC. 273. REPORT.

`Not later than 3 years after the date of the enactment of the Energy Policy Act of 1992, the Secretary shall transmit to the President and the Congress a final report containing--

`(1) a description of actions taken by the Secretary and other Federal agencies to implement this

part;

`(2) a description of the action taken by States, local governments, and other organizations to implement the voluntary guidelines issued under section 271 and any problems encountered in implementing such guidelines; and

`(3) recommendations on the feasibility of requiring, as a prerequisite to receiving federally assisted, guaranteed, or insured mortgages, the achievement of a minimum energy efficiency rating.'.

(b) CONFORMING AMENDMENT- The table of contents for such Act is amended by adding at the end of title II the following:

`PART 6--RESIDENTIAL ENERGY EFFICIENCY RATINGS

SEC. 103. ENERGY EFFICIENT LIGHTING AND BUILDING CENTERS.

(a) PURPOSE- The purpose of this section is to encourage energy efficiency in buildings through the establishment of regional centers to promote energy efficient lighting, heating and cooling, and building design.

(b) GRANTS FOR ESTABLISHMENT- Not later than 18 months after the date of the enactment of this Act, the Secretary shall make grants to nonprofit institutions, or to consortiums that may include nonprofit institutions, State and local governments, universities, and utilities, to establish or enhance one regional building energy efficiency center (hereafter in this section referred to as a `regional center') in each of the 10 regions served by a Department of Energy regional support office.

(c) PERMITTED ACTIVITIES- Each regional center established under this section may--

(1) provide information, training, and technical assistance to building professionals such as architects, designers, engineers, contractors, and building code officials, on building energy efficiency methods and technologies, including lighting, heating and cooling, and passive solar;

(2) operate an outreach program to inform such building professionals of the benefits and opportunities of energy efficiency, and of the services of the center;

(3) provide displays demonstrating building energy efficiency methods and technologies, such as lighting, windows, and heating and cooling equipment;

(4) coordinate its activities and programs with other institutions within the region, such as State and local governments, utilities, and educational institutions, in order to support their efforts to promote building energy efficiency;

(5) serve as a clearinghouse to ensure that information about new building energy efficiency

technologies, including case studies of successful applications, is disseminated to end-users in the region;

(6) study the building energy needs of the region and make available region-specific energy efficiency information to facilitate the adoption of cost-effective energy efficiency improvements;

(7) assist educational institutions in establishing building energy efficiency engineering and technical programs and curricula; and

(8) evaluate the performance of the center in promoting building energy efficiency.

(d) APPLICATION- Any nonprofit institution or consortium interested in receiving a grant under this section shall submit to the Secretary an application in such form and containing such information as the Secretary may require. A lighting or building energy center in existence on the date of the enactment of this section which is owned and operated by a nonprofit institution or a consortium as described in subsection (b) shall be eligible for a grant under this section.

(e) SELECTION CRITERIA- The Secretary shall select recipients of grants under this section on the basis of the following criteria:

(1) The capability of the grant recipient to establish a board of directors for the regional center composed of representatives from utilities, State and local governments, building trade and professional organizations, manufacturers, and nonprofit energy and environmental organizations.

(2) The demonstrated or potential resources available to the grant recipient for carrying out this subsection.

(3) The demonstrated or potential ability of the grant recipient to promote building energy efficiency by carrying out the activities specified in subsection (c).

(4) The activities which the grant recipient proposes to carry out under the grant.

(f) REQUIREMENT OF MATCHING FUNDS-

(1) FEDERAL SHARE- The Federal share of a grant under this section shall be no more than 50 percent of the costs of establishing, and no more than 25 percent of the cost of operating the regional center.

(2) NON-FEDERAL CONTRIBUTIONS- No grant may be made under this section in any fiscal year unless the recipient of such grant enters into such agreements with the Secretary as the Secretary may require to ensure that such recipient will provide the necessary non-Federal contributions. Such non-Federal contributions may be provided by utilities, State and local governments, nonprofit institutions, foundations, corporations, and other non-Federal entities.

(g) TASK FORCE- The Secretary shall establish a task force to--

(1) advise the Secretary on activities to be carried out by grant recipients;

(2) review and evaluate programs carried out by grant recipients; and

(3) make recommendations regarding the building energy efficiency center grant program.

(h) MEMBERSHIP TERMS AND ADMINISTRATION OF TASK FORCE-

(1) IN GENERAL- The task force shall be composed of approximately 20 members, appointed by the Secretary, with expertise in the area of building energy efficiency, including representatives from--

(A) State or local energy offices;

(B) utilities;

(C) building construction trade or professional associations;

(D) architecture, engineering or professional associations;

(E) building component or equipment manufacturers;

(F) from national laboratories;

(G) building code officials or professional associations; and

(H) nonprofit energy or environmental organizations.

(2) GEOGRAPHIC REPRESENTATION- The Secretary shall ensure that there is broad geographical representation among task force members.

(3) TERMS- Members shall be appointed for a term of 3 years. A vacancy in the task force shall be filled in the manner in which the original appointment was made.

(4) PAY- Members shall serve without pay. Each member shall receive travel expenses, including per diem in lieu of subsistence, in accordance with sections 5702 and 5703 of title 5, United States Code.

(5) CHAIRPERSON- The Chairperson and Vice Chairperson of the task force shall be elected by the members.

(6) MEETINGS- The task force shall meet biannually and at the call of the Chairperson.

(7) INAPPLICABILITY OF TERMINATION DATE- Section 14 of the Federal Advisory Committee Act shall not apply to the task force.

(i) REPORT- The Secretary shall transmit annually to the Congress a report on the activities of regional centers established under this section, including the degree to which matching funds are being leveraged from private sources to establish and operate such centers.

(j) AUTHORIZATION OF APPROPRIATIONS- There is authorized to be appropriated for purposes of carrying out this section, to remain available until expended, not more than $10,000,000 for each of fiscal years 1994, 1995, and 1996.

SEC. 104. MANUFACTURED HOUSING ENERGY EFFICIENCY.

(a) AMENDMENTS TO CRANSTON-GONZALEZ NATIONAL AFFORDABLE HOUSING ACT- Section 943(d)(1) of the Cranston-Gonzalez National Affordable Housing Act (Public Law 101-625; 109 Stat. 4413) is amended--

(1) in subparagraph (D), by striking `thermal insulation, energy efficiency';

(2) by redesignating subparagraphs (E), (F), (G), and (H) as subparagraphs (F), (G), (H), and (I), respectively; and

(3) by inserting after subparagraph (D) the following new subparagraph:

`(E) consult with the Secretary of Energy and make recommendations regarding additional or revised standards for thermal insulation and energy efficiency applicable to manufactured housing;'.

(b) DUTIES OF THE SECRETARY- The Secretary of Housing and Urban Development shall assess the energy performance of manufactured housing and make recommendations to the National Commission on Manufactured Housing established under section 943 of the Cranston-Gonzalez National Affordable Housing Act regarding any thermal insulation and energy efficiency improvements applicable to manufactured housing which are technologically feasible and economically justified. The Secretary shall also test the performance and determine the cost effectiveness of manufactured housing constructed in compliance with the standards established under such section.

(c) EXCEPTION TO FEDERAL PREEMPTION- If the Secretary of Housing and Urban Development has not issued, within 1 year after the date of the enactment of this Act, final regulations pursuant to section 604 of the National Manufactured Housing Construction and Safety Standards Act of 1974 (42 U.S.C. 5403) that establish thermal insulation and energy efficiency standards for manufactured housing that take effect before January 1, 1995, then States may establish thermal insulation and energy efficiency standards for manufactured housing if such standards are at least as stringent as thermal performance standards for manufactured housing contained in the Second Public Review Draft of BSR/ASHRAE 90.2P entitled `Energy Efficient Design of Low-Rise Residential Buildings' and all public reviews of Independent Substantive Changes to such document that have been approved on or before the date of the enactment of this Act.

SEC. 105. ENERGY EFFICIENT MORTGAGES.

(a) DEFINITION OF ENERGY EFFICIENT MORTGAGE- Section 104 of the Cranston-Gonzalez National Affordable Housing Act (42 U.S.C. 12704) is amended by adding at the end the following new paragraph:

`(24) The term `energy efficient mortgage' means a mortgage that provides financing incentives for the purchase of energy efficient homes, or that provides financing incentives to make energy efficiency improvements in existing homes by incorporating the cost of such improvements in the mortgage.'.

(b) UNIFORM MORTGAGE FINANCING PLAN FOR ENERGY EFFICIENCY- Section 946 of the Cranston-Gonzalez National Affordable Housing Act (42 U.S.C. 12712 note) is amended--

(1) in subsection (a), by striking `mortgage financing incentives for energy efficiency' and inserting `energy efficient mortgages (as such term is defined in section 104 of this Act)'; and

(2) in subsection (b)--

(A) in the second sentence, by inserting `, but not be limited to,' after `include'; and

(B) by inserting after the period at the end of the following new sentence: `The Task Force shall determine whether notifying potential home purchasers of the availability of energy efficient mortgages would promote energy efficiency in residential buildings, and if so, the Task Force shall recommend appropriate notification guidelines, and agencies and organizations referred to in the preceding sentence are authorized to implement such guidelines.'.

SEC. 106. ENERGY EFFICIENT MORTGAGES PILOT PROGRAM.

(a) ESTABLISHMENT OF PILOT PROGRAM-

(1) IN GENERAL- Not later than 6 months after the date of enactment of this Act, the Secretary of Housing and Urban Development (hereafter referred to as the `Secretary') shall establish an energy efficient mortgage pilot program in 5 States, to promote the purchase of existing energy efficient residential buildings and the installation of cost-effective improvements in existing residential buildings.

(2) PILOT PROGRAM- The pilot program established under this subsection shall include the following criteria, where applicable:

(A) ORIGINATION- The lender shall originate a housing loan that is insured under title II of the National Housing Act in accordance with the applicable requirements.

(B) APPROVAL- The mortgagor's base loan application shall be approved if the mortgagor's income and credit record is found to be satisfactory.

(C) COST OF IMPROVEMENTS- The cost of cost-effective energy efficiency improvements shall not exceed the greater of--

(i) 5 percent of the property value (not to exceed $8,000); or

(ii) $4,000.

(3) AUTHORITY FOR MORTGAGEES- In granting mortgages under the pilot program established pursuant to this subsection, the Secretary shall grant mortgagees the authority--

(A) to permit the final loan amount to exceed the loan limits established under title II of the National Housing Act by an amount not to exceed 100 percent of the cost of the cost-effective energy efficiency improvements, if the mortgagor's request to add the cost of such improvements is received by the mortgagee prior to funding of the base loan;

(B) to hold in escrow all funds provided to the mortgagor to undertake the energy efficiency improvements until the efficiency improvements are actually installed; and

(C) to transfer or sell the energy efficient mortgage to the appropriate secondary market agency, after the mortgage is issued, but before the energy efficiency improvements are actually installed.

(4) PROMOTION OF PILOT PROGRAM- The Secretary shall encourage participation in the energy efficient mortgage pilot program by--

(A) making available information to lending agencies and other appropriate authorities regarding the availability and benefits of energy efficient mortgages;

(B) requiring mortgagees and designated lending authorities to provide written notice of the availability and benefits of the pilot program to mortgagors applying for financing in those States designated by the Secretary as participating under the pilot program; and

(C) requiring each applicant for a mortgage insured under title II of the National Housing Act in those States participating under the pilot program to sign a statement that such applicant has been informed of the program requirements and understands the benefits of energy efficient mortgages.

(5) TRAINING PROGRAM- Not later than 9 months after the date of enactment of this Act, the Secretary, in consultation with the Secretary of Energy, shall establish and implement a program for training personnel at relevant lending agencies, real estate companies, and other appropriate organizations regarding the benefits of energy efficient mortgages and the operation of the pilot program under this subsection.

(6) REPORT- Not later than 18 months after the date of enactment of this Act, the Secretary shall prepare and submit a report to the Congress describing the effectiveness and implementation of the energy efficient mortgage pilot program as described under this subsection, and assessing the potential for expanding the pilot program nationwide.

(b) EXPANSION OF PROGRAM- Not later than the expiration of the 2-year period beginning on the date of the implementation of the energy efficient mortgage pilot program under this section, the Secretary of Housing and Urban Development shall expand the pilot program on a nationwide basis and shall expand the program to include new residential housing, unless the Secretary determines that either such expansion would not be practicable, in which case the Secretary shall submit to the Congress, before the expiration of such period, a report explaining why either expansion would not be practicable.

(c) DEFINITIONS- For purposes of this section:

(1) The term `base loan' means any mortgage loan for a residential building eligible for insurance under title II of the National Housing Act or title 38, United States Code, that does not include the cost of cost-effective energy improvements.

(2) The term `cost-effective' means, with respect to energy efficiency improvements to a residential building, improvements that result in the total present value cost of the improvements (including any maintenance and repair expenses) being less than the total present value of the energy saved over the useful life of the improvement, when 100 percent of the cost of improvements is added to the base loan. For purposes of this paragraph, savings and cost-effectiveness shall be determined pursuant to a home energy rating report sufficient for purposes of the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation,

or by other technically accurate methods.

(3) The term `energy efficient mortgage' means a mortgage on a residential building that recognizes the energy savings of a home that has cost-effective energy saving construction or improvements (including solar water heaters, solar-assisted air conditioners and ventilators, super-insulation, and insulating glass and film) and that has the effect of not disqualifying a borrower who, but for the expenditures on energy saving construction or improvements, would otherwise have qualified for a base loan.

(4) The term `residential building' means any attached or unattached single family residence.

(d) RULE OF CONSTRUCTION- This section may not be construed to affect any other programs of the Secretary of Housing and Urban Development for energy-efficient mortgages. The pilot program carried out under this section shall not replace or result in the termination of such other programs.

(e) REGULATIONS- The Secretary shall issue any regulations necessary to carry out this section not later than the expiration of the 180-day period beginning on the date of the enactment of this Act. The regulations shall be issued after notice and opportunity for public comment pursuant to the provisions of section 553 of title 5, United States Code (notwithstanding subsections (a)(2), (b)(B), and (d)(3) of such section).

(f) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necessary to carry out this section.

Subtitle B--Utilities

SEC. 111. ENCOURAGEMENT OF INVESTMENTS IN CONSERVATION AND ENERGY EFFICIENCY BY ELECTRIC UTILITIES.

(a) AMENDMENT TO THE PUBLIC UTILITY REGULATORY POLICIES ACT- The Public Utility Regulatory Policies Act of 1978 (P.L. 95-617; 92 Stat. 3117; 16 U.S.C. 2601 and following) is amended by adding the following at the end of section 111(d):

`(7) INTEGRATED RESOURCE PLANNING- Each electric utility shall employ integrated resource planning. All plans or filings before a State regulatory authority to meet the requirements of this paragraph must be updated on a regular basis, must provide the opportunity for public participation and comment, and contain a requirement that the plan be implemented.

`(8) INVESTMENTS IN CONSERVATION AND DEMAND MANAGEMENT- The rates allowed to be charged by a State regulated electric utility shall be such that the utility's investment in and expenditures for energy conservation, energy efficiency resources, and other demand side management measures are at least as profitable, giving appropriate consideration to income lost from reduced sales due to investments in and expenditures for conservation and efficiency, as its investments in and expenditures for the construction of new generation, transmission, and distribution equipment. Such energy conservation, energy efficiency resources and other demand side management measures shall be appropriately monitored and evaluated.

`(9) ENERGY EFFICIENCY INVESTMENTS IN POWER GENERATION AND SUPPLY- The rates charged by any electric utility shall be such that the utility is encouraged to make investments in, and expenditures for, all cost-effective improvements in the energy efficiency of power

generation, transmission and distribution. In considering regulatory changes to achieve the objectives of this paragraph, State regulatory authorities and nonregulated electric utilities shall consider the disincentives caused by existing ratemaking policies, and practices, and consider incentives that would encourage better maintenance, and investment in more efficient power generation, transmission and distribution equipment.'.

(b) PROTECTION FOR SMALL BUSINESS- The Public Utility Regulatory Policies Act of 1978 (Public Law 95-617; 92 Stat. 3117; 16 U.S.C. 2601 and following) is amended by inserting the following new paragraph at the end of subsection 111(c):

`(3) If a State regulatory authority implements a standard established by subsection (d)(7) or (8), such authority shall--

`(A) consider the impact that implementation of such standard would have on small businesses engaged in the design, sale, supply, installation or servicing of energy conservation, energy efficiency or other demand side management measures, and

`(B) implement such standard so as to assure that utility actions would not provide such utilities with unfair competitive advantages over such small businesses.'.

(c) EFFECTIVE DATE- Section 112(b) of such Act is amended by inserting `(or after the enactment of the Comprehensive National Energy Policy Act in the case of standards under paragraphs (7), (8), and (9) of section 111(d))' after `Act' in both places such word appears in paragraphs (1) and (2).

(d) DEFINITIONS- Section 3 of such Act is amended by adding the following new paragraphs at the end thereof:

`(19) The term `integrated resource planning' means, in the case of an electric utility, a planning and selection process for new energy resources that evaluates the full range of alternatives, including new generating capacity, power purchases, energy conservation and efficiency, cogeneration and district heating and cooling applications, and renewable energy resources, in order to provide adequate and reliable service to its electric customers at the lowest system cost. The process shall take into account necessary features for system operation, such as diversity, reliability, dispatchability, and other factors of risk; shall take into account the ability to verify energy savings achieved through energy conservation and efficiency and the projected durability of such savings measured over time; and shall treat demand and supply resources on a consistent and integrated basis.

`(20) The term `system cost' means all direct and quantifiable net costs for an energy resource over its available life, including the cost of production, distribution, transportation, utilization, waste management, and environmental compliance.

`(21) The term `demand side management' includes load management techniques.'.

(e) REPORT- Not later than 2 years after the date of the enactment of this Act, the Secretary shall transmit a report to the President and to the Congress containing--

(1) a survey of all State laws, regulations, practices, and policies under which State regulatory authorities implement the provisions of paragraphs (7), (8), and (9) of section 111(d) of the Public Utility Regulatory Policies Act of 1978;

(2) an evaluation by the Secretary of whether and to what extent, integrated resource planning is likely to result in--

(A) higher or lower electricity costs to an electric utility's ultimate consumers or to classes or groups of such consumers;

(B) enhanced or reduced reliability of electric service; and

(C) increased or decreased dependence on particular energy resources; and

(3) a survey of practices and policies under which electric cooperatives prepare integrated resource plans, submit such plans to the Rural Electrification Administration and the extent to which such integrated resource planning is reflected in rates charged to customers.

The report shall include an analysis prepared in conjunction with the Federal Trade Commission, of the competitive impact of implementation of energy conservation, energy efficiency, and other demand side management programs by utilities on small businesses engaged in the design, sale, supply, installation, or servicing of similar energy conservation, energy efficiency, or other demand side management measures and whether any unfair, deceptive, or predatory acts exist, or are likely to exist, from implementation of such programs.

SEC. 112. ENERGY EFFICIENCY GRANTS TO STATE REGULATORY AUTHORITIES.

(a) ENERGY EFFICIENCY GRANTS- The Secretary is authorized in accordance with the provisions of this section to provide grants to State regulatory authorities in an amount not to exceed $250,000 per authority, for purposes of encouraging demand-side management including energy conservation, energy efficiency and load management techniques and for meeting the requirements of paragraphs (7), (8), and (9) of section 111(d) of the Public Utility Regulatory Policies Act of 1978 and as a means of meeting gas supply needs and to meet the requirements of paragraphs (3) and (4) of section 303(b) of the Public Utility Regulatory Policies Act of 1978. Such grants may be utilized by a State regulatory authority to provide financial assistance to nonprofit subgrantees of the Department of Energy's Weatherization Assistance Program in order to facilitate participation by such subgrantees in proceedings of such regulatory authority to examine energy conservation, energy efficiency, or other demand-side management programs.

(b) PLAN- A State regulatory authority wishing to receive a grant under this section shall submit a plan to the Secretary that specifies the actions such authority proposes to take that would achieve the purposes of this section.

(c) SECRETARIAL ACTION- (1) In determining whether, and in what amount, to provide a grant to a State regulatory authority under this section the Secretary shall consider, in addition to other appropriate factors, the actions proposed by the State regulatory authority to achieve the purposes of this section and to consider implementation of the ratemaking standards established in--

(A) paragraphs (7), (8) and (9) of section 111(d) of the Public Utility Regulatory Policies Act of 1978; or

(B) paragraphs (3) and (4) of section 303(b) of the Public Utility Regulatory Policies Act of 1978.

(2) Such actions--

(A) shall include procedures to facilitate the participation of grantees and nonprofit subgrantees of the Department of Energy's Weatherization Assistance Program in proceedings of such regulatory authorities examining demand-side management programs; and

(B) shall provide for coverage of the cost of such grantee and subgrantees' participation in such proceedings.

(d) RECORDKEEPING- Each State regulatory authority that receives a grant under this section shall keep such records as the Secretary shall require.

(e) DEFINITION- For purposes of this section, the term `State regulatory authority' shall have the same meaning as provided by section 3 of the Public Utility Regulatory Policies Act of 1978 in the case of electric utilities, and such term shall have the same meaning as provided by section 302 of the Public Utility Regulatory Policies Act of 1978 in the case of gas utilities, except that in the case of any State without a statewide ratemaking authority, such term shall mean the State energy office.

(f) AUTHORIZATION- There are authorized to be appropriated $5,000,000 for each of the fiscal years 1994, 1995 and 1996 to carry out the purposes of this section.

SEC. 113. TENNESSEE VALLEY AUTHORITY LEAST-COST PLANNING PROGRAM.

(a) IN GENERAL- The Tennessee Valley Authority shall conduct a least-cost planning program in accordance with this section.

(b) CONDUCT OF PROGRAM-

(1) IN GENERAL- In conducting a least-cost planning program under subsection (a), the Tennessee Valley Authority shall employ and implement a planning and selection process for new energy resources which evaluates the full range of existing and incremental resources (including new power supplies, energy conservation and efficiency, and renewable energy resources) in order to provide adequate and reliable service to electric customers of the Tennessee Valley Authority at the lowest system cost.

(2) PLANNING AND SELECTION PROCESS- The planning and selection process referred to in paragraph (1) shall--

(A) take into account necessary features for system operation, including diversity, reliability, dispatchability, and other factors of risk;

(B) take into account the ability to verify energy savings achieved through energy conservation and efficiency and the projected durability of such savings measured over time; and

(C) treat demand and supply resources on a consistent and integrated basis.

(3) SYSTEM COST DEFINED- As used in paragraph (1), the term `system cost' means all direct and quantifiable net costs for an energy resource over its available life, including the cost of production, transportation, utilization, waste management, environmental compliance, and, in the case of imported energy resources, maintaining access to foreign sources of supply.

(c) PARTICIPATION BY DISTRIBUTORS-

(1) IN GENERAL- In conducting a least-cost planning program under subsection (a), the Tennessee Valley Authority shall--

(A) provide an opportunity for distributors of the Tennessee Valley Authority to recommend cost-effective energy efficiency opportunities, rate structure incentives, and renewable energy proposals for inclusion in such program; and

(B) encourage and assist such distributors in the planning and implementation of cost-effective energy efficiency options.

(2) ASSISTANCE- The Tennessee Valley Authority shall provide appropriate assistance to distributors under paragraph (1)(B). Such assistance shall, where cost effective, be provided by the Tennessee Valley Authority acting through, or in cooperation with, an association of distributors. Such assistance may include publications, workshops, conferences, one-on-one assistance, financial assistance, equipment loans, technology assessment studies, marketing studies, and other appropriate mechanisms to transfer information on energy efficiency and renewable energy options and programs to customers.

(d) PUBLIC REVIEW AND COMMENT- Before the selection and addition of a major new energy resource on the Tennessee Valley Authority system, the Tennessee Valley Authority shall provide an opportunity for public review and comment and shall include a description of any such action in an annual report to the President and Congress.

(e) EXEMPTION FROM CERTAIN REQUIREMENTS- The Tennessee Valley Authority shall not be subject to the least-cost planning requirements contained in section 111(d) of the Public Utility Regulatory Policies Act of 1978 or any similar requirement which might arise out of the Tennessee Valley Authority's electric power transactions with the Southeastern Power Administration.

SEC. 114. AMENDMENT OF HOOVER POWER PLANT ACT.

Title II of the Hoover Power Plant Act of 1984 (42 U.S.C. 7275-7276, Public Law 98-381) is amended to read as follows:

`TITLE II--INTEGRATED RESOURCE PLANNING

`SEC. 201. DEFINITIONS.

`As used in this title:

`(1) The term `Administrator' means the Administrator of the Western Area Power Administration.

`(2) The term `integrated resource planning' means a planning process for new energy resources that evaluates the full range of alternatives, including new generating capacity, power purchases, energy conservation and efficiency, cogeneration and district heating and cooling applications, and renewable energy resources, in order to provide adequate and reliable service to its electric customers at the lowest system cost. The process shall take into account necessary features for system operation, such as diversity, reliability, dispatchability, and other factors of risk; shall take into account the ability to verify energy savings achieved through energy conservation and efficiency and the projected durability of such savings measured over time; and shall treat demand and supply resources on a consistent and integrated basis.

`(3) The term `least cost option' means an option for providing reliable electric services to electric customers which will, to the extent practicable, minimize life-cycle system costs, including adverse environmental effects, of providing such service. To the extent practicable, energy efficiency and renewable resources may be given priority in any least-cost option.

`(4) The term `long-term firm power service contract' means any contract for the sale by Western Area Power Administration of firm capacity, with or without energy, which is to be delivered over a period of more than one year.

`(5) The terms `customer' or `customers' means any entity or entities purchasing firm capacity with or without energy, from the Western Area Power Administration under a long-term firm power service contract. Such terms include parent-type entities and their distribution or user members.

`(6) For any customer, the term `applicable integrated resource plan' means the integrated resource plan approved by the Administrator under this title for that customer.

`SEC. 202. REGULATIONS TO REQUIRE INTEGRATED RESOURCE PLANNING.

`(a) REGULATIONS- Within 1 year after the enactment of this section, the Administrator shall, by regulation, revise the Final Amended Guidelines and Acceptance Criteria for Customer Conservation and Renewable Energy Programs published in the Federal Register on August 21, 1985 (50 F.R. 33892), or any subsequent amendments thereto, to require each customer purchasing electric energy under a long-term firm power service contract with the Western Area Power Administration to implement, within 3 years after the enactment of this section, integrated resource planning in accordance with the requirements of this title.

`(b) CERTAIN SMALL CUSTOMERS- Notwithstanding subsection (a), for customers with total annual energy sales or usage of 25 Gigawatt Hours or less which are not members of a joint action agency or a generation and transmission cooperative with power supply responsibility, the Administrator may establish different regulations and apply such regulations to customers that the Administrator finds have limited economic, managerial, and resource capability to conduct integrated resource planning. The regulations under this subsection shall require such customers to consider all reasonable opportunities to meet their future energy service requirements using demand-side techniques, new renewable resources and other programs that will provide retail customers with electricity at the lowest possible cost, and minimize, to the extent practicable, adverse environmental effects.

`SEC. 203. TECHNICAL ASSISTANCE.

`The Administrator may provide technical assistance to customers to, among other things, conduct integrated resource planning, implement applicable integrated resource plans, and otherwise comply with the requirements of this title. Technical assistance may include publications, workshops, conferences, one-to-one assistance, equipment loans, technology and resource assessment studies, marketing studies, and other mechanisms to transfer information on energy efficiency and renewable energy options and programs to customers. The Administrator shall give priority to providing technical assistance to customers that have limited capability to conduct integrated resource planning.

`SEC. 204. INTEGRATED RESOURCE PLANS.

`(a) REVIEW BY WESTERN AREA POWER ADMINISTRATION- Within 1 year after the enactment of this section, the Administrator shall, by regulation, revise the Final Amended Guidelines and Acceptance Criteria for Customer Conservation and Renewable Energy Programs published in the Federal Register on August 21, 1985 (50 F.R. 33892), or any subsequent amendments thereto, to require each customer to submit an integrated resource plan to the Administrator within 12 months after such regulations are amended. The regulation shall require a revision of such plan to be submitted every 5 years after the initial submission. The Administrator shall review the initial plan in accordance with a schedule established by the Administrator (which schedule will provide for the review of all initial plans within 24 months after such regulations are amended), and each revision thereof within 120 days after his receipt of the plan or revision and determine whether the customer has in the development of the plan or revision, complied with this title. Plan amendments may be submitted to the Administrator at any time and the Administrator shall review each such amendment within 120 days after receipt thereof to determine whether the customer in amending its plan has complied with this title. If the Administrator determines that the customer, in developing its plan, revision, or amendment, has not complied with the requirements of this title, the customer shall resubmit the plan at any time thereafter. Whenever a plan or revision or amendment is resubmitted the Administrator shall review the plan or revision or amendment within 120 days after his receipt thereof to determine whether the customer has complied with this title.

`(b) CRITERIA FOR APPROVAL OF INTEGRATED RESOURCE PLANS- The Administrator shall approve an integrated resource plan submitted as required under subsection (a) if, in developing the plan, the customer has:

`(1) Identified and accurately compared all practicable energy efficiency and energy supply resource options available to the customer.

`(2) Included a 2-year action plan and a 5-year action plan which describe specific actions the customer will take to implement its integrated resource plan.

`(3) Designated `least-cost options' to be utilized by the customer for the purpose of providing reliable electric service to its retail consumers and explained the reasons why such options were selected.

`(4) To the extent practicable, minimized adverse environmental effects of new resource acquisitions.

`(5) In preparation and development of the plan (and each revision or amendment of the plan) has provided for full public participation, including participation by governing boards.

`(6) Included load forecasting.

`(7) Provided methods of validating predicted performance in order to determine whether objectives in the plan are being met.

`(8) Met such other criteria as the Administrator shall require.

`(c) USE OF OTHER INTEGRATED RESOURCE PLANS- Where a customer or group of customers are implementing integrated resource planning under a program responding to Federal, State, or other initiatives, including integrated resource planning considered and implemented pursuant to section 111 (d) of the Public Utility Regulatory Policies Act of 1978, in evaluating that customer's integrated resource plan under this title, the Administrator shall accept such plan as fulfillment of the requirements of this title to the extent such plan substantially complies with the requirements of this title.

`(d) COMPLIANCE WITH INTEGRATED RESOURCE PLANS- Within 1 year after the enactment of this section, the Administrator shall, by regulation, revise the Final Amended Guidelines and Acceptance Criteria for Customer Conservation and Renewable Energy Programs published in the Federal Register on August 21, 1985 (50 F.R. 33892), or any subsequent amendments thereto, to require each customer to fully comply with the applicable integrated resource plan and submit an annual report to the Administrator (in such form and containing such information as the Administrator may require) describing the customer's progress to the goals established in such plan. After the initial review under subsection (a) the Administrator shall periodically conduct reviews of a representative sample of applicable integrated resource plans and the customer's implementation of the applicable integrated resource plan to determine if the customers are in compliance with their plans. If the Administrator finds a customer out-of-compliance, the Administrator shall impose a surcharge under this section on all electric energy purchased by the customer from the Western Area Power Administration or reduce such customer's power allocation by 10 percent, unless the Administrator finds that a good faith effort has been made to comply with the approved plan.

`(e) ENFORCEMENT-

`(1) NO APPROVED PLAN- If an integrated resource plan for any customer is not submitted before the date 12 months after the guidelines are amended as required under this section or if the plan is disapproved by the Administrator and a revised plan is not resubmitted by the date 9 months after the date of such disapproval, the Administrator shall impose a surcharge of 10 percent of the purchase price on all power obtained by that customer from the Western Area Power Administration after such date. The surcharge shall remain in effect until an integrated resource plan is approved for that customer. If the plan is not submitted for more than one year after the required date, the surcharge shall increase to 20 percent for the second year (or any portion thereof prior to approval of the plan) and to 30 percent thereafter until the plan is submitted or the contract for the purchase of power by such customer from the Western Area Power Administration terminates.

`(2) FAILURE TO COMPLY WITH APPROVED PLAN- After approval by the Administrator of an applicable integrated resource plan for any customer, the Administrator shall impose a 10 percent surcharge on all power purchased by such customer from the Western Area Power Administration whenever the Administrator determines that such customer's activities are not consistent with the applicable integrated resource plan. The surcharge shall remain in effect until the Administrator determines that the customer's activities are consistent with the applicable integrated resource plan. The surcharge shall be increased to 20 percent if the customer's activities

are out of compliance for more than one year and to 30 percent after more than 2 years, except that no surcharge shall be imposed if the customer demonstrates, to the satisfaction of the Administrator, that a good faith effort has been made to comply with the approved plan.

`(3) REDUCTION IN POWER ALLOCATION- In the case of any customer subject to a surcharge under paragraph (1) or (2), in lieu of imposing such surcharge the Administrator may reduce such customer's power allocation from the Western Area Power Administration by 10 percent. The Administrator shall provide by regulation the terms and conditions under which a power allocation terminated under this subsection may be reinstated.

`(f) INTEGRATED RESOURCE PLANNING COOPERATIVES- With the approval of the Administrator, customers within any State or region may form integrated resource planning cooperatives for the purposes of complying with this title, and such customers shall be allowed an additional 6 months to submit an initial integrated resource plan to the Administrator.

`(g) CUSTOMERS WITH MORE THAN 1 CONTRACT- If more than one long-term firm power service contract exists between the Administrator and a customer, only one integrated resource plan shall be required for that customer under this title.

`(h) PROGRAM REVIEW- Within 1 year after January 1, 1999, and at appropriate intervals thereafter, the Administrator shall initiate a public process to review the program established by this section. The Administrator is authorized at that time to revise the criteria set forth in section 204(b) to reflect changes, if any, in technology, needs, or other developments.

`SEC. 205. MISCELLANEOUS PROVISIONS.

`(a) ENVIRONMENTAL IMPACT STATEMENT- The provisions of the National Environmental Policy Act of 1969 shall apply to actions of the Administrator implementing this title in the same manner and to the same extent as such provisions apply to other major Federal actions significantly affecting the quality of the human environment.

`(b) ANNUAL REPORTS- The Administrator shall include in the annual report submitted by the Western Area Power Administration (1) a description of the activities undertaken by the Administrator and by customers under this title and (2) an estimate of the energy savings and renewable resource benefits achieved as a result of such activities.

`(c) STATE REGULATED INVESTOR-OWNED UTILITIES- Any State regulated electric utility (as defined in section 3(18) of the Public Utility Regulatory Policies Act of 1978) shall be exempt from the provisions of this title.

`(d) RURAL ELECTRIFICATION ADMINISTRATION REQUIREMENTS- Nothing in this title shall require a customer to take any action inconsistent with a requirement imposed by the Rural Electrification Administration'.

SEC. 115. ENCOURAGEMENT OF INVESTMENTS IN CONSERVATION AND ENERGY EFFICIENCY BY GAS UTILITIES.

(a) DEFINITIONS- Section 302 of the Public Utility Regulatory Policies Act of 1978 (15 U.S.C. 3202) is amended by adding the following at the end thereof:

`(9) The term `integrated resource planning' means, in the case of a gas utility, planning by the use of any standard, regulation, practice, or policy to undertake a systematic comparison between demand-side management measures and the supply of gas by a gas utility to minimize life-cycle costs of adequate and reliable utility services to gas consumers. Integrated resource planning shall take into account necessary features for system operation such as diversity, reliability, dispatchability, and other factors of risk and shall treat demand and supply to gas consumers on a consistent and integrated basis.

`(10) The term `demand-side management' includes energy conservation, energy efficiency, and load management techniques.'.

(b) IN GENERAL- Section 303(b) of the Public Utility Regulatory Policies Act of 1978 (15 U.S.C. 3202) is amended by inserting at the end the following new paragraphs:

`(3) INTEGRATED RESOURCE PLANNING- Each gas utility shall employ, in order to provide adequate and reliable service to its gas customers at the lowest system cost. All plans or filings of a State regulated gas utility before a State regulatory authority to meet the requirements of this paragraph shall (A) be updated on a regular basis, (B) provide the opportunity for public participation and comment, (C) provide for methods of validating predicted performance, and (D) contain a requirement that the plan be implemented after approval of the State regulatory authority. Subsection (c) shall not apply to this paragraph to the extent that it could be construed to require the State regulatory authority to extend the record of a State proceeding in submitting reports to the Federal Government.

`(4) INVESTMENTS IN CONSERVATION AND DEMAND MANAGEMENT- The rates charged by any State regulated gas utility shall be such that the utility's prudent investments in, and expenditures for, energy conservation and load shifting programs and for other demand-side management measures which are consistent with the findings and purposes of the Energy Policy Act of 1992 are at least as profitable (taking into account the income lost due to reduced sales resulting from such programs) as prudent investments in, and expenditures for, the acquisition or construction of supplies and facilities. This objective requires that (A) regulators link the utility's net revenues, at least in part, to the utility's performance in implementing cost-effective programs promoted by this section; and (B) regulators ensure that, for purposes of recovering fixed costs, including its authorized return, the utility's performance is not affected by reductions in its retail sales volumes.'.

(c) IMPACT ON SMALL BUSINESS- Section 303 of such Act is amended by inserting the following new subsection at the end thereof:

`(d) SMALL BUSINESS IMPACTS- If a State regulatory authority implements a standard established by subsection (b) (3) or (4), such authority shall--

`(1) consider the impact that implementation of such standard would have on small businesses engaged in the design, sale, supply, installation, or servicing of energy conservation, energy efficiency, or other demand-side management measures, and

`(2) implement such standard so as to assure that utility actions would not provide such utilities with unfair competitive advantages over such small businesses.'.

(d) EFFECTIVE DATE- Section 303(a) of such Act is amended by inserting `(or after the enactment of

the Energy Policy Act of 1992 in the case of standards under paragraphs (3), and (4) of subsection (b))' after `Act' and by striking out `standard established by subsection (b)(2)' in paragraph (2) and inserting `standards established by paragraphs (2), (3) and (4) of subsection (b)'.

(e) REPORT- The report under section 111(e) of this Act transmitted by the Secretary of Energy to the President and to the Congress shall contain a survey of all State laws, regulations, practices, and policies under which State regulatory authorities implement the provisions of paragraphs (3) and (4) of section 303(b) of the Public Utility Regulatory Policies Act of 1978. The report shall include an analysis, prepared in conjunction with the Federal Trade Commission, of the competitive impact of implementation of energy conservation, energy efficiency, and other demand side management programs by gas utilities on small businesses engaged in the design, sale, supply, installation, or servicing of similar energy conservation, energy efficiency, or other demand-side management measures and whether any unfair, deceptive, or predatory acts or practices exist, or are likely to exist, from implementation of such programs.

Subtitle C--Appliance and Equipment Energy Efficiency Standards

SEC. 121. ENERGY EFFICIENCY LABELING FOR WINDOWS AND WINDOW SYSTEMS.

(a) IN GENERAL- (1) The Secretary shall, after consulting with the National Fenestration Rating Council, industry representatives, and other appropriate organizations, provide financial assistance to support a voluntary national window rating program that will develop energy ratings and labels for windows and window systems.

(2) Such rating program shall include--

> (A) specifications for testing procedures and labels that will enable window buyers to make more informed purchasing decisions about the energy efficiency of windows and window systems; and
>
> (B) information (which may be disseminated through catalogs, trade publications, labels, or other mechanisms) that will allow window buyers to assess the energy consumption and potential cost savings of alternative window products.

(3) Such rating program shall be developed by the National Fenestration Rating Council according to commonly accepted procedures for the development of national testing procedures and labeling programs.

(b) MONITORING- The Secretary shall monitor and evaluate the efforts of the National Fenestration Rating Council and, not later than one year after the date of the enactment of this Act, make a determination as to whether the program developed by the Council is consistent with the objectives of subsection (a).

(c) ALTERNATIVE SYSTEM- (1) If the Secretary makes a determination under subsection (b) that a voluntary national window rating program consistent with the objectives of subsection (a) has not been developed, the Secretary shall, after consultation with the National Institute of Standards and Technology, develop, not later than two years after such determination, test procedures under section 323 of the Energy Policy and Conservation Act (42 U.S.C. 6293) for windows and window systems.

(2) Not later than one year after the Secretary develops test procedures under paragraph (1), the Federal Trade Commission (hereafter in this section referred to as the `Commission') shall prescribe labeling

rules under section 324 of such Act (42 U.S.C. 6294) for those windows and window systems for which the Secretary has prescribed test procedures under paragraph (1) except that, with respect to any type of window or window system (or class thereof), the Secretary may determine that such labeling is not technologically feasible or economically justified or is not likely to assist consumers in making purchasing decisions.

(3) For purposes of sections 323, 324, and 327 of such Act, each product for which the Secretary has established test procedures or labeling rules pursuant to this subsection shall be considered a new covered product under section 322 of such Act (42 U.S.C. 6292) to the extent necessary to carry out this subsection.

(4) For purposes of section 327(a) of such Act, the term `this part' includes this subsection to the extent necessary to carry out this subsection.

SEC. 122. ENERGY CONSERVATION REQUIREMENTS FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT.

(a) DEFINITIONS- Section 340 of the Energy Policy and Conservation Act (42 U.S.C. 6311) is amended--

(1) in paragraph (1)--

(A) by redesignating subparagraph (B) as subparagraph (G); and

(B) by inserting after subparagraph (A) the following:

`(B) Small commercial package air conditioning and heating equipment.

`(C) Large commercial package air conditioning and heating equipment.

`(D) Packaged terminal air-conditioners and packaged terminal heat pumps.

`(E) Warm air furnaces and packaged boilers.

`(F) Storage water heaters, instantaneous water heaters, and unfired hot water storage tanks.'; and

(2) in paragraph (2)(B)--

(A) by striking out `pumps)' and inserting in lieu thereof `pumps, small and large commercial package air conditioning and heating equipment, packaged terminal air-conditioners, packaged terminal heat pumps, warm air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks)'; and

(B) by striking out clauses (v) and (xi) and redesignating clauses (vi), (vii), (viii), (ix), (x), (xii), (xiii), and (xiv) as clauses (v), (vi), (vii), (viii), (ix), (x), (xi), and (xii), respectively; and

(3) by adding at the end the following:

`(8) The term `small commercial package air conditioning and heating equipment' means air-cooled, water-cooled, evaporatively-cooled, or water source (not including ground water source) electrically operated, unitary central air conditioners and central air conditioning heat pumps for commercial application which are rated below 135,000 Btu per hour (cooling capacity).

`(9) The term `large commercial package air conditioning and heating equipment' means air-cooled, water-cooled, evaporatively-cooled, or water source (not including ground water source) electrically operated, unitary central air conditioners and central air conditioning heat pumps for commercial application which are rated at or above 135,000 Btu per hour and below 240,000 Btu per hour (cooling capacity).

`(10)(A) The term `packaged terminal air conditioner' means a wall sleeve and a separate unencased combination of heating and cooling assemblies specified by the builder and intended for mounting through the wall. It includes a prime source of refrigeration, separable outdoor louvers, forced ventilation, and heating availability by builder's choice of hot water, steam, or electricity.

`(B) The term `packaged terminal heat pump' means a packaged terminal air conditioner that utilizes reverse cycle refrigeration as its prime heat source and should have supplementary heat source available to builders with the choice of hot water, steam, or electric resistant heat.

`(11)(A) The term `warm air furnace' means a self-contained oil- or gas-fired furnace designed to supply heated air through ducts to spaces that require it and includes combination warm air furnace/electric air conditioning units but does not include unit heaters and duct furnaces.

`(B) The term `packaged boiler' means a boiler that is shipped complete with heating equipment, mechanical draft equipment, and automatic controls; usually shipped in one or more sections.

`(12)(A) The term `storage water heater' means a water heater that heats and stores water within the appliance at a thermostatically controlled temperature for delivery on demand. Such term does not include units with an input rating of 4000 Btu per hour or more per gallon of stored water.

`(B) The term `instantaneous water heater' means a water heater that has an input rating of at least 4000 Btu per hour per gallon of stored water.

`(C) The term `unfired hot water storage tank' means a tank used to store water that is heated externally.

`(13)(A) The term `electric motor' means any motor which is a general purpose T-frame, single-speed, foot-mounting, polyphase squirrel-cage induction motor of the National Electrical Manufacturers Association, Design A and B, continuous rated, operating on 230/460 volts and constant 60 Hertz line power as defined in NEMA Standards Publication MG1-1987.

`(B) The term `definite purpose motor' means any motor designed in standard ratings with standard operating characteristics or standard mechanical construction for use under service conditions other than usual or for use on a particular type of application and which cannot be used in most general purpose applications.

`(C) The term `special purpose motor' means any motor, other than a general purpose motor or definite purpose motor, which has special operating characteristics or special mechanical

construction, or both, designed for a particular application.

`(D) The term `open motor' means a motor having ventilating openings which permit passage of external cooling air over and around the windings of the machine.

`(E) The term `enclosed motor' means a motor so enclosed as to prevent the free exchange of air between the inside and outside of the case but not sufficiently enclosed to be termed airtight.

`(F) The term `small electric motor' means a NEMA general purpose alternating current single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1-1987.

`(G) The term `efficiency' when used with respect to an electric motor means the ratio of an electric motor's useful power output to its total power input, expressed in percentage.

`(H) The term `nominal full load efficiency' means the average efficiency of a population of motors of duplicate design as determined in accordance with NEMA Standards Publication MG1-1987.

`(14) The term `ASHRAE' means the American Society of Heating, Refrigerating, and Air Conditioning Engineers.

`(15) The term `IES' means the Illuminating Engineering Society of North America.

`(16) The term `NEMA' means the National Electrical Manufacturers Association.

`(17) The term `IEEE' means the Institute of Electrical and Electronics Engineers.

`(18) The term `energy conservation standard' means--

`(A) a performance standard that prescribes a minimum level of energy efficiency or a maximum quantity of energy use for a product; or

`(B) a design requirement for a product.'.

(b) TEST PROCEDURES- (1) Section 343(a) of such Act (42 U.S.C. 6314) is amended--

(A) by striking out paragraph (1) and inserting in lieu thereof the following:

`(1) The Secretary may conduct an evaluation of a class of covered equipment and may prescribe test procedures for such class in accordance with the provisions of this section.'; and

(B) by adding at the end the following new paragraphs:

`(4)(A) With respect to small commercial package air conditioning and heating equipment, large commercial package air conditioning and heating equipment, packaged terminal air conditioners, packaged terminal heat pumps, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks to which standards are applicable under section 342, the test procedures shall be those generally accepted industry testing procedures or rating procedures developed or recognized by the Air-Conditioning and Refrigeration Institute or by the American Society

of Heating, Refrigerating and Air Conditioning Engineers, as referenced in ASHRAE/IES Standard 90.1 and in effect on June 30, 1992.

`(B) If such an industry test procedure or rating procedure for small commercial package air conditioning and heating equipment, large commercial package air conditioning and heating equipment, packaged terminal air conditioners, packaged terminal heat pumps, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, or unfired hot water storage tanks is amended, the Secretary shall amend the test procedure for the product as necessary to be consistent with the amended industry test procedure or rating procedure unless the Secretary determines, by rule, published in the Federal Register and supported by clear and convincing evidence, that to do so would not meet the requirements for test procedures described in paragraphs (2) and (3) of this subsection.

`(C) If the Secretary prescribes a rule containing such a determination, the rule may establish an amended test procedure for such product that meets the requirements of paragraphs (2) and (3) of this subsection. In establishing any amended test procedure under this subparagraph or subparagraph (B), the Secretary shall follow the procedures and meet the requirements specified in section 323(e).

`(5)(A) With respect to electric motors to which standards are applicable under section 342, the test procedures shall be the test procedures specified in NEMA Standards Publication MG1-1987 and IEEE Standard 112 Test Method B for motor efficiency, as in effect on the date of the enactment of the Energy Policy Act of 1992.

`(B) If the test procedure requirements of NEMA Standards Publication MG-1987 and IEEE Standard 112 Test Method B for motor efficiency are amended, the Secretary shall amend the test procedures established by subparagraph (A) to conform to such amended test procedure requirements unless the Secretary determines, by rule, published in the Federal Register and supported by clear and convincing evidence, that to do so would not meet the requirements for test procedures described in paragraphs (2) and (3) of this subsection.

`(C) If the Secretary prescribes a rule containing such a determination, the rule may establish amended test procedures for such electric motors that meets the requirements of paragraphs (2) and (3) of this subsection. In establishing any amended test procedure under this subparagraph or subparagraph (B), the Secretary shall follow the procedures and meet the requirements specified in section 323(e).'.

(2) The second subsection designated as subsection (d) of section 343 of such Act (42 U.S.C. 6314(d)(1)) is amended in paragraph (1) in the material preceding subparagraph (A), by inserting after `180 days' the following: `(or, in the case of small commercial package air conditioning and heating equipment, large commercial package air conditioning and heating equipment, packaged terminal air conditioners, packaged terminal heat pumps, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks, 360 days)'.

(c) LABELING- Section 344 of such Act (42 U.S.C. 6315) is amended--

(1) in subsection (a), by striking out `may' and inserting in lieu thereof `shall';

(2) in subsection (c), by striking out `may' in the material preceding paragraph (1) and inserting in lieu thereof `shall';

(3) by redesignating subsections (d), (e), (f), (g), (h), and (i) as subsections (f), (g), (h), (i), (j), and (k), respectively; and

(4) by inserting after subsection (c), the following new subsections:

`(d) Subject to subsection (h), not later than 12 months after the Secretary establishes test procedures for electric motors under section 343, the Secretary shall prescribe labeling rules under this section applicable to electric motors taking into consideration NEMA Standards Publication MG1-1987. Such rules shall provide that the labeling of any electric motor manufactured after the 12-month period beginning on the date the Secretary prescribes such labeling rules, shall--

`(1) indicate the energy efficiency of the motor on the permanent nameplate attached to such motor;

`(2) prominently display the energy efficiency of the motor in equipment catalogs and other material used to market the equipment; and

`(3) include such other markings as the Secretary determines necessary solely to facilitate enforcement of the standards established for electric motors under section 342.

`(e) Subject to subsection (h), not later than 12 months after the Secretary establishes test procedures for small commercial package air conditioning and heating equipment, large commercial package air conditioning and heating equipment, packaged terminal air conditioners, packaged terminal heat pumps, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks under section 343, the Secretary shall prescribe labeling rules under this section for such equipment. Such rules shall provide that the labeling of any small commercial package air conditioning and heating equipment, large commercial package air conditioning and heating equipment, packaged terminal air conditioner, packaged terminal heat pump, warm-air furnace, packaged boiler, storage water heater, instantaneous water heater, and unfired hot water storage tank manufactured after the 12-month period beginning on the date the Secretary prescribes such rules shall--

`(1) indicate the energy efficiency of the equipment on the permanent nameplate attached to such equipment or other nearby permanent marking;

`(2) prominently display the energy efficiency of the equipment in new equipment catalogs used by the manufacturer to advertise the equipment; and

`(3) include such other markings as the Secretary determines necessary solely to facilitate enforcement of the standards established for such equipment under section 342.'.

(d) STANDARDS- Section 342 of such Act is amended to read as follows:

`standards

`SEC. 342. (a) SMALL AND LARGE COMMERCIAL PACKAGE AIR CONDITIONING AND HEATING EQUIPMENT, PACKAGED TERMINAL AIR CONDITIONERS AND HEAT PUMPS, WARM-AIR FURNACES, PACKAGED BOILERS, STORAGE WATER HEATERS, INSTANTANEOUS WATER HEATERS, AND UNFIRED HOT WATER STORAGE TANKS- (1) Each small commercial package air conditioning and heating equipment manufactured on or after January 1, 1994, shall meet the following standard levels:

`(A) The minimum seasonal energy efficiency ratio of air-cooled three-phase electric central air conditioners and central air conditioning heat pumps less than 65,000 Btu per hour (cooling

capacity), split systems, shall be 10.0.

`(B) The minimum seasonal energy efficiency ratio of air-cooled three-phase electric central air conditioners and central air conditioning heat pumps less than 65,000 Btu per hour (cooling capacity), single package, shall be 9.7.

`(C) The minimum energy efficiency ratio of air-cooled central air conditioners and central air conditioning heat pumps at or above 65,000 Btu per hour (cooling capacity) and less than 135,000 Btu per hour (cooling capacity) shall be 8.9 (at a standard rating of 95 degrees F db).

`(D) The minimum heating seasonal performance factor of air-cooled three-phase electric central air conditioning heat pumps less than 65,000 Btu per hour (cooling capacity), split systems, shall be 6.8.

`(E) The minimum heating seasonal performance factor of air-cooled three-phase electric central air conditioning heat pumps less than 65,000 Btu per hour (cooling capacity), single package, shall be 6.6.

`(F) The minimum coefficient of performance in the heating mode of air-cooled central air conditioning heat pumps at or above 65,000 Btu per hour (cooling capacity) and less than 135,000 Btu per hour (cooling capacity) shall be 3.0 (at a high temperature rating of 47 degrees F db).

`(G) The minimum energy efficiency ratio of water-cooled, evaporatively-cooled and water-source central air conditioners and central air conditioning heat pumps less than 65,000 Btu per hour (cooling capacity) shall be 9.3 (at a standard rating of 95 degrees F db, outdoor temperature for evaporatively cooled equipment, and 85 degrees Fahrenheit entering water temperature for water-source and water-cooled equipment).

`(H) The minimum energy efficiency ratio of water-cooled, evaporatively-cooled and water-source central air conditioners and central air conditioning heat pumps at or above 65,000 Btu per hour (cooling capacity) and less than 135,000 Btu per hour (cooling capacity) shall be 10.5 (at a standard rating of 95 degrees F db, outdoor temperature for evaporatively cooled equipment, and 85 degrees Fahrenheit entering water temperature for water source and water-cooled equipment).

`(I) The minimum coefficient of performance in the heating mode of water-source heat pumps less than 135,000 Btu per hour (cooling capacity) shall be 3.8 (at a standard rating of 70 degrees Fahrenheit entering water).

`(2) Each large commercial package air conditioning and heating equipment manufactured on or after January 1, 1995, shall meet the following standard levels:

`(A) The minimum energy efficiency ratio of air-cooled central air conditioners and central air conditioning heat pumps at or above 135,000 Btu per hour (cooling capacity) and less than 240,000 Btu per hour (cooling capacity) shall be 8.5 (at a standard rating of 95 degrees F db).

`(B) The minimum coefficient of performance in the heating mode of air-cooled central air conditioning heat pumps at or above 135,000 Btu per hour (cooling capacity) and less than 240,000 Btu per hour (cooling capacity) shall be 2.9.

`(C) The minimum energy efficiency ratio of water- and evaporatively-cooled central air

conditioners and central air conditioning heat pumps at or above 135,000 Btu per hour (cooling capacity) and less than 240,000 Btu per hour (cooling capacity) shall be 9.6 (according to ARI Standard 360-86).

`(3) Each packaged terminal air conditioner and packaged terminal heat pump manufactured on or after January 1, 1994, shall meet the following standard levels:

`(A) The minimum energy efficiency ratio (EER) of packaged terminal air conditioners and packaged terminal heat pumps in the cooling mode shall be 10.0 -- (0.16 x Capacity [in thousands of Btu per hour at a standard rating of 95 degrees F db, outdoor temperature]). If a unit has a capacity of less than 7,000 Btu per hour, then 7,000 Btu per hour shall be used in the calculation. If a unit has a capacity of greater than 15,000 Btu per hour, then 15,000 Btu per hour shall be used in the calculation.

`(B) The minimum coefficient of performance (COP) of packaged terminal heat pumps in the heating mode shall be 1.3 + (0.16 x the minimum cooling EER as specified in subparagraph (A)) (at a standard rating of 47 degrees F db).

`(4) Each warm air furnace and packaged boiler manufactured on or after January 1, 1994, shall meet the following standard levels:

`(A) The minimum thermal efficiency at the maximum rated capacity of gas-fired warm-air furnaces with capacity of 225,000 Btu per hour or more shall be 80 percent.

`(B) The minimum thermal efficiency at the maximum rated capacity of oil-fired warm-air furnaces with capacity of 225,000 Btu per hour or more shall be 81 percent.

`(C) The minimum combustion efficiency at the maximum rated capacity of gas-fired packaged boilers with capacity of 300,000 Btu per hour or more shall be 80 percent.

`(D) The minimum combustion efficiency at the maximum rated capacity of oil-fired packaged boilers with capacity of 300,000 Btu per hour or more shall be 83 percent.

`(5) Each storage water heater, instantaneous water heater, and unfired water storage tank manufactured on or after January 1, 1994, shall meet the following standard levels:

`(A) Except as provided in subparagraph (G), the maximum standby loss, in percent per hour, of electric storage water heaters shall be 0.30 + (27/Measured Storage Volume [in gallons]).

`(B) Except as provided in subparagraph (G), the maximum standby loss, in percent per hour, of gas- and oil-fired storage water heaters with input ratings of 155,000 Btu per hour or less shall be 1.30 + (114/Measured Storage Volume [in gallons]). The minimum thermal efficiency of such units shall be 78 percent.

`(C) Except as provided in subparagraph (G), the maximum standby loss, in percent per hour, of gas- and oil-fired storage water heaters with input ratings of more than 155,000 Btu per hour shall be 1.30 + (95/Measured Storage Volume [in gallons]). The minimum thermal efficiency of such units shall be 78 percent.

`(D) The minimum thermal efficiency of instantaneous water heaters with a storage volume of less

than 10 gallons shall be 80 percent.

`(E) Except as provided in subparagraph (G), the minimum thermal efficiency of instantaneous water heaters with a storage volume of 10 gallons or more shall be 77 percent. The maximum standby loss, in percent/hour, of such units shall be 2.30 + (67/Measured Storage Volume [in gallons]).

`(F) Except as provided in subparagraph (G), the maximum heat loss of unfired hot water storage tanks shall be 6.5 Btu per hour per square foot of tank surface area.

`(G) Storage water heaters and hot water storage tanks having more than 140 gallons of storage capacity need not meet the standby loss or heat loss requirements specified in subparagraphs (A) through (C) and subparagraphs (E) and (F) if the tank surface area is thermally insulated to R-12.5 and if a standing pilot light is not used.

`(6)(A) If ASHRAE/IES Standard 90.1, as in effect on the date of enactment of the Energy Policy Act of 1992, is amended with respect to any small commercial package air conditioning and heating equipment, large commercial package air conditioning and heating equipment, packaged terminal air conditioners, packaged terminal heat pumps, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, or unfired hot water storage tanks, the Secretary shall establish an amended uniform national standard for that product at the minimum level for each effective date specified in the amended ASHRAE/IES Standard 90.1, unless the Secretary determines, by rule published in the Federal Register and supported by clear and convincing evidence, that adoption of a uniform national standard more stringent than such amended ASHRAE/IES Standard 90.1 for such product would result in significant additional conservation of energy and is technologically feasible and economically justified.

`(B)(i) If the Secretary issues a rule containing such a determination, the rule shall establish such amended standard. In determining whether a standard is economically justified for the purposes of subparagraph (A), the Secretary shall, after receiving views and comments furnished with respect to the proposed standard, determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering--

`(I) the economic impact of the standard on the manufacturers and on the consumers of the products subject to such standard;

`(II) the savings in operating costs throughout the estimated average life of the product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the products which are likely to result from the imposition of the standard;

`(III) the total projected amount of energy savings likely to result directly from the imposition of the standard;

`(IV) any lessening of the utility or the performance of the products likely to result from the imposition of the standard;

`(V) the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard;

`(VI) the need for national energy conservation; and

`(VII) other factors the Secretary considers relevant.

`(ii) The Secretary may not prescribe any amended standard under this paragraph which increases the maximum allowable energy use, or decreases the minimum required energy efficiency, of a covered product. The Secretary may not prescribe an amended standard under this subparagraph if the Secretary finds (and publishes such finding) that interested persons have established by a preponderance of the evidence that a standard is likely to result in the unavailability in the United States in any product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States at the time of the Secretary's finding. The failure of some types (or classes) to meet this criterion shall not affect the Secretary's determination of whether to prescribe a standard for other types or classes.

`(C) A standard amended by the Secretary under this paragraph shall become effective for products manufactured--

`(i) with respect to small commercial package air conditioning and heating equipment, packaged terminal air conditioners, packaged terminal heat pumps, warm-air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired hot water storage tanks, on or after a date which is two years after the effective date of the applicable minimum energy efficiency requirement in the amended ASHRAE/IES standard referred to in subparagraph (A); and

`(ii) with respect to large commercial package air conditioning and heating equipment, on or after a date which is three years after the effective date of the applicable minimum energy efficiency requirement in the amended ASHRAE/IES standard referred to in subparagraph (A);

except that an energy conservation standard amended by the Secretary pursuant to a rule under subparagraph (B) shall become effective for products manufactured on or after a date which is four years after the date such rule is published in the Federal Register.

`(b) ELECTRIC MOTORS- (1) Except for definite purpose motors, special purpose motors, and those motors exempted by the Secretary under paragraph (2), each electric motor manufactured (alone or as a component of another piece of equipment) after the 60-month period beginning on the date of the enactment of this subsection, or in the case of an electric motor which requires listing or certification by a nationally recognized safety testing laboratory, after the 84-month period beginning on such date, shall have a nominal full load efficiency of not less than the following:

`Number of poles	`Nominal Full-Load Efficiency					
	Open Motors			Closed Motors		
	6	4	2	6	4	2
Motor Horsepower						
1	80.0	82.5		80.0	82.5	75.5
1.5	84.0	84.0	82.5	85.5	84.0	82.5

2	85.5	84.0	84.0	86.5	84.0	84.0
3	86.5	86.5	84.0	87.5	87.5	85.5
5	87.5	87.5	85.5	87.5	87.5	87.5
7.5	88.5	88.5	87.5	89.5	89.5	88.5
10	90.2	89.5	88.5	89.5	89.5	89.5
15	90.2	91.0	89.5	90.2	91.0	90.2
20	91.0	91.0	90.2	90.2	91.0	90.2
25	91.7	91.7	91.0	91.7	92.4	91.0
30	92.4	92.4	91.0	91.7	92.4	91.0
40	93.0	93.0	91.7	93.0	93.0	91.7
50	93.0	93.0	92.4	93.0	93.0	92.4
60	93.6	93.6	93.0	93.6	93.6	93.0
75	93.6	94.1	93.0	93.6	94.1	93.0
100	94.1	94.1	93.0	94.1	94.5	93.6
125	94.1	94.5	93.6	94.1	94.5	94.5
150	94.5	95.0	93.6	95.0	95.0	94.5
200	94.5	95.0	94.5	95.0	95.0	95.0

`(2)(A) The Secretary may, by rule, provide that the standards specified in paragraph (1) shall not apply to certain types or classes of electric motors if--

`(i) compliance with such standards would not result in significant energy savings because such motors cannot be used in most general purpose applications or are very unlikely to be used in most general purpose applications; and

`(ii) standards for such motors would not be technologically feasible or economically justified.

`(B) Not later than one year after the date of the enactment of this subsection, a manufacturer seeking an exemption under this paragraph with respect to a type or class of electric motor developed on or before the date of the enactment of such subsection shall submit a petition to the Secretary requesting such exemption. Such petition shall include evidence that the type or class of motor meets the criteria for exemption specified in subparagraph (A).

`(C) Not later than two years after the date of the enactment of this subsection, the Secretary shall rule on

each petition for exemption submitted pursuant to subparagraph (B). In making such ruling, the Secretary shall afford an opportunity for public comment.

`(D) Manufacturers of types or classes of motors developed after the date of the enactment of this subsection to which standards under paragraph (1) would be applicable may petition the Secretary for exemptions from compliance with such standards based on the criteria specified in subparagraph (A).

`(3)(A) The Secretary shall publish a final rule no later than the end of the 24-month period beginning on the effective date of the standards established under paragraph (1) to determine if such standards should be amended. Such rule shall provide that any amendment shall apply to electric motors manufactured on or after a date which is five years after the effective date of the standards established under paragraph (1).

`(B) The Secretary shall publish a final rule no later than 24 months after the effective date of the previous final rule to determine whether to amend the standards in effect for such product. Any such amendment shall apply to electric motors manufactured after a date which is five years after--

`(i) the effective date of the previous amendment; or

`(ii) if the previous final rule did not amend the standards, the earliest date by which a previous amendment could have been effective.'.

(e) ADMINISTRATION, PENALTIES, ENFORCEMENT, AND PREEMPTION- (1) Section 345(a) of such Act (42 U.S.C. 6316(a)) is amended--

(A) in the material preceding paragraph (1)--

(i) by inserting after `to this part' the following: `(other than the equipment specified in subparagraphs (B), (C), (D), (E), and (F) of section 340(1))'; and

(ii) by striking out `and sections 328' and inserting in lieu thereof `, the provisions of subsections (l) through (s) of section 325, and section 327';

(B) in paragraph (1)--

(i) by striking out `and 324' and inserting in lieu thereof `, 324, and 325'; and

(ii) by striking out `343 and 344, respectively' and inserting in lieu thereof `343, 344, and 342, respectively';

(C) in paragraph (3), by striking out `and' at the end thereof;

(D) in paragraph (4), by striking out the period and inserting in lieu thereof a semicolon; and

(E) by adding after paragraph (4) the following new paragraphs:

`(5) section 327(a) shall be applied, in the case of electric motors, as if the National Appliance Energy Conservation Act of 1987 was the Energy Policy Act of 1992;

`(6) section 327(b)(1) shall be applied as if electric motors were fluorescent lamp ballasts and as if

the National Appliance Energy Conservation Amendments of 1988 were the Energy Policy Act of 1992;

`(7) section 327(b)(4) shall be applied as if electric motors were fluorescent lamp ballasts and as if paragraph (5) of section 325(g) were section 342; and

`(8) notwithstanding any other provision of law, a regulation or other requirement adopted by a State or subdivision of a State contained in a State or local building code for new construction concerning the energy efficiency or energy use of an electric motor covered under this part is not superseded by the standards for such electric motor established or prescribed under section 342(b) if such regulation or requirement is identical to the standards established or prescribed under such section.'.

(2) Section 345 of such Act (42 U.S.C. 6316) is amended by adding at the end the following new subsections:

`(b)(1) The provisions of section 326(a), (b), and (d), section 327(a), and sections 328 through 336 shall apply with respect to the equipment specified in subparagraphs (B), (C), (D), (E), and (F) of section 340 (1) to the same extent and in the same manner as they apply in part B. In applying such provisions for the purposes of such equipment, paragraphs (1), (2), (3), and (4) of subsection (a) shall apply.

`(2)(A) A standard prescribed or established under section 342(a) shall, beginning on the effective date of such standard, supersede any State or local regulation concerning the energy efficiency or energy use of a product for which a standard is prescribed or established pursuant to such section.

`(B) Notwithstanding subparagraph (A), a standard prescribed or established under section 342(a) shall not supersede a standard for such a product contained in a State or local building code for new construction if--

`(i) the standard in the building code does not require that the energy efficiency of such product exceed the applicable minimum energy efficiency requirement in amended ASHRAE/IES Standard 90.1; and

`(ii) the standard in the building code does not take effect prior to the effective date of the applicable minimum energy efficiency requirement in amended ASHRAE/IES Standard 90.1.

`(C) Notwithstanding subparagraph (A), a standard prescribed or established under section 342(a) shall not supersede the standards established by the State of California set forth in Table C-6, California Code of Regulations, Title 24, Part 2, Chapter 2-53, for water-source heat pumps below 135,000 Btu per hour (cooling capacity) that become effective on January 1, 1993.

`(D) Notwithstanding subparagraph (A), a standard prescribed or established under section 342(a) shall not supersede a State regulation which has been granted a waiver by the Secretary. The Secretary may grant a waiver pursuant to the terms, conditions, criteria, procedures, and other requirements specified in section 327(d) of this Act.

`(c) With respect to any electric motor to which standards are applicable under section 342(b), the Secretary shall require manufacturers to certify, through an independent testing or certification program nationally recognized in the United States, that such motor meets the applicable.'.

(3) Section 345 of such Act (42 U.S.C. 6316) is amended by striking out the section heading and inserting in lieu thereof `ADMINISTRATION, PENALTIES, ENFORCEMENT, AND PREEMPTION'.

(f) TECHNICAL AMENDMENTS- (1) Section 340(3) of such Act is amended by striking out `(3) the' and inserting in lieu thereof the following: `(3) The'.

(2) Section 343 of such Act (42 U.S.C. 6314) is amended by redesignating the first subsection designated as subsection (d) as subsection (c).

(3) The table of contents of such Act is amended--

(A) by striking out the item relating to section 342 and inserting in lieu thereof the following new item:

`Sec. 342. Standards.';

and

(B) by striking the item for section 345 and inserting in lieu thereof the following new item:

`Sec. 345. Administration, penalties, enforcement, and preemption.'.

SEC. 123. ENERGY CONSERVATION REQUIREMENTS FOR CERTAIN LAMPS AND PLUMBING PRODUCTS.

(a) STATEMENT OF PURPOSE- Section 2 of the Energy Policy and Conservation Act (42 U.S.C. 6201) is amended--

(1) in paragraph (6), by striking out `and' at the end;

(2) in paragraph (7), by striking out the period at the end and inserting in lieu thereof `; and'; and

(3) by adding at the end the following new paragraph:

`(8) to conserve water by improving the water efficiency of certain plumbing products and appliances.'.

(b) DEFINITIONS- Section 321(a) of the Energy Policy and Conservation Act (42 U.S.C. 6291(a)) is amended--

(1) by striking out the subsection designation;

(2) in paragraph (1)--

(A) in subparagraph (A), by inserting before the semicolon the following: `or, with respect to showerheads, faucets, water closets, and urinals, water'; and

(B) in subparagraph (B), by striking out `ballasts' and inserting in lieu thereof the following: `ballasts, general service fluorescent lamps, incandescent reflector lamps, showerheads, faucets, water closets, and urinals';

(3) in paragraph (6)--

(A) in subparagraph (A), by inserting `, or, in the case of showerheads, faucets, water closets, and urinals, water use,' after `energy use'; and

(B) in subparagraph (B)--

(i) by striking out `and (14)' and inserting in lieu thereof `(15), (16), (17), and (19)'; and

(ii) by striking out `325(o)' and inserting in lieu thereof `325(r)';

(4) in paragraph (7), by inserting after `to be consumed annually' the following: `, and in the case of showerheads, faucets, water closets, and urinals, the aggregate retail cost of water and wastewater treatment services likely to be incurred annually,'; and

(5) by adding at the end the following new paragraphs:

`(30)(A) Except as provided in subparagraph (E), the term `fluorescent lamp' means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

`(i) Any straight-shaped lamp (commonly referred to as 4-foot medium bi-pin lamps) with medium bi-pin bases of nominal overall length of 48 inches and rated wattage of 28 or more.

`(ii) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bi-pin bases of nominal overall length between 22 and 25 inches and rated wattage of 28 or more.

`(iii) Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches and 0.800 nominal amperes, as defined in ANSI C78.1-1978 and related supplements.

`(iv) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more, as defined in ANSI C78.3-1978 (R1984) and related supplement ANSI C78.3a-1985.

`(B) The term `general service fluorescent lamp' means fluorescent lamps which can be used to satisfy the majority of fluorescent applications, but does not include any lamp designed and marketed for the following nongeneral lighting applications:

`(i) Fluorescent lamps designed to promote plant growth.

`(ii) Fluorescent lamps specifically designed for cold temperature installations.

`(iii) Colored fluorescent lamps.

`(iv) Impact-resistant fluorescent lamps.

`(v) Reflectorized or aperture lamps.

`(vi) Fluorescent lamps designed for use in reprographic equipment.

`(vii) Lamps primarily designed to produce radiation in the ultra-violet region of the spectrum.

`(viii) Lamps with a color rendering index of 82 or greater.

`(C) Except as provided in subparagraph (E), the term `incandescent lamp' means a lamp in which light is produced by a filament heated to incandescence by an electric current, including only the following:

`(i) Any lamp (commonly referred to as lower wattage nonreflector general service lamps, including any tungsten-halogen lamp) that has a rated wattage between 30 and 199 watts, has an E26 medium screw base, has a rated voltage or voltage range that lies at least partially within 115 and 130 volts, and is not a reflector lamp.

`(ii) Any lamp (commonly referred to as a reflector lamp) which is not colored or designed for rough or vibration service applications, that contains an inner reflective coating on the outer bulb to direct the light, an R, PAR, or similar bulb shapes (excluding ER or BR) with E26 medium screw bases, a rated voltage or voltage range that lies at least partially within 115 and 130 volts, a diameter which exceeds 2.75 inches, and is either--

`(I) a low(er) wattage reflector lamp which has a rated wattage between 40 and 205 watts; or

`(II) a high(er) wattage reflector lamp which has a rated wattage above 205 watts.

`(iii) Any general service incandescent lamp (commonly referred to as a high- or higher-wattage lamp) that has a rated wattage above 199 watts (above 205 watts for a high wattage reflector lamp).

`(D) The term `general service incandescent lamp' means any incandescent lamp (other than a miniature or photographic lamp) that has an E26 medium screw base, a rated voltage range at least partially within 115 and 130 volts, and which can be used to satisfy the majority of lighting applications, but does not include any lamps specifically designed for--

`(i) traffic signal, or street lighting service;

`(ii) airway, airport, aircraft, or other aviation service;

`(iii) marine or marine signal service;

`(iv) photo, projection, sound reproduction, or film viewer service;

`(v) stage, studio, or television service;

`(vi) mill, saw mill, or other industrial process service;

`(vii) mine service;

`(viii) headlight, locomotive, street railway, or other transportation service;

`(ix) heating service;

`(x) code beacon, marine signal, lighthouse, reprographic, or other communication service;

`(xi) medical or dental service;

`(xii) microscope, map, microfilm, or other specialized equipment service;

`(xiii) swimming pool or other underwater service;

`(xiv) decorative or showcase service;

`(xv) producing colored light;

`(xvi) shatter resistance which has an external protective coating; or

`(xvii) appliance service.

`(E) The terms `fluorescent lamp' and `incandescent lamp' do not include any lamp excluded by the Secretary, by rule, as a result of a determination that standards for such lamp would not result in significant energy savings because such lamp is designed for special applications or has special characteristics not available in reasonably substitutable lamp types.

`(F) The term `incandescent reflector lamp' means a lamp described in subparagraph (C)(ii).

`(G) The term `average lamp efficacy' means the lamp efficacy readings taken over a statistically significant period of manufacture with the readings averaged over that period.

`(H) The term `base' means the portion of the lamp which connects with the socket as described in ANSI C81.61-1990.

`(I) The term `bulb shape' means the shape of lamp, especially the glass bulb with designations for bulb shapes found in ANSI C79.1-1980 (R1984).

`(J) The term `color rendering index' or `CRI' means the measure of the degree of color shift objects undergo when illuminated by a light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature.

`(K) The term `correlated color temperature' means the absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source.

`(L) The term `IES' means the Illuminating Engineering Society of North America.

`(M) The term `lamp efficacy' means the lumen output of a lamp divided by its wattage, expressed in lumens per watt (LPW).

`(N) The term `lamp type' means all lamps designated as having the same electrical and lighting characteristics and made by one manufacturer.

`(O) The term `lamp wattage' means the total electrical power consumed by a lamp in watts, after the initial seasoning period referenced in the appropriate IES standard test procedure and including, for fluorescent, arc watts plus cathode watts.

`(P) The terms `life' and `lifetime' mean length of operating time of a statistically large group of lamps between first use and failure of 50 percent of the group in accordance with test procedures described in the IES Lighting Handbook-Reference Volume.

`(Q) The term `lumen output' means total luminous flux (power) of a lamp in lumens, as measured in accordance with applicable IES standards as determined by the Secretary.

`(R) The term `tungsten-halogen lamp' means a gas-filled tungsten filament incandescent lamp containing a certain proportion of halogens in an inert gas.

`(S) The term `medium base compact fluorescent lamp' means an integrally ballasted fluorescent lamp with a medium screw base and a rated input voltage of 115 to 130 volts and which is designed as a direct replacement for a general service incandescent lamp.

`(31)(A) The term `water use' means the quantity of water flowing through a showerhead, faucet, water closet, or urinal at point of use, determined in accordance with test procedures under section 323.

`(B) The term `ASME' means the American Society of Mechanical Engineers.

`(C) The term `ANSI' means the American National Standards Institute.

`(D) The term `showerhead' means any showerhead (including a handheld showerhead), except a safety shower showerhead.

`(E) The term `faucet' means a lavatory faucet, kitchen faucet, metering faucet, or replacement aerator for a lavatory or kitchen faucet.

`(F) The term `water closet' has the meaning given such term in ASME A112.19.2M-1990, except such term does not include fixtures designed for installation in prisons.

`(G) The term `urinal' has the meaning given such term in ASME A112.19.2M-1990, except such term does not include fixtures designed for installation in prisons.

`(H) The terms `blowout', `flushometer tank', `low consumption', and `flushometer valve' have the meaning given such terms in ASME A112.19.2M-1990.'.

(c) COVERAGE- Section 322(a) of such Act (42 U.S.C. 6292(a)) is amended--

(1) by redesignating paragraph (14) as paragraph (19); and

(2) by inserting after paragraph (13) the following new paragraphs:

`(14) General service fluorescent lamps and incandescent reflector lamps.

`(15) Showerheads, except safety shower showerheads.

`(16) Faucets.

`(17) Water closets.

`(18) Urinals.'.

(d) TEST PROCEDURES- Section 323 of such Act (42 U.S.C. 6293) is amended--

(1) in subsection (b)--

(A) in paragraph (3), by inserting after `energy use,' the following `water use (in the case of showerheads, faucets, water closets and urinals),';

(B) in paragraph (4)--

(i) by inserting `or, in the case of showerheads, faucets, water closets, or urinals, water use' after `energy use';

(ii) by inserting after `such cycle' the following: `, or in the case of showerheads, faucets, water closets, or urinals, representative average unit costs of water and wastewater treatment service resulting from the operation of such products during such cycle'; and

(iii) by inserting `, water, and wastewater treatment' before the period at the end of the second sentence; and

(C) by adding at the end the following new paragraphs:

`(6) With respect to fluorescent lamps and incandescent reflector lamps to which standards are applicable under subsection (i) of section 325, the Secretary shall prescribe test procedures, to be carried out by accredited test laboratories, that take into consideration the applicable IES or ANSI standard.

`(7)(A) Test procedures for showerheads and faucets to which standards are applicable under subsection (j) of section 325 shall be the test procedures specified in ASME A112.18.1M-1989 for such products.

`(B) If the test procedure requirements of ASME A112.18.1M-1989 are revised at any time and approved by ANSI, the Secretary shall amend the test procedures established by subparagraph (A) to conform to such revised ASME/ANSI requirements unless the Secretary determines, by rule, that to do so would not meet the requirements of paragraph (3).

`(8)(A) Test procedures for water closets and urinals to which standards are applicable under subsection (k) of section 325 shall be the test procedures specified in ASME A112.19.6-1990 for such products.

`(B) If the test procedure requirements of ASME A112.19.6-1990 are revised at any time and approved by ANSI, the Secretary shall amend the test procedures established by subparagraph (A) to conform to such revised ASME/ANSI requirements unless the Secretary determines, by rule, that to do so would not meet the requirements of paragraph (3).';

(2) in paragraphs (1) and (2) of subsection (c), by inserting `or, in the case of showerheads, faucets, water closets, and urinals, water use' after `efficiency' each place it appears;

(3) in subsection (c)(2), in the material preceding subparagraph (A), by inserting `or established' after `prescribed'; and

(4) in subsection (e)--

(A) in paragraph (1), by striking out `or measured energy use' and inserting in lieu thereof `, measured energy use, or measured water use';

(B) in paragraph (2), by striking out `energy efficiency or energy use' each place it appears and inserting in lieu thereof `energy efficiency, energy use, or water use'; and

(C) in paragraph (3), by striking out `energy efficiency or energy use' and inserting in lieu thereof `energy efficiency, energy use, or water use'.

(e) LABELING- Section 324 of such Act (42 U.S.C. 6294) is amended--

(1) in subsection (a)(2), by adding at the end the following new subparagraphs:

`(C)(i) Not later than 18 months after the date of the enactment of the Energy Policy Act of 1992, the Commission shall prescribe labeling rules under this section applicable to general service fluorescent lamps, medium base compact fluorescent lamps, and general service incandescent lamps. Except as provided in clause (ii), such rules shall provide that the labeling of any general service fluorescent lamp, medium base compact fluorescent lamp, and general service incandescent lamp manufactured after the 12-month period beginning on the date of the publication of such rule shall indicate conspicuously on the packaging of the lamp, in a manner prescribed by the Commission under subsection (b), such information as the Commission deems necessary to enable consumers to select the most energy efficient lamps which meet their requirements. Labeling information for incandescent lamps shall be based on performance when operated at 120 volts input, regardless of the rated lamp voltage.

`(ii) If the Secretary determines that compliance with the standards specified in section 325(j) for any lamp will result in the discontinuance of the manufacture of such lamp, the Commission may exempt such lamp from the labeling rules prescribed under clause (i).

`(D)(i) Not later than one year after the date of the enactment of the Energy Policy Act of 1992, the Commission shall prescribe labeling rules under this section for showerheads and faucets to which standards are applicable under subsection (j) of section 325. Such rules shall provide that the labeling of any showerhead or faucet manufactured after the 12-month period beginning on the date of the publication of such rule shall be consistent with the marking and labeling requirements of ASME A112.18.1M-1989, except that each showerhead and flow restricting or controlling spout-end device shall bear a permanent legible marking indicating the flow rate, expressed in gallons per minute (gpm) or gallons per cycle (gpc), and the flow rate value shall be the actual flow rate or the maximum flow rate specified by the standards established in subsection (j) of section 325.

`(ii) If the marking and labeling requirements of ASME A112.18.1M-1989 are revised at any time and approved by ANSI, the Commission shall amend the labeling rules established pursuant to clause (i) to be consistent with such revised ASME/ANSI requirements unless such requirements are inconsistent with the purposes of this Act or the requirement specified in clause (i) requiring each showerhead and flow restricting or controlling spout-end device to bear a permanent legible marking indicating the flow rate of such product.

`(E)(i) Not later than one year after the date of the enactment of the Energy Policy Act of 1992, the Commission shall prescribe labeling rules under this section for water closets and urinals to which standards are applicable under subsection (k) of section 325. Such rules shall provide that the labeling of any water closet or urinal manufactured after the 12-month period beginning on the date of the publication of such rule shall be consistent with the marking and labeling requirements of ASME A112.19.2M-1990, except that each fixture (and flushometer valve associated with such fixture) shall bear a permanent legible marking indicating the water use, expressed in gallons per flush (gpf), and the water use value shall be the actual water use or the maximum water use specified by the standards established in subsection (k) of section 325.

`(ii) If the marking and labeling requirements of ASME A112.19.2M-1990 are revised at any time and approved by ANSI, the Commission shall amend the labeling rules established pursuant to clause (i) to be consistent with such revised ASME/ANSI requirements unless such requirements are inconsistent with the purposes of this Act or the requirement specified in clause (i) requiring each fixture and flushometer valve to bear a permanent legible marking indicating the water use of such fixture or flushometer valve.

`(iii) Any labeling rules prescribed under this subparagraph before January 1, 1997, shall provide that, with respect to any gravity tank-type white 2-piece toilet which has a water use greater than 1.6 gallons per flush (gpf), any printed matter distributed or displayed in connection with such product (including packaging and point of sale material, catalog material, and print advertising) shall include, in a conspicuous manner, the words `For Commercial Use Only'.';

(2) in subsection (a)(3), by striking out `(14)' and inserting in lieu thereof `(19)';

(3) in subsection (b)(1)(B), by striking out `(14)' and inserting in lieu thereof `(13), and paragraphs (15) through (19)';

(4) in paragraphs (3) and (5) of subsection (b), by striking out `(14)' and inserting in lieu thereof `(19)'; and

(5) in subsection (c)--

(A) in paragraph (7), by striking out `paragraph (13) of section 322' and inserting in lieu thereof `paragraphs (13), (14), (15), (16), (17), and (18) of section 322(a)'; and

(B) by adding at the end the following:

`(8) If a manufacturer of a covered product specified in paragraph (15) or (17) of section 322(a) elects to provide a label for such covered product conveying the estimated annual operating cost of such product or the range of estimated annual operating costs for the type or class of such product--

`(A) such estimated cost or range of costs shall be determined in accordance with test procedures prescribed under section 323;

`(B) the format of such label shall be in accordance with a format prescribed by the Commission; and

`(C) such label shall be displayed in a manner, prescribed by the Commission, to be likely to assist consumers in making purchasing decisions and appropriate to carry out the purposes of this Act.'.

(f) STANDARDS- Section 325 of such Act (42 U.S.C. 6295) is amended--

(1) by redesignating subsections (i) through (q) as subsections (l) through (t);

(2) by inserting after subsection (h) the following:

`(i) GENERAL SERVICE FLUORESCENT LAMPS AND INCANDESCENT REFLECTOR LAMPS- (1)(A) Each of the following general service fluorescent lamps and incandescent reflector lamps manufactured after the effective date specified in the tables listed in this paragraph shall meet or exceed the following lamp efficacy and CRI standards:

`FLUORESCENT LAMPS

`Lamp Type	Nominal Lamp Wattage	Minimum CRI	Minimum Average Lamp Efficacy (LPW)
4-foot medium bi-pin	>35W	69	75.0
	¾35W	45	75.0
2-foot U-shaped	>35W	69	68.0
	¾35W	45	64.0
8-foot slimline	65W	69	80.0
	¾65W	45	80.0
8-foot high output	>100W	69	80.0
	¾100W	45	80.0

`INCANDESCENT REFLECTOR LAMPS

`Nominal Lamp Wattage	Minimum Average Lamp Efficacy (LPW)	Effective Date (Months)
40-50	10.5	36
51-66	11.0	36
67-85	12.5	36
86-115	14.0	36

116-155	14.5	36
156-205	15.0	36

`(B) For the purposes of the tables set forth in subparagraph (A), the term `effective date' means the last day of the month set forth in the table which follows the date of the enactment of the Energy Policy Act of 1992.

`(2) Notwithstanding section 332(a)(5) and section 332(b), it shall not be unlawful for a manufacturer to sell a lamp which is in compliance with the law at the time such lamp was manufactured.

`(3) Not less than 36 months after the date of the enactment of this subsection, the Secretary shall initiate a rulemaking procedure and shall publish a final rule not later than the end of the 54-month period beginning on the date of the enactment of this subsection to determine if the standards established under paragraph (1) should be amended. Such rule shall contain such amendment, if any, and provide that the amendment shall apply to products manufactured on or after the 36-month period beginning on the date such final rule is published.

`(4) Not less than eight years after the date of the enactment of this subsection, the Secretary shall initiate a rulemaking procedure and shall publish a final rule not later than nine years and six months after the date of the enactment of this subsection to determine if the standards in effect for fluorescent lamps and incandescent lamps should be amended. Such rule shall contain such amendment, if any, and provide that the amendment shall apply to products manufactured on or after the 36-month period beginning on the date such final rule is published.

`(5) Not later than the end of the 24-month period beginning on the date labeling requirements under section 324(a)(2)(C) become effective, the Secretary shall initiate a rulemaking procedure to determine if the standards in effect for fluorescent lamps and incandescent lamps should be amended so that they would be applicable to additional general service fluorescent and general service incandescent lamps and shall publish, not later than 18 months after initiating such rulemaking, a final rule including such amended standards, if any. Such rule shall provide that the amendment shall apply to products manufactured after a date which is 36 months after the date such rule is published.

`(6)(A) With respect to any lamp to which standards are applicable under this subsection or any lamp specified in section 346, the Secretary shall inform any Federal entity proposing actions which would adversely impact the energy consumption or energy efficiency of such lamp of the energy conservation consequences of such action. It shall be the responsibility of such Federal entity to carefully consider the Secretary's comments.

`(B) Notwithstanding section 325(n)(1), the Secretary shall not be prohibited from amending any standard, by rule, to permit increased energy use or to decrease the minimum required energy efficiency of any lamp to which standards are applicable under this subsection if such action is warranted as a result of other Federal action (including restrictions on materials or processes) which would have the effect of either increasing the energy use or decreasing the energy efficiency of such product.

`(7) Not later than the date on which standards established pursuant to this subsection become effective, or, with respect to high-intensity discharge lamps covered under section 346, the effective date of standards established pursuant to such section, each manufacturer of a product to which such standards are applicable shall file with the Secretary a laboratory report certifying compliance with the applicable

standard for each lamp type. Such report shall include the lumen output and wattage consumption for each lamp type as an average of measurements taken over the preceding 12-month period. With respect to lamp types which are not manufactured during the 12-month period preceding the date such standards become effective, such report shall be filed with the Secretary not later than the date which is 12 months after the date manufacturing is commenced and shall include the lumen output and wattage consumption for each such lamp type as an average of measurements taken during such 12-month period.

`(j) STANDARDS FOR SHOWERHEADS AND FAUCETS- (1) The maximum water use allowed for any showerhead manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing water pressure of 80 pounds per square inch. Any such showerhead shall also meet the requirements of ASME/ANSI A112.18.1M-1989, 7.4.3(a).

`(2) The maximum water use allowed for any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

`Lavatory faucets

2.5 gallons per minute

`Lavatory replacement aerators

2.5 gallons per minute

`Kitchen faucets

2.5 gallons per minute

`Kitchen replacement aerators

2.5 gallons per minute

`Metering faucets

0.25 gallons per cycle

`(3)(A) If the maximum flow rate requirements or the design requirements of ASME/ANSI Standard A112.18.1M-1989 are amended to improve the efficiency of water use of any type or class of showerhead or faucet and are approved by ANSI, the Secretary shall, not later than 12 months after the date of such amendment, publish a final rule establishing an amended uniform national standard for that product at the level specified in the amended ASME/ANSI Standard A112.18.1M and providing that

such standard shall apply to products manufactured after a date which is 12 months after the publication of such rule, unless the Secretary determines, by rule published in the Federal Register, that adoption of a uniform national standard at the level specified in such amended ASME/ANSI Standard A112.18.1M--

`(i) is not technologically feasible and economically justified under subsection (o);

`(ii) is not consistent with the maintenance of public health and safety; or

`(iii) is not consistent with the purposes of this Act.

`(B)(i) As part of the rulemaking conducted under subparagraph (A), the Secretary shall also determine if adoption of a uniform national standard for any type or class of showerhead or faucet more stringent than such amended ASME/ANSI Standard A112.18.1M--

`(I) would result in additional conservation of energy or water;

`(II) would be technologically feasible and economically justified under subsection (o); and

`(III) would be consistent with the maintenance of public health and safety.

`(ii) If the Secretary makes an affirmative determination under clause (i), the final rule published under subparagraph (A) shall waive the provisions of section 327(c) with respect to any State regulation concerning the water use or water efficiency of such type or class of showerhead or faucet if such State regulation--

`(I) is more stringent than amended ASME/ANSI Standard A112.18.1M for such type or class of showerhead or faucet and the standard in effect for such product on the day before the date on which a final rule is published under subparagraph (A); and

`(II) is applicable to any sale or installation of all products in such type or class of showerhead or faucet.

`(C) If, after any period of five consecutive years, the maximum flow rate requirements of the ASME/ANSI standard for showerheads are not amended to improve the efficiency of water use of such products, or after any such period such requirements for faucets are not amended to improve the efficiency of water use of such products, the Secretary shall, not later than six months after the end of such five-year period, publish a final rule waiving the provisions of section 327(c) with respect to any State regulation concerning the water use or water efficiency of such type or class of showerhead or faucet if such State regulation--

`(i) is more stringent than the standards in effect for such type of class of showerhead or faucet; and

`(ii) is applicable to any sale or installation of all products in such type or class of showerhead or faucet.

`(k) STANDARDS FOR WATER CLOSETS AND URINALS- (1)(A) Except as provided in subparagraph (B), the maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is the following:

`Gravity tank-type toilets

--1.6 gpf.

`Flushometer tank toilets

--1.6 gpf.

`Electromechanical hydraulic toilets

--1.6 gpf.

`Blowout toilets

--3.5 gpf.

`(B) The maximum water use allowed for any gravity tank-type white 2-piece toilet which bears an adhesive label conspicuous upon installation consisting of the words `Commercial Use Only' manufactured after January 1, 1994, and before January 1, 1997, is 3.5 gallons per flush.

`(C) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

`(2) The maximum water use allowed for any urinal manufactured after January 1, 1994, is 1.0 gallon per flush.

`(3)(A) If the maximum flush volume requirements of ASME Standard A112.19.6-1990 are amended to improve the efficiency of water use of any low consumption water closet or low consumption urinal and are approved by ANSI, the Secretary shall, not later than 12 months after the date of such amendment, publish a final rule establishing an amended uniform national standard for that product at the level specified in amended ASME/ANSI Standard A112.19.6 and providing that such standard shall apply to products manufactured after a date which is one year after the publication of such rule, unless the Secretary determines, by rule published in the Federal Register, that adoption of a uniform national standard at the level specified in such amended ASME/ANSI Standard A112.19.6--

`(i) is not technologically feasible and economically justified under subsection (o);

`(ii) is not consistent with the maintenance of public health and safety; or

`(iii) is not consistent with the purposes of this Act.

`(B)(i) As part of the rulemaking conducted under subparagraph (A), the Secretary shall also determine if adoption of a uniform national standard for any type or class of low consumption water closet or low consumption urinal more stringent than such amended ASME/ANSI Standard A112.19.6 for such product--

`(I) would result in additional conservation of energy or water;

`(II) would be technologically feasible and economically justified under subsection (o); and

`(III) would be consistent with the maintenance of public health and safety.

`(ii) If the Secretary makes an affirmative determination under clause (i), the final rule published under subparagraph (A) shall waive the provisions of section 327(c) with respect to any State regulation concerning the water use or water efficiency of such type or class of low consumption water closet or low consumption urinal if such State regulation--

`(I) is more stringent than amended ASME/ANSI Standard A112.19.6 for such type or class of low consumption water closet or low consumption urinal and the standard in effect for such product on the day before the date on which a final rule is published under subparagraph (A); and

`(II) is applicable to any sale or installation of all products in such type or class of low consumption water closet or low consumption urinal.

`(C) If, after any period of five consecutive years, the maximum flush volume requirements of the ASME/ANSI standard for low consumption water closets are not amended to improve the efficiency of water use of such products, or after any such period such requirements for low consumption urinals are not amended to improve the efficiency of water use of such products, the Secretary shall, not later than six months after the end of such five-year period, publish a final rule waiving the provisions of section 327(c) with respect to any State regulation concerning the water use or water efficiency of such type or class of water closet or urinal if such State regulation--

`(i) is more stringent than the standards in effect for such type or class of water closet or urinal; and

`(ii) is applicable to any sale or installation of all products in such type or class of water closet or urinal.';

(3) in subsection (l) (as redesignated by paragraph (1) of this subsection)--

(A) in paragraphs (1) and (2), by striking out `(14)' and inserting in lieu thereof `(19)'; and

(B) in paragraphs (1) and (3), by striking out `(l) and (m)' and inserting in lieu thereof `(o) and (p)';

(4) in subsection (m) (as redesignated by paragraph (1) of this subsection), by striking out `(h)' and inserting in lieu thereof `(i)';

(5) in subsection (n) (as redesignated by paragraph (1) of this subsection)--

(A) in paragraph (1)--

(i) by striking out `and in paragraph (13)' and inserting in lieu thereof `, and in paragraphs (13) and (14)'; and

(ii) by striking out `(h)' and inserting in lieu thereof `(i)';

(B) in paragraph (2)(C), by striking out `(l)(2)(B)(i)(II)' and inserting in lieu thereof `(o)(2)(B)(i)(II)'; and

(C) in paragraph (3)(B), by inserting `general service fluorescent lamps, incandescent reflector lamps,' after `fluorescent lamp ballasts,';

(6) in subsection (o) (as redesignated by paragraph (1) of this subsection)--

(A) in paragraph (1), by inserting `or, in the case of showerheads, faucets, water closets, or urinals, water use,' after `energy use,';

(B) in paragraph (2)(A), by inserting `, or, in the case of showerheads, faucets, water closets, or urinals, water efficiency,' after `energy efficiency';

(C) in paragraph (2)(B)(i)(III), by inserting `, or as applicable, water,' after `energy';

(D) in paragraph (2)(B)(i)(VI), by inserting `and water' after `energy';

(E) in paragraph (2)(B)(iii), by striking out `energy savings' and inserting `energy, and as applicable, water savings'; and

(F) in paragraph (3)(B), by inserting `, in the case of showerheads, faucets, water closets, or urinals, water, or' after `energy or'; and

(7) in subsection (p)(3)(A) (as redesignated by paragraph (1) of this subsection)--

(A) by striking out `(l)(2)' and inserting in lieu thereof `(o)(2)'; and

(B) by striking out `(l)(4)' and inserting in lieu thereof `(o)(4)'.

(g) REQUIREMENTS OF MANUFACTURERS- Section 326 of such Act (42 U.S.C. 6296) is amended--

(1) in subsection (b)(4), by inserting `or water use' after `consumption'; and

(2) in subsection (d)(1), by striking out `or energy use' and inserting in lieu thereof `, energy use, or, in the case of showerheads, faucets, water closets, and urinals, water use'.

(h) EFFECT ON OTHER LAW- Section 327 of such Act (42 U.S.C. 6297) is amended--

(1) in subsection (a)--

(A) in paragraph (1), in the material preceding subparagraph (A), by inserting `or water use' after `energy consumption';

(B) in paragraph (1)(A), by inserting `, water use,' after `energy consumption';

(C) in paragraph (1)(B), by striking out `or energy efficiency' and inserting in lieu thereof `, energy efficiency, or water use'; and

(D) by amending paragraph (2) to read as follows:

`(2) For purposes of this section, the following definitions apply:

`(A) The term `State regulation' means a law, regulation, or other requirement of a State or its political subdivisions. With respect to showerheads, faucets, water closets, and urinals, such term shall also mean a law, regulation, or other requirement of a river basin commission that has jurisdiction within a State.

`(B) The term `river basin commission' means--

`(i) a commission established by interstate compact to apportion, store, regulate, or otherwise manage or coordinate the management of the waters of a river basin; and

`(ii) a commission established under section 201(a) of the Water Resources Planning Act (42 U.S.C. 1962b(a)).';

(2) in subsection (b)--

(A) in the material preceding paragraph (1), by striking out `or energy use of the covered product' and inserting in lieu thereof `, energy use, or water use of the covered product';

(B) by inserting before the semicolon at the end of paragraph (1) the following: `, or in the case of any portion of any regulation which establishes requirements for fluorescent or incandescent lamps, flow rate requirements for showerheads or faucets, or water use requirements for water closets or urinals, was prescribed or enacted before the date of the enactment of the Energy Policy Act of 1992';

(C) in paragraph (4), by inserting before the semicolon at the end the following: `, or is a regulation (or portion thereof) regulating fluorescent or incandescent lamps other than those to which section 325(i) is applicable, or is a regulation (or portion thereof) regulating showerheads or faucets other than those to which section 325(j) is applicable or regulating lavatory faucets (other than metering faucets) for installation in public places, or is a regulation (or portion thereof) regulating water closets or urinals other than those to which section 325(k) is applicable';

(D) in paragraph (5), by striking out `or';

(E) in paragraph (6), by striking out the period at the end and inserting `; or'; and

(F) by adding at the end the following new paragraph:

`(7) is a regulation (or portion thereof) concerning the water efficiency or water use of low consumption flushometer valve water closets.';

(3) in subsection (c)--

(A) in the material preceding paragraph (1)--

(i) by inserting `, subparagraphs (B) and (C) of section 325(j)(3), and subparagraphs (B) and (C) of section 325(k)(3)' after `section 325(b)(3)(A)(ii)'; and

(ii) by striking out `or energy use' and inserting in lieu thereof the following: `, energy use, or water use';

(B) in paragraph (1), by inserting before the semicolon at the end the following: `, except that a State regulation (or portion thereof) regulating fluorescent or incandescent lamps other than those for which section 325(i) is applicable shall be effective only until the effective date of a standard that is prescribed by the Secretary and is applicable to such lamps';

(C) in paragraph (2), by striking out `or';

(D) in paragraph (3), by striking out the period at the end and inserting a semicolon; and

(E) by adding at the end the following new paragraphs:

`(4) is a regulation concerning the water use of lavatory faucets adopted by the State of New York or the State of Georgia before the date of the enactment of the Energy Policy Act of 1992;

`(5) is a regulation concerning the water use of lavatory or kitchen faucets adopted by the State of Rhode Island prior to the date of the enactment of the Energy Policy Act of 1992; or

`(6) is a regulation (or portion thereof) concerning the water efficiency or water use of gravity tank-type low consumption water closets for installation in public places, except that such a regulation shall be effective only until January 1, 1997.';

(4) in subsection (d)(1)--

(A) in subparagraph (A)--

(i) by inserting `or river basin commission' after `Any State'; and

(ii) by striking out `or energy efficiency' and inserting in lieu thereof `, energy efficiency, or water use';

(B) in subparagraph (B)--

(i) by striking out `State has' and inserting `State or river basin commission has'; and

(ii) by inserting `or water' after `energy';

(C) in subparagraph (C)--

(i) in the material preceding clause (i) and in clause (ii), by inserting `or water' after `energy' each place it appears; and

(ii) by inserting before the period at the end the following: `, and, with respect to a State regulation for which a petition has been submitted to the Secretary which provides for any energy conservation standard or requirement with respect to water use of a covered product, within the context of the water supply and groundwater management plan, water quality program, and comprehensive plan (if any) of the State or river basin commission for improving, developing, or conserving a waterway affected by water supply development'; and

(5) in subsection (d)(5)(B), by striking clause (i) and inserting the following:

`(i) there exists within the State an energy emergency condition or, if the State regulation provides for an energy conservation standard or other requirement with respect to the water use of a covered product for which there is a Federal energy conservation standard under subsection (j) or (k) of section 325, a water emergency condition, which--

`(I) imperils the health, safety, and welfare of its residents because of the inability of the State or utilities within the State to provide adequate quantities of gas or electric energy or, in the case of a water emergency condition, water or wastewater treatment, to its residents at less than prohibitive costs; and

`(II) cannot be substantially alleviated by the importation of energy or, in the case of a water emergency condition, by the importation of water, or by the use of interconnection agreements; and'.

(i) INCENTIVE PROGRAMS- Section 337 of such Act (42 U.S.C. 6307) is amended--

(1) by striking out `337.' and inserting `337. (a) IN GENERAL- '; and

(2) by adding at the end the following:

`(b) STATE AND LOCAL INCENTIVE PROGRAMS- (1) The Secretary shall, not later than one year after the date of the enactment of this subsection, issue recommendations to the States for establishing State and local incentive programs designed to encourage the acceleration of voluntary replacement, by consumers, of existing showerheads, faucets, water closets, and urinals with those products that meet the standards established for such products pursuant to subsections (j) and (k) of section 325.

`(2) In developing such recommendations, the Secretary shall consult with the heads of other federal agencies, including the Administrator of the Environmental Protection Agency; State officials; manufacturers, suppliers, and installers of plumbing products; and other interested parties.'.

SEC. 124. HIGH-INTENSITY DISCHARGE LAMPS, DISTRIBUTION TRANSFORMERS, AND SMALL ELECTRIC MOTORS.

(a) STANDARDS- Section 346 of the Energy Policy and Conservation Act (42 U.S.C. 6317) is amended to read as follows:

`ENERGY CONSERVATION STANDARDS FOR HIGH-INTENSITY DISCHARGE LAMPS, DISTRIBUTION TRANSFORMERS, AND SMALL ELECTRIC MOTORS

`SEC. 346. (a)(1) The Secretary shall, within 30 months after the date of the enactment of the Energy Policy Act of 1992, prescribe testing requirements for those high-intensity discharge lamps and distribution transformers for which the Secretary makes a determination that energy conservation standards would be technologically feasible and economically justified, and would result in significant energy savings.

`(2) The Secretary shall, within 18 months after the date on which testing requirements are prescribed by the Secretary pursuant to paragraph (1), prescribe, by rule, energy conservation standards for those high-intensity discharge lamps and distribution transformers for which the Secretary prescribed testing

requirements under paragraph (1).

`(3) Any standard prescribed under paragraph (2) with respect to high-intensity discharge lamps shall apply to such lamps manufactured 36 months after the date such rule is published.

`(b)(1) The Secretary shall, within 30 months after the date of the enactment of the Energy Policy Act of 1992, prescribe testing requirements for those small electric motors for which the Secretary makes a determination that energy conservation standards would be technologically feasible and economically justified, and would result in significant energy savings.

`(2) The Secretary shall, within 18 months after the date on which testing requirements are prescribed by the Secretary pursuant to paragraph (1), prescribe, by rule, energy conservation standards for those small electric motors for which the Secretary prescribed testing requirements under paragraph (1).

`(3) Any standard prescribed under paragraph (2) shall apply to small electric motors manufactured 60 months after the date such rule is published or, in the case of small electric motors which require listing or certification by a nationally recognized testing laboratory, 84 months after such date. Such standards shall not apply to any small electric motor which is a component of a covered product under section 322 (a) or a covered equipment under section 340.

`(c) In establishing any standard under this section, the Secretary shall take into consideration the criteria contained in section 325(n).

`(d) The Secretary shall, within six months after the date on which energy conservation standards are prescribed by the Secretary for high-intensity discharge lamps and distribution transformers pursuant to subsection (a)(2) and small electric motors pursuant to subsection (b)(2), prescribe labeling requirements for such lamps, transformers, and small electric motors.

`(e) Beginning on the date which occurs six months after the date on which a labeling rule is prescribed for a product under subsection (d), each manufacturer of a product to which such a rule applies shall provide a label which meets, and is displayed in accordance with, the requirements of such rule.

`(f)(1) After the date on which a manufacturer must provide a label for a product pursuant to subsection (e)--

`(A) each such product shall be considered, for purposes of paragraphs (1) and (2) of section 332 (a), a new covered product to which a rule under section 324 applies; and

`(B) it shall be unlawful for any manufacturer or private labeler to distribute in commerce any new product for which an energy conservation standard is prescribed under subsection (a)(2) or (b)(2) which is not in conformity with the applicable energy conservation standard.

`(2) For purposes of section 333(a), paragraph (1) of this subsection shall be considered to be a part of section 332.'.

(b) TECHNICAL AMENDMENT- The table of contents of such Act is amended by striking out the item for section 346 and inserting in lieu thereof the following new item:

`Sec. 346. Energy conservation standards for high-intensity discharge lamps, distribution transformers, and small electric motors.'.

(c) STUDY OF UTILITY DISTRIBUTION TRANSFORMERS- The Secretary shall evaluate the practicability, cost-effectiveness, and potential energy savings of replacing, or upgrading components of, existing utility distribution transformers during routine maintenance and, not later than 18 months after the date of the enactment of this Act, report the findings of such evaluation to the Congress with recommendations on how such energy savings, if any, could be achieved.

SEC. 125. ENERGY EFFICIENCY INFORMATION FOR COMMERCIAL OFFICE EQUIPMENT.

(a) IN GENERAL- (1) The Secretary shall, after consulting with the Computer and Business Equipment Manufacturers Association and other interested organizations, provide financial and technical assistance to support a voluntary national testing and information program for those types of commercial office equipment that are widely used and for which there is a potential for significant energy savings as a result of such program.

(2) Such program shall--

(A) consistent with the objectives of paragraph (1), determine the commercial office equipment to be covered under such program;

(B) include specifications for testing procedures that will enable purchasers of such commercial office equipment to make more informed decisions about the energy efficiency and costs of alternative products; and

(C) include information, which may be disseminated through catalogs, trade publications, labels, or other mechanisms, that will allow consumers to assess the energy consumption and potential cost savings of alternative products.

(3) Such program shall be developed by an appropriate organization (composed of interested parties) according to commonly accepted procedures for the development of national testing procedure and labeling programs.

(b) MONITORING- The Secretary shall monitor and evaluate the efforts to develop the program described in subsection (a) and, not later than three years after the date of the enactment of this Act, shall make a determination as to whether such program is consistent with the objectives of subsection (a).

(c) ALTERNATIVE SYSTEM- (1) If the Secretary makes a determination under subsection (b) that a voluntary national testing and information program for commercial office equipment consistent with the objectives of subsection (a) has not been developed, the Secretary shall, after consultation with the National Institute of Standards and Technology, develop, not later than two years after such determination, test procedures under section 323 of the Energy Policy and Conservation Act (42 U.S.C. 6293) for such commercial office equipment.

(2) Not later than one year after the Secretary develops test procedures under paragraph (1), the Federal Trade Commission (hereafter in this section referred to as the `Commission') shall prescribe labeling rules under section 324 of such Act (42 U.S.C. 6294) for commercial office equipment for which the Secretary has prescribed test procedures under paragraph (1) except that, with respect to any type of commercial office equipment (or class thereof), the Secretary may determine that such labeling is not technologically feasible or economically justified or is not likely to assist consumers in making purchasing decisions.

(3) For purposes of sections 323, 324, and 327 of such Act, each product for which the Secretary has established test procedures or labeling rules pursuant to this subsection shall be considered a new covered product under section 322 of such Act (42 U.S.C. 6292) to the extent necessary to carry out this subsection.

(4) For purposes of section 327(a) of such Act, the term `this part' includes this subsection to the extent necessary to carry out this subsection.

SEC. 126. ENERGY EFFICIENCY INFORMATION FOR LUMINAIRES.

(a) IN GENERAL- (1) The Secretary shall, after consulting with the National Electric Manufacturers Association, the American Lighting Association, and other interested organizations, provide financial and technical assistance to support a voluntary national testing and information program for those types of luminaires that are widely used and for which there is a potential for significant energy savings as a result of such program.

(2) Such program shall--

(A) consistent with the objectives of paragraph (1), determine the luminaires to be covered under such program;

(B) include specifications for testing procedures that will enable purchasers of such luminaires to make more informed decisions about the energy efficiency and costs of alternative products; and

(C) include information, which may be disseminated through catalogs, trade publications, labels, or other mechanisms, that will allow consumers to assess the energy consumption and potential cost savings of alternative products.

(3) Such program shall be developed by an appropriate organization (composed of interested parties) according to commonly accepted procedures for the development of national testing procedures and labeling programs.

(b) MONITORING- The Secretary shall monitor and evaluate the efforts to develop the program described in subsection (a) and, not later than three years after the date of the enactment of this Act, shall make a determination as to whether the program developed is consistent with the objectives of subsection (a).

(c) ALTERNATIVE SYSTEM- (1) If the Secretary makes a determination under subsection (b) that a voluntary national testing and information program for luminaires consistent with the objectives of subsection (a) has not been developed, the Secretary shall, after consultation with the National Institute of Standards and Technology, develop, not later than two years after such determination, test procedures under section 323 of the Energy Policy and Conservation Act (42 U.S.C. 6293) for such luminaires.

(2) Not later than one year after the Secretary develops test procedures under paragraph (1), the Federal Trade Commission (hereafter in this section referred to as the `Commission') shall prescribe labeling rules under section 324 of such Act (42 U.S.C. 6294) for those luminaires for which the Secretary has prescribed test procedures under paragraph (1) except that, with respect to any type of luminaire (or class thereof), the Secretary may determine that such labeling is not technologically feasible or economically justified or is not likely to assist consumers in making purchasing decisions.

(3) For purposes of sections 323, 324, and 327 of such Act, each product for which the Secretary has established test procedures or labeling rules pursuant to this subsection shall be considered a new covered product under section 322 of such Act (42 U.S.C. 6292) to the extent necessary to carry out this subsection.

(4) For purposes of section 327(a) of such Act, the term `this part' includes this subsection to the extent necessary to carry out this subsection.

SEC. 127. REPORT ON THE POTENTIAL OF COOPERATIVE ADVANCED APPLIANCE DEVELOPMENT.

(a) IN GENERAL- Not later than 18 months after the date of the enactment of this Act, the Secretary shall, in consultation with the Administrator of the Environmental Protection Agency, utilities, and appliance manufacturers, prepare and submit to the Congress, a report on the potential for the development and commercialization of appliances which are substantially more efficient than required by Federal or State law.

(b) IDENTIFICATION OF HIGH-EFFICIENCY APPLIANCES- The report submitted under subsection (a) shall identify candidate high-efficiency appliances which meet the following criteria:

(1) The potential exists for substantial improvement in the appliance's energy efficiency, beyond the minimum established in Federal and State law.

(2) There is the potential for significant energy savings at the national or regional level.

(3) Such appliances are likely to be cost-effective for consumers.

(4) Electric, water, or gas utilities are prepared to support and promote the commercialization of such appliances.

(5) Manufacturers are unlikely to undertake development and commercialization of such appliances on their own, or development and production would be substantially accelerated by support to manufacturers.

(c) RECOMMENDATIONS AND PROPOSALS- The report submitted under subsection (a) shall also--

(1) describe the general actions the Secretary or the Administrator of the Environmental Protection Agency could take to coordinate and assist utilities and appliance manufacturers in developing and commercializing highly efficient appliances;

(2) describe specific proposals for Department of Energy or Environmental Protection Agency assistance to utilities and appliance manufacturers to promote the development and commercialization of highly efficient appliances;

(3) identify methods by which Federal purchase of highly efficient appliances could assist in the development and commercialization of such appliances; and

(4) identify the funding levels needed to develop and implement a Federal program to assist in the development and commercialization of highly efficient appliances.

SEC. 128. EVALUATION OF UTILITY EARLY REPLACEMENT PROGRAMS FOR APPLIANCES.

Within 18 months after the date of the enactment of this Act, the Secretary, in consultation with the Administrator of the Environmental Protection Agency, utilities, and appliance manufacturers, shall evaluate and report to the Congress on the energy savings and environmental benefits of programs which are directed to the early replacement of older, less efficient appliances presently in use by consumers with existing products which are more efficient than required by Federal law. For the purposes of this section, the term `appliance' means those consumer products specified in section 322(a).

Subtitle D--Industrial

SEC. 131. ENERGY EFFICIENCY IN INDUSTRIAL FACILITIES.

(a) GRANT PROGRAM-

(1) IN GENERAL- The Secretary shall make grants to industry associations to support programs to improve energy efficiency in industry. In order to be eligible for a grant under this subsection, an industry association shall establish a voluntary energy efficiency improvement target program.

(2) AWARDING OF GRANTS- The Secretary shall request project proposals and provide annual grants on a competitive basis. In evaluating grant proposals under this subsection, the Secretary shall consider--

(A) potential energy savings;

(B) potential environmental benefits;

(C) the degree of cost sharing;

(D) the degree to which new and innovative technologies will be encouraged;

(E) the level of industry involvement;

(F) estimated project cost-effectiveness; and

(G) the degree to which progress toward the energy improvement targets can be monitored.

(3) ELIGIBLE PROJECTS- Projects eligible for grants under this subsection may include the following:

(A) Workshops.

(B) Training seminars.

(C) Handbooks.

(D) Newsletters.

(E) Data bases.

(F) Other activities approved by the Secretary.

(4) LIMITATION ON COST SHARING- Grants provided under this subsection shall not exceed $250,000 and each grant shall not exceed 75 percent of the total cost of the project for which the grant is made.

(5) AUTHORIZATION- There are authorized to be appropriated such sums as are necessary to carry out this subsection.

(b) AWARD PROGRAM- The Secretary shall establish an annual award program to recognize those industry associations or individual industrial companies that have significantly improved their energy efficiency.

(c) REPORT ON INDUSTRIAL REPORTING AND VOLUNTARY TARGETS- Not later than one year after the date of the enactment of this Act, the Secretary shall, in consultation with affected industries, evaluate and report to the Congress regarding the establishment of Federally mandated energy efficiency reporting requirements and voluntary energy efficiency improvement targets for energy intensive industries. Such report shall include an evaluation of the costs and benefits of such reporting requirements and voluntary energy efficiency improvement targets, and recommendations regarding the role of such activities in improving energy efficiency in energy intensive industries.

SEC. 132. PROCESS-ORIENTED INDUSTRIAL ENERGY EFFICIENCY.

(a) DEFINITIONS- For the purposes of this section--

(1) the term `covered industry' means the food and food products industry, lumber and wood products industry, petroleum and coal products industry, and all other manufacturing industries specified in Standard Industrial Classification Codes 20 through 39 (or successor classification codes);

(2) the term `process-oriented industrial assessment' means--

(A) the identification of opportunities in the production process (from the introduction of materials to final packaging of the product for shipping) for--

(i) improving energy efficiency;

(ii) reducing environmental impact; and

(iii) designing technological improvements to increase competitiveness and achieve cost-effective product quality enhancement;

(B) the identification of opportunities for improving the energy efficiency of lighting, heating, ventilation, air conditioning, and the associated building envelope; and

(C) the identification of cost-effective opportunities for using renewable energy technology in the production process and in the systems described in subparagraph (B); and

(3) the term `utility' means any person, State agency (including any municipality), or Federal agency, which sells electric or gas energy to retail customers.

(b) GRANT PROGRAM-

(1) USE OF FUNDS- The Secretary shall, to the extent funds are made available for such purpose, make grants to States which, consistent with State law, shall be used for the following purposes:

(A) To promote, through appropriate institutions such as universities, nonprofit organizations, State and local government entities, technical centers, utilities, and trade organizations, the use of energy-efficient technologies in covered industries.

(B) To establish programs to train individuals (on an industry-by-industry basis) in conducting process-oriented industrial assessments and to encourage the use of such trained assessors.

(C) To assist utilities in developing, testing, and evaluating energy efficiency programs and technologies for industrial customers in covered industries.

(2) CONSULTATION- States receiving grants under this subsection shall consult with utilities and representatives of affected industries, as appropriate, in determining the most effective use of such funds consistent with the requirements of paragraph (1).

(3) ELIGIBILITY CRITERIA- Not later than 1 year after the date of the enactment of this Act, the Secretary shall establish eligibility criteria for grants made pursuant to this subsection. Such criteria shall require a State applying for a grant to demonstrate that such State--

(A) pursuant to section 111(a) of the Public Utility and Regulatory Policies Act of 1978 (16 U.S.C. 2621(a)), has considered and made a determination regarding the implementation of the standards specified in paragraphs (7) and (8) of section 111(d) of such Act (with respect to integrated resources planning and investments in conservation and demand management); and

(B) by legislation or regulation--

(i) allows utilities to recover the costs prudently incurred in providing process-oriented industrial assessments; and

(ii) encourages utilities to provide to covered industries--

(I) process-oriented industrial assessments; and

(II) financial incentives for implementing energy efficiency improvements.

(4) ALLOCATION OF FUNDS- Grants made pursuant to this subsection shall be allocated each fiscal year among States meeting the criteria specified in paragraph (3) who have submitted applications 60 days before the first day of such fiscal year. Such allocation shall be made in accordance with a formula to be prescribed by the Secretary based on each State's share of value added in industry (as determined by the Census of Manufacturers) as a percentage of the value added by all such States.

(5) RENEWAL OF GRANTS- A grant under this subsection may continue to be renewed after 2 consecutive fiscal years during which a State receives a grant under this subsection, subject to the

availability of funds, if--

(A) the Secretary determines that the funds made available to the State during the previous 2 years were used in a manner required under paragraph (1); and

(B) such State demonstrates, in a manner prescribed by the Secretary, utility participation in programs established pursuant to this subsection.

(6) COORDINATION WITH OTHER FEDERAL PROGRAMS- In carrying out the functions described in paragraph (1), States shall, to the extent practicable, coordinate such functions with activities and programs conducted by the Energy Analysis and Diagnostic Centers of the Department of Energy and the Manufacturing Technology Centers of the National Institute of Standards and Technology.

(c) OTHER FEDERAL ASSISTANCE-

(1) ASSESSMENT CRITERIA- Not later than 2 years after the date of the enactment of this Act, the Secretary shall, by contract with nonprofit organizations with expertise in process-oriented industrial energy efficiency technologies, establish and, as appropriate, update criteria for conducting process-oriented industrial assessments on an industry-by-industry basis. Such criteria shall be made available to State and local government, public utility commissions, utilities, representatives of affected process-oriented industries, and other interested parties.

(2) DIRECTORY- The Secretary shall establish a nationwide directory of organizations offering industrial energy efficiency assessments, technologies, and services consistent with the purposes of this section. Such directory shall be made available to State governments, public utility commissions, utilities, industry representatives, and other interested parties.

(3) AWARD PROGRAM- The Secretary shall establish an annual award program to recognize utilities operating outstanding or innovative industrial energy efficiency technology assistance programs.

(4) MEETINGS- In order to further the purposes of this section, the Secretary shall convene annual meetings of parties interested in process-oriented industrial assessments, including representatives of State government, public utility commissions, utilities, and affected process-oriented industries.

(d) REPORT- Not later than 2 years after the date of the enactment of this Act, and annually thereafter, the Secretary shall submit to the Congress a report which--

(1) identifies barriers encountered in implementing this section;

(2) makes recommendations for overcoming such barriers;

(3) documents the results achieved by the programs established and grants awarded pursuant to this section;

(4) reviews any difficulties encountered by industry in securing and implementing energy efficiency technologies recommended in process-oriented industrial assessments or otherwise identified as a result of programs established pursuant to this section; and

(5) recommends methods for further promoting the distribution and implementation of energy efficiency technologies consistent with the purposes of this section.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necessary to carry out the purposes of this section.

SEC. 133. INDUSTRIAL INSULATION AND AUDIT GUIDELINES.

(a) VOLUNTARY GUIDELINES FOR ENERGY EFFICIENCY AUDITING AND INSULATING- Not later than 18 months after the date of the enactment of this Act, the Secretary, after consultation with utilities, major industrial energy consumers, and representatives of the insulation industry, shall establish voluntary guidelines for--

(1) the conduct of energy efficiency audits of industrial facilities to identify cost-effective opportunities to increase energy efficiency; and

(2) the installation of insulation to achieve cost-effective increases in energy efficiency in industrial facilities.

(b) EDUCATIONAL AND TECHNICAL ASSISTANCE- The Secretary shall conduct a program of educational and technical assistance to promote the use of the voluntary guidelines established under subsection (a).

(c) REPORT- Not later than 2 years after the date of the enactment of this Act, and biennially thereafter, the Secretary shall report to the Congress on activities conducted pursuant to this section, including--

(1) a review of the status of industrial energy auditing procedures; and

(2) an evaluation of the effectiveness of the guidelines established under subsection (a) and the responsiveness of the industrial sector to such guidelines.

Subtitle E--State and Local Assistance

SEC. 141. AMENDMENTS TO STATE ENERGY CONSERVATION PROGRAM.

(a) STATE BUILDINGS ENERGY INCENTIVE FUND-

(1) IN GENERAL- Section 363 of the Energy Policy and Conservation Act (42 U.S.C. 6323) is amended by adding at the end the following new subsection:

`(f) If the Secretary determines that a State has demonstrated a commitment to improving the energy efficiency of buildings within such State, the Secretary may, beginning in fiscal year 1994, provide up to $1,000,000 to such State for deposit into a revolving fund established by such State for the purpose of financing energy efficiency improvements in State and local government buildings. In making such determination the Secretary shall consider whether--

`(1) such State, or a majority of the units of local government with jurisdiction over building energy codes within such State, has adopted codes for energy efficiency in new buildings that are at least as stringent as American Society of Heating, Refrigerating, and Air-Conditioning Engineers Standard 90.1-1989 (with respect to commercial buildings) and Council of American

Building Officials Model Energy Code, 1992 (with respect to residential buildings);

`(2) such State has established a program, including a revolving fund, to finance energy efficiency improvement projects in State and local government facilities and buildings; and

`(3) such State has obtained funding from non-Federal sources, including but not limited to, oil overcharge funds, State or local government appropriations, or utility contributions (including rebates) equal to or greater than three times the amount provided by the Secretary under this subsection for deposit into such revolving fund.'.

(2) AUTHORIZATION OF APPROPRIATIONS- Section 365(f) of such Act (42 U.S.C. 6325(f)) is amended--

(A) by striking `(f) For the purpose' and inserting the following: `(f)(1) Except as provided in paragraph (2), for the purpose'; and

(B) by inserting at the end the following:

`(2) For the purposes of carrying out section 363(f), there is authorized to be appropriated for fiscal year 1994 and each fiscal year thereafter such sums as may be necessary, to remain available until expended.'.

(b) TRAINING OF BUILDING DESIGNERS AND CONTRACTORS; BUILDING RETROFIT STANDARDS; FEASIBILITY; RURAL RENEWABLE ENERGY- Subsection 362(d) of the Energy Policy and Conservation Act (42 U.S.C. 6322(d)) is amended--

(1) in paragraph (12) by striking `and';

(2) by redesignating paragraph (13) as paragraph (17); and

(3) by inserting after paragraph (12) the following new paragraphs:

`(13) programs (enlisting appropriate trade and professional organizations in the development and financing of such programs) to provide training and education (including, if appropriate, training workshops, practice manuals, and testing for each area of energy efficiency technology) to building designers and contractors involved in building design and construction or in the sale, installation, and maintenance of energy systems and equipment to promote building energy efficiency improvements;

`(14) programs for the development of building retrofit standards and regulations, including retrofit ordinances enforced at the time of the sale of a building;

`(15) support for prefeasibility and feasibility studies for projects that utilize renewable energy and energy efficiency resource technologies in order to facilitate access to capital and credit for such projects;

`(16) programs to facilitate and encourage the voluntary use of renewable energy technologies for eligible participants in Federal agency programs, including the Rural Electrification Administration and the Farmers Home Administration; and'

(c) STATE ENERGY CONSERVATION PLAN REQUIREMENT-

(1) IN GENERAL- Section 362(c)(5) of the Energy Policy and Conservation Act (42 U.S.C. 6322 (c)(5)) is amended by striking `; and' and by inserting the following: `and to turn such vehicle left from a one-way street onto a one-way street at a red light after stopping; and'.

(2) EFFECTIVE DATE- The amendment made by paragraph (1) shall take effect January 1, 1995.

(d) STUDY REGARDING IMPACT OF PERMITTING RIGHT AND LEFT TURNS ON RED LIGHTS-

(1) IN GENERAL- The Administrator of the National Highway Traffic Safety Administration, in consultation with State agencies with jurisdiction over traffic safety issues, shall conduct a study on the safety impact of the requirement specified in section 362(c)(5) of the Energy Policy and Conservation Act (42 U.S.C. 6322(c)(5)), particularly with respect to the impact on pedestrian safety.

(2) REPORT- The Administrator shall report the findings of the study conducted under paragraph (1) to the Congress and the Secretary not later than 2 years after the date of the enactment of this Act.

SEC. 142. AMENDMENTS TO LOW-INCOME WEATHERIZATION PROGRAM.

(a) PRIVATE SECTOR INVESTMENTS IN LOW-INCOME WEATHERIZATION- Part A of title IV of the Energy Conservation and Production Act (42 U.S.C. 6861 et seq.) is amended by inserting after section 414 the following new sections:

`SEC. 414A. PRIVATE SECTOR INVESTMENTS.

`(a) IN GENERAL- The Secretary shall, to the extent funds are made available for such purpose, provide financial assistance to entities receiving funding from the Federal Government or from a State through a weatherization assistance program under section 413 or section 414 for the development and initial implementation of partnerships, agreements, or other arrangements with utilities, private sector interests, or other institutions, under which non-Federal financial assistance would be made available to support programs which install energy efficiency improvements in low-income housing.

`(b) USE OF FUNDS- Financial assistance provided under this section may be used for--

`(1) the negotiation of such partnerships, agreements and other arrangements;

`(2) the presentation of arguments before State or local agencies;

`(3) expert advice on the development of such partnerships, agreements, and other arrangements; or

`(4) other activities reasonably associated with the development and initial implementation of such arrangements.

`(c) CONDITIONS- (1) Financial assistance provided under this section to entities other than States shall, to the extent practicable, coincide with the timing of financial assistance provided to such entities

under section 413 or section 414.

`(2) Not less than 80 percent of amounts provided under this section shall be provided to entities other than States.

`(3) A recipient of financial assistance under this section shall have up to three years to complete projects undertaken with such assistance.

`SEC. 414B. TECHNICAL TRANSFER GRANTS.

`(a) IN GENERAL- The Secretary may, to the extent funds are made available, provide financial assistance to entities receiving funding from the Federal Government or from a State through a weatherization assistance program under section 413 or section 414 for--

`(1) evaluating technical and management measures which increase program and/or private entity performance in weatherizing low-income housing;

`(2) producing technical information for use by persons involved in weatherizing low-income housing;

`(3) exchanging information; and

`(4) conducting training programs for persons involved in weatherizing low-income housing.

`(b) CONDITIONS- (1) Not less than 50 percent of amounts provided under this section shall be awarded to entities other than States.

`(2) A recipient of financial assistance under this section may contract with nonprofit entities to carry out all or part of the activities for which such financial assistance is provided.'.

(b) USE OF SOLAR THERMAL WATER HEATERS AND WOOD-BURNING HEATING APPLIANCES FOR LOW-INCOME WEATHERIZATION- Section 412(9) of the Energy Conservation and Production Act (42 U.S.C. 6862(9)) is amended--

(1) by moving subparagraph (G) 2-ems to the right and by striking `and';

(2) by redesignating subparagraph (H) as subparagraph (J); and

(3) by inserting after subparagraph (G), the following:

`(H) solar thermal water heaters;

`(I) wood-heating appliances; and'.

(c) CLERICAL AMENDMENT- The table of contents for part A of title IV of the Energy Conservation and Production Act is amended by inserting after the item related to section 414 the following items:

`Sec. 414A. Private sector investments.

`Sec. 414B. Technical transfer grants.'.

SEC. 143. ENERGY EXTENSION SERVICE PROGRAM.

(a) REPEAL- The National Energy Extension Service Act, title V of Public Law 95-39, is repealed.

(b) CONFORMING AMENDMENT- Section 103 of the Energy Reorganization Act of 1974 (42 U.S.C. 5813(7)) is amended--

(1) by striking paragraph (7); and

(2) by redesignating paragraphs (8), (9), (10), (11), and (12) as paragraphs (7), (8), (9), (10), and (11), respectively.

Subtitle F--Federal Agency Energy Management

SEC. 151. DEFINITIONS.

For purposes of this subtitle--

(1) the term `agency' means has the meaning given such term in section 551(1) of title 5, United States Code, except that such term does not include the United States Postal Service;

(2) the term `facility energy supervisor' means the employee with responsibility for the daily operations of a Federal facility, including the management, installation, operation, and maintenance of energy systems in Federal facilities which may include more than one building;

(3) the term `trained energy manager' means a person who has demonstrated proficiency, or who has completed a course of study in the areas of fundamentals of building energy systems, building energy codes and applicable professional standards, energy accounting and analysis, life-cycle cost methodology, fuel supply and pricing, and instrumentation for energy surveys and audits;

(4) the term `Task Force' means the Interagency Energy Management Task Force established under section 547 of the National Energy Conservation Policy Act (42 U.S.C. 8257); and

(5) the term `energy conservation measures' has the meaning given such term in section 551(4) of the National Energy Conservation Policy Act.

SEC. 152. FEDERAL ENERGY MANAGEMENT AMENDMENTS.

(a) PURPOSE- Section 542 of the National Energy Conservation Policy Act (42 U.S.C. 8252) is amended by inserting after `use of energy' the following: `and water, and the use of renewable energy sources,'.

(b) REQUIREMENTS FOR FEDERAL AGENCIES- Section 543 of such Act (42 U.S.C. 8253(a)) is amended--

(1) in the section heading by striking `GOALS' and inserting `REQUIREMENTS';

(2) in subsection (a) by striking `GOAL' and inserting `REQUIREMENT';

(3) in subsection (a)(1), by striking the period at the end and inserting the following: `and so that the energy consumption per gross square foot of its Federal buildings in use during the fiscal year 2000 is at least 20 percent less than the energy consumption per gross square foot of its Federal buildings in use during fiscal year 1985.'; and

(4) by redesignating subsection (b) as subsection (d) and inserting after subsection (a) the following:

`(b) ENERGY MANAGEMENT REQUIREMENT FOR FEDERAL AGENCIES- (1) Not later than January 1, 2005, each agency shall, to the maximum extent practicable, install in Federal buildings owned by the United States all energy and water conservation measures with payback periods of less than 10 years, as determined by using the methods and procedures developed pursuant to section 544.

`(2) The Secretary may waive the requirements of this subsection for any agency for such periods as the Secretary may determine if the Secretary finds that the agency is taking all practicable steps to meet the requirements and that the requirements of this subsection will pose an unacceptable burden upon the agency. If the Secretary waives the requirements of this subsection, the Secretary shall notify the Congress promptly in writing with an explanation and a justification of the reasons for such waiver.

`(3) This subsection shall not apply to an agency's facilities that generate or transmit electric energy or to the uranium enrichment facilities operated by the Department of Energy.

`(4) An agency may participate in the Environmental Protection Agency's `Green Lights' program for purposes of receiving technical assistance in complying with the requirements of this section.

`(c) EXCLUSIONS- (1) An agency may exclude, from the energy consumption requirements for the year 2000 established under subsection (a) and the requirements of subsection (b)(1), any Federal building or collection of Federal buildings, and the associated energy consumption and gross square footage, if the head of such agency finds that compliance with such requirements would be impractical. A finding of impracticability shall be based on the energy intensiveness of activities carried out in such Federal buildings or collection of Federal buildings, the type and amount of energy consumed, the technical feasibility of making the desired changes, and, in the cases of the Departments of Defense and Energy, the unique character of certain facilities operated by such Departments.

`(2) Each agency shall identify and list, in each report made under section 548(a), the Federal buildings designated by it for such exclusion. The Secretary shall review such findings for consistency with the impracticability standards set forth in paragraph (1), and may within 90 days after receipt of the findings, reverse a finding of impracticability. In the case of any such reversal, the agency shall comply with the energy consumption requirements for the building concerned.'.

(c) IMPLEMENTATION- Section 543(d) of such Act (as redesignated by subsection (b)(4) of this section) is amended--

(1) in the material preceding paragraph (1), by striking out `To achieve the goal established in subsection (a),' and inserting in lieu thereof the following: `The Secretary shall consult with the Secretary of Defense and the Administrator of General Services in developing guidelines for the implementation of this part. To meet the requirements of this section,';

(2) by striking out paragraph (1) and inserting in lieu thereof the following:

`(1) prepare and submit to the Secretary, not later than December 31, 1993, a plan describing how the agency intends to meet such requirements, including how it will--

`(A) designate personnel primarily responsible for achieving such requirements;

`(B) identify high priority projects through calculation of payback periods;

`(C) take maximum advantage of contracts authorized under title VIII of this Act, of financial incentives and other services provided by utilities for efficiency investment, and of other forms of financing to reduce the direct costs to the Government; and

`(D) otherwise implement this part;';

(3) in paragraph (2), by inserting before the semicolon at the end the following: `and update such surveys as needed, incorporating any relevant information obtained from the survey conducted pursuant to section 550';

(4) by striking out paragraph (3) and inserting in lieu thereof the following:

`(3) using such surveys, determine the cost and payback period of energy and water conservation measures likely to achieve the requirements of this section;

`(4) install energy and water conservation measures that will achieve the requirements of this section through the methods and procedures established pursuant to section 544; and'; and

(5) by redesignating paragraph (4) as paragraph (5).

(d) LIFE CYCLE COST METHODS AND PROCEDURES- Section 544 of such Act (42 U.S.C. 8254) is amended--

(1) in subsection (a), in the material preceding paragraph (1), by striking out `National Bureau of Standards,' and inserting in lieu thereof `National Institute of Standards and Technology,'; and

(2) in subsection (b)(2), by striking `agency shall' and all that follows through the period at the end and inserting the following: `agency shall, after January 1, 1994, fully consider the efficiency of all potential building space at the time of renewing or entering into a new lease.'.

(e) IDENTIFICATION OF FUNDS- Section 545 of such Act (42 U.S.C. 8255) is amended to read as follows:

`SEC. 545. BUDGET TREATMENT FOR ENERGY CONSERVATION MEASURES.

`The President shall transmit to the Congress, along with each budget that is submitted to the Congress under section 1105 of title 31, United States Code, a statement of the amount of appropriations requested in such budget, if any, on an individual agency basis, for--

`(1) electric and other energy costs to be incurred in operating and maintaining agency facilities; and

`(2) compliance with the provisions of this part, the Energy Policy and Conservation Act (42 U.S.C. 6201 et seq.), and all applicable Executive orders, including Executive Order 12003 (42 U.S.C. 6201 note) and Executive Order 12759 (56 Fed. Reg. 16257).'.

(f) INCENTIVE PROGRAM- Section 546 of such Act (42 U.S.C. 8256) is amended--

(1) by striking `(a) IN GENERAL- ' and inserting in lieu thereof `(a) CONTRACTS- (1)';

(2) by redesignating subsection (b) as paragraph (2) and amending it to read as follows:

`(2) The Secretary shall, not later than 18 months after the date of the enactment of the Energy Policy Act of 1992 and after consultation with the Director of the Office of Management and Budget, the Secretary of Defense, and the Administrator of General Services, develop appropriate procedures and methods for use by agencies to implement the incentives referred to in paragraph (1).';

(3) by striking out subsection (c); and

(4) by adding at the end the following new subsections:

`(b) FEDERAL ENERGY EFFICIENCY FUND- (1) The Secretary shall establish a Federal Energy Efficiency Fund to provide grants to agencies to assist them in meeting the requirements of section 543.

`(2) Not later than June 30, 1993, the Secretary shall issue guidelines to be followed by agencies submitting proposals for such grants. All agencies shall be eligible to submit proposals for grants under the Fund.

`(3) The Secretary shall award grants from the Fund after a competitive assessment of the technical and economic effectiveness of each agency proposal. The Secretary shall consider the following factors in determining whether to provide funding under this subsection:

`(A) The cost-effectiveness of the project.

`(B) The amount of energy and cost savings anticipated to the Federal Government.

`(C) The amount of funding committed to the project by the agency requesting financial assistance.

`(D) The extent that a proposal leverages financing from other non-Federal sources.

`(E) Any other factor which the Secretary determines will result in the greatest amount of energy and cost savings to the Federal Government.

`(4) There are authorized to be appropriated, to remain available to be expended, to carry out this subsection not more than $10,000,000 for fiscal year 1994, $50,000,000 for fiscal year 1995, and such sums as may be necessary for fiscal years thereafter.

`(c) UTILITY INCENTIVE PROGRAMS- (1) Agencies are authorized and encouraged to participate in programs to increase energy efficiency and for water conservation or the management of electricity demand conducted by gas, water, or electric utilities and generally available to customers of such utilities.

`(2) Each agency may accept any financial incentive, goods, or services generally available from any such utility, to increase energy efficiency or to conserve water or manage electricity demand.

`(3) Each agency is encouraged to enter into negotiations with electric, water, and gas utilities to design cost-effective demand management and conservation incentive programs to address the unique needs of facilities utilized by such agency.

`(4) If an agency satisfies the criteria which generally apply to other customers of a utility incentive program, such agency may not be denied collection of rebates or other incentives.

`(5)(A) An amount equal to fifty percent of the energy and water cost savings realized by an agency (other than the Department of Defense) with respect to funds appropriated for any fiscal year beginning after fiscal year 1992 (including financial benefits resulting from energy savings performance contracts under title VIII and utility energy efficiency rebates) shall, subject to appropriation, remain available for expenditure by such agency for additional energy efficiency measures which may include related employee incentive programs, particularly at those facilities at which energy savings were achieved.

(B) Agencies shall establish a fund and maintain strict financial accounting and controls for savings realized and expenditures made under this subsection. Records maintained pursuant to this subparagraph shall be made available for public inspection upon request.

`(d) FINANCIAL INCENTIVE PROGRAM FOR FACILITY ENERGY MANAGERS- (1) The Secretary shall, in consultation with the Task Force established pursuant to section 547, establish a financial bonus program to reward, with funds made available for such purpose, outstanding Federal facility energy managers in agencies and the United States Postal Service.

`(2) Not later than June 1, 1993, the Secretary shall issue procedures for implementing and conducting the award program, including the criteria to be used in selecting outstanding energy managers and contributors who have--

`(A) improved energy performance through increased energy efficiency;

`(B) implemented proven energy efficiency and energy conservation techniques, devices, equipment, or procedures;

`(C) developed and implemented training programs for facility energy managers, operators, and maintenance personnel;

`(D) developed and implemented employee awareness programs;

`(E) succeeded in generating utility incentives, shared energy savings contracts, and other federally approved performance based energy savings contracts;

`(F) made successful efforts to fulfill compliance with energy reduction mandates, including the provisions of section 543; and

`(G) succeeded in the implementation of the guidelines established under section 159.

`(3) There is authorized to be appropriated to carry out this subsection not more than $250,000 for each of the fiscal years 1993, 1994, and 1995.

(g) REPORTS- Section 548 of such Act (42 U.S.C. 8258) is amended--

(1) in subsection (b)(1), by striking `including' and all that follows through the semicolon and inserting the following: `including--

`(A) a copy of the list of the exclusions made under sections 543(a)(2) and 543(c)(3); and

`(B) a statement detailing the amount of funds awarded to each agency under section 546(b), the energy and water conservation measures installed with such funds, the projected energy and water savings to be realized from installed measures, and, for each installed measure for which the projected energy and water savings reported in the previous year were not realized, the percentage of such projected savings that was not realized, the reasons such savings were not realized, and proposals for, and projected costs of, achieving such projected savings in the future;'; and

(2) by adding at the end the following new subsection:

`(c) OTHER REPORT- The Secretary, in consultation with the Administrator of General Services, shall--

`(1) conduct a study and evaluate legal, institutional, and other constraints to connecting buildings owned or leased by the Federal Government to district heating and district cooling systems; and

`(2) not later than 18 months after the date of the enactment of this subsection, transmit to the Congress a report containing the findings and conclusions of such study, including recommendations for the development of streamlined processes for the consideration of connecting buildings owned or leased by the Federal Government to district heating and cooling systems.'.

(h) DEMONSTRATION OF NEW TECHNOLOGY; SURVEY OF ENERGY SAVING POTENTIAL- Such Act is amended--

(1) by redesignating section 549 as section 551; and

(2) by inserting the following new sections after section 548:

`SEC. 549. DEMONSTRATION OF NEW TECHNOLOGY.

`(a) DEMONSTRATION PROGRAM- Not later than January 1, 1994, the Secretary, in cooperation with the Administrator of General Services, shall establish a demonstration program to install, in federally owned facilities or federally assisted housing, energy conservation measures for which the Secretary has determined that such installation would accelerate commercial viability. In those cases where technologies are determined to be equivalent, priority shall be given to those technologies that have received or are receiving Federal financial assistance.

`(b) SELECTION CRITERIA- In addition to the determination under subsection (a), the Secretary shall select, in cooperation with the Administrator of General Services, proposals to be funded under this section on the basis of--

`(1) cost-effectiveness;

`(2) technical feasibility and system reliability in a working environment;

`(3) lack of market penetration in the Federal sector;

`(4) the potential needs of the proposing Federal agency for the technology, projected over 5 to 10 years;

`(5) the potential Federal sector market, projected over 5 to 10 years;

`(6) energy efficiency; and

`(7) other environmental benefits, including the projected reduction of greenhouse gas emissions and indoor air pollution.

`(c) PROPOSALS- Federal agencies may submit to the Secretary, for each fiscal year, proposals for projects to be funded by the Secretary under this section. Each such proposal shall include--

`(1) a description of the proposed project emphasizing the innovative use of technology in the Federal sector;

`(2) a description of the technical reliability and cost-effectiveness data expected to be acquired;

`(3) an identification of the potential needs of the Federal agency for the technology;

`(4) a commitment to adopt the technology, if the project establishes its technical reliability and life cycle cost-effectiveness, to supply at least 10 percent of the Federal agency's potential needs identified under paragraph (3);

`(5) schedules and milestones for installing additional units; and

`(6) a technology transfer plan to publicize the results of the project.

`(d) PARTICIPATION BY GSA- The Secretary may only select a project for funding under this section which is proposed to be carried out in a building under the jurisdiction of the General Services Administration if the project will be carried out by the Administrator of General Services. If such project involves a total expenditure in excess of $1,600,000, no appropriation shall be made for such project unless such project has been approved by a resolution adopted by the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate.

`(e) STUDY- The Secretary shall conduct a study to evaluate the potential use of the purchasing power of the Federal Government to promote the development and commercialization of energy efficient products. The study shall identify products for which there is a high potential for Federal purchasing power to substantially promote their development and commercialization, and shall include a plan to develop such potential. The study shall be conducted in consultation with utilities, manufacturers, and appropriate nonprofit organizations concerned with energy efficiency. The Secretary shall report to the Congress on the results of the study not later than two years after the date of the enactment of this Act.

`(f) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $5,000,000 for each of the fiscal years 1993, 1994, and 1995.

`SEC. 550. SURVEY OF ENERGY SAVING POTENTIAL.

`(a) IN GENERAL- The Secretary shall, in consultation with the Interagency Energy Management Task Force established under section 547, carry out an energy survey for the purposes of--

`(1) determining the maximum potential cost effective energy savings that may be achieved in a representative sample of buildings owned or leased by the Federal Government in different areas of the country;

`(2) making recommendations for cost effective energy efficiency and renewable energy improvements in those buildings and in other similar Federal buildings; and

`(3) identifying barriers which may prevent an agency's ability to comply with section 543 and other energy management goals.

`(b) IMPLEMENTATION- (1) The Secretary shall transmit to the Committee on Energy and Natural Resources and the Committee on Governmental Affairs of the Senate and the Committee on Energy and Commerce, the Committee on Government Operations, and the Committee on Public Works and Transportation of the House of Representatives, within 180 days after the date of the enactment of the Energy Policy Act of 1992, a plan for implementing this section.

`(2) The Secretary shall designate buildings to be surveyed in the project so as to obtain a sample of the buildings of the types and in the climates that is representative of buildings owned or leased by Federal agencies in the United States that consume the major portion of the energy consumed in Federal buildings. Such sample shall include, where appropriate, the following types of Federal facility space:

`(A) Housing.

`(B) Storage.

`(C) Office.

`(D) Services.

`(E) Schools.

`(F) Research and Development.

`(G) Industrial.

`(H) Prisons.

`(I) Hospitals.

`(3) For purposes of this section, an improvement shall be considered cost effective if the cost of the energy saved or displaced by the improvement exceeds the cost of the improvement over the remaining life of a Federal building or the remaining term of a lease of a building leased by the Federal Government as determined by the life cycle costing methodology developed under section 544.

`(c) PERSONNEL- (1) In carrying out this section, the Secretary shall utilize personnel who are--

`(A) employees of the Department of Energy; or

`(B) selected by the agencies utilizing the buildings which are being surveyed under this section.

`(2) Such personnel shall be detailed for the purpose of carrying out this section without any reduction of salary or benefits.

`(d) REPORT- As soon as practicable after the completion of the project carried out under this section, the Secretary shall transmit a report of the findings and conclusions of the project to the Committee on Energy and Natural Resources and the Committee on Governmental Affairs of the Senate, the Committee on Energy and Commerce, the Committee on Government Operations, and the Committee on Public Works and Transportation of the House of Representatives, and the agencies who own the buildings involved in such project. Such report shall include an analysis of the probability of each agency achieving the 20 percent reduction goal established under section 543(a) of the National Energy Conservation Policy Act (42 U.S.C. 8253(a)).'.

(i) TECHNICAL AMENDMENTS- (1) Section 548 of such Act (42 U.S.C. 8258) is amended--

(A) in subsection (a)(2), by striking `546(b)' and inserting in lieu thereof `546(a)(2)'; and

(B) in subsection (b), in the material preceding paragraph (1), by striking `annually,' and insert the following: `, not later than April 2 of each year,'.

(2) The table of contents of such Act is amended by striking the item for section 549 and inserting in lieu thereof the following new items:

`Sec. 549. Demonstration of new technology.

`Sec. 550. Survey of energy saving potential.

`Sec. 551. Definitions.'.

(3) Section 3 of the Federal Energy Management Improvement Act of 1988 (42 U.S.C. 8253 note) is hereby repealed.

SEC. 153. GENERAL SERVICES ADMINISTRATION FEDERAL BUILDINGS FUND.

Section 210(f) of the Federal Property and Administrative Services Act of 1949 (40 U.S.C. 490(f)), is amended--

(1) in paragraph (1), by inserting `(to be known as the Federal Buildings Fund)' after `a fund'; and

(2) by adding at the end the following new paragraphs:

`(7)(A) The Administrator is authorized to receive amounts from rebates or other cash incentives related to energy savings and shall deposit such amounts in the Federal Buildings Fund for use as provided in subparagraph (D).

`(B) The Administrator may accept, from a utility, goods or services which enhance the energy efficiency of Federal facilities.

`(C) In the administration of any real property for which the Administrator leases and pays utility costs, the Administrator may assign all or a portion of energy rebates to the lessor to underwrite the costs incurred in undertaking energy efficiency improvements in such real property if the payback period for such improvement is at least 2 years less than the remainder of the term of the lease.

`(D) The Administrator may, in addition to amounts appropriated for such purposes and without regard to paragraph (2), obligate for energy management improvement programs--

`(i) amounts received and deposited in the Federal Buildings Fund under subparagraph (A);

`(ii) goods and services received under subparagraph (B); and

`(iii) amounts the Administrator determines are not needed for other authorized projects and are otherwise available to implement energy efficiency programs.

`(8)(A) The Administrator is authorized to receive amounts from the sale of recycled materials and shall deposit such amounts in the Federal Buildings Fund for use as provided in subparagraph (B).

`(B) The Administrator may, in addition to amounts appropriated for such purposes and without regard to paragraph (2), obligate amounts received and deposited in the Federal Buildings Fund under subparagraph (A) for programs which--

`(i) promote further source reduction and recycling programs; and

`(ii) encourage employees to participate in recycling programs by providing funding for child care.'.

SEC. 154. REPORT BY GENERAL SERVICES ADMINISTRATION.

Not later than one year after the date of the enactment of this Act, and annually thereafter, the Administrator of General Services shall report to the Committee on Governmental Affairs and the Committee on Energy and Natural Resources of the Senate and the Committee on Energy and Commerce, the Committee on Government Operations, and the Committee on Public Works and Transportation of the House of Representatives on the activities of the General Services Administration conducted pursuant to this subtitle.

SEC. 155. ENERGY SAVINGS PERFORMANCE CONTRACTS.

(a) IN GENERAL- Section 801 of the National Energy Conservation Policy Act (42 U.S.C. 8287) is amended--

(1) by striking `The head' and inserting the following:

`(a) IN GENERAL- (1) The head'; and

(2) by inserting at the end the following:

`(2)(A) Contracts under this title shall be energy savings performance contracts and shall require an annual energy audit and specify the terms and conditions of any Government payments and performance guarantees. Any such performance guarantee shall provide that the contractor is responsible for

maintenance and repair services for any energy related equipment, including computer software systems.

`(B) Aggregate annual payments by an agency to both utilities and energy savings performance contractors, under an energy savings performance contract, may not exceed the amount that the agency would have paid for utilities without an energy savings performance contract (as estimated through the procedures developed pursuant to this section) during contract years. The contract shall provide for a guarantee of savings to the agency, and shall establish payment schedules reflecting such guarantee, taking into account any capital costs under the contract.

`(C) Federal agencies may incur obligations pursuant to such contracts to finance energy conservation measures provided guaranteed savings exceed the debt service requirements.

`(D) A Federal agency may enter into a multiyear contract under this title for a period not to exceed 25 years, without funding of cancellation charges before cancellation, if--

`(i) such contract was awarded in a competitive manner pursuant to subsection (b)(2), using procedures and methods established under this title;

`(ii) funds are available and adequate for payment of the costs of such contract for the first fiscal year;

`(iii) 30 days before the award of any such contract that contains a clause setting forth a cancellation ceiling in excess of $750,000, the head of such agency gives written notification of such proposed contract and of the proposed cancellation ceiling for such contract to the appropriate authorizing and appropriating committees of the Congress; and

`(iv) such contract is governed by part 17.1 of the Federal Acquisition Regulation promulgated under section 25 of the Office of Federal Procurement Policy Act (41 U.S.C. 421) or the applicable rules promulgated under this title.

`(b) IMPLEMENTATION- (1)(A) The Secretary, with the concurrence of the Federal Acquisition Regulatory Council established under section 25(a) of the Office of Federal Procurement Policy Act, not later than 180 days after the date of the enactment of the Energy Policy Act of 1992, shall, by rule, establish appropriate procedures and methods for use by Federal agencies to select, monitor, and terminate contracts with energy service contractors in accordance with laws governing Federal procurement that will achieve the intent of this section in a cost-effective manner. In developing such procedures and methods, the Secretary, with the concurrence of the Federal Acquisition Regulatory Council, shall determine which existing regulations are inconsistent with the intent of this section and shall formulate substitute regulations consistent with laws governing Federal procurement.

`(B) The procedures and methods established pursuant to subparagraph (A) shall be the procedures and contracting methods for selection, by an agency, of a contractor to provide energy savings performance services. Such procedures and methods shall provide for the calculation of energy savings based on sound engineering and financial practices.

`(2) The procedures and methods established pursuant to paragraph (1)(A) shall--

`(A) allow the Secretary to--

`(i) request statements of qualifications, which shall, at a minimum, include prior experience

and capabilities of contractors to perform the proposed types of energy savings services and financial and performance information, from firms engaged in providing energy savings services; and

`(ii) from the statements received, designate and prepare a list, with an update at least annually, of those firms that are qualified to provide energy savings services;

`(B) require each agency to use the list prepared by the Secretary pursuant to subparagraph (A)(ii) unless the agency elects to develop an agency list of firms qualified to provide energy savings performance services using the same selection procedures and methods as are required of the Secretary in preparing such lists; and

`(C) allow the head of each agency to--

`(i) select firms from the list prepared pursuant to subparagraph (A)(ii) or the list prepared by the agency pursuant to subparagraph (B) to conduct discussions concerning a particular proposed energy savings project, including requesting a technical and price proposal from such selected firms for such project;

`(ii) select from such firms the most qualified firm to provide energy savings services based on technical and price proposals and any other relevant information;

`(iii) permit receipt of unsolicited proposals for energy savings performance contracting services from a firm that such agency has determined is qualified to provide such services under the procedures established pursuant to paragraph (1)(A), and require agency facility managers to place a notice in the Commerce Business Daily announcing they have received such a proposal and invite other similarly qualified firms to submit competing proposals; and

`(iv) enter into an energy savings performance contract with a firm qualified under clause (iii), consistent with the procedures and methods established pursuant to paragraph (1)(A).

`(3) A firm not designated as qualified to provide energy savings services under paragraph (2)(A)(i) or paragraph (2)(B) may request a review of such decision to be conducted in accordance with procedures to be developed by the board of contract appeals of the General Services Administration. Procedures developed by the board of contract appeals under this paragraph shall be substantially equivalent to procedures established under section 111(f) of the Federal Property and Administrative Services Act of 1949 (40 U.S.C. 759(f)).

`(c) SUNSET AND REPORTING REQUIREMENTS- (1) The authority to enter into new contracts under this section shall cease to be effective five years after the date procedures and methods are established under subsection (b).

`(2) Beginning one year after the date procedures and methods are established under subsection (b), and annually thereafter, for a period of five years after such date, the Comptroller General of the United States shall report on the implementation of this section. Such reports shall include, but not be limited to, an assessment of the following issues:

`(A) The quality of the energy audits conducted for the agencies.

`(B) The Government's ability to maximize energy savings.

`(C) The total energy cost savings accrued by the agencies that have entered into such contracts.

`(D) The total costs associated with entering into and performing such contracts.

`(E) A comparison of the total costs incurred by agencies under such contracts and the total costs incurred under similar contracts performed in the private sector.

`(F) The number of firms selected as qualified firms under this section and their respective shares of awarded contracts.

`(G) The number of firms engaged in similar activity in the private sector and their respective market shares.

`(H) The number of applicant firms not selected as qualified firms under this section and the reason for their nonselection.

`(I) The frequency with which agencies have utilized the services of Government labs to perform any of the functions specified in this section.

`(J) With the respect to the final report submitted pursuant to this paragraph, an assessment of whether the contracting procedures developed pursuant to this section and utilized by agencies have been effective and whether continued use of such procedures, as opposed to the procedures provided by existing public contract law, is necessary for implementation of successful energy savings performance contracts.'.

(b) DEFINITION- Section 804 of such Act (42 U.S.C. 8287c) is amended--

(1) in the material preceding paragraph (1), by striking `title--' and inserting `title, the following definitions apply:';

(2) in paragraph (1), by striking `the' and inserting `The' and by striking `, and' and inserting a period;

(3) in paragraph (2), by striking `the term' and inserting `The term'; and

(4) by adding at the end the following:

`(3) The terms `energy savings contract' and `energy savings performance contract' mean a contract which provides for the performance of services for the design, acquisition, installation, testing, operation, and, where appropriate, maintenance and repair, of an identified energy conservation measure or series of measures at one or more locations. Such contracts--

`(A) may provide for appropriate software licensing agreements; and

`(B) shall, with respect to an agency facility that is a public building as such term is defined in section 13(1) of the Public Buildings Act of 1959 (40 U.S.C. 612(1)), be in compliance with the prospectus requirements and procedures of section 7 of the Public Buildings Act of 1959 (40 U.S.C. 606).

`(4) The term `energy conservation measures' has the meaning given such term in section 551(4).'.

(c) TECHNICAL AND CONFORMING AMENDMENTS- (1) The title heading for title VIII of such Act is amended to read as follows:

`TITLE VIII--ENERGY SAVINGS PERFORMANCE CONTRACTS'.

(2) The table of contents of such Act is amended by striking the item relating to title VIII and inserting the following: `ENERGY SAVINGS PERFORMANCE CONTRACTS'.

SEC. 156. INTERGOVERNMENTAL ENERGY MANAGEMENT PLANNING AND COORDINATION.

(a) CONFERENCE WORKSHOPS- The Administrator of General Services, in consultation with the Secretary and the Task Force, shall hold regular, biennial conference workshops in each of the 10 standard Federal regions on energy management, conservation, efficiency, and planning strategy. The Administrator shall work and consult with the Department of Energy and other Federal agencies to plan for particular regional conferences. The Administrator shall invite Department of Energy, State, local, tribal, and county public officials who have responsibilities for energy management or may have an interest in such conferences and shall seek the input of, and be responsive to, the views of such officials in the planning and organization of such workshops.

(b) FOCUS OF WORKSHOPS- Such workshops and conferences shall focus on the following (but may include other topics):

(1) Developing strategies among Federal, State, tribal, and local governments to coordinate energy management policies and to maximize available intergovernmental energy management resources within the region regarding the use of governmental facilities and buildings.

(2) The design, construction, maintenance, and retrofitting of governmental facilities to incorporate energy efficient techniques.

(3) Procurement and use of energy efficient products.

(4) Dissemination of energy information on innovative programs, technologies, and methods which have proven successful in government.

(5) Technical assistance to design and incorporate effective energy management strategies.

(c) ESTABLISHMENT OF WORKSHOP TIMETABLE- As a part of the first report to be submitted pursuant to section 154, the Administrator shall set forth the schedule for the regional energy management workshops to be conducted under this section. Not less than five such workshops shall be held by September 30, 1993, and at least one such workshop shall be held in each of the 10 Federal regions every two years beginning on September 30, 1993.

SEC. 157. FEDERAL AGENCY ENERGY MANAGEMENT TRAINING.

(a) ENERGY MANAGEMENT TRAINING- (1) Each executive department described under section 101 of title 5, United States Code, the Environmental Protection Agency, the National Aeronautics and Space Administration, the General Services Administration, and the United States Postal Service shall

establish and maintain a program to ensure that facility energy managers are trained energy managers. Such programs shall be managed--

(A) by the department or agency representative on the Task Force; or

(B) if a department or agency is not represented on the Task Force, by the designee of the head of such department or agency.

(2) Departments and agencies described in paragraph (1) shall encourage appropriate employees to participate in energy manager training courses. Employees may enroll in courses of study in the areas described in section 151(3) including, but not limited to, courses offered by--

(A) private or public educational institutions;

(B) Federal agencies; or

(C) professional associations.

(b) REPORT TO TASK FORCE- (1) Each department and agency described in subsection (a)(1) shall, not later than 60 days following the date of the enactment of this Act, report to the Task Force the following information:

(A) Those individuals employed by such department or agency on the date of the enactment of this Act who qualify as trained energy managers.

(B) The General Schedule (GS) or grade level at which each of the individuals described in subparagraph (A) is employed.

(C) The facility or facilities for which such individuals are responsible or otherwise stationed.

(2) The Secretary shall provide a summary of the reports described in paragraph (1) to the Congress as part of the first report submitted under section 548 of the National Energy Conservation Policy Act (42 U.S.C. 8258) after the date of the enactment of this Act.

(c) REQUIREMENTS AT FEDERAL FACILITIES- (1) Not later than one year after the date of the enactment of this Act, the departments and agencies described under subsection (a)(1) shall upgrade their energy management capabilities by--

(A) designating facility energy supervisors;

(B) encouraging facility energy supervisors to become trained energy managers; and

(C) increasing the overall number of trained energy managers within such department or agency to a sufficient level to ensure effective implementation of this Act.

(2) Departments and agencies described in subsection (a)(1) may hire trained energy managers to be facility energy supervisors. Trained energy managers, including those who are facility supervisors as well as other trained personnel, shall focus their efforts on improving energy efficiency in the following facilities--

(A) department or agency facilities identified as most costly to operate or most energy inefficient; or

(B) other facilities identified by the department or agency head as having significant energy savings potential.

(d) ANNUAL REPORT TO SECRETARY AND CONGRESS- Each department and agency listed in subsection (a)(1) shall report to the Secretary on the status and implementation of the requirements of this section. The Secretary shall include a summary of each such report in the annual report to Congress as required under section 548(b) of the National Energy Conservation Policy Act (42 U.S.C. 8258).

SEC. 158. ENERGY AUDIT TEAMS.

(a) ESTABLISHMENT- The Secretary shall assemble from existing personnel with appropriate expertise, and with particular utilization of the national laboratories, and make available to all Federal agencies, one or more energy audit teams which shall be equipped with instruments and other advanced equipment needed to perform energy audits of Federal facilities.

(b) MONITORING PROGRAMS- The Secretary shall also assist in establishing, at each site that has utilized an energy audit team, a program for monitoring the implementation of energy efficiency improvements based upon energy audit team recommendations, and for recording the operating history of such improvements.

SEC. 159. FEDERAL ENERGY COST ACCOUNTING AND MANAGEMENT.

(a) GUIDELINES- Not later than 120 days after the date of the enactment of this Act, the Director of the Office of Management and Budget, in cooperation with the Secretary, the Administrator of General Services, and the Secretary of Defense, shall establish guidelines to be employed by each Federal agency to assess accurate energy consumption for all buildings or facilities which the agency owns, operates, manages or leases, where the Government pays utilities separate from the lease and the Government operates the leased space. Such guidelines are to be used in reports required under section 548 of the National Energy Conservation Policy Act (42 U.S.C. 8258). Each agency shall implement such guidelines no later than 120 days after their establishment. Each facility energy manager shall maintain energy consumption and energy cost records for review by the Inspector General, the Congress, and the general public.

(b) CONTENTS OF GUIDELINES- Such guidelines shall include the establishment of a monitoring system to determine--

(1) which facilities are the most costly to operate when measured on an energy consumption per square foot basis or other relevant analytical basis;

(2) unusual or abnormal changes in energy consumption; and

(3) the accuracy of utility charges for electric and gas consumption.

(c) FEDERALLY LEASED SPACE ENERGY REPORTING REQUIREMENT- The Administrator of General Services shall include, in each report submitted under section 154, the estimated energy cost of leased buildings or space in which the Federal Government does not directly pay the utility bills.

SEC. 160. INSPECTOR GENERAL REVIEW AND AGENCY ACCOUNTABILITY.

(a) AUDIT SURVEY- Not later than 120 days after the date of the enactment of this Act, each Inspector General created to conduct and supervise audits and investigations relating to the programs and operations of the establishments listed in section 11(2) of the Inspector General Act of 1978 (5 U.S.C. App.), and the Chief Postal Inspector of the United States Postal Service, in accordance with section 8E (f)(1) as established by section 8E(a)(2) of the Inspector General Act Amendments of 1988 (Public Law 100-504) shall--

(1) identify agency compliance activities to meet the requirements of section 543 of the National Energy Conservation Policy Act (42 U.S.C. 8253) and any other matters relevant to implementing the goals of such Act; and

(2) determine if the agency has the internal accounting mechanisms necessary to assess the accuracy and reliability of energy consumption and energy cost figures required under such section.

(b) PRESIDENTS COUNCIL ON INTEGRITY AND EFFICIENCY REPORT TO CONGRESS- Not later than 150 days after the date of the enactment of this Act, the President's Council on Integrity and Efficiency shall submit a report to the Committee on Energy and Natural Resources and the Committee on Governmental Affairs of the Senate, the Committee on Energy and Commerce, the Committee on Government Operations, and the Committee on Public Works and Transportation of the House of Representatives, on the review conducted by the Inspector General of each agency under this section.

(c) INSPECTOR GENERAL REVIEW- Each Inspector General established under section 2 of the Inspector General Act of 1978 (5 U.S.C. App.) is encouraged to conduct periodic reviews of agency compliance with part 3 of title V of the National Energy Conservation Policy Act, the provisions of this subtitle, and other laws relating to energy consumption. Such reviews shall not be inconsistent with the performance of the required duties of the Inspector General's office.

SEC. 161. PROCUREMENT AND IDENTIFICATION OF ENERGY EFFICIENT PRODUCTS.

(a) PROCUREMENT- The Administrator of General Services, the Secretary of Defense, and the Director of the Defense Logistics Agency, each shall undertake a program to include energy efficient products in carrying out their procurement and supply functions.

(b) IDENTIFICATION PROGRAM- The Administrator of General Services, the Secretary of Defense, and the Director of the Defense Logistics Agency, in consultation with the Secretary of Energy, each shall implement, in conjunction with carrying out their procurement and supply functions, a program to identify and designate those energy efficient products that offer significant potential savings, using, to the extent practicable, the life cycle cost methods and procedures developed under section 544 of the National Energy Conservation Policy Act (42 U.S.C. 8254). The Secretary of Energy shall, to the extent necessary to carry out this section and after consultation with the aforementioned agency heads, provide estimates of the degree of relative energy efficiency of products.

(c) GUIDELINES- The Administrator for Federal Procurement Policy, in consultation with the Administrator of General Services, the Secretary of Energy, the Secretary of Defense, and the Director of the Defense Logistics Agency, shall issue guidelines to encourage the acquisition and use by all Federal agencies of products identified pursuant to this section. The Secretary of Defense and the Director of the Defense Logistics Agency shall consider, and place emphasis on, the acquisition of such products as part

of the Agency's ongoing review of military specifications.

(d) REPORT TO CONGRESS- Not later than December 31 of 1993 and of each year thereafter, the Secretary of Energy, in consultation with the Administrator for Federal Procurement Policy, the Administrator of General Services, the Secretary of Defense, and the Director of the Defense Logistics Agency, shall report on the progress, status, activities, and results of the programs under subsections (a), (b), and (c). The report shall include--

(1) the types and functions of each product identified under subsection (b), and efforts undertaken by the Administrator of General Services, the Secretary of Defense, and the Director of the Defense Logistics Agency to encourage the acquisition and use of such products;

(2) the actions taken by the Administrator of General Services, the Secretary of Defense, and the Director of the Defense Logistics Agency to identify products under subsection (b), the barriers which inhibit implementation of identification of such products, and recommendations for legislative action, if necessary;

(3) progress on the development and issuance of guidelines under subsection (c);

(4) an indication of whether energy cost savings technologies identified by the Advanced Building Technology Council, under section 809(h) of the National Housing Act (12 U.S.C. 1701j-2), have been used in the identification of products under subsection (b);

(5) an estimate of the potential cost savings to the Federal Government from acquiring products identified under subsection (b) with respect to which energy is a significant component of life cycle cost, based on the quantities of such products that could be utilized throughout the Government; and

(6) the actual quantities acquired of products described in paragraph (5).

SEC. 162. FEDERAL ENERGY EFFICIENCY FUNDING STUDY.

(a) STUDY- The Secretary shall, in consultation with the Secretary of the Treasury, the Director of the Office of Management and Budget, the Administrator of General Services, and such other individuals and organizations as the Secretary deems appropriate, conduct a detailed study of options for the financing of energy and water conservation measures required under part 3 of title V of the National Energy Conservation Policy Act (42 U.S.C. 8251 et seq.) and all applicable Executive orders. Such study shall, taking into account the unique characteristics of Federal agencies, consider and analyze--

(1) the Federal financial investment necessary to comply with such requirements;

(2) the use of revolving funds and other funding mechanisms which offer stable, long-term financing of energy and water conservation measures; and

(3) the means for capitalizing such funds.

(b) REPORT TO CONGRESS- Not later than 180 days after the date of the enactment of this Act, the Secretary shall submit to the Congress a report containing the results of the study required under subsection (a).

SEC. 163. UNITED STATES POSTAL SERVICE ENERGY REGULATIONS.

(a) IN GENERAL- The Postmaster General shall issue regulations to ensure the reliable and accurate accounting of energy consumption costs for all buildings or facilities which it owns, leases, operates, or manages. Such regulations shall--

(1) establish a monitoring system to determine which facilities are the most costly to operate on an energy consumption per square foot basis or other relevant analytical basis;

(2) identify unusual or abnormal changes in energy consumption; and

(3) check the accuracy of utility charges for electricity and gas consumption.

(b) IDENTIFICATION OF ENERGY EFFICIENCY PRODUCTS- The Postmaster General shall actively undertake a program to identify and procure energy efficiency products for use in its facilities. In carrying out this subsection, the Postmaster General shall, to the maximum extent practicable, incorporate energy efficient information available on Federal Supply Schedules maintained by the General Services Administration and the Defense Logistics Agency.

SEC. 164. UNITED STATES POSTAL SERVICE BUILDING ENERGY SURVEY AND REPORT.

(a) IN GENERAL- The Postmaster General shall conduct an energy survey, as defined in section 551(5) of the National Energy Conservation Policy Act, for the purposes of--

(1) determining the maximum potential cost effective energy savings that may be achieved in a representative sample of buildings owned or leased by the United States Postal Service in different areas of the country;

(2) making recommendations for cost effective energy efficiency and renewable energy improvements in those buildings and in other similar United States Postal Service buildings; and

(3) identifying barriers which may prevent the United States Postal Service from complying with energy management goals, including Executive Orders No. 12003 and 12579.

(b) IMPLEMENTATION- (1) The Postmaster General shall transmit to the Committee on Governmental Affairs and the Committee on Energy and Natural Resources of the Senate, and the Committee on Energy and Commerce and the Committee on Post Office and Civil Service of the House of Representatives, within 180 days after the date of the enactment of this Act, a plan for implementing this section.

(2) The Postmaster General shall designate buildings to be surveyed in the project so as to obtain a sample of United States Postal Service facilities of the types and in the climates that consume the major portion of the energy consumed by the United States Postal Service.

(3) For the purposes of this section, an improvement shall be considered cost effective if the cost of the energy saved or displaced by the improvement exceeds the cost of the improvement over the remaining life of the facility or the remaining term of a lease of a building leased by the United States Postal Service.

(c) REPORT- As soon as practicable after the completion of the project carried out under this section,

the Postmaster General shall transmit a report of the findings and conclusions of the survey to the Committee on Governmental Affairs and the Committee on Energy and Natural Resources of the Senate, and the Committee on Energy and Commerce and the Committee on Post Office and Civil Service of the House of Representatives.

SEC. 165. UNITED STATES POSTAL SERVICE ENERGY MANAGEMENT REPORT.

Not later than one year after the date of the enactment of this Act, and not later than January 1 of each year thereafter, the Postmaster General shall submit a report to the Committee on Governmental Affairs and the Committee on Energy and Natural Resources of the Senate and the Committee on Energy and Commerce and the Committee on Post Office and Civil Service of the House of Representatives on the United States Postal Service's building management program as it relates to energy efficiency. The report shall include, but not be limited to--

(1) a description of actions taken to reduce energy consumption;

(2) future plans to reduce energy consumption;

(3) an assessment of the success of the energy conservation program;

(4) a statement of energy costs incurred in operating and maintaining all United States Postal Service facilities; and

(5) the status of the energy efficient procurement program established under section 163.

SEC. 166. ENERGY MANAGEMENT REQUIREMENTS FOR THE UNITED STATES POSTAL SERVICE.

(a) ENERGY MANAGEMENT REQUIREMENTS FOR POSTAL FACILITIES- (1) The Postmaster General shall, to the maximum extent practicable, ensure that each United States Postal Service facility meets the energy management requirements for Federal buildings and agencies specified in section 543 of the National Energy Conservation Policy Act (42 U.S.C. 8253).

(2) The Postmaster General may exclude from the requirements of such section any facility or collection of facilities, and the associated energy consumption and gross square footage if the Postmaster General finds that compliance with the requirements of such section would be impracticable. A finding of impracticability shall be based on the energy intensiveness of activities carried out in such facility or collection of facilities, the type and amount of energy consumed, or the technical feasibility of making the desired changes. The Postmaster General shall identify and list in the report required under section 165 the facilities designated by it for such exclusion.

(b) IMPLEMENTATION STEPS- In carrying subsection (a), the Postmaster General shall--

(1) not later than 1 year after the date of the enactment of this Act, prepare or update, as appropriate, a plan (which may be submitted as part of the first report submitted under section 165)--

(A) describing how this section will be implemented;

(B) designating personnel primarily responsible for achieving the requirements of this

section; and

(C) identifying high priority projects;

(2) perform energy surveys of United States Postal Service facilities as necessary to achieve the requirements of this section;

(3) install those energy conservation measures that will attain the requirements of this section in a cost-effective manner as defined in section 544 of the National Energy Conservation Policy Act (42 U.S.C. 8254); and

(4) ensure that the operation and maintenance procedures applied under this section are continued.

SEC. 167. GOVERNMENT CONTRACT INCENTIVES.

(a) ESTABLISHMENT OF CRITERIA- Each agency, in consultation with the Federal Acquisition Regulatory Council, shall establish criteria for the improvement of energy efficiency in Federal facilities operated by Federal Government contractors or subcontractors.

(b) PURPOSE OF CRITERIA- The criteria established under subsection (a) shall be used to encourage Federal contractors, and their subcontractors, which manage and operate federally-owned facilities, to adopt and utilize energy conservation measures designed to reduce energy costs in Government-owned and contractor-operated facilities and which are ultimately borne by the Federal Government.

SEC. 168. ENERGY MANAGEMENT REQUIREMENTS FOR CONGRESSIONAL BUILDINGS.

(a) IN GENERAL- The Architect of the Capitol (hereafter in this section referred to as the `Architect') shall undertake a program of analysis and, as necessary, retrofit of the Capitol Building, the Senate Office Buildings, the House Office Buildings, and the Capitol Grounds, in accordance with subsection (b).

(b) PROGRAM-

(1) LIGHTING-

(A) IMPLEMENTATION-

(i) IN GENERAL- Not later than 18 months after the date of the enactment of this Act and subject to the availability of funds to carry out this section, the Architect shall begin implementing a program to replace in each building described in subsection (a) all inefficient office and general use area fluorescent lighting systems with systems that incorporate the best available design and technology and that have payback periods of 10 years or less, as determined by using methods and procedures established under section 544(a) of the National Energy and Conservation Policy Act (42 U.S.C. 8254(a)).

(ii) REPLACEMENT OF INCANDESCENT LIGHTING- Whenever practicable in office and general use areas, the Architect shall replace incandescent lighting with efficient fluorescent lighting.

(B) COMPLETION- Subject to the availability of funds to carry out this section, the program described in subparagraph (A) shall be completed not later than 5 years after the date of the enactment of this Act.

(2) EVALUATION AND REPORT-

(A) IN GENERAL- Not later than 6 months after the date of the enactment of this Act, the Architect shall submit to the Speaker of the House of Representatives and the President pro tempore of the Senate a report evaluating potential energy conservation measures for each building described in subsection (a) in the areas of heating, ventilation, air conditioning equipment, insulation, windows, domestic hot water, food service equipment, and automatic control equipment.

(B) COSTS- The report submitted under subparagraph (A) shall detail the projected installation cost, energy and cost savings, and payback period of each energy conservation measure, as determined by using methods and procedures established under section 544(a) of the National Energy Conservation Policy Act (42 U.S.C. 8254(a)).

(3) REVIEW AND APPROVAL OF ENERGY CONSERVATION MEASURES- The Committee on Public Works and Transportation of the House of Representatives and the Committee on Rules and Administration of the Senate shall review the energy conservation measures identified in accordance with paragraph (2) and shall approve any such measure before it may be implemented.

(4) UTILITY INCENTIVE PROGRAMS- In carrying out this section, the Architect is authorized and encouraged to--

(A) accept any rebate or other financial incentive offered through a program for energy conservation or demand management of electricity, water, or gas that--

(i) is conducted by an electric, natural gas, or water utility;

(ii) is generally available to customers of the utility; and

(iii) provides for the adoption of energy efficiency technologies or practices that the Architect determines are cost-effective for the buildings described in subsection (a); and

(B) enter into negotiations with electric and natural gas utilities to design a special demand management and conservation incentive program to address the unique needs of the buildings described in subsection (a).

(5) USE OF SAVINGS- The Architect shall use an amount equal to the rebate or other savings from the financial incentive programs under paragraph (4)(A), without additional authorization or appropriation, for the implementation of additional energy and water conservation measures in the buildings under the jurisdiction of the Architect.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as are necessary to carry out this section.

Subtitle G--Miscellaneous

SEC. 171. ENERGY INFORMATION.

(a) ENERGY INFORMATION ADMINISTRATION- Section 205(i)(1) of the Department of Energy Organization Act (42 U.S.C. 7135(i)(1)) is amended--

(1) in the matter preceding subparagraph (A), by striking `on at least a triennial basis' and inserting in lieu thereof the following: `at least once every two years'; and

(2) by amending subparagraph (D) to read as follows:

`(D) use of nonpurchased sources of energy, such as solar, wind, biomass, geothermal, waste by-products, and cogeneration.'.

(b) RENEWABLE ENERGY INFORMATION- Section 205 of the Department of Energy Organization Act (42 U.S.C. 7135) is amended by adding at the end the following new subsections:

`(j)(1) The Administrator shall annually collect and publish the results of a survey of electricity production from domestic renewable energy resources, including production in kilowatt hours, total installed capacity, capacity factor, and any other measure of production efficiency. Such results shall distinguish between various renewable energy resources.

`(2) In carrying out this subsection, the Administrator shall--

`(A) utilize, to the maximum extent practicable and consistent with the faithful execution of his responsibilities under this Act, reliable statistical sampling techniques; and

`(B) otherwise take into account the reporting burdens of energy information by small businesses.

`(3) As used in this subsection, the term `renewable energy resources' includes energy derived from solar thermal, geothermal, biomass, wind, and photovoltaic resources.

`(k) Pursuant to section 52(a) of the Federal Energy Administration Act of 1974 (15 U.S.C. 790a(a)), the Administrator shall--

`(1) conduct surveys of residential and commercial energy use at least once every 3 years, and make such information available to the public;

`(2) when surveying electric utilities, collect information on demand-side management programs conducted by such utilities, including information regarding the types of demand-side management programs being operated, the quantity of measures installed, expenditures on demand-side management programs, estimates of energy savings resulting from such programs, and whether the savings estimates were verified; and

`(3) in carrying out this subsection, take into account reporting burdens and the protection of proprietary information as required by law.

`(l) In order to improve the ability to evaluate the effectiveness of the Nation's energy efficiency policies and programs, the Administrator shall, in carrying out the data collection provisions of subsections (i) and (k), consider--

`(1) expanding the survey instruments to include questions regarding participation in Government and utility conservation programs;

`(2) expanding fuel-use surveys in order to provide greater detail on energy use by user subgroups; and

`(3) expanding the scope of data collection on energy efficiency and load-management programs, including the effects of building construction practices such as those designed to obtain peak load shifting.'.

SEC. 172. DISTRICT HEATING AND COOLING PROGRAMS.

(a) IN GENERAL- The Secretary, in consultation with appropriate industry organizations, shall conduct a study to--

(1) assess existing district heating and cooling technologies to determine cost-effectiveness, technical performance, energy efficiency, and environmental impacts as compared to alternative methods for heating and cooling buildings;

(2) estimate the economic value of benefits that may result from implementation of district heating and cooling systems but that are not currently recognized, such as reduced emissions of air pollutants, local economic development, and energy security;

(3) evaluate the cost-effectiveness, including the economic value referred to in paragraph (2), of cogenerated district heating and cooling technologies compared to other alternatives for generating or conserving electricity; and

(4) assess and make recommendations for reducing institutional and other constraints on the implementation of district heating and cooling systems.

(b) REPORT- Not later than 2 years after the date of the enactment of this Act, the Secretary shall transmit to the Congress a report containing the findings, conclusions and recommendations, if any, of the Secretary for carrying out Federal, State, and local programs as a result of the study conducted under subsection (a).

SEC. 173. STUDY AND REPORT ON VIBRATION REDUCTION TECHNOLOGIES.

(a) IN GENERAL- The Secretary shall, in consultation with the appropriate industry representatives, conduct a study to assess the cost-effectiveness, technical performance, energy efficiency, and environmental impacts of active noise and vibration cancellation technologies that use fast adapting algorithms.

(b) PROCEDURE- In carrying out such study, the Secretary shall--

(1) estimate the potential for conserving energy and the economic and environmental benefits that may result from implementing active noise and vibration abatement technologies in demand side management; and

(2) evaluate the cost-effectiveness of active noise and vibration cancellation technologies as compared to other alternatives for reducing noise and vibration.

(c) REPORT- The Secretary shall transmit to the Congress, not later than 12 months after the date of the enactment of this Act, a report containing the findings and conclusions of the study carried out under this section.

(d) DEMONSTRATION- The Secretary may, based on the findings and conclusions of the study carried out under this section, conduct at least one project designed to demonstrate the commercial application of active noise and vibration cancellation technologies using fast adapting algorithms in products or equipment with a significant potential for increased energy efficiency.

TITLE II--NATURAL GAS

SEC. 201. FEWER RESTRICTIONS ON CERTAIN NATURAL GAS IMPORTS AND EXPORTS.

Section 3 of the Natural Gas Act (15 U.S.C. 717b) is amended by inserting `(a)' before `After six months'; and by adding at the end the following new subsections:

`(b) With respect to natural gas which is imported into the United States from a nation with which there is in effect a free trade agreement requiring national treatment for trade in natural gas, and with respect to liquefied natural gas--

`(1) the importation of such natural gas shall be treated as a `first sale' within the meaning of section 2(21) of the Natural Gas Policy Act of 1978; and

`(2) the Commission shall not, on the basis of national origin, treat any such imported natural gas on an unjust, unreasonable, unduly discriminatory, or preferential basis.

`(c) For purposes of subsection (a), the importation of the natural gas referred to in subsection (b), or the exportation of natural gas to a nation with which there is in effect a free trade agreement requiring national treatment for trade in natural gas, shall be deemed to be consistent with the public interest, and applications for such importation or exportation shall be granted without modification or delay.'.

SEC. 202. SENSE OF CONGRESS.

It is the sense of the Congress that natural gas consumers and producers, and the national economy, are best served by a competitive natural gas wellhead market.

TITLE III--ALTERNATIVE FUELS--GENERAL

SEC. 301. DEFINITIONS.

For purposes of this title, title IV, and title V (unless otherwise specified)--

(1) the term `Administrator' means the Administrator of the Environmental Protection Agency;

(2) the term `alternative fuel' means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar

energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits;

(3) the term `alternative fueled vehicle' means a dedicated vehicle or a dual fueled vehicle;

(4) the term `comparable conventionally fueled motor vehicle' means a motor vehicle which is, as determined by the Secretary--

(A) commercially available at the time the comparability of the vehicle is being assessed;

(B) powered by an internal combustion engine that utilizes gasoline or diesel fuel as its fuel source; and

(C) provides passenger capacity or payload capacity the same or similar to the alternative fueled vehicle to which it is being compared;

(5) `covered person' means a person that owns, operates, leases, or otherwise controls--

(A) a fleet that contains at least 20 motor vehicles that are centrally fueled or capable of being centrally fueled, and are used primarily within a metropolitan statistical area or a consolidated metropolitan statistical area, as established by the Bureau of the Census, with a 1980 population of 250,000 or more; and

(B) at least 50 motor vehicles within the United States;

(6) the term `dedicated vehicle' means--

(A) a dedicated automobile, as such term is defined in section 513(h)(1)(C) of the Motor Vehicle Information and Cost Savings Act; or

(B) a motor vehicle, other than an automobile, that operates solely on alternative fuel;

(7) the term `domestic' means derived from resources within the several States, the District of Columbia, the Commonwealth of Puerto Rico, the United States Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or any other Commonwealth, territory, or possession of the United States, including the outer Continental Shelf, as such term is defined in the Outer Continental Shelf Lands Act, or from resources within a Nation with which there is in effect a free trade agreement requiring national treatment for trade;

(8) the term `dual fueled vehicle' means--

(A) dual fueled automobile, as such term is defined in section 513(h)(1)(D) of the Motor Vehicle Information and Cost Savings Act; or

(B) a motor vehicle, other than an automobile, that is capable of operating on alternative fuel and is capable of operating on gasoline or diesel fuel;

(9) the term `fleet' means a group of 20 or more light duty motor vehicles, used primarily in a metropolitan statistical area or consolidated metropolitan statistical area, as established by the Bureau of the Census, with a 1980 population of more than 250,000, that are centrally fueled or

capable of being centrally fueled and are owned, operated, leased, or otherwise controlled by a governmental entity or other person who owns, operates, leases, or otherwise controls 50 or more such vehicles, by any person who controls such person, by any person controlled by such person, and by any person under common control with such person, except that such term does not include--

(A) motor vehicles held for lease or rental to the general public;

(B) motor vehicles held for sale by motor vehicle dealers, including demonstration motor vehicles;

(C) motor vehicles used for motor vehicle manufacturer product evaluations or tests;

(D) law enforcement motor vehicles;

(E) emergency motor vehicles;

(F) motor vehicles acquired and used for military purposes that the Secretary of Defense has certified to the Secretary must be exempt for national security reasons;

(G) nonroad vehicles, including farm and construction motor vehicles; or

(H) motor vehicles which under normal operations are garaged at personal residences at night;

(10) the term `fuel supplier' means--

(A) any person engaged in the importing, refining, or processing of crude oil to produce motor fuel;

(B) any person engaged in the importation, production, storage, transportation, distribution, or sale of motor fuel; and

(C) any person engaged in generating, transmitting, importing, or selling at wholesale or retail electricity;

(11) the term `light duty motor vehicle' means a light duty truck or light duty vehicle, as such terms are defined under section 216(7) of the Clean Air Act (42 U.S.C. 7550(7)), of less than or equal to 8,500 pounds gross vehicle weight rating;

(12) the term `motor fuel' means any substance suitable as a fuel for a motor vehicle;

(13) the term `motor vehicle' has the meaning given such term under section 216(2) of the Clean Air Act (42 U.S.C. 7550(2)); and

(14) the term `replacement fuel' means the portion of any motor fuel that is methanol, ethanol, or other alcohols, natural gas, liquefied petroleum gas, hydrogen, coal derived liquid fuels, fuels (other than alcohol) derived from biological materials, electricity (including electricity from solar energy), ethers, or any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits.

SEC. 302. AMENDMENTS TO THE ENERGY POLICY AND CONSERVATION ACT.

(a) AMENDMENTS- Section 400AA of the Energy Policy and Conservation Act (42 U.S.C. 6374) is amended--

(1) in subsection (a)(1)--

(A) by striking `passenger automobiles and light duty trucks' and inserting in lieu thereof `vehicles'; and

(B) by striking `alcohol powered vehicles, dual energy vehicles, natural gas powered vehicles, or natural gas dual energy vehicles.' and inserting in lieu thereof `alternative fueled vehicles. In no event shall the number of such vehicles acquired be less than the number required under section 303 of the Energy Policy Act of 1992.';

(2) by amending subsection (a)(3) to read as follows:

`(3)(A) To the extent practicable, the Secretary shall acquire both dedicated and dual fueled vehicles, and shall ensure that each type of alternative fueled vehicle is used by the Federal Government.

`(B) Vehicles acquired under this section shall be acquired from original equipment manufacturers. If such vehicles are not available from original equipment manufacturers, vehicles converted to use alternative fuels may be acquired if, after conversion, the original equipment manufacturer's warranty continues to apply to such vehicles, pursuant to an agreement between the original equipment manufacturer and the person performing the conversion. This subparagraph shall not apply to vehicles acquired by the United States Postal Service pursuant to a contract entered into by the United States Postal Service before the date of enactment of this subparagraph and which terminates on or before December 31, 1997.

`(C) Alternative fueled vehicles, other than those described in subparagraph (B), may be acquired solely for the purposes of studies under subsection (b), whether or not original equipment manufacturer warranties still apply.

`(D) In deciding which types of alternative fueled vehicles to acquire in implementing this part, the Secretary shall consider as a factor--

`(i) which types of vehicles yield the greatest reduction in pollutants emitted per dollar spent; and

`(ii) the source of the fuel to supply the vehicles, giving preference to vehicles that operate on alternative fuels derived from domestic sources.

`(E) Dual fueled vehicles acquired pursuant to this section shall be operated on alternative fuels unless the Secretary determines that operation on such alternative fuels is not feasible.

`(F) At least 50 percent of the alternative fuels used in vehicles acquired pursuant to this section shall be derived from domestic feedstocks, except to the extent inconsistent with the General Agreement on Tariffs and Trade. The Secretary shall issue regulations to implement this requirement. For purposes of this subparagraph, the term `domestic' has the meaning given such term in section 301(7) of the Energy Policy Act of 1992.

`(G) Except to the extent inconsistent with the General Agreement on Tariffs and Trade, vehicles acquired under this section shall be motor vehicles manufactured in the United States or Canada.';

(3) by adding at the end of subsection (a) the following new paragraph:

`(4) Acquisitions of vehicles under this section shall, to the extent practicable, be coordinated with acquisitions of alternative fueled vehicles by State and local governments.';

(4) in subsection (b), by inserting after paragraph (2) the following new paragraphs:

`(3)(A) The Secretary, in cooperation with the Environmental Protection Agency and the Department of Transportation, shall collect data and conduct a study of heavy duty vehicles acquired under subsection (a), which shall at a minimum address--

`(i) the performance of such vehicles, including reliability, durability, and performance in cold weather and at high altitude;

`(ii) the fuel economy, safety, and emissions of such vehicles; and

`(iii) a comparison of the operation and maintenance costs of such vehicles to the operation and maintenance costs of conventionally fueled heavy duty vehicles.

`(B) The Secretary shall provide a report on the results of the study conducted under subparagraph (A) to the Committees on Commerce, Science, and Transportation, Governmental Affairs, and Energy and Natural Resources of the Senate, and the Committees on Energy and Commerce and Government Operations of the House of Representatives, within one year after the first such vehicles are acquired, and annually thereafter.

`(4)(A) The Secretary and the Administrator of the General Services Administration shall conduct a study of the advisability, feasibility, and timing of the disposal of heavy duty vehicles acquired under subsection (a) and any problems with such disposal. Such study shall take into account existing laws governing the sale of Government vehicles and shall specifically focus on when to sell such vehicles and what price to charge.

`(B) The Secretary and the Administrator of the General Services Administration shall report the results of the study conducted under subparagraph (A) to the Committees on Commerce, Science, and Transportation, Governmental Affairs, and Energy and Natural Resources of the Senate, and the Committee on Energy and Commerce and the Committee on Government Operations of the House of Representatives, within one year after funds are appropriated for carrying out this paragraph.

`(5) Studies undertaken under this subsection shall be coordinated with relevant testing activities of the Environmental Protection Agency and the Department of Transportation.';

(5) in subsection (c)--

(A) by striking `alcohol or natural gas, alcohol or natural gas' and inserting in lieu thereof `alternative fuels, such fuels'; and

(B) by striking `alcohol or natural gas' and inserting in lieu thereof `alternative fuel' in paragraph (1);

(6) in subsection (d)(2)(B), by striking `The Secretary' and inserting in lieu thereof `To the extent that appropriations are available for such purposes, the Secretary';

(7) in subsection (g), by striking paragraphs (2) through (6) and inserting in lieu thereof the following:

`(2) the term `alternative fuel' means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits;

`(3) the term `alternative fueled vehicle' means a dedicated vehicle or a dual fueled vehicle;

`(4) the term `dedicated vehicle' means--

`(A) a dedicated automobile, as such term is defined in section 513(h)(1)(C) of the Motor Vehicle Information and Cost Savings Act; or

`(B) a motor vehicle, other than an automobile, that operates solely on alternative fuel;

`(5) the term `dual fueled vehicle' means--

`(A) dual fueled automobile, as such term is defined in section 513(h)(1)(D) of the Motor Vehicle Information and Cost Savings Act; or

`(B) a motor vehicle, other than an automobile, that is capable of operating on alternative fuel and is capable of operating on gasoline or diesel fuel; and

`(6) the term `heavy duty vehicle' means a vehicle of greater than 8,500 pounds gross vehicle weight rating.'; and

(8) by amending subsection (i)(1) to read as follows: `(1) For the purposes of this section, there are authorized to be appropriated such sums as may be necessary for fiscal years 1993 through 1998, to remain available until expended.'.

(b) REPEAL OF TERMINATION DATE- Section 4(b) of the Alternative Motor Fuels Act of 1988 is repealed.

SEC. 303. MINIMUM FEDERAL FLEET REQUIREMENT.

(a) GENERAL REQUIREMENTS- (1) The Federal Government shall acquire at least--

(A) 5,000 light duty alternative fueled vehicles in fiscal year 1993;

(B) 7,500 light duty alternative fueled vehicles in fiscal year 1994; and

(C) 10,000 light duty alternative fueled vehicles in fiscal year 1995.

(2) The Secretary shall allocate the acquisitions necessary to meet the requirements under paragraph (1).

(b) PERCENTAGE REQUIREMENTS- (1) Of the total number of vehicles acquired by a Federal fleet, at least--

(A) 25 percent in fiscal year 1996;

(B) 33 percent in fiscal year 1997;

(C) 50 percent in fiscal year 1998; and

(D) 75 percent in fiscal year 1999 and thereafter,

shall be alternative fueled vehicles.

(2) The Secretary, in consultation with the Administrator of General Services where appropriate, may permit a Federal fleet to acquire a smaller percentage than is required in paragraph (1), so long as the aggregate percentage acquired by all Federal fleets is at least equal to the required percentage.

(3) For purposes of this subsection, the term `Federal fleet' means 20 or more light duty motor vehicles, located in a metropolitan statistical area or consolidated metropolitan statistical area, as established by the Bureau of the Census, with a 1980 population of more than 250,000, that are centrally fueled or capable of being centrally fueled and are owned, operated, leased, or otherwise controlled by or assigned to any Federal executive department, military department, Government corporation, independent establishment, or executive agency, the United States Postal Service, the Congress, the courts of the United States, or the Executive Office of the President. Such term does not include--

(A) motor vehicles held for lease or rental to the general public;

(B) motor vehicles used for motor vehicle manufacturer product evaluations or tests;

(C) law enforcement vehicles;

(D) emergency vehicles;

(E) motor vehicles acquired and used for military purposes that the Secretary of Defense has certified to the Secretary must be exempt for national security reasons; or

(F) nonroad vehicles, including farm and construction vehicles.

(c) ALLOCATION OF INCREMENTAL COSTS- The General Services Administration and any other Federal agency that procures motor vehicles for distribution to other Federal agencies may allocate the incremental cost of alternative fueled vehicles over the cost of comparable gasoline vehicles across the entire fleet of motor vehicles distributed by such agency.

(d) APPLICATION OF REQUIREMENTS- The provisions of section 400AA of the Energy Policy and Conservation Act relating to the Federal acquisition of alternative fueled vehicles shall apply to the acquisition of vehicles pursuant to this section.

(e) RESALE- The Administrator of General Services shall take all feasible steps to ensure that all alternative fueled vehicles sold by the Federal Government shall remain alternative fueled vehicles at time of sale.

(f) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated for carrying out this section, such sums as may be necessary for fiscal years 1993 through 1998, to remain available until expended.

SEC. 304. REFUELING.

(a) IN GENERAL- Federal agencies shall, to the maximum extent practicable, arrange for the fueling of alternative fueled vehicles acquired under section 303 at commercial fueling facilities that offer alternative fuels for sale to the public. If publicly available fueling facilities are not convenient or accessible to the location of Federal alternative fueled vehicles purchased under section 303, Federal agencies are authorized to enter into commercial arrangements for the purposes of fueling Federal alternative fueled vehicles, including, as appropriate, purchase, lease, contract, construction, or other arrangements in which the Federal Government is a participant.

(b) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section such sums as may be necessary for fiscal years 1993 through 1998, to remain available until expended.

SEC. 305. FEDERAL AGENCY PROMOTION, EDUCATION, AND COORDINATION.

(a) PROMOTION AND EDUCATION- The Secretary, in cooperation with the Administrator of General Services, shall promote programs and educate officials and employees of Federal agencies on the merits of alternative fueled vehicles. The Secretary, in cooperation with the Administrator of General Services, shall provide and disseminate information to Federal agencies on--

(1) the location of refueling and maintenance facilities available to alternative fueled vehicles in the Federal fleet;

(2) the range and performance capabilities of alternative fueled vehicles;

(3) State and local government and commercial alternative fueled vehicle programs;

(4) Federal alternative fueled vehicle purchases and placements;

(5) the operation and maintenance of alternative fueled vehicles in accordance with the manufacturer's standards and recommendations; and

(6) incentive programs established pursuant to sections 306 and 307 of this Act.

(b) ASSISTANCE IN PROCUREMENT AND PLACEMENT- The Secretary, in cooperation with the Administrator of General Services, shall provide guidance, coordination and technical assistance to Federal agencies in the procurement and geographic location of alternative fueled vehicles purchased through the Administrator of General Services. The procurement and geographic location of such vehicles shall comply with the purchase requirements under section 303 of this Act.

SEC. 306. AGENCY INCENTIVES PROGRAM.

(a) REDUCTION IN RATES- To encourage and promote use of alternative fueled vehicles in Federal agencies, the Administrator of General Services may offer a reduction in fees charged to agencies for the lease of alternative fueled vehicles below those fees charged for the lease of comparable conventionally fueled motor vehicles.

(b) SUNSET PROVISION- This section shall cease to be effective 3 years after the date of the enactment of this Act.

SEC. 307. RECOGNITION AND INCENTIVE AWARDS PROGRAM.

(a) AWARDS PROGRAM- The Administrator of General Services shall establish annual awards program to recognize those Federal employees who demonstrate the strongest commitment to the use of alternative fuels and fuel conservation in Federal motor vehicles.

(b) CRITERIA- The Administrator of General Services shall provide annual awards to Federal employees who best demonstrate a commitment--

(1) to the success of the Federal alternative fueled vehicle program through--

(A) exemplary promotion of alternative fueled vehicle use within Federal agencies;

(B) proper alternative fueled vehicle care and maintenance;

(C) coordination with Federal, State, and local efforts;

(D) innovative alternative fueled vehicle procurement, refueling, and maintenance arrangements with commercial entities;

(E) making regular requests for alternative fueled vehicles for agency use; and

(F) maintaining a high number of alternative fueled vehicles used relative to comparable conventionally fueled motor vehicles used; and

(2) to fuel efficiency in Federal motor vehicle use through the promotion of such measures as increased use of fuel-efficient vehicles, carpooling, ride-sharing, regular maintenance, and other conservation and awareness measures.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated for the purpose of carrying out this section not more than $35,000 for fiscal year 1994 and such sums as may be necessary for each of the fiscal years 1995 and 1996.

SEC. 308. MEASUREMENT OF ALTERNATIVE FUEL USE.

The Administrator of General Services shall use such means as may be necessary to measure the percentage of alternative fuel use in dual-fueled vehicles procured by the Administrator of General Services. Not later than one year after the date of the enactment of this Act, the Secretary, in consultation with the Administrator of General Services, shall issue guidelines to Federal agencies for use in measuring the aggregate percentage of alternative fuel use in dual-fueled vehicles in their fleets.

SEC. 309. INFORMATION COLLECTION.

Section 400AA(b)(1)(A) of the Energy Policy and Conservation Act is amended by striking `the vehicles acquired under subsection (a)' and inserting in lieu thereof `a representative sample of alternative fueled vehicles in Federal fleets'.

SEC. 310. GENERAL SERVICES ADMINISTRATION REPORT.

Not later than one year after the date of the enactment of this Act, and biennially thereafter, the Administrator of General Services shall report to the Congress on the General Services Administration's alternative fueled vehicle program under this Act. The report shall contain information on--

(1) the number and type of alternative fueled vehicles procured;

(2) the location of alternative fueled vehicles by standard Federal region;

(3) the total number of alternative fueled vehicles used by each Federal agency;

(4) arrangements with commercial entities for refueling and maintenance of alternative fueled vehicles;

(5) future alternative fueled vehicle procurement and placement strategy;

(6) the difference in cost between the purchase, maintenance, and operation of alternative fueled vehicles and the purchase, maintenance, and operation of comparable conventionally fueled motor vehicles;

(7) coordination among Federal, State, and local governments for alternative fueled vehicle procurement and placement;

(8) the percentage of alternative fuel use in dual-fueled vehicles procured by the Administrator of General Services as measured under section 308;

(9) a description of the representative sample of alternative fueled vehicles as determined under section 400AA(b)(1)(A) of the Energy Policy and Conservation Act; and

(10) award recipients under this title.

SEC. 311. UNITED STATES POSTAL SERVICE.

(a) REPORT- Not later than one year after the date of the enactment of this Act, and biennially thereafter, the Postmaster General shall submit a report to the Congress on the Postal Service's alternative fueled vehicle program. The report shall contain information on--

(1) the total number and type of alternative fueled vehicles procured prior to the date of the enactment of this Act (first report only);

(2) the number and type of alternative fueled vehicles procured in the preceding year;

(3) the location of alternative fueled vehicles by region;

(4) arrangements with commercial entities for purposes of refueling and maintenance;

(5) future alternative fuel procurement and placement strategy;

(6) the difference in cost between the purchase, maintenance, and operation of alternative fueled vehicles and the purchase, maintenance, and operation of comparable conventionally fueled motor vehicles;

(7) the percentage of alternative fuel use in dual-fueled vehicles procured by the Postmaster General;

(8) promotions and incentives to encourage the use of alternative fuels in dual-fueled vehicles; and

(9) an assessment of the program's relative success and policy recommendations for strengthening the program.

(b) COORDINATION- To the maximum extent practicable, the Postmaster General shall coordinate the Postal Service's alternative fueled vehicle procurement, placement, refueling, and maintenance programs with those at the Federal, State, and local level. The Postmaster General shall communicate, share, and disseminate, on a regular basis, information on such programs with the Secretary, the Administrator of General Services, and heads of appropriate Federal agencies.

(c) PROGRAM CRITERIA- The Postmaster General shall consider the following criteria in the procurement and placement of alternative fueled vehicles:

(1) The procurement plans of State and local governments and other public and private institutions.

(2) The current and future availability of refueling and repair facilities.

(3) The reduction in emissions of the Postal fleet.

(4) Whether the vehicle is to be used in a nonattainment area as specified in the Clean Air Act Amendments of 1990.

(5) The operational requirements of the Postal fleet.

(6) The contribution to the reduction in the consumption of oil in the transportation sector.

TITLE IV--ALTERNATIVE FUELS--NON-FEDERAL PROGRAMS

SEC. 401. TRUCK COMMERCIAL APPLICATION PROGRAM.

(a) ALTERNATIVE FUELED TRUCKS- Section 400BB(a) of the Energy Policy and Conservation Act (42 U.S.C. 6374a(a)) is amended by striking `alcohol and natural gas' and inserting in lieu thereof `alternative fuels'.

(b) FUNDING- Section 400BB(b)(1) of such Act (42 U.S.C. 6374a(b)(1)) is amended to read as follows:

`(1) There are authorized to be appropriated to the Secretary for carrying out this section such sums as may be necessary for fiscal years 1993 through 1995, to remain available until expended.'.

SEC. 402. CONFORMING AMENDMENTS.

Part J of title III of the Energy Policy and Conservation Act is amended--

(1) in section 400CC(a)--

(A) by striking `alcohol and buses capable of operating on natural gas' and inserting in lieu thereof `alternative fuels'; and

(B) by striking `both buses capable of operating on alcohol and buses capable of operating on natural gas' and inserting in lieu thereof `each of the various types of alternative fuel buses';

(2) in section 400DD(d), by striking `alcohols, natural gas, and other potential alternative motor' and inserting in lieu thereof `alternative'; and

(3) in section 400DD (d) and (e), by striking `motor' each place it appears.

SEC. 403. ALTERNATIVE MOTOR FUELS AMENDMENTS.

Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2001 et seq.) is amended--

(1) in section 501(1), by striking `alcohol or natural gas' and inserting in lieu thereof `alternative fuel';

(2) in section 502(e)--

(A) by striking `alcohol powered automobiles or natural gas powered' and inserting in lieu thereof `dedicated'; and

(B) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled';

(3) in section 506(a)(4)--

(A) in subparagraph (A)--

(i) by striking `alcohol powered automobiles or natural gas powered' and inserting in lieu thereof `dedicated'; and

(ii) by striking `alcohol or natural gas, as the case may be' and inserting in lieu thereof `alternative fuels'; and

(B) in subparagraph (B)--

(i) by striking `energy automobiles or natural gas dual energy' and inserting in lieu

thereof `fueled'; and

(ii) by striking `energy automobile or natural gas dual energy automobile, as the case may be' and inserting in lieu thereof `fueled automobile'; and

(4) in section 506(b)(3)--

(A) in subparagraph (A)--

(i) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled';

(ii) by striking `alcohol or natural gas, as the case may be' and inserting in lieu thereof `alternative fuels' in clause (i); and

(iii) by striking `alcohol or natural gas, as the case may be' and inserting in lieu thereof `alternative fuels' in clause (ii); and

(B) in subparagraph (B)--

(i) by striking `dual energy' and inserting in lieu thereof `dual fueled'; and

(ii) by striking `alcohol' and inserting in lieu thereof `alternative fuels' in clauses (i) and (ii); and

(5) in section 513--

(A) in subsection (a)--

(i) by striking `ALCOHOL POWERED' and inserting in lieu thereof `DEDICATED';

(ii) by striking `If' and inserting in lieu thereof `Except as provided in subsection (c) or in section 503(a)(3), if';

(iii) by striking `alcohol powered' and inserting in lieu thereof `dedicated';

(iv) by striking `content of the alcohol' and inserting in lieu thereof `content of the alternative fuel'; and

(v) by striking `gallon of alcohol' and inserting in lieu thereof `gallon of a liquid alternative fuel';

(B) in subsection (b)--

(i) by striking `ENERGY' and inserting in lieu thereof `FUELED';

(ii) by striking `If' and inserting in lieu thereof `Except as provided in subsection (d) or in section 503(a)(3), if';

(iii) by striking `energy' and inserting in lieu thereof `fueled'; and

(iv) by striking `alcohol' and inserting in lieu thereof `alternative fuel' in paragraph (2);

(C) in subsection (c)--

(i) by striking `NATURAL GAS POWERED' and inserting in lieu thereof `GASEOUS FUEL DEDICATED';

(ii) by striking `powered' and inserting in lieu thereof `dedicated';

(iii) by striking `natural gas' each place it appears in the first sentence and inserting in lieu thereof `gaseous fuel'; and

(iv) by adding at the end the following new sentence: `For purposes of this section, the Secretary shall determine the appropriate gallons equivalent measurement for gaseous fuels other than natural gas, and a gallon equivalent of such gaseous fuel shall be considered to have a fuel content of 15 one-hundredths of a gallon of fuel.';

(D) in subsection (d)--

(i) by striking `NATURAL GAS DUAL ENERGY' and inserting in lieu thereof `GASEOUS FUEL DUAL FUELED';

(ii) by striking `dual energy' and inserting in lieu thereof `dual fueled'; and

(iii) by striking `natural gas' each place it appears and inserting in lieu thereof `gaseous fuel';

(E) in subsection (e), by striking `alcohol powered automobile, dual energy automobile, natural gas powered automobile, or natural gas dual energy' and inserting in lieu thereof `dedicated automobile or dual fueled';

(F) in subsection (f)(2)(A)(i), by striking `alcohol powered automobiles, natural gas powered automobiles,' and inserting in lieu thereof `alternative fueled automobiles';

(G) in subsection (g)--

(i) in paragraph (1)--

(I) by inserting `, other than electric automobiles,' after `each category of automobiles' in subparagraph (A);

(II) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled' in subparagraph (A);

(III) by inserting `, other than electric automobiles,' after `each category of automobiles' in subparagraph (B);

(IV) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled' in subparagraph (B);

(V) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled' both places it appears in subparagraph (C); and

(VI) by striking `energy automobile or natural gas dual energy' and inserting in lieu thereof `fueled' in subparagraph (C); and

(ii) in paragraph (2)--

(I) by striking `energy passenger automobiles or natural gas dual energy' and inserting in lieu thereof `fueled' in subparagraph (A);

(II) by striking `alcohol powered automobiles or natural gas powered' and inserting in lieu thereof `dedicated' in subparagraph (B); and

(III) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled' in subparagraph (B);

(H) in subsection (h)(1)--

(i) by striking subparagraphs (D) and (E) and redesignating subparagraph (C) as subparagraph (D);

(ii) by striking subparagraphs (A) and (B) and inserting in lieu thereof the following new subparagraphs:

`(A) the term `alternative fuel' means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits;

`(B) the term `alternative fueled automobile' means an automobile that--

`(i) is a dedicated automobile; or

`(ii) is a dual fueled automobile;

`(C) the term `dedicated automobile' means an automobile that operates solely on alternative fuels; and'; and

(iii) in subparagraph (D), as so redesignated by clause (i) of this subparagraph--

(I) by striking `dual energy' and inserting in lieu thereof `dual fueled';

(II) by striking `alcohol' and inserting in lieu thereof `alternative fuel' in clauses (i), (ii), and (iii);

(III) by inserting `in the case of an automobile capable of operating on a mixture of an alternative fuel and gasoline or diesel fuel,' before `which, for model years' in clause (iii); and

(IV) by striking the semicolon at the end of clause (iv) and inserting in lieu thereof a period; and

(I) in subsection (h)(2)--

(i) by striking `paragraphs (1)(C) and (D)' and inserting in lieu thereof `paragraph (1)(D)' in subparagraph (A);

(ii) by striking `energy automobiles when operating on alcohol, and by natural gas dual energy automobiles when operating on natural gas' and inserting in lieu thereof `fueled automobiles when operating on alternative fuels' in subparagraph (A);

(iii) by striking `energy automobiles or natural gas dual energy' and inserting in lieu thereof `fueled' both places it appears in subparagraph (A);

(iv) by striking `energy automobiles and natural gas dual energy' and inserting in lieu thereof `fueled' in subparagraph (A);

(v) by striking `energy' and inserting in lieu thereof `fueled' each place it appears in subparagraphs (B) and (C); and

(vi) by inserting `other than electric automobiles' after `automobiles' each place it appears in subparagraphs (B) and (C).

SEC. 404. VEHICULAR NATURAL GAS JURISDICTION.

(a) NATURAL GAS ACT AMENDMENTS- (1) Section 1 of the Natural Gas Act (15 U.S.C. 717) is amended by inserting after subsection (c) the following new subsection:

`(d) The provisions of this Act shall not apply to any person solely by reason of, or with respect to, any sale or transportation of vehicular natural gas if such person is--

`(1) not otherwise a natural-gas company; or

`(2) subject primarily to regulation by a State commission, whether or not such State commission has, or is exercising, jurisdiction over the sale, sale for resale, or transportation of vehicular natural gas.'.

(2) Section 2 of the Natural Gas Act (15 U.S.C. 717a) is amended by inserting after paragraph (9) the following new paragraph:

`(10) `Vehicular natural gas' means natural gas that is ultimately used as a fuel in a self-propelled vehicle.'.

(b) STATE LAWS AND REGULATIONS- The transportation or sale of natural gas by any person who is not otherwise a public utility, within the meaning of State law--

(1) in closed containers; or

(2) otherwise to any person for use by such person as a fuel in a self-propelled vehicle,

shall not be considered to be a transportation or sale of natural gas within the meaning of any State law, regulation, or order in effect before January 1, 1989. This subsection shall not apply to any provision of any State law, regulation, or order to the extent that such provision has as its primary purpose the protection of public safety.

(c) NONAPPLICABILITY OF THE PUBLIC UTILITY HOLDING COMPANY ACT OF 1935- (1) A company shall not be considered to be a gas utility company under section 2(a)(4) of the Public Utility Holding Company Act of 1935 (15 U.S.C. 79b(a)(4)) solely because it owns or operates facilities used for the distribution at retail of vehicular natural gas.

(2) Notwithstanding section 11(b)(1) of the Public Utility Holding Company Act of 1935 (15 U.S.C. 79k (b)(1)), a holding company registered under such Act solely by reason of the application of section 2(a)(7) (A) or (B) of such Act with respect to control of a gas utility company or subsidiary thereof, may acquire or retain, in any geographic area, any interest in a company that is not a public utility company and which, as a primary business, is involved in the sale of vehicular natural gas or the manufacture, sale, transport, installation, servicing, or financing of equipment related to the sale for consumption of vehicular natural gas.

(3) The sale or transportation of vehicular natural gas by a company, or any subsidiary of such company, shall not be taken into consideration in determining whether under section 3 of the Public Utility Holding Company Act of 1935 (15 U.S.C. 79c) such company is exempt from registration.

(4) For purposes of this subsection, terms that are defined under the Public Utility Holding Company Act of 1935 shall have the meaning given such terms in such Act.

(5) For purposes of this subsection, the term `vehicular natural gas' means natural or manufactured gas that is ultimately used as a fuel in a self-propelled vehicle.

SEC. 405. PUBLIC INFORMATION PROGRAM.

The Secretary, in consultation with appropriate Federal agencies and individuals and organizations with practical experience in the production and use of alternative fuels and alternative fueled vehicles, shall, for the purposes of promoting the use of alternative fuels and alternative fueled vehicles, establish a public information program on the benefits and costs of the use of alternative fuels in motor vehicles. Within 18 months after the date of enactment of this Act, the Secretary shall produce and make available an information package for consumers to assist them in choosing among alternative fuels and alternative fueled vehicles. Such information package shall provide relevant and objective information on motor vehicle characteristics and fuel characteristics as compared to gasoline, on a life cycle basis, including environmental performance, energy efficiency, domestic content, cost, maintenance requirements, reliability, and safety. Such information package shall also include information with respect to the conversion of conventional motor vehicles to alternative fueled vehicles. The Secretary shall include such other information as the Secretary determines is reasonable and necessary to help promote the use of alternative fuels in motor vehicles. Such information package shall be updated annually to reflect the most recent available information.

SEC. 406. LABELING REQUIREMENTS.

(a) ESTABLISHMENT OF REQUIREMENTS- The Federal Trade Commission, in consultation with the Secretary, the Administrator of the Environmental Protection Agency, and the Secretary of Transportation, shall, within 18 months after the date of enactment of this Act, issue a notice of proposed rulemaking for a rule to establish uniform labeling requirements, to the greatest extent practicable, for alternative fuels and alternative fueled vehicles, including requirements for appropriate information with respect to costs and benefits, so as to reasonably enable the consumer to make choices and comparisons. Required labeling under the rule shall be simple and, where appropriate, consolidated with other labels providing information to the consumer. In formulating the rule, the Federal Trade Commission shall give consideration to the problems associated with developing and publishing useful and timely cost and benefit information, taking into account lead time, costs, the frequency of changes in costs and benefits that may occur, and other relevant factors. The Commission shall obtain the views of affected industries, consumer organizations, Federal and State agencies, and others in formulating the rule. A final rule shall be issued within 1 year after the notice of proposed rulemaking is issued. Such rule shall be updated periodically to reflect the most recent available information.

(b) TECHNICAL ASSISTANCE AND COORDINATION- The Secretary shall provide technical assistance to the Federal Trade Commission in developing labeling requirements under subsection (a). The Secretary shall coordinate activities under this section with activities under section 405.

SEC. 407. DATA ACQUISITION PROGRAM.

(a) Not later than one year after the date of enactment of this Act, the Secretary, through the Energy Information Administration, and in cooperation with appropriate State, regional, and local authorities, shall establish a data collection program to be conducted in at least 5 geographically and climatically diverse regions of the United States for the purpose of collecting data which would be useful to persons seeking to manufacture, convert, sell, own, or operate alternative fueled vehicles or alternative fueling facilities. Such data shall include--

(1) identification of the number and types of motor vehicle trips made daily and miles driven per trip, including commuting, business, and recreational trips;

(2) the projections of the Secretary as to the most likely combination of alternative fueled vehicle use and other forms of transit, including rail and other forms of mass transit;

(3) cost, performance, environmental, energy, and safety data on alternative fuels and alternative fueled vehicles; and

(4) other appropriate demographic information and consumer preferences.

(b) The Secretary shall consult with interested parties, including other appropriate Federal agencies, manufacturers, public utilities, owners and operators of fleets of light duty motor vehicles, and State or local governmental entities, to determine the types of data to be collected and analyzed under subsection (a).

SEC. 408. FEDERAL ENERGY REGULATORY COMMISSION AUTHORITY TO APPROVE RECOVERY OF CERTAIN EXPENSES IN ADVANCE.

(a) NATURAL GAS MOTOR VEHICLES- The Federal Energy Regulatory Commission may, under section 4 of the Natural Gas Act, allow recovery of expenses in advance by natural-gas companies for research, development, and demonstration activities by the Gas Research Institute for projects on the use

of natural gas, including fuels derived from natural gas, for transportation, and projects on the use of natural gas to control pollutants and to control emissions from the combustion of other fuels, if the Commission finds that the benefits, including environmental benefits, to existing and future ratepayers resulting from such activities exceed all direct costs to existing and future ratepayers. To the maximum extent practicable, through the establishment of cofunding requirements applicable to such projects, the Commission shall ensure that the costs of such activities shall be provided in part, through contributions of cash, personnel, services, equipment, and other resources, by sources other than the recovery of expenses pursuant to this section.

(b) ELECTRIC MOTOR VEHICLES- The Federal Energy Regulatory Commission may, under section 205 of the Federal Power Act, allow recovery of expenses in advance by electric utilities for research, development, and demonstration activities by the Electric Power Research Institute for projects on electric motor vehicles, if the Commission finds that the benefits, including environmental benefits, to existing and future ratepayers resulting from such activities exceed all direct costs to existing and future ratepayers. To the maximum extent practicable, through the establishment of cofunding requirements applicable to each project, the costs of such activities shall be provided, in part, through contributions of cash, personnel, services, equipment, and other resources, by sources other than the recovery of expenses pursuant to this section.

(c) REPEAL- The second paragraph of the matter under the heading `FEDERAL ENERGY REGULATORY COMMISSION, SALARIES AND EXPENSES' in title III of the Energy and Water Development Appropriations Act, 1992, is repealed.

SEC. 409. STATE AND LOCAL INCENTIVES PROGRAMS.

(a) ESTABLISHMENT OF PROGRAM- (1) The Secretary shall, within one year after the date of enactment of this Act, issue regulations establishing guidelines for comprehensive State alternative fuels and alternative fueled vehicle incentives and program plans designed to accelerate the introduction and use of such fuels and vehicles. Such guideline shall address the development, modification, and implementation of such State plans and shall describe those program elements, as described in paragraph (3), to be addressed in such plans.

(2) The Secretary, after consultation with the Secretary of Transportation and the Administrator of the Environmental Protection Agency, shall invite the Governor of each State to submit to the Secretary a State plan within one year after the effective date of the regulations issued under paragraph (1). Such plan shall include--

(A) provisions designed to result in scheduled progress toward, and achievement of, the goal of introducing substantial numbers of alternative fueled vehicles in such State by the year 2000; and

(B) a detailed description of the requirements, including the estimated cost of implementation, of such plan.

(3) Each proposed State plan, in order to be eligible for Federal assistance under this section, shall describe the manner in which coordination shall be achieved with Federal and local governmental entities in implementing such plan, and shall include an examination of--

(A) exemption from State sales tax or other State or local taxes or surcharges (other than such taxes or surcharges which are dedicated for transportation purposes) with respect to alternative fueled vehicles, alternative fuels, or alternative fueling facilities;

(B) the introduction of alternative fueled vehicles into State-owned or operated motor vehicle fleets;

(C) special parking at public buildings and airport and transportation facilities;

(D) programs of public education to promote the use of alternative fueled vehicles;

(E) the treatment of sales of alternative fuels for use in alternative fueled vehicles;

(F) methods by which State and local governments might facilitate--

(i) the availability of alternative fuels; and

(ii) the ability to recharge electric motor vehicles at public locations;

(G) allowing public utilities to include in rates the incremental cost of--

(i) new alternative fueled vehicles;

(ii) converting conventional vehicles to operate on alternative fuels; and

(iii) installing alternative fuel fueling facilities,

but only to the extent that the inclusion of such costs in rates would not create competitive disadvantages for other market participants, and taking into consideration the effect inclusion of such costs would have on rates, service, and reliability to other utility customers;

(H) such other programs and incentives as the State may describe;

(I) whether accomplishing any of the goals in this subsection would require amendment to State law or regulation, including traffic safety prohibitions;

(J) services provided by municipal, county, and regional transit authorities; and

(K) effects of such plan on programs authorized by the Intermodal Surface Transportation Efficiency Act of 1991 and amendments made by that Act.

(b) FEDERAL ASSISTANCE TO STATES- (1) Upon request of the Governor of any State with a plan approved under this section, the Secretary may provide to such State--

(A) information and technical assistance, including model State laws and proposed regulations relating to alternative fueled vehicles;

(B) grants of Federal financial assistance for the purpose of assisting such State in the implementation of such plan or any part thereof; and

(C) grants of Federal financial assistance for the acquisition of alternative fueled vehicles.

(2) In determining whether to approve a State plan submitted under subsection (a), and in determining the amount of Federal financial assistance, if any, to be provided to any State under this subsection, the

Secretary shall take into account--

(A) the energy-related and environmental-related impacts, on a life cycle basis, of the introduction and use of alternative fueled vehicles included in the plan compared to conventional motor vehicles;

(B) the number of alternative fueled vehicles likely to be introduced by the year 2000, as a result of successful implementation of the plan; and

(C) such other factors as the Secretary considers appropriate.

(3) The Secretary, in consultation with the Administrator of General Services, shall provide assistance to States in procuring alternative fueled vehicles, including coordination with Federal procurements of such vehicles.

(4) The Secretary may not approve a State plan submitted under subsection (a) unless the State agrees to provide at least 20 percent of the cost of activities for which assistance is provided under paragraph (1).

(c) GENERAL PROVISIONS- (1) In carrying out this section, the Secretary shall consult with the Secretary of Transportation on matters relating to transportation and with other appropriate Federal and State departments and agencies.

(2) The Secretary shall report annually to the President and the Congress, and shall furnish copies of such report to the Governor of each State participating in the program, on the operation of the program under this section. Such report shall include--

(A) an estimate of the number of alternative fueled vehicles in use in each State;

(B) the degree of each State's participation in the program;

(C) a description of Federal, State, and local programs undertaken in the various States, whether pursuant to a State plan under this section or not, to provide incentives for introduction of alternative fueled vehicles;

(D) an estimate of the energy and environmental benefits of the program; and

(E) the recommendations of the Secretary, if any, for additional action by the Federal Government.

(d) DEFINITIONS- For the purposes of this section, the following definitions apply:

(1) GOVERNOR- The term `Governor' means the chief executive of a State.

(2) STATE- The term `State' means each of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the United States Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and any other Commonwealth, territory, or possession of the United States.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated for carrying out this section, $10,000,000 for each of the 5 fiscal years beginning after the date of enactment of this Act.

SEC. 410. ALTERNATIVE FUEL BUS PROGRAM.

(a) COOPERATIVE AGREEMENTS AND JOINT VENTURES- (1) The Secretary of Transportation, in consultation with the Secretary, may enter into cooperative agreements and joint ventures proposed by any municipal, county, or regional transit authority in an urban area with a population over 100,000 (according to latest available census information) to demonstrate the feasibility of commercial application, including safety of specific vehicle design, of using alternative fuels for urban buses and other motor vehicles used for mass transit.

(2) The cooperative agreements and joint ventures under paragraph (1) may include interested or affected private firms willing to provide assistance in cash, or in kind, for any such demonstration.

(3) Federal assistance provided under cooperative agreements and joint ventures entered into under paragraph (1) to demonstrate the feasibility of commercial application of using alternative fuels for urban buses shall be in addition to Federal assistance provided under any other law for such purpose.

(b) LIMITATIONS- (1) The Secretary of Transportation may not enter into cooperative agreement or joint venture under subsection (a) with any municipal, county, or regional transit authority, unless such government body agrees to provide 20 percent of the costs of such demonstration.

(2) The Secretary of Transportation may grant such priority under this section to any entity that demonstrates that the use of alternative fuels for transportation would have a significant beneficial effect on the environment.

(c) SCHOOL BUSES- The Secretary of Transportation may also provide, in accordance with such rules as he may prescribe, financial assistance to any agency, municipality, or political subdivision in an urban area referred to in subsection (a), of any State or the District of Columbia for the purpose of meeting the incremental costs of school buses that are dedicated vehicles and used regularly for such transportation during the school term. Such costs may include the purchase and installation of alternative fuel refueling facilities to be used for school bus refueling, and the conversion of school buses to dedicated vehicles. The Secretary of Transportation may provide such assistance directly to a person who is a contractor of such agency, municipality, or political subdivision, upon the request of the agency, municipality, or political subdivision, and who, under such contract, provides for such transportation. Any conversion under this subsection shall comply with the warranty and safety requirements for alternative fuel conversions contained in section 247 of the Clean Air Act Amendments of 1990.

(d) FUNDING AUTHORIZATION- There are authorized to be appropriated not more than $30,000,000 for each of the fiscal years 1993, 1994, and 1995 for purposes of this section.

SEC. 411. CERTIFICATION OF TRAINING PROGRAMS.

The Secretary shall ensure that the Federal Government establishes and carries out a program for the certification of training programs for technicians who are responsible for motor vehicle installation of equipment that converts gasoline or diesel-fueled motor vehicles into dedicated vehicles or dual fueled vehicles, and for the maintenance of such converted motor vehicles. A training program shall not be certified under the program established under this section unless it provides technicians with instruction on the proper and safe installation procedures and techniques, adherence to specifications (including original equipment manufacturer specifications), motor vehicle operating procedures, emissions testing, and other appropriate mechanical concerns applicable to these motor vehicle conversions. The Secretary shall ensure that, in the development of the program required under this section, original equipment

manufacturers, fuel suppliers, companies that convert conventional vehicles to use alternative fuels, and other affected persons are consulted.

SEC. 412. ALTERNATIVE FUEL USE IN NONROAD VEHICLES AND ENGINES.

(a) NONROAD VEHICLES AND ENGINES- (1) The Secretary shall conduct a study to determine whether the use of alternative fuels in nonroad vehicles and engines would contribute substantially to reduced reliance on imported energy sources. Such study shall be completed, and the results thereof reported to Congress, within 2 years after the date of enactment of this Act.

(2) The study shall assess the potential of nonroad vehicles and engines to run on alternative fuels. Taking into account the nonroad vehicles and engines for which running on alternative fuels is feasible, the study shall assess the potential reduction in reliance on foreign energy sources that could be achieved if such vehicles were to run on alternative fuels.

(3) The report required under paragraph (1) may include the Secretary's recommendations for encouraging or requiring nonroad vehicles and engines which can feasibly be run on alternative fuels, to utilize such alternative fuels.

(b) DEFINITION OF NONROAD VEHICLES AND ENGINES- Nonroad vehicles and engines, for purposes of this section, shall include nonroad vehicles and engines used for surface transportation or principally for industrial or commercial purposes, vehicles used for rail transportation, vehicles used at airports, vehicles or engines used for marine purposes, and other vehicles or engines at the discretion of the Secretary.

(c) DESIGNATION- Upon completion of the study required pursuant to subsection (a) of this section, the Secretary may designate such vehicles and engines as qualifying for loans pursuant to section 414 of this title.

SEC. 413. REPORTS TO CONGRESS.

Within 6 months after the date of enactment of this Act, the Secretary shall--

(1) identify and report to Congress on purchasing policies of the Federal Government which inhibit or prevent the purchase by the Federal Government of alternative fueled vehicles; and

(2) report to Congress on Federal, State, and local traffic control measures and policies and how the use of alternative fueled vehicles could be promoted by granting such vehicles exemptions or preferential treatment under such measures.

SEC. 414. LOW INTEREST LOAN PROGRAM.

(a) ESTABLISHMENT- Within 1 year after the date of enactment of this Act, the Secretary shall establish a program for making low interest loans, giving preference to small businesses that own or operate fleets, for--

(1) the conversion of motor vehicles to operation on alternative fuels;

(2) covering the incremental costs of the purchase of motor vehicles which operate on alternative fuels, when compared with purchase costs of comparable conventionally fueled motor vehicles; or

(3) covering the incremental costs of purchase of non-road vehicles and engines designated by the Secretary pursuant to section 412(c) of this title.

(b) LOAN TERMS- The Secretary, to the extent practicable, shall establish reasonable terms for loans made under this subsection, with preference given to repayment schedules that enable such loans to be repaid by the borrower from the cost differential between gasoline and the alternative fuel on which the motor vehicle operates.

(c) CRITERIA- In deciding to whom loans shall be made under this subsection, the Secretary shall consider--

(1) the financial need of the applicant;

(2) the goal of assisting the greatest number of applicants; and

(3) the ability of an applicant to repay the loan, taking into account the fuel cost savings likely to accrue to the applicant.

(d) PRIORITIES- Priority shall be given under this section to fleets where the use of alternative fuels would have a significant beneficial effect on energy security and the environment.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section, $25,000,000 for each of the fiscal years 1993, 1994, and 1995.

TITLE V--AVAILABILITY AND USE OF REPLACEMENT FUELS, ALTERNATIVE FUELS, AND ALTERNATIVE FUELED PRIVATE VEHICLES

SEC. 501. MANDATE FOR ALTERNATIVE FUEL PROVIDERS.

(a) IN GENERAL- (1) The Secretary shall, before January 1, 1994, issue regulations requiring that of the new light duty motor vehicles acquired by a covered person described in paragraph (2), the following percentages shall be alternative fueled vehicles for the following model years:

(A) 30 percent for model year 1996.

(B) 50 percent for model year 1997.

(C) 70 percent for model year 1998.

(D) 90 percent for model year 1999 and thereafter.

(2) For purposes of this section, a person referred to in paragraph (1) is--

(A) a covered person whose principal business is producing, storing, refining, processing, transporting, distributing, importing, or selling at wholesale or retail any alternative fuel other than electricity;

(B) a non-Federal covered person whose principal business is generating, transmitting, importing, or selling at wholesale or retail electricity; or

(C) a covered person--

(i) who produces, imports, or produces and imports in combination, an average of 50,000 barrels per day or more of petroleum; and

(ii) a substantial portion of whose business is producing alternative fuels.

(3)(A) In the case of a covered person described in paragraph (2) with more than one affiliate, division, or other business unit, only an affiliate, division, or business unit which is substantially engaged in the alternative fuels business (as determined by the Secretary by rule) shall be subject to this subsection.

(B) No covered person or affiliate, division, or other business unit of such person whose principal business is--

(i) transforming alternative fuels into a product that is not an alternative fuel; or

(ii) consuming alternative fuels as a feedstock or fuel in the manufacture of a product that is not an alternative fuel,

shall be subject to this subsection.

(4) The vehicles purchased pursuant to this section shall be operated solely on alternative fuels except when operating in an area where the appropriate alternative fuel is unavailable.

(5) Regulations issued under paragraph (1) shall provide for the prompt exemption by the Secretary, through a simple and reasonable process, from the requirements of paragraph (1) of any covered person, in whole or in part, if such person demonstrates to the satisfaction of the Secretary that--

(A) alternative fueled vehicles that meet the normal requirements and practices of the principal business of that person are not reasonably available for acquisition; or

(B) alternative fuels that meet the normal requirements and practices of the principal business of that person are not available in the area in which the vehicles are to be operated.

(b) REVISIONS AND EXTENSIONS- With respect to model years 1997 and thereafter, the Secretary may--

(1) revise the percentage requirements under subsection (a)(1) downward, except that under no circumstances shall the percentage requirement for a model year be less than 20 percent; and

(2) extend the time under subsection (a)(1) for up to 2 model years.

(c) OPTION FOR ELECTRIC UTILITIES- The Secretary shall, within 1 year after the date of enactment of this Act, issue regulations requiring that, in the case of a covered person whose principal business is generating, transmitting, importing, or selling at wholesale or retail electricity, the requirements of subsection (a)(1) shall not apply until after December 31, 1997, with respect to electric motor vehicles. Any covered person described in this subsection which plans to acquire electric motor vehicles to comply with the requirements of this section shall so notify the Secretary before January 1, 1996.

(d) REPORT TO CONGRESS- The Secretary shall, before January 1, 1998, submit a report to the Congress providing detailed information on actions taken to carry out this section, and the progress made and problems encountered thereunder.

SEC. 502. REPLACEMENT FUEL SUPPLY AND DEMAND PROGRAM.

(a) ESTABLISHMENT OF PROGRAM- The Secretary shall establish a program to promote the development and use in light duty motor vehicles of domestic replacement fuels. Such program shall promote the replacement of petroleum motor fuels with replacement fuels to the maximum extent practicable. Such program shall, to the extent practicable, ensure the availability of those replacement fuels that will have the greatest impact in reducing oil imports, improving the health of our Nation's economy and reducing greenhouse gas emissions.

(b) DEVELOPMENT PLAN AND PRODUCTION GOALS- Under the program established under subsection (a), the Secretary, before October 1, 1993, in consultation with the Administrator, the Secretary of Transportation, the Secretary of Agriculture, the Secretary of Commerce, and the heads of other appropriate agencies, shall review appropriate information and--

(1) estimate the domestic and nondomestic production capacity for replacement fuels and alternative fueled vehicles needed to implement this section;

(2) determine the technical and economic feasibility of achieving the goals of producing sufficient replacement fuels to replace, on an energy equivalent basis--

(A) at least 10 percent by the year 2000; and

(B) at least 30 percent by the year 2010,

of the projected consumption of motor fuel in the United States for each such year, with at least one half of such replacement fuels being domestic fuels;

(3) determine the most suitable means and methods of developing and encouraging the production, distribution, and use of replacement fuels and alternative fueled vehicles in a manner that would meet the program goals described in subsection (a);

(4) identify ways to encourage the development of reliable replacement fuels and alternative fueled vehicle industries in the United States, and the technical, economic, and institutional barriers to such development; and

(5) determine the greenhouse gas emission implications of increasing the use of replacement fuels, including an estimate of the maximum feasible reduction in such emissions from the use of replacement fuels.

The Secretary shall publish in the Federal Register the results of actions taken under this subsection, and provide for an opportunity for public comment.

SEC. 503. REPLACEMENT FUEL DEMAND ESTIMATES AND SUPPLY INFORMATION.

(a) ESTIMATES- Not later than October 1, 1993, and annually thereafter, the Secretary, in consultation with the Administrator, the Secretary of Transportation, and other appropriate State and Federal officials,

shall estimate for the following calendar year--

(1) the number of each type of alternative fueled vehicle likely to be in use in the United States;

(2) the probable geographic distribution of such vehicles;

(3) the amount and distribution of each type of replacement fuel; and

(4) the greenhouse gas emissions likely to result from replacement fuel use.

(b) INFORMATION- Beginning on October 1, 1994, the Secretary shall annually require--

(1) fuel suppliers to report to the Secretary on the amount of each type of replacement fuel that such supplier--

(A) has supplied in the previous calendar year; and

(B) plans to supply for the following calendar year;

(2) suppliers of alternative fueled vehicles to report to the Secretary on the number of each type of alternative fueled vehicle that such supplier--

(A) has made available in the previous calendar year; and

(B) plans to make available for the following calendar year; and

(3) such fuel suppliers to provide the Secretary information necessary to determine the greenhouse gas emissions from the replacement fuels used, taking into account the entire fuel cycle.

(c) PROTECTION OF INFORMATION- Information provided to the Secretary under subsection (b) shall be subject to applicable provisions of law protecting the confidentiality of trade secrets and business and financial information, including section 1905 of title 18, United States Code.

SEC. 504. MODIFICATION OF GOALS; ADDITIONAL RULEMAKING AUTHORITY.

(a) EXAMINATION OF GOALS- Within 3 years after the date of enactment of this Act, and periodically thereafter, the Secretary shall examine the goals established under section 502(b)(2), in the context of the program goals stated under section 502(a), to determine if the goals under section 502(b)(2), including the applicable percentage requirements and dates, should be modified under this section. The Secretary shall publish in the Federal Register the results of each examination under this subsection and provide an opportunity for public comment.

(b) MODIFICATION OF GOALS- If, after analysis of information obtained in connection with carrying out subsection (a) or section 502, or other information, and taking into account the determination of technical and economic feasibility made under section 502(b)(2), the Secretary determines that goals described in section 502(b)(2), including the percentage requirements or dates, are not achievable, the Secretary, in consultation with appropriate Federal agencies, shall, by rule, establish goals that are achievable, for purposes of this title. The modification of goals under this section may include changing the target dates specified in section 502(b)(2).

(c) ADDITIONAL RULEMAKING AUTHORITY- If the Secretary determines that the achievement of goals described in section 502(b)(2) would result in a significant and correctable failure to meet the program goals described in section 502(a), the Secretary shall issue such additional regulations as are necessary to remedy such failure. The Secretary shall have no authority under this Act to mandate the production of alternative fueled vehicles or to specify, as applicable, the models, lines, or types of, or marketing or pricing practices, policies, or strategies for, vehicles subject to this Act. Nothing in this Act shall be construed to give the Secretary authority to mandate marketing or pricing practices, policies, or strategies for alternative fuels or to mandate the production or delivery of such fuels.

SEC. 505. VOLUNTARY SUPPLY COMMITMENTS.

The Secretary shall, by January 1, 1994, and thereafter, undertake to obtain voluntary commitments in geographically diverse regions of the United States--

(1) from fuel suppliers to make available to the public replacement fuels, including providing for the construction or availability of related fuel delivery systems;

(2) from owners of 10 or more motor vehicles to acquire and use alternative fueled vehicles and alternative fuels; and

(3) from suppliers of alternative fueled vehicles to make available to the public alternative fueled vehicles and to ensure the availability of necessary related services,

in sufficient volume to achieve the goals described in section 502(b)(2) or as modified under section 504, and in order to meet any fleet requirement program established by rule under this title. The Secretary shall periodically report to the Congress on the results of efforts under this section. All voluntary commitments obtained pursuant to this section shall be available to the public, except to the extent provided in applicable provisions of law protecting the confidentiality of trade secrets and business and financial information, including section 1905 of title 18, United States Code.

SEC. 506. TECHNICAL AND POLICY ANALYSIS.

(a) REQUIREMENT- Not later than March 1, 1995, and March 1, 1997, the Secretary shall prepare and transmit to the President and the Congress a technical and policy analysis under this section. The Secretary shall utilize the analytical capability and authorities of the Energy Information Administration and such other offices of the Department of Energy as the Secretary considers appropriate.

(b) PURPOSES- The technical and policy analysis prepared under this section shall be based on the best available data and information obtainable by the Secretary under section 503, or otherwise, and on experience under this title and other provisions of law in the development and use of replacement fuels and alternative fueled vehicles, and shall evaluate--

(1) progress made in achieving the goals described in section 502(b)(2), as modified under section 504;

(2) the actual and potential role of replacement fuels and alternative fueled vehicles in significantly reducing United States reliance on imported oil to the extent of the goals referred to in paragraph (1); and

(3) the actual and potential availability of various domestic replacement fuels and dedicated

vehicles and dual fueled vehicles.

(c) PUBLICATION- The Secretary shall publish a proposed version of each analysis under this section in the Federal Register for public comment before transmittal to the President and the Congress. Public comment received in response to such publication shall be preserved for use in rulemaking proceedings under section 507.

SEC. 507. FLEET REQUIREMENT PROGRAM.

(a) FLEET PROGRAM PURCHASE GOALS- (1) Except as provided in paragraph (2), the following percentages of new light duty motor vehicles acquired in each model year for a fleet, other than a Federal fleet, State fleet, or fleet owned, operated, leased, or otherwise controlled by a covered person subject to section 501, shall be alternative fueled vehicles:

(A) 20 percent of the motor vehicles acquired in model years 1999, 2000, and 2001;

(B) 30 percent of the motor vehicles acquired in model year 2002;

(C) 40 percent of the motor vehicles acquired in model year 2003;

(D) 50 percent of the motor vehicles acquired in model year 2004;

(E) 60 percent of the motor vehicles acquired in model year 2005; and

(F) 70 percent of the motor vehicles acquired in model year 2006 and thereafter.

(2) The Secretary may not establish percentage requirements higher than those described in paragraph (1). The Secretary may, if appropriate, and pursuant to a rule under subsection (b), establish a lesser percentage requirement for any model year. The Secretary may, by rule, establish a date later than 1998 (or model year 1999) for initiating the fleet requirements under paragraph (1).

(3) The Secretary shall publish an advance notice of proposed rulemaking for the purpose of--

(A) evaluating the progress toward achieving the goals of replacement fuel use described in section 502(b)(2), as modified under section 504;

(B) identifying the problems associated with achieving those goals;

(C) assessing the adequacy and practicability of those goals; and

(D) considering all actions needed to achieve those goals.

The Secretary shall provide for at least 3 regional hearings on the advance notice of proposed rulemaking, with respect to which official transcripts shall be maintained. The comment period in connection with such advance notice of proposed rulemaking shall be completed within 7 months after publication of the advance notice.

(4) After the completion of such advance notice of proposed rulemaking, the Secretary shall publish in the Federal Register a proposed rule for the rule required under subsection (b), and shall provide for a public comment period, with hearings, of not less than 90 days.

(b) EARLY RULEMAKING- (1) Not earlier than 1 year after the date of the enactment of this Act, and after carrying out the requirements of subsection (a), the Secretary shall initiate a rulemaking to determine whether a fleet requirement program to begin in calendar year 1998 (when model year 1999 begins), or such other later date as he may select pursuant to subsection (a), is necessary under this section. Such rule, consistent with subsection (a)(1), shall establish the annual applicable model year percentage. No rule under this subsection may be promulgated after December 15, 1996, and be enforceable. A fleet requirement program shall be considered necessary and a rule therefor shall be promulgated if the Secretary finds that--

(A) the goal of replacement fuel use described in section 502(b)(2)(B), as modified under section 504, is not expected to be actually achieved by 2010, or such other date as is established under section 504, by voluntary means or pursuant to this title or any other law without such a fleet requirement program, taking into consideration the status of the achievement of the interim goal described in section 502(b)(2)(A), as modified under section 504;

(B) such goal is practicable and actually achievable within periods specified in section 502(b)(2), as modified under section 504, through implementation of such a fleet requirement program in combination with voluntary means and the application of other programs relevant to achieving such goals; and

(C) by 1998 (when model year 1999 begins) or the date specified by the Secretary in such rule for initiating a fleet requirement program--

(i) there exists sufficient evidence to ensure that the fuel and the needed infrastructure, including the supply and deliverability systems, will be installed and located at convenient places in the fleet areas subject to the rule and will be fully operational when the rule is effective to offer a reliable and timely supply of the applicable alternative fuel at reasonable costs (as compared to conventional fuels) to meet the fleet requirement program, as demonstrated through use of the provisions of section 505(1) of this title regarding voluntary commitments or other adequate, reliable, and convincing forms of agreements, arrangements, or representations that such fuels and infrastructure are in existence or will exist when the rule is effective and will be expanded as the percentages increase annually;

(ii) there will be a sufficient number of new alternative fueled vehicles from original equipment manufacturers that comply with all applicable requirements of the Clean Air Act and the National Traffic and Motor Vehicle Safety Act of 1966;

(iii) such new vehicles will meet the applicable non-Federal and non-State fleet performance requirements of such fleets (including range, passenger or cargo-carrying capacity, reliability, refueling capability, vehicle mix, and economical operation and maintenance); and

(iv) establishment of a fleet requirement program by rule under this subsection will not result in unfair competitive advantages or disadvantages, or result in undue economic hardship, to the affected fleets.

(2) The Secretary shall not promulgate a rule under this subsection if he is unable to make affirmative findings in the case of each of the subparagraphs under paragraph (1), and each of the clauses under subparagraph (C) of paragraph (1).

(3) If the Secretary does not determine that such program is necessary under this subsection, the provisions of subsection (e) shall apply to the consideration in the future of any fleet requirement program. The record of this rulemaking, including the Secretary's findings, shall be incorporated into a rulemaking under that subsection. If the Secretary determines under this subsection that such program is necessary, the Secretary shall not initiate the later rulemaking under subsection (e).

(c) ADVANCE NOTICE OF PROPOSED RULEMAKING- Not later than April 1, 1998, the Secretary shall publish an advance notice of proposed rulemaking for the purpose of--

(1) evaluating the progress toward achieving the goals of replacement fuel use described in section 502(b)(2), as modified under section 504;

(2) identifying the problems associated with achieving those goals;

(3) assessing the adequacy and practicability of those goals; and

(4) considering all actions needed to achieve those goals.

The Secretary shall provide for at least 3 regional hearings on the advance notice of proposed rulemaking, with respect to which official transcripts shall be maintained. The comment period in connection with such advance notice of proposed rulemaking shall be completed within 7 months after publication of the advance notice.

(d) PROPOSED RULE- Before May 1, 1999, the Secretary shall publish in the Federal Register a proposed rule for the rule required under subsection (g), and shall provide for a public comment period, with hearings, of not less than 90 days.

(e) DETERMINATION- (1) Not later than January 1, 2000, the Secretary shall, through the rule required under subsection (g), determine whether a fleet requirement program is necessary under this section. Such a program shall be considered necessary and a rule therefor shall be promulgated if the Secretary finds that--

(A) the goal of replacement fuel use described in section 502(b)(2)(B), as modified under section 504, is not expected to be actually achieved by 2010, or such other date as is established under section 504, by voluntary means or pursuant to this title or any other law without such a fleet requirement program, taking into consideration the status of the achievement of the interim goal described in section 502(b)(2)(A), as modified under section 504; and

(B) such goal is practicable and actually achievable within periods specified in section 502(b)(2), as modified under section 504, through implementation of such a fleet requirement program in combination with voluntary means and the application of other programs relevant to achieving such goals.

(2) The rule under subsection (b) or (g) shall also modify the goal described in section 502(b)(2)(B) and establish a revised goal pursuant to section 504 if the Secretary determines, based on the proceeding required under subsection (a) or (c), that the goal in effect at the time of that proceeding is inadequate or impracticable, and not expected to be achievable. Such goal as modified and established shall be applicable in making the findings described in paragraph (1). If the Secretary modifies the goal under this paragraph, he may also modify the percentages stated in subsection (a)(1) or (g)(1) and the minimum percentage stated in subsection (a)(2) or (g)(2) shall be not less than 10 percent.

(f) EXPLANATION OF DETERMINATION THAT FLEET REQUIREMENT PROGRAM IS NOT NECESSARY- If the Secretary determines, based on findings under subsection (b) or (e), that a fleet requirement program under this section is not necessary, the Secretary shall--

(1) by December 15, 1996, with respect to a rulemaking under subsection (b); and

(2) by January 1, 2000, with respect to a rulemaking under subsection (e),

publish such determination in the Federal Register as a final agency action, including an explanation of the findings on which such determination is made and the basis for the determination.

(g) FLEET REQUIREMENT PROGRAM- (1) If the Secretary determines under subsection (e) that a fleet requirement program is necessary, the Secretary shall, by January 1, 2000, by rule require that, except as provided in paragraph (2), of the total number of new light duty motor vehicles acquired for a fleet, other than a Federal fleet, State fleet, or fleet owned, operated, leased, or otherwise controlled by a covered person under section 501--

(A) 20 percent of the motor vehicles acquired in model year 2002;

(B) 40 percent of the motor vehicles acquired in model year 2003;

(C) 60 percent of the motor vehicles acquired in model year 2004; and

(D) 70 percent of the motor vehicles acquired in model year 2005 and thereafter,

shall be alternative fueled vehicles.

(2) The Secretary may not establish percentage requirements higher than those described in paragraph (1). The Secretary may, if appropriate, and pursuant to a rule under subsection (g), establish a lesser percentage requirement for any model year. The Secretary may, by rule, establish a date later than 2002 (when model year 2003 begins) for initiating the fleet requirements under paragraph (1).

(3) Nothing in this title shall be construed as requiring any fleet to acquire alternative fueled vehicles or alternative fuels that do not meet the normal business requirements and practices and needs of that fleet.

(4) A vehicle operating only on gasoline that complies with applicable requirements of the Clean Air Act shall not be considered an alternative fueled vehicle under subsection (b) or this subsection, except that the Secretary, as part of the rule under subsection (b) or this subsection, may determine that such vehicle should be treated as an alternative fueled vehicle for purposes of this section, for fleets subject to part C of title II of the Clean Air Act, taking into consideration the impact on energy security and the goals stated in section 502(a).

(h) EXTENSION OF DEADLINES- The Secretary may, by notice published in the Federal Register, extend the deadlines established under subsections (e), (f)(2), and (g) for an additional 90 days if the Secretary is unable to meet such deadlines. Such extension shall not be reviewable.

(i) EXEMPTIONS- (1) A rule issued under subsection (b), (g), or (o) shall provide for the prompt exemption by the Secretary, through a simple and reasonable process, of any fleet from the requirements of subsection (b), (g), or (o), in whole or in part, if it is demonstrated to the satisfaction of the Secretary that--

(A) alternative fueled vehicles that meet the normal requirements and practices of the principal business of the fleet owner are not reasonably available for acquisition;

(B) alternative fuels that meet the normal requirements and practices of the principal business of the fleet owner are not available in the area in which the vehicles are to be operated; or

(C) in the case of State and local government entities, the application of such requirements would pose an unreasonable financial hardship.

(2) In the case of private fleets, if the motor vehicles, when under normal operations, are garaged at personal residences at night, such motor vehicles shall be exempt from the requirements of subsections (b) and (g).

(j) CONVERSIONS- Nothing in this title or the amendments made by this title shall require a fleet owner to acquire conversion vehicles.

(k) INCLUSION OF LAW ENFORCEMENT VEHICLES AND URBAN BUSES- (1) If the Secretary determines, by rule, that the inclusion of fleets of law enforcement motor vehicles in the fleet requirement program established under subsection (g) would contribute to achieving the goal described in section 502(b)(2)(B), as modified under section 504, and the Secretary finds that such inclusion would not hinder the use of the motor vehicles for law enforcement purposes, the Secretary may include such fleets in such program. The Secretary may only initiate one rulemaking under this paragraph.

(2) If the Secretary determines, by rule, that the inclusion of new urban buses, as defined by the Administrator under title II of the Clean Air Act, in a fleet requirement program established under subsection (g) would contribute to achieving the goal described in section 502(b)(2)(B), as modified under section 504, the Secretary may include such urban buses in such program, if the Secretary finds that such application will be consistent with energy security goals and the needs and objectives of encouraging and facilitating the greater use of such urban buses by the public, taking into consideration the impact of such application on public transit entities. The Secretary may only initiate one rulemaking under this paragraph.

(3) Rulemakings under paragraph (1) or (2) shall be separate from a rulemaking under subsection (g), but may not occur unless a rulemaking is carried out under subsection (g).

(l) CONSIDERATION OF FACTORS- In carrying out this section, the Secretary shall take into consideration energy security, costs, safety, lead time requirements, vehicle miles traveled annually, effect on greenhouse gases, technological feasibility, energy requirements, economic impacts, including impacts on workers and the impact on consumers (including users of the alternative fuel for purposes such as for residences, agriculture, process use, and non-fuel purposes) and fleets, the availability of alternative fuels and alternative fueled vehicles, and other relevant factors.

(m) CONSULTATION AND PARTICIPATION OF OTHER FEDERAL AGENCIES- In carrying out this section and section 506, the Secretary shall consult with the Secretary of Transportation, the Administrator, and other appropriate Federal agencies. The Secretary shall provide for the participation of the Secretary of Transportation and the Administrator in the development and issuance of the rule under this section, including the public process concerning such rule.

(n) PETITIONS- As part of the rule promulgated either pursuant to subsection (b) or (g) of this section, the Secretary shall establish procedures for any fleet owner or operator or motor vehicle manufacturer to

request that the Secretary modify or suspend a fleet requirement program established under either subsection nationally, by region, or in an applicable fleet area because, as demonstrated by the petitioner, the infrastructure or fuel supply or distribution system for an applicable alternative fuel is inadequate to meet the needs of a fleet. In the event that the Secretary determines that a modification or suspension of the fleet requirement program on a regional basis would detract from the nationwide character of any fleet requirement program established by rule or would sufficiently diminish the economies of scale for the production of alternative fueled vehicles or alternative fuels and thereafter the practicability and effectiveness of such program, the Secretary may only modify or suspend the program nationally. The procedures shall include provisions for notice and public hearings. The Secretary shall deny or grant the petition within 180 days after filing.

(o) MANDATORY STATE FLEET PROGRAMS- (1) Pursuant to a rule promulgated by the Secretary, beginning in calendar year 1995 (when model year 1996 begins), the following percentages of new light duty motor vehicles acquired annually for State government fleets, including agencies thereof, but not municipal fleets, shall be alternative fueled vehicles:

(A) 10 percent of the motor vehicles acquired in model year 1996;

(B) 15 percent of the motor vehicles acquired in model year 1997;

(C) 25 percent of the motor vehicles acquired in model year 1998;

(D) 50 percent of the motor vehicles acquired in model year 1999;

(E) 75 percent of the motor vehicles acquired in model year 2000 and thereafter.

(2)(A) The Secretary shall within 18 months after the date of the enactment of this Act promulgate a rule providing that a State may submit a plan within 12 months after such promulgation containing a light duty alternative fueled vehicle plan for State fleets to meet the annual percentages established under paragraph (1) for the acquisition of light duty motor vehicles. The plan shall provide for the voluntary conversion or acquisition or combination thereof, beyond any acquisition required by this title, of such motor vehicles by State, local, or private fleets, in numbers greater than or equal to the number of State alternative fueled vehicles required pursuant to paragraph (1).

(B) The plan, if approved by the Secretary, would be in lieu of the State meeting such annual percentages solely through purchases of new State-owned vehicles. All conversions or acquisitions or combinations thereof of any alternative fueled vehicles under the plan must be voluntary and must conform with the requirements of section 247 of the Clean Air Act and must comply with applicable safety requirements. The Secretary of Transportation shall within 3 years after enactment promulgate rules setting forth safety standards in accordance with the National Traffic and Motor Vehicle Safety Act of 1966 applicable to all conversions.

SEC. 508. CREDITS.

(a) IN GENERAL- The Secretary shall allocate a credit to a fleet or covered person that is required to acquire an alternative fueled vehicle under this title, if that fleet or person acquires an alternative fueled vehicle in excess of the number that fleet or person is required to acquire under this title or acquires an alternative fueled vehicle before the date that fleet or person is required to acquire an alternative fueled vehicle under such title.

(b) ALLOCATION- In allocating credits under subsection (a), the Secretary shall allocate one credit for each alternative fueled vehicle the fleet or covered person acquires that exceeds the number of alternative fueled vehicles that fleet or person is required to acquire under this title or that is acquired before the date that fleet or person is required to acquire an alternative fueled vehicle under such title. In the event that a vehicle is acquired before the date otherwise required, the Secretary shall allocate one credit per vehicle for each year the vehicle is acquired before the required date. The credit shall be allocated for the same type vehicle as the excess vehicle or earlier acquired vehicle.

(c) USE OF CREDITS- At the request of a fleet or covered person allocated a credit under this section, the Secretary shall treat the credit as the acquisition of one alternative fueled vehicle of the type for which the credit is allocated in the year designated by that fleet or person when determining whether that fleet or person has complied with this title in the year designated. A credit may be counted toward compliance for only one year.

(d) TRANSFERABILITY- A fleet or covered person allocated a credit under this section or to whom a credit is transferred under this section, may transfer freely the credit to another fleet or person who is required to comply with this title. At the request of the fleet or person to whom a credit is transferred, the Secretary shall treat the transferred credit as the acquisition of one alternative fueled vehicle of the type for which the credit is allocated in the year designated by the fleet or person to whom the credit is transferred when determining whether that fleet or person has complied with this title in the year designated. A transferred credit may be counted toward compliance for only one year. In the case of the alternative fuel provider program under section 501, a transferred credit may be counted toward compliance only if the requirement of section 501(a)(4) is met.

SEC. 509. SECRETARY'S RECOMMENDATIONS TO CONGRESS.

(a) RECOMMENDATIONS TO REQUIRE AVAILABILITY OR ACQUISITION- If the Secretary determines, under section 507(f), that a fleet requirement program under section 507 is not necessary, the Secretary shall so notify the Congress. If the Secretary so notifies the Congress, the Secretary shall, within 2 years after such notification and by rule, prepare and submit to the Congress recommendations for requirements or incentives for--

(1) fuel suppliers to make available to the public replacement fuels, including providing for the construction or availability of related fuel delivery systems;

(2) suppliers of alternative fueled vehicles to make available to the public alternative fueled vehicles and to ensure the availability of necessary related services; and

(3) motor vehicle drivers to use replacement fuels,

to the extent necessary to achieve such goals of replacement fuel use and to ensure that the availability of alternative fuels and of alternative fueled vehicles are consistent with each other.

(b) FAIR AND EQUITABLE APPLICATION- In carrying out this section, the Secretary shall recommend the imposition of requirements proportionately on all appropriate fuel suppliers and purchasers of motor fuels and suppliers and purchasers of motor vehicles in a fair and equitable manner.

SEC. 510. EFFECT ON OTHER LAWS.

(a) IN GENERAL- Nothing in this Act or the amendments made by this Act shall be construed to alter,

affect, or modify the provisions of the Clean Air Act, or regulations issued thereunder.

(b) COMPLIANCE BY ALTERNATIVE FUELED VEHICLES- Alternative fueled vehicles, whether dedicated vehicles or dual fueled vehicles, and the alternative fuels for operating such vehicles, shall comply with requirements of the Clean Air Act applicable to such vehicles and fuels.

SEC. 511. PROHIBITED ACTS.

It shall be unlawful for any person to violate any provision of section 501, 503(b), or 507, or any regulation issued under such sections.

SEC. 512. ENFORCEMENT.

(a) Whoever violates section 511 shall be subject to a civil penalty of not more than $5,000 for each violation.

(b) Whoever willfully violates section 511 shall be fined not more than $10,000 for each violation.

(c) Any person who knowingly and willfully violates section 511 after having been subjected to a civil penalty for a prior violation of section 511 shall be fined not more than $50,000.

SEC. 513. POWERS OF THE SECRETARY.

For the purpose of carrying out title III, title IV, this title, and title VI, the Secretary, or the duly designated agent of the Secretary, may hold such hearings, take such testimony, sit and act at such times and places, administer such oaths, and require, by subpena, the attendance and testimony of such witnesses and the production of such books, papers, correspondence, memorandums, contracts, agreements, or other records as the Secretary of Transportation is authorized to do under section 505(b)(1) of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2005(b)(1)).

SEC. 514. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary for carrying out this title $10,000,000 for each of the fiscal years 1993 through 1997, and such sums as may be necessary for fiscal years 1998 through 2000.

TITLE VI--ELECTRIC MOTOR VEHICLES

SEC. 601. DEFINITIONS.

For the purposes of this title--

(1) the term `antitrust laws' means the Acts set forth in section 1 of the Clayton Act (15 U.S.C. 12);

(2) the term `associated equipment' means equipment necessary for the regeneration, refueling, or recharging of batteries or other forms of electric energy used to power an electric motor vehicle and, in the case of electric-hybrid vehicles, such term includes nonpetroleum-related equipment necessary for, and solely related to, the demonstration of such vehicles;

(3) the term `discount payment' means the amount determined pursuant to section 613 of this title;

(4) the term `electric motor vehicle' means a motor vehicle primarily powered by an electric motor that draws current from rechargeable storage batteries, fuel cells, photovoltaic arrays, or other sources of electric current and may include an electric-hybrid vehicle;

(5) the term `electric-hybrid vehicle' means a vehicle primarily powered by an electric motor that draws current from rechargeable storage batteries, fuel cells, or other source of electric current and also relies on a non-electric source of power;

(6) the term `eligible metropolitan area' means any Metropolitan Area (as such term is defined by the Office of Management and Budget pursuant to section 3504 of title 44, United States Code) with a 1980 population of 250,000 or more that has been designated by a proposer and the Secretary for a demonstration project under this title, except that the Secretary may designate an area with a 1990 population of 50,000 or more as an eligible metropolitan area;

(7) the term `infrastructure and support systems' includes support and maintenance services and facilities, electricity delivery mechanisms and methods, regulatory treatment of investment in electric motor vehicles and associated equipment, consumer education programs, safety and health procedures, and battery availability, replacement, recycling, and disposal, that may be required to enable electric utilities, manufacturers, and others to support the operation and maintenance of electric motor vehicles and associated equipment;

(8) the term `motor vehicle' has the meaning given such term under section 216(2) of the Clean Air Act (42 U.S.C. 7550(2));

(9) the term `non-Federal person' means an entity not part of the Federal Government that is either--

(A) organized under the laws of the United States or the laws of a State of the United States; or

(B) a unit of State or local government;

(10) the term `proposer' means a non-Federal person that submits a proposal to conduct a demonstration project under this title;

(11) the term `price differential' means--

(A) in the case of a purchased electric motor vehicle, the difference between the manufacturer's suggested retail price of such electric motor vehicle and the manufacturer's suggested retail price of a comparable conventionally fueled motor vehicle; and

(B) in the case of a leased electric motor vehicle, the difference between the monthly lease payment of such electric motor vehicle over the life of the lease and the monthly lease payment of a comparable conventionally fueled motor vehicle over the life of the lease; and

(12) the term `user' means a person or entity that purchases or leases an electric motor vehicle.

Subtitle A--Electric Motor Vehicle Commercial Demonstration Program

SEC. 611. PROGRAM AND SOLICITATION.

(a) PROGRAM- The Secretary shall conduct a program to demonstrate electric motor vehicles and the associated equipment of such vehicles, in consultation with the Electric and Hybrid Vehicle Program Site Operators, manufacturers, the electric utility industry, and such other persons as the Secretary considers appropriate. Such program shall be--

(1) designed to accelerate the development and use of electric motor vehicles; and

(2) structured to evaluate the performance of such electric motor vehicles in field operation, including fleet operation, and evaluate the necessary supporting infrastructure.

(b) SOLICITATION- (1) Not later than 18 months after the date of enactment of this Act, the Secretary shall solicit proposals to demonstrate electric motor vehicles and associated equipment in one or more eligible metropolitan areas. The Secretary may make additional solicitations for proposals if the Secretary determines that such solicitations are necessary to carry out this subtitle.

(2)(A) Solicitations for proposals under this subsection shall require the proposer to include a description, including the manufacturer or manufacturers of the electric motor vehicles; the proposed users of the electric motor vehicles; the eligible metropolitan area or areas involved; the number of electric motor vehicles to be demonstrated and their type, characteristics, and life-cycle costs; the price differential; the proposed discount payment; the contributions of State or local governments and other persons to the demonstration project; the type of associated equipment to be demonstrated; the domestic content of the electric motor vehicles and associated equipment; and any other information the Secretary considers appropriate.

(B) If the proposal includes a lease arrangement, the proposal shall indicate the terms of such lease arrangement for the electric motor vehicles or associated equipment.

(3) The solicitation for proposals under this subsection shall establish a closing date for receipt of proposals. The Secretary may, if necessary, extend the closing date for receipt of proposals for a period not to exceed 90 days.

SEC. 612. SELECTION OF PROPOSALS.

(a) SELECTION- (1) The Secretary, in consultation with the Secretary of Transportation, the Secretary of Commerce, and the Administrator of the Environmental Protection Agency, shall, not later than 120 days after the closing date, as established by the Secretary, for receipt of proposals under section 611, select at least one, but not more than 10, proposals to receive financial assistance under section 613.

(2) The Secretary may select more than 10 proposals under this section, if the Secretary determines that the total amount of available funds is not likely to be otherwise utilized.

(3) Any proposal selected under paragraph (1) must satisfy the limitations set forth in section 613(c).

(4) No one project selected under this section shall receive more than 25 percent of the funds authorized under section 616.

(5) A demonstration project may not include electric motor vehicles in more than one eligible metropolitan area, unless the total number of electric motor vehicles in that project is equal to, or greater

than, 100.

(b) CRITERIA- In selecting a proposal and in negotiating financial assistance under this section, the Secretary shall consider--

(1) the ability of the manufacturer, directly, indirectly, or in combination with the proposer, to develop, assist in the demonstration of, manufacture, distribute, sell, provide warranties for, service, and ensure the continued availability of parts for, electric motor vehicles in the demonstration project;

(2) the geographic and climatic diversity of the eligible metropolitan area or areas in which the demonstration project is to be undertaken, when considered in combination with other proposals and other selected demonstration projects;

(3) the long-term technical and competitive viability of the electric motor vehicles;

(4) the suitability of the electric motor vehicles for their intended uses;

(5) the environmental effects of the use of the proposed electric motor vehicles;

(6) the price differential and the proposed discount payment;

(7) the extent of involvement of State or local government and other persons in the demonstration project, and whether such involvement will--

(A) permit a reduction of the Federal cost share per vehicle; or

(B) otherwise be used to allow the Federal contribution to be provided for a greater number of electric motor vehicles;

(8) the proportion of domestic content of the electric motor vehicles and associated equipment;

(9) the safety of the electric motor vehicles; and

(10) such other criteria as the Secretary considers appropriate.

(c) CONDITIONS- The Secretary shall require that--

(1) as a part of a demonstration project, the user or users of the electric motor vehicles will provide to the proposer and the manufacturer information regarding the operation, maintenance, performance, and use of the electric motor vehicles for 5 years after the beginning of the demonstration project;

(2) the proposer shall provide to the Secretary such information regarding the operation, maintenance, performance, and use of the electric motor vehicles as the Secretary may request during the period of the demonstration project;

(3) in the case of a demonstration project including automobiles or light duty trucks, the number of electric motor vehicles to be included in the demonstration project shall be no less than 50, except that the Secretary may select a demonstration project with fewer than 50 electric motor vehicles if

the Secretary determines that selection of such a proposal will ensure that there is geographic or climatic diversity among the proposals selected and that an adequate demonstration to accelerate the development and use of electric motor vehicles can be undertaken with fewer than 50 electric motor vehicles; and

(4) the procurement practices of the manufacturer do not discriminate against United States producers of vehicle parts.

SEC. 613. DISCOUNT PAYMENTS.

(a) CERTIFICATION- The Secretary shall provide a discount payment to a proposer of a proposal selected under this subtitle for purposes of reimbursing the proposer for a discount provided to the users if the proposer certifies to the Secretary that--

(1) the electric motor vehicles have been purchased or leased by a user or users in accordance with the requirements of this subtitle; and

(2) the proposer has provided to the user or users a discount payment in accordance with the requirements of this subtitle.

(b) PAYMENT- Not later than 30 days after receipt from the proposer of certification that the Secretary determines satisfies the requirements of subsection (a), the Secretary shall pay to the proposer the full amount of the discount payment, to the extent provided in advance in appropriations Acts.

(c) CALCULATIONS OF DISCOUNT PAYMENTS- (1) The discount payment shall be no greater than--

(A) the price differential; or

(B) the price of the comparable conventionally fueled motor vehicle.

(2) The purchase price of the electric motor vehicle, less the discount payment and less any additional reduction in the purchase price of the electric motor vehicle that may result from contributions provided by other parties, may not be less than the manufacturer's suggested retail price of a comparable conventionally fueled motor vehicle.

(3) The maximum discount payment shall be no greater than $10,000 per electric motor vehicle.

SEC. 614. COST-SHARING.

(a) REQUIREMENT- The Secretary shall require at least 50 percent of the costs directly and specifically related to any project under this subtitle to be from non-Federal sources. Such share may be in the form of cash, personnel, services, equipment, and other resources.

(b) REDUCTION- The Secretary may reduce the amount of costs required to be provided by non-Federal sources under subsection (a) if the Secretary determines that the reduction is necessary and appropriate--

(1) considering the technological risks involved in the project; and

(2) in order to meet the objectives of this subtitle.

SEC. 615. REPORTS TO CONGRESS.

(a) PROGRESS REPORTS- The Secretary shall report annually to Congress on the progress being made, through demonstration projects supported under this subtitle, to accelerate the development and use of electric motor vehicles.

(b) REPORT ON ENCOURAGING THE PURCHASE AND USE OF ELECTRIC MOTOR VEHICLES- Within 18 months after the date of enactment of this Act, the Secretary shall submit to the Congress a report on methods for encouraging the purchase and use of electric motor vehicles. Such report shall--

(1) address the potential cost of purchasing and maintaining electric motor vehicles, including the initial cost of the batteries and the cost of replacement batteries;

(2) identify methods for reducing, subsidizing, or sharing such costs; and

(3) include recommendations for legislative and administrative measures to encourage the purchase and use of electric motor vehicles.

SEC. 616. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary for purposes of this subtitle $50,000,000 for the 10-year period beginning with the first full fiscal year after the date of enactment of this Act, to remain available until expended.

Subtitle B--Electric Motor Vehicle Infrastructure and Support Systems Development Program

SEC. 621. GENERAL AUTHORITY.

(a) PROGRAM- The Secretary shall undertake a program with one or more non-Federal persons, including fleet operators, for cost-shared research, development, demonstration, or commercial application of an infrastructure and support systems program.

(b) ELIGIBILITY- A non-Federal person shall be eligible to receive financial assistance under this subtitle only if such person demonstrates, to the satisfaction of the Secretary, that the person will conduct a substantial portion of activities under the project in the United States using domestic labor and materials.

(c) COORDINATION- Activities under this subtitle shall be coordinated with activities under subtitle A.

SEC. 622. PROPOSALS.

(a) SOLICITATION- Not later than one year after the date of enactment of this Act, the Secretary shall solicit proposals from non-Federal persons, including fleet operators, for projects under this subtitle. Within 240 days after proposals have been solicited, the Secretary shall select proposals.

(b) CRITERIA- (1) The Secretary shall provide financial assistance to no more than 10 projects under

this subtitle, unless the Secretary determines that the total amount of available funds is not likely to be otherwise used.

(2) The proposals selected by the Secretary shall, to the extent practicable, represent geographically and climatically diverse regions of the United States.

(3) The aggregate Federal financial assistance for each project under this subtitle may not exceed $4,000,000.

(c) PROJECTS- The infrastructure and support systems programs for which projects are selected under this subtitle may address--

(1) the ability to service electric motor vehicles and to provide or service associated equipment;

(2) the installation of charging facilities;

(3) rates and cost recovery for electric utilities who invest in infrastructure capital-related expenditures;

(4) the development of safety and health procedures and guidelines related to battery charging, watering, and emissions;

(5) the conduct of information dissemination programs; and

(6) such other subjects as the Secretary considers necessary in order to address the infrastructure and support systems needed to support the development and use of energy storage technologies, including advanced batteries, and the demonstration of electric motor vehicles.

SEC. 623. PROTECTION OF PROPRIETARY INFORMATION.

(a) IN GENERAL- In the case of activities, including joint venture activities, under this title, and in the case of any existing or future activities, including joint venture activities, related primarily to battery technology for electric motor vehicles under other provisions of law, where the knowledge resulting from research and development activities conducted pursuant to such activities, including joint venture activities, is for the benefit of the participants (particularly domestic companies) that provide financial resources to a project under this title, the Secretary, for a period of up to 5 years after the development of information that--

(1) results from research and development activities conducted under this title; and

(2) would be a trade secret or commercial or financial information that is privileged or confidential if the information had been obtained from a participant,

shall, notwithstanding any other provision of law, provide appropriate protections against the dissemination of such information to the public, and the provisions of section 1905 of title 18, United States Code, shall apply to such information. Nothing in this subsection provides protections against the dissemination of such information to Congress.

(b) DEFINITION- For purposes of subsection (a), the term `domestic companies' means entities which are substantially involved in the United States in the domestic production of motor vehicles for sale in

the United States and have a substantial percentage of their production facilities in the United States.

SEC. 624. COMPLIANCE WITH EXISTING LAW.

Nothing in this title shall be deemed to convey to any person, partnership, corporation, or other entity, immunity from civil or criminal liability under any antitrust law or to create defenses to actions under any antitrust law.

SEC. 625. ELECTRIC UTILITY PARTICIPATION STUDY.

The Secretary, in consultation with appropriate Federal agencies, representatives of State regulatory commissions and electric utilities, and such other persons as the Secretary considers appropriate, shall undertake or cause to have undertaken a study to determine the means by which electric utilities may invest in, own, sell, lease, service, or recharge batteries used to power electric motor vehicles.

SEC. 626. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary for purposes of this subtitle $40,000,000 for the 5-year period beginning with the first full fiscal year after the date of enactment of this Act, to remain available until expended.

TITLE VII--ELECTRICITY

Subtitle A--Exempt Wholesale Generators

SEC. 711. PUBLIC UTILITY HOLDING COMPANY ACT REFORM.

The Public Utility Holding Company Act of 1935 (15 U.S.C. 79 and following) is amended by redesignating sections 32 and 33 as sections 34 and 35 respectively and by adding the following new section after section 31:

`SEC. 32. EXEMPT WHOLESALE GENERATORS.

`(a) DEFINITIONS- For purposes of this section--

`(1) EXEMPT WHOLESALE GENERATOR- The term `exempt wholesale generator' means any person determined by the Federal Energy Regulatory Commission to be engaged directly, or indirectly through one or more affiliates as defined in section 2(a)(11)(B), and exclusively in the business of owning or operating, or both owning and operating, all or part of one or more eligible facilities and selling electric energy at wholesale. No person shall be deemed to be an exempt wholesale generator under this section unless such person has applied to the Federal Energy Regulatory Commission for a determination under this paragraph. A person applying in good faith for such a determination shall be deemed an exempt wholesale generator under this section, with all of the exemptions provided by this section, until the Federal Energy Regulatory Commission makes such determination. The Federal Energy Regulatory Commission shall make such determination within 60 days of its receipt of such application and shall notify the Commission whenever a determination is made under this paragraph that any person is an exempt wholesale generator. Not later than 12 months after the date of enactment of this section, the Federal Energy Regulatory Commission shall promulgate rules implementing the provisions of this paragraph.

Applications for determination filed after the effective date of such rules shall be subject thereto.

`(2) ELIGIBLE FACILITY- The term `eligible facility' means a facility, wherever located, which is either--

`(A) used for the generation of electric energy exclusively for sale at wholesale, or

`(B) used for the generation of electric energy and leased to one or more public utility companies; *Provided*, That any such lease shall be treated as a sale of electric energy at wholesale for purposes of sections 205 and 206 of the Federal Power Act.

Such term shall not include any facility for which consent is required under subsection (c) if such consent has not been obtained. Such term includes interconnecting transmission facilities necessary to effect a sale of electric energy at wholesale. For purposes of this paragraph, the term `facility' may include a portion of a facility subject to the limitations of subsection (d) and shall include a facility the construction of which has not been commenced or completed.

`(3) SALE OF ELECTRIC ENERGY AT WHOLESALE- The term `sale of electric energy at wholesale' shall have the same meaning as provided in section 201(d) of the Federal Power Act (16 U.S.C. 824(d)).

`(4) RETAIL RATES AND CHARGES- The term `retail rates and charges' means rates and charges for the sale of electric energy directly to consumers.

`(b) FOREIGN RETAIL SALES- Notwithstanding paragraphs (1) and (2) of subsection (a), retail sales of electric energy produced by a facility located in a foreign country shall not prevent such facility from being an eligible facility, or prevent a person owning or operating, or both owning and operating, such facility from being an exempt wholesale generator if none of the electric energy generated by such facility is sold to consumers in the United States.

`(c) STATE CONSENT FOR EXISTING RATE-BASED FACILITIES- If a rate or charge for, or in connection with, the construction of a facility, or for electric energy produced by a facility (other than any portion of a rate or charge which represents recovery of the cost of a wholesale rate or charge) was in effect under the laws of any State as of the date of enactment of this section, in order for the facility to be considered an eligible facility, every State commission having jurisdiction over any such rate or charge must make a specific determination that allowing such facility to be an eligible facility (1) will benefit consumers, (2) is in the public interest, and (3) does not violate State law; *Provided,* That in the case of such a rate or charge which is a rate or charge of an affiliate of a registered holding company:

`(A) such determination with respect to the facility in question shall be required from every State commission having jurisdiction over the retail rates and charges of the affiliates of such registered holding company; and

`(B) the approval of the Commission under this Act shall not be required for the transfer of the facility to an exempt wholesale generator.

`(d) HYBRIDS- (1) No exempt wholesale generator may own or operate a portion of any facility if any other portion of the facility is owned or operated by an electric utility company that is an affiliate or associate company of such exempt wholesale generator.

`(2) ELIGIBLE FACILITY- Notwithstanding paragraph (1), an exempt wholesale generator may own or operate a portion of a facility identified in paragraph (1) if such portion has become an eligible facility as a result of the operation of subsection (c).

`(e) EXEMPTION OF EWGS- An exempt wholesale generator shall not be considered an electric utility company under section 2(a)(3) of this Act and, whether or not a subsidiary company, an affiliate, or an associate company of a holding company, an exempt wholesale generator shall be exempt from all provisions of this Act.

`(f) OWNERSHIP OF EWGS BY EXEMPT HOLDING COMPANIES- Notwithstanding any provision of this Act, a holding company that is exempt under section 3 of this Act shall be permitted, without condition or limitation under this Act, to acquire and maintain an interest in the business of one or more exempt wholesale generators.

`(g) OWNERSHIP OF EWGS BY REGISTERED HOLDING COMPANIES- Notwithstanding any provision of this Act and the Commission's jurisdiction as provided under subsection (h) of this section, a registered holding company shall be permitted (without the need to apply for, or receive, approval from the Commission, and otherwise without condition under this Act) to acquire and hold the securities, or an interest in the business, of one or more exempt wholesale generators.

`(h) FINANCING AND OTHER RELATIONSHIPS BETWEEN EWGS AND REGISTERED HOLDING COMPANIES- The issuance of securities by a registered holding company for purposes of financing the acquisition of an exempt wholesale generator, the guarantee of securities of an exempt wholesale generator by a registered holding company, the entering into service, sales or construction contracts, and the creation or maintenance of any other relationship in addition to that described in subsection (g) between an exempt wholesale generator and a registered holding company, its affiliates and associate companies, shall remain subject to the jurisdiction of the Commission under this Act: *Provided*, That--

> `(1) section 11 of this Act shall not prohibit the ownership of an interest in the business of one or more exempt wholesale generators by a registered holding company (regardless of where facilities owned or operated by such exempt wholesale generators are located), and such ownership by a registered holding company shall be deemed consistent with the operation of an integrated public utility system;
>
> `(2) the ownership of an interest in the business of one or more exempt wholesale generators by a registered holding company (regardless of where facilities owned or operated by such exempt wholesale generators are located) shall be considered as reasonably incidental, or economically necessary or appropriate, to the operations of an integrated public utility system;
>
> `(3) in determining whether to approve (A) the issue or sale of a security by a registered holding company for purposes of financing the acquisition of an exempt wholesale generator, or (B) the guarantee of a security of an exempt wholesale generator by a registered holding company, the Commission shall not make a finding that such security is not reasonably adapted to the earning power of such company or to the security structure of such company and other companies in the same holding company system, or that the circumstances are such as to constitute the making of such guarantee an improper risk for such company, unless the Commission first finds that the issue or sale of such security, or the making of the guarantee, would have a substantial adverse impact on the financial integrity of the registered holding company system;

`(4) in determining whether to approve (A) the issue or sale of a security by a registered holding company for purposes other than the acquisition of an exempt wholesale generator, or (B) other transactions by such registered holding company or by its subsidiaries other than with respect to exempt wholesale generators, the Commission shall not consider the effect of the capitalization or earnings of any subsidiary which is an exempt wholesale generator upon the registered holding company system, unless the approval of the issue or sale or other transaction, together with the effect of such capitalization and earnings, would have a substantial adverse impact on the financial integrity of the registered holding company system;

`(5) the Commission shall make its decision under paragraph (3) to approve or disapprove the issue or sale of a security or the guarantee of a security within 120 days of the filing of a declaration concerning such issue, sale or guarantee; and

`(6) the Commission shall promulgate regulations with respect to the actions which would be considered, for purposes of this subsection, to have a substantial adverse impact on the financial integrity of the registered holding company system; such regulations shall ensure that the action has no adverse impact on any utility subsidiary or its customers, or on the ability of State commissions to protect such subsidiary or customers, and shall take into account the amount and type of capital invested in exempt wholesale generators, the ratio of such capital to the total capital invested in utility operations, the availability of books and records, and the financial and operating experience of the registered holding company and the exempt wholesale generator; the Commission shall promulgate such regulations within 6 months after the enactment of this section; after such 6-month period the Commission shall not approve any actions under paragraph (3), (4) or (5) except in accordance with such issued regulations.

`(i) APPLICATION OF ACT TO OTHER ELIGIBLE FACILITIES- In the case of any person engaged directly and exclusively in the business of owning or operating (or both owning and operating) all or part of one or more eligible facilities, an advisory letter issued by the Commission staff under this Act after the date of enactment of this section, or an order issued by the Commission under this Act after the date of enactment of this section, shall not be required for the purpose, or have the effect, of exempting such person from treatment as an electric utility company under section 2(a)(3) or exempting such person from any provision of this Act.

`(j) OWNERSHIP OF EXEMPT WHOLESALE GENERATORS AND QUALIFYING FACILITIES- The ownership by a person of one or more exempt wholesale generators shall not result in such person being considered as being primarily engaged in the generation or sale of electric power within the meaning of sections 3(17)(C)(ii) and 3(18)(B)(ii) of the Federal Power Act (16 U.S.C. 796(17)(C)(ii) and 796(18)(B)(ii)).

`(k) PROTECTION AGAINST ABUSIVE AFFILIATE TRANSACTIONS-

`(1) PROHIBITION- After the date of enactment of this section, an electric utility company may not enter into a contract to purchase electric energy at wholesale from an exempt wholesale generator if the exempt wholesale generator is an affiliate or associate company of the electric utility company.

`(2) STATE AUTHORITY TO EXEMPT FROM PROHIBITION- Notwithstanding paragraph (1), an electric utility company may enter into a contract to purchase electric energy at wholesale from an exempt wholesale generator that is an affiliate or associate company of the electric utility company--

`(A) if every State commission having jurisdiction over the retail rates of such electric utility company makes each of the following specific determinations in advance of the electric utility company entering into such contract:

`(i) A determination that such commission has sufficient regulatory authority, resources and access to books and records of the electric utility company and any relevant associate, affiliate or subsidiary company to exercise its duties under this subparagraph.

`(ii) A determination that the transaction--

`(I) will benefit consumers,

`(II) does not violate any State law (including where applicable, least cost planning),

`(III) would not provide the exempt wholesale generator any unfair competitive advantage by virtue of its affiliation or association with the electric utility company, and

`(IV) is in the public interest; or

`(B) if such electric utility company is not subject to State commission retail rate regulation and the purchased electric energy:

`(i) would not be resold to any affiliate or associate company, or

`(ii) the purchased electric energy would be resold to an affiliate or associate company and every State commission having jurisdiction over the retail rates of such affiliate or associate company makes each of the determinations provided under subparagraph (A), including the determination concerning a State commission's duties.

`(l) RECIPROCAL ARRANGEMENTS PROHIBITED- Reciprocal arrangements among companies that are not affiliates or associate companies of each other that are entered into in order to avoid the provisions of this section are prohibited.'.

SEC. 712. STATE CONSIDERATION OF THE EFFECTS OF POWER PURCHASES ON UTILITY COST OF CAPITAL; CONSIDERATION OF THE EFFECTS OF LEVERAGED CAPITAL STRUCTURES ON THE RELIABILITY OF WHOLESALE POWER SELLERS; AND CONSIDERATION OF ADEQUATE FUEL SUPPLIES.

Section 111 of the Public Utility Regulatory Policies Act of 1978 (16 U.S.C. 2601 and following) is amended by inserting the following new paragraph after paragraph (9):

`(10) CONSIDERATION OF THE EFFECTS OF WHOLESALE POWER PURCHASES ON UTILITY COST OF CAPITAL; EFFECTS OF LEVERAGED CAPITAL STRUCTURES ON THE RELIABILITY OF WHOLESALE POWER SELLERS; AND ASSURANCE OF ADEQUATE FUEL SUPPLIES- (A) To the extent that a State regulatory authority requires or allows electric utilities for which it has ratemaking authority to consider the purchase of long-term wholesale power supplies as a means of meeting electric demand, such authority shall perform a

general evaluation of:

`(i) the potential for increases or decreases in the costs of capital for such utilities, and any resulting increases or decreases in the retail rates paid by electric consumers, that may result from purchases of long-term wholesale power supplies in lieu of the construction of new generation facilities by such utilities;

`(ii) whether the use by exempt wholesale generators (as defined in section 32 of the Public Utility Holding Company Act of 1935) of capital structures which employ proportionally greater amounts of debt than the capital structures of such utilities threatens reliability or provides an unfair advantage for exempt wholesale generators over such utilities;

`(iii) whether to implement procedures for the advance approval or disapproval of the purchase of a particular long-term wholesale power supply; and

`(iv) whether to require as a condition for the approval of the purchase of power that there be reasonable assurances of fuel supply adequacy.

`(B) For purposes of implementing the provisions of this paragraph, any reference contained in this section to the date of enactment of the Public Utility Regulatory Policies Act of 1978 shall be deemed to be a reference to the date of enactment of this paragraph.

`(C) Notwithstanding any other provision of Federal law, nothing in this paragraph shall prevent a State regulatory authority from taking such action, including action with respect to the allowable capital structure of exempt wholesale generators, as such State regulatory authority may determine to be in the public interest as a result of performing evaluations under the standards of subparagraph (A).

`(D) Notwithstanding section 124 and paragraphs (1) and (2) of section 112(a), each State regulatory authority shall consider and make a determination concerning the standards of subparagraph (A) in accordance with the requirements of subsections (a) and (b) of this section, without regard to any proceedings commenced prior to the enactment of this paragraph.

`(E) Notwithstanding subsections (b) and (c) of section 112, each State regulatory authority shall consider and make a determination concerning whether it is appropriate to implement the standards set out in subparagraph (A) not later than one year after the date of enactment of this paragraph.'.

SEC. 713. PUBLIC UTILITY HOLDING COMPANIES TO OWN INTERESTS IN COGENERATION FACILITIES.

Public Law 99-186 (99 Stat. 1180, as amended by Public Law 99-553, 100 Stat. 3087), is amended to read as follows:

`SECTION 1. Notwithstanding section 11(b)(1) of the Public Utility Holding Company Act of 1935, a company registered under said Act, or a subsidiary company of such registered company, may acquire or retain, in any geographic area, an interest in any qualifying cogeneration facilities and qualifying small power production facilities as defined pursuant to the Public Utility Regulatory Policies Act of 1978, and shall qualify for any exemption relating to the Public Utility Holding Company Act of 1935 prescribed pursuant to section 210 of the Public Utility Regulatory Policies Act of 1978.

`SEC. 2. Nothing herein shall be construed to affect the applicability of section 3(17)(C) or section 3(18)(B) of the Federal Power Act or any provision of the Public Utility Holding Company Act of 1935, other than section 11(b)(1), to the acquisition or retention of any such interest by any such company.'.

SEC. 714. BOOKS AND RECORDS.

Section 201 of the Federal Power Act is amended by adding the following new subsection at the end thereof:

`(g) BOOKS AND RECORDS- (1) Upon written order of a State commission, a State commission may examine the books, accounts, memoranda, contracts, and records of--

`(A) an electric utility company subject to its regulatory authority under State law,

`(B) any exempt wholesale generator selling energy at wholesale to such electric utility, and

`(C) any electric utility company, or holding company thereof, which is an associate company or affiliate of an exempt wholesale generator which sells electric energy to an electric utility company referred to in subparagraph (A),

wherever located, if such examination is required for the effective discharge of the State commission's regulatory responsibilities affecting the provision of electric service.

`(2) Where a State commission issues an order pursuant to paragraph (1), the State commission shall not publicly disclose trade secrets or sensitive commercial information.

`(3) Any United States district court located in the State in which the State commission referred to in paragraph (1) is located shall have jurisdiction to enforce compliance with this subsection.

`(4) Nothing in this section shall--

`(A) preempt applicable State law concerning the provision of records and other information; or

`(B) in any way limit rights to obtain records and other information under Federal law, contracts, or otherwise.

`(5) As used in this subsection the terms `affiliate', `associate company', `electric utility company', `holding company', `subsidiary company', and `exempt wholesale generator' shall have the same meaning as when used in the Public Utility Holding Company Act of 1935.'.

SEC. 715. INVESTMENT IN FOREIGN UTILITIES.

The Public Utility Holding Company Act of 1935 (15 U.S.C. 79 et seq.) is amended by inserting after section 32 the following new section:

`SEC. 33. TREATMENT OF FOREIGN UTILITIES.

`(a) EXEMPTIONS FOR FOREIGN UTILITY COMPANIES-

`(1) IN GENERAL- A foreign utility company shall be exempt from all of the provisions of this Act, except as otherwise provided under this section, and shall not, for any purpose under this Act, be deemed to be a public utility company under section 2(a)(5), notwithstanding that the foreign utility company may be a subsidiary company, an affiliate, or an associate company of a holding company or of a public utility company.

`(2) STATE COMMISSION CERTIFICATION- Section (a)(1) shall not apply or be effective unless every State commission having jurisdiction over the retail electric or gas rates of a public utility company that is an associate company or an affiliate of a company otherwise exempted under section (a)(1) (other than a public utility company that is an associate company or an affiliate of a registered holding company) has certified to the Commission that it has the authority and resources to protect ratepayers subject to its jurisdiction and that it intends to exercise its authority. Such certification, upon the filing of a notice by such State commission, may be revised or withdrawn by the State commission prospectively as to any future acquisition. The requirement of State certification shall be deemed satisfied if the relevant State commission had, prior to the date of enactment of this section, on the basis of prescribed conditions of general applicability, determined that ratepayers of a public utility company are adequately insulated from the effects of diversification and the diversification would not impair the ability of the State commission to regulate effectively the operations of such company.

`(3) DEFINITION- For purposes of this section, the term `foreign utility company' means any company that--

`(A) owns or operates facilities that are not located in any State and that are used for the generation, transmission, or distribution of electric energy for sale or the distribution at retail of natural or manufactured gas for heat, light, or power, if such company--

`(i) derives no part of its income, directly or indirectly, from the generation, transmission, or distribution of electric energy for sale or the distribution at retail of natural or manufactured gas for heat, light, or power, within the United States; and

`(ii) neither the company nor any of its subsidiary companies is a public utility company operating in the United States; and

`(B) provides notice to the Commission, in such form as the Commission may prescribe, that such company is a foreign utility company.

`(b) OWNERSHIP OF FOREIGN UTILITY COMPANIES BY EXEMPT HOLDING COMPANIES- Notwithstanding any provision of this Act except as provided under this section, a holding company that is exempt under section 3 of the Act shall be permitted without condition or limitation under the Act to acquire and maintain an interest in the business of one or more foreign utility companies.

`(c) REGISTERED HOLDING COMPANIES-

`(1) OWNERSHIP OF FOREIGN UTILITY COMPANIES BY REGISTERED HOLDING COMPANIES- Notwithstanding any provision of this Act except as otherwise provided under this section, a registered holding company shall be permitted as of the date of enactment of this section (without the need to apply for, or receive approval from the Commission) to acquire and hold the securities or an interest in the business, of one or more foreign utility companies. The Commission shall promulgate rules or regulations regarding registered holding companies' acquisition of

interests in foreign utility companies which shall provide for the protection of the customers of a public utility company which is an associate company of a foreign utility company and the maintenance of the financial integrity of the registered holding company system.

`(2) ISSUANCE OF SECURITIES- The issuance of securities by a registered holding company for purposes of financing the acquisition of a foreign utility company, the guarantee of securities of a foreign utility company by a registered holding company, the entering into service, sales, or construction contracts, and the creation or maintenance of any other relationship between a foreign utility company and a registered holding company, its affiliates and associate companies, shall remain subject to the jurisdiction of the Commission under this Act (unless otherwise exempted under this Act, in the case of a transaction with an affiliate or associate company located outside of the United States). Any State commission with jurisdiction over the retail rates of a public utility company which is part of a registered holding company system may make such recommendations to the Commission regarding the registered holding company's relationship to a foreign utility company, and the Commission shall reasonably and fully consider such State recommendation.

`(3) CONSTRUCTION- Any interest in the business of 1 or more foreign utility companies, or 1 or more companies organized exclusively to own, directly or indirectly, the securities or other interest in a foreign utility company, shall for all purposes of this Act, be considered to be--

`(A) consistent with the operation of a single integrated public utility system, within the meaning of section 11; and

`(B) reasonably incidental, or economically necessary or appropriate, to the operations of an integrated public utility system, within the meaning of section 11.

`(d) EFFECT ON EXISTING LAW; NO STATE PREEMPTION- Nothing in this section shall--

`(1) preclude any person from qualifying for or maintaining any exemption otherwise provided for under this Act or the rules, regulations, or orders promulgated or issued under this Act; or

`(2) be deemed or construed to limit the authority of any State (including any State regulatory authority) with respect to--

`(A) any public utility company or holding company subject to such State's jurisdiction; or

`(B) any transaction between any foreign utility company (or any affiliate or associate company thereof) and any public utility company or holding company subject to such State's jurisdiction.

`(e) REPORTING REQUIREMENTS-

`(1) FILING OF REPORTS- A public utility company that is an associate company of a foreign utility company shall file with the Commission such reports (with respect to such foreign utility company) as the Commission may by rules, regulations, or order prescribe as necessary or appropriate in the public interest or for the protection of investors or consumers.

`(2) NOTICE OF ACQUISITIONS- Not later than 30 days after the consummation of the acquisition of an interest in a foreign utility company by an associate company of a public utility company that is subject to the jurisdiction of a State commission with respect to its retail electric

or gas rates or by such public utility company, such associate company or such public utility company, shall provide notice of such acquisition to every State commission having jurisdiction over the retail electric or gas rates of such public utility company, in such form as may be prescribed by the State commission.

`(f) PROHIBITION ON ASSUMPTION OF LIABILITIES-

`(1) IN GENERAL- No public utility company that is subject to the jurisdiction of a State commission with respect to its retail electric or gas rates shall issue any security for the purpose of financing the acquisition, or for the purposes of financing the ownership or operation, of a foreign utility company, nor shall any such public utility company assume any obligation or liability as guarantor, endorser, surety, or otherwise in respect of any security of a foreign utility company.

`(2) EXCEPTION FOR HOLDING COMPANIES WHICH ARE PREDOMINANTLY PUBLIC UTILITY COMPANIES- Subsection (f)(1) shall not apply if:

`(A) the public utility company that is subject to the jurisdiction of a State commission with respect to its retail electric or gas rates is a holding company and is not an affiliate under section 2(a)(11)(B) of another holding company or is not subject to regulation as a holding company and has no affiliate as defined in section 2(a)(11)(A) that is a public utility company subject to the jurisdiction of a State commission with respect to its retail electric or gas rates; and

`(B) each State commission having jurisdiction with respect to the retail electric and gas rates of such public utility company expressly permits such public utility to engage in a transaction otherwise prohibited under section (f)(1); and

`(C) the transaction (aggregated with all other then-outstanding transactions exempted under this subsection) does not exceed 5 per centum of the then-outstanding total capitalization of the public utility.

`(g) PROHIBITION ON PLEDGING OR ENCUMBERING UTILITY ASSETS- No public utility company that is subject to the jurisdiction of a State commission with respect to its retail electric or gas rates shall pledge or encumber any utility assets or utility assets of any subsidiary thereof for the benefit of an associate foreign utility company.'.

Subtitle B--Federal Power Act; Interstate Commerce in Electricity

SEC. 721. AMENDMENTS TO SECTION 211 OF FEDERAL POWER ACT.

Section 211 of the Federal Power Act (16 U.S.C. 824j) is amended as follows:

(1) The first sentence of subsection (a) is amended to read as follows: `Any electric utility, Federal power marketing agency, or any other person generating electric energy for sale for resale, may apply to the Commission for an order under this subsection requiring a transmitting utility to provide transmission services (including any enlargement of transmission capacity necessary to provide such services) to the applicant.'.

(2) In the second sentence of subsection (a), strike `the Commission may' and all that follows and insert `the Commission may issue such order if it finds that such order meets the requirements of

section 212, and would otherwise be in the public interest. No order may be issued under this subsection unless the applicant has made a request for transmission services to the transmitting utility that would be the subject of such order at least 60 days prior to its filing of an application for such order.'.

(3) Amend subsection (b) to read as follows:

`(b) RELIABILITY OF ELECTRIC SERVICE- No order may be issued under this section or section 210 if, after giving consideration to consistently applied regional or national reliability standards, guidelines, or criteria, the Commission finds that such order would unreasonably impair the continued reliability of electric systems affected by the order.'.

(4) In subsection (c)--

(A) Strike out paragraph (1).

(B) In paragraph (2) strike `which requires the electric' and insert `which requires the transmitting'.

(C) Strike out paragraphs (3) and (4).

(5) In subsection (d)--

(A) In the first sentence of paragraph (1), strike `electric' and insert `transmitting' in each place it appears.

(B) In the second sentence of paragraph (1) before `and each affected electric utility,' insert `each affected transmitting utility,'.

(C) In paragraph (3), strike `electric' and insert `transmitting'.

(D) Strike the period in subparagraph (B) of paragraph (1) and insert `, or' and after subparagraph (B) insert the following new subparagraph:

`(C) the ordered transmission services require enlargement of transmission capacity and the transmitting utility subject to the order has failed, after making a good faith effort, to obtain the necessary approvals or property rights under applicable Federal, State, and local laws.'.

SEC. 722. TRANSMISSION SERVICES.

Section 212 of the Federal Power Act is amended as follows:

(1) Strike subsections (a) and (b) and insert the following:

`(a) RATES, CHARGES, TERMS, AND CONDITIONS FOR WHOLESALE TRANSMISSION SERVICES- An order under section 211 shall require the transmitting utility subject to the order to provide wholesale transmission services at rates, charges, terms, and conditions which permit the recovery by such utility of all the costs incurred in connection with the transmission services and necessary associated services, including, but not limited to, an appropriate share, if any, of legitimate, verifiable and economic costs, including taking into account any benefits to the transmission system of

providing the transmission service, and the costs of any enlargement of transmission facilities. Such rates, charges, terms, and conditions shall promote the economically efficient transmission and generation of electricity and shall be just and reasonable, and not unduly discriminatory or preferential. Rates, charges, terms, and conditions for transmission services provided pursuant to an order under section 211 shall ensure that, to the extent practicable, costs incurred in providing the wholesale transmission services, and properly allocable to the provision of such services, are recovered from the applicant for such order and not from a transmitting utility's existing wholesale, retail, and transmission customers.'.

(2) Subsection (e) is amended to read as follows:

`(e) SAVINGS PROVISIONS- (1) No provision of section 210, 211, 214, or this section shall be treated as requiring any person to utilize the authority of any such section in lieu of any other authority of law. Except as provided in section 210, 211, 214, or this section, such sections shall not be construed as limiting or impairing any authority of the Commission under any other provision of law.

`(2) Sections 210, 211, 213, 214, and this section, shall not be construed to modify, impair, or supersede the antitrust laws. For purposes of this section, the term `antitrust laws' has the meaning given in subsection (a) of the first sentence of the Clayton Act, except that such term includes section 5 of the Federal Trade Commission Act to the extent that such section relates to unfair methods of competition.'.

(3) Add the following new subsections at the end thereof:

`(g) PROHIBITION ON ORDERS INCONSISTENT WITH RETAIL MARKETING AREAS- No order may be issued under this Act which is inconsistent with any State law which governs the retail marketing areas of electric utilities.

`(h) PROHIBITION ON MANDATORY RETAIL WHEELING AND SHAM WHOLESALE TRANSACTIONS- No order issued under this Act shall be conditioned upon or require the transmission of electric energy:

`(1) directly to an ultimate consumer, or

`(2) to, or for the benefit of, an entity if such electric energy would be sold by such entity directly to an ultimate consumer, unless:

`(A) such entity is a Federal power marketing agency; the Tennessee Valley Authority; a State or any political subdivision of a State (or an agency, authority, or instrumentality of a State or a political subdivision); a corporation or association that has ever received a loan for the purposes of providing electric service from the Administrator of the Rural Electrification Administration under the Rural Electrification Act of 1936; a person having an obligation arising under State or local law (exclusive of an obligation arising solely from a contract entered into by such person) to provide electric service to the public; or any corporation or association which is wholly owned, directly or indirectly, by any one or more of the foregoing; and

`(B) such entity was providing electric service to such ultimate consumer on the date of enactment of this subsection or would utilize transmission or distribution facilities that it owns or controls to deliver all such electric energy to such electric consumer.

Nothing in this subsection shall affect any authority of any State or local government under State law concerning the transmission of electric energy directly to an ultimate consumer.'.

`(i) LAWS APPLICABLE TO FEDERAL COLUMBIA RIVER TRANSMISSION SYSTEM- (1) The Commission shall have authority pursuant to section 210, section 211, this section, and section 213 to (A) order the Administrator of the Bonneville Power Administration to provide transmission service and (B) establish the terms and conditions of such service. In applying such sections to the Federal Columbia River Transmission System, the Commission shall assure that--

`(i) the provisions of otherwise applicable Federal laws shall continue in full force and effect and shall continue to be applicable to the system; and

`(ii) the rates for the transmission of electric power on the system shall be governed only by such otherwise applicable provisions of law and not by any provision of section 210, section 211, this section, or section 213, except that no rate for the transmission of power on the system shall be unjust, unreasonable, or unduly discriminatory or preferential, as determined by the Commission.

`(2) Notwithstanding any other provision of this Act with respect to the procedures for the determination of terms and conditions for transmission service--

`(A) when the Administrator of the Bonneville Power Administration either (i) in response to a written request for specific transmission service terms and conditions does not offer the requested terms and conditions, or (ii) proposes to establish terms and conditions of general applicability for transmission service on the Federal Columbia River Transmission System, then the Administrator may provide opportunity for a hearing and, in so doing, shall--

`(I) give notice in the Federal Register and state in such notice the written explanation of the reasons why the specific terms and conditions for transmission services are not being offered or are being proposed;

`(II) adhere to the procedural requirements of paragraphs (1) through (3) of section 7(i) of the Pacific Northwest Electric Power Planning and Conservation Act (16 U.S.C. 839(i) (1) through (3)), except that the hearing officer shall, unless the hearing officer becomes unavailable to the agency, make a recommended decision to the Administrator that states the hearing officer's findings and conclusions, and the reasons or basis thereof, on all material issues of fact, law, or discretion presented on the record; and

`(III) make a determination, setting forth the reasons for reaching any findings and conclusions which may differ from those of the hearing officer, based on the hearing record, consideration of the hearing officer's recommended decision, section 211 and this section, as amended by the Energy Policy Act of 1992, and the provisions of law as preserved in this section; and

`(B) if application is made to the Commission under section 211 for transmission service under terms and conditions different than those offered by the Administrator, or following the denial of a request for transmission service by the Administrator, and such application is filed within 60 days of the Administrator's final determination and in accordance with Commission procedures, the Commission shall--

`(i) in the event the Administrator has conducted a hearing as herein provided for (I) accord

parties to the Administrator's hearing the opportunity to offer for the Commission record materials excluded by the Administrator from the hearing record, (II) accord such parties the opportunity to submit for the Commission record comments on appropriate terms and conditions, (III) afford those parties the opportunity for a hearing if and to the extent that the Commission finds the Administrator's hearing record to be inadequate to support a decision by the Commission, and (IV) establish terms and conditions for or deny transmission service based on the Administrator's hearing record, the Commission record, section 211 and this section, as amended by the Energy Policy Act of 1992, and the provisions of law as preserved in this section, or

`(ii) in the event the Administrator has not conducted a hearing as herein provided for, determine whether to issue an order for transmission service in accordance with section 211 and this section, including providing the opportunity for a hearing.

`(3) Notwithstanding those provisions of section 313(b) of this Act (16 U.S.C. 825l) which designate the court in which review may be obtained, any party to a proceeding concerning transmission service sought to be furnished by the Administrator of the Bonneville Power Administration seeking review of an order issued by the Commission in such proceeding shall obtain a review of such order in the United States Court of Appeals for the Pacific Northwest, as that region is defined by section 3(14) of the Pacific Northwest Electric Power Planning and Conservation Act (16 U.S.C. 839a(14)).

`(4) To the extent the Administrator of the Bonneville Power Administration cannot be required under section 211, as a result of the Administrator's other statutory mandates, either to (A) provide transmission service to an applicant which the Commission would otherwise order, or (B) provide such service under rates, terms, and conditions which the Commission would otherwise require, the applicant shall not be required to provide similar transmission services to the Administrator or to provide such services under similar rates, terms, and conditions.

`(5) The Commission shall not issue any order under section 210, section 211, this section, or section 213 requiring the Administrator of the Bonneville Power Administration to provide transmission service if such an order would impair the Administrator's ability to provide such transmission service to the Administrator's power and transmission customers in the Pacific Northwest, as that region is defined in section 3(14) of the Pacific Northwest Electric Power Planning and Conservation Act (16 U.S.C. 839a (14)), as is needed to assure adequate and reliable service to loads in that region.

`(j) EQUITABILITY WITHIN TERRITORY RESTRICTED ELECTRIC SYSTEMS- With respect to an electric utility which is prohibited by Federal law from being a source of power supply, either directly or through a distributor of its electric energy, outside an area set forth in such law, no order issued under section 211 may require such electric utility (or a distributor of such electric utility) to provide transmission services to another entity if the electric energy to be transmitted will be consumed within the area set forth in such Federal law, unless the order is in furtherance of a sale of electric energy to that electric utility: *Provided, however*, That the foregoing provision shall not apply to any area served at retail by an electric transmission system which was such a distributor on the date of enactment of this subsection and which before October 1, 1991, gave its notice of termination under its power supply contract with such electric utility.

`(k) ERCOT UTILITIES-

`(1) RATES- Any order under section 211 requiring provision of transmission services in whole or in part within ERCOT shall provide that any ERCOT utility which is not a public utility and the

transmission facilities of which are actually used for such transmission service is entitled to receive compensation based, insofar as practicable and consistent with subsection (a), on the transmission ratemaking methodology used by the Public Utility Commission of Texas.

`(2) DEFINITIONS- For purposes of this subsection--

`(A) the term `ERCOT' means the Electric Reliability Council of Texas; and

`(B) the term `ERCOT utility' means a transmitting utility which is a member of ERCOT.'.

SEC. 723. INFORMATION REQUIREMENTS.

Part II of the Federal Power Act is amended by adding the following new section after section 212:

`SEC. 213. INFORMATION REQUIREMENTS.

`(a) REQUESTS FOR WHOLESALE TRANSMISSION SERVICES- Whenever any electric utility, Federal power marketing agency, or any other person generating electric energy for sale for resale makes a good faith request to a transmitting utility to provide wholesale transmission services and requests specific rates and charges, and other terms and conditions, unless the transmitting utility agrees to provide such services at rates, charges, terms and conditions acceptable to such person, the transmitting utility shall, within 60 days of its receipt of the request, or other mutually agreed upon period, provide such person with a detailed written explanation, with specific reference to the facts and circumstances of the request, stating (1) the transmitting utility's basis for the proposed rates, charges, terms, and conditions for such services, and (2) its analysis of any physical or other constraints affecting the provision of such services.

`(b) TRANSMISSION CAPACITY AND CONSTRAINTS- Not later than 1 year after the enactment of this section, the Commission shall promulgate a rule requiring that information be submitted annually to the Commission by transmitting utilities which is adequate to inform potential transmission customers, State regulatory authorities, and the public of potentially available transmission capacity and known constraints.'.

SEC. 724. SALES BY EXEMPT WHOLESALE GENERATORS.

Part II of the Federal Power Act is amended by adding the following new section after section 213:

`SEC. 214. SALES BY EXEMPT WHOLESALE GENERATORS.

`No rate or charge received by an exempt wholesale generator for the sale of electric energy shall be lawful under section 205 if, after notice and opportunity for hearing, the Commission finds that such rate or charge results from the receipt of any undue preference or advantage from an electric utility which is an associate company or an affiliate of the exempt wholesale generator. For purposes of this section, the terms `associate company' and `affiliate' shall have the same meaning as provided in section 2(a) of the Public Utility Holding Company Act of 1935.'.

SEC. 725. PENALTIES.

(a) EXISTING PENALTIES NOT APPLICABLE TO TRANSMISSION PROVISIONS- Sections 315

and 316 of the Federal Power Act are each amended by adding the following at the end thereof:

`(c) This subsection shall not apply in the case of any provision of section 211, 212, 213, or 214 or any rule or order issued under any such provision.'.

(b) PENALTIES APPLICABLE TO TRANSMISSION PROVISIONS- Title III of the Federal Power Act is amended by inserting the following new section after section 316:

`SEC. 316A. ENFORCEMENT OF CERTAIN PROVISIONS.

`(a) VIOLATIONS- It shall be unlawful for any person to violate any provision of section 211, 212, 213, or 214 or any rule or order issued under any such provision.

`(b) CIVIL PENALTIES- Any person who violates any provision of section 211, 212, 213, or 214 or any provision of any rule or order thereunder shall be subject to a civil penalty of not more than $10,000 for each day that such violation continues. Such penalty shall be assessed by the Commission, after notice and opportunity for public hearing, in accordance with the same provisions as are applicable under section 31(d) in the case of civil penalties assessed under section 31. In determining the amount of a proposed penalty, the Commission shall take into consideration the seriousness of the violation and the efforts of such person to remedy the violation in a timely manner.'.

SEC. 726. DEFINITIONS.

(a) ADDITIONAL DEFINITIONS- Section 3 of the Federal Power Act is amended by adding the following at the end thereof:

`(23) TRANSMITTING UTILITY- The term `transmitting utility' means any electric utility, qualifying cogeneration facility, qualifying small power production facility, or Federal power marketing agency which owns or operates electric power transmission facilities which are used for the sale of electric energy at wholesale.

`(24) WHOLESALE TRANSMISSION SERVICES- The term `wholesale transmission services' means the transmission of electric energy sold, or to be sold, at wholesale in interstate commerce.

`(25) EXEMPT WHOLESALE GENERATOR- The term `exempt wholesale generator' shall have the meaning provided by section 32 of the Public Utility Holding Company Act of 1935.'.

(b) CLARIFICATION OF TERMS- Section 3(22) of the Federal Power Act is amended by inserting `(including any municipality)' after `State agency'.

Subtitle C--State and Local Authorities

SEC. 731. STATE AUTHORITIES.

Nothing in this title or in any amendment made by this title shall be construed as affecting or intending to affect, or in any way to interfere with, the authority of any State or local government relating to environmental protection or the siting of facilities.

TITLE VIII--HIGH-LEVEL RADIOACTIVE WASTE

SEC. 801. NUCLEAR WASTE DISPOSAL.

(a) ENVIRONMENTAL PROTECTION AGENCY STANDARDS-

(1) PROMULGATION- Notwithstanding the provisions of section 121(a) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10141(a)), section 161 b. of the Atomic Energy Act of 1954 (42 U.S.C. 2201(b)), and any other authority of the Administrator of the Environmental Protection Agency to set generally applicable standards for the Yucca Mountain site, the Administrator shall, based upon and consistent with the findings and recommendations of the National Academy of Sciences, promulgate, by rule, public health and safety standards for protection of the public from releases from radioactive materials stored or disposed of in the repository at the Yucca Mountain site. Such standards shall prescribe the maximum annual effective dose equivalent to individual members of the public from releases to the accessible environment from radioactive materials stored or disposed of in the repository. The standards shall be promulgated not later than 1 year after the Administrator receives the findings and recommendations of the National Academy of Sciences under paragraph (2) and shall be the only such standards applicable to the Yucca Mountain site.

(2) STUDY BY NATIONAL ACADEMY OF SCIENCES- Within 90 days after the date of the enactment of this Act, the Administrator shall contract with the National Academy of Sciences to conduct a study to provide, by not later than December 31, 1993, findings and recommendations on reasonable standards for protection of the public health and safety, including--

(A) whether a health-based standard based upon doses to individual members of the public from releases to the accessible environment (as that term is defined in the regulations contained in subpart B of part 191 of title 40, Code of Federal Regulations, as in effect on November 18, 1985) will provide a reasonable standard for protection of the health and safety of the general public;

(B) whether it is reasonable to assume that a system for post-closure oversight of the repository can be developed, based upon active institutional controls, that will prevent an unreasonable risk of breaching the repository's engineered or geologic barriers or increasing the exposure of individual members of the public to radiation beyond allowable limits; and

(C) whether it is possible to make scientifically supportable predictions of the probability that the repository's engineered or geologic barriers will be breached as a result of human intrusion over a period of 10,000 years.

(3) APPLICABILITY- The provisions of this section shall apply to the Yucca Mountain site, rather than any other authority of the Administrator to set generally applicable standards for radiation protection.

(b) NUCLEAR REGULATORY COMMISSION REQUIREMENTS AND CRITERIA-

(1) MODIFICATIONS- Not later than 1 year after the Administrator promulgates standards under subsection (a), the Nuclear Regulatory Commission shall, by rule, modify its technical requirements and criteria under section 121(b) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10141(b)), as necessary, to be consistent with the Administrator's standards promulgated under subsection (a).

(2) REQUIRED ASSUMPTIONS- The Commission's requirements and criteria shall assume, to the extent consistent with the findings and recommendations of the National Academy of Sciences, that, following repository closure, the inclusion of engineered barriers and the Secretary's post-closure oversight of the Yucca Mountain site, in accordance with subsection (c), shall be sufficient to--

(A) prevent any activity at the site that poses an unreasonable risk of breaching the repository's engineered or geologic barriers; and

(B) prevent any increase in the exposure of individual members of the public to radiation beyond allowable limits.

(c) POST-CLOSURE OVERSIGHT- Following repository closure, the Secretary of Energy shall continue to oversee the Yucca Mountain site to prevent any activity at the site that poses an unreasonable risk of--

(1) breaching the repository's engineered or geologic barriers; or

(2) increasing the exposure of individual members of the public to radiation beyond allowable limits.

SEC. 802. OFFICE OF THE NUCLEAR WASTE NEGOTIATOR.

(a) EXTENSION- Section 410 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10250) is amended by striking `5 years' and inserting `7 years'.

(b) DEFINITION OF STATE- Section 401 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10241) is amended--

(1) by striking `States,' the first place it appears and inserting `States and'; and

(2) by inserting a period after `District of Columbia' and striking the remainder of the sentence.

SEC. 803. NUCLEAR WASTE MANAGEMENT PLAN.

(a) PREPARATION AND SUBMISSION OF REPORT- The Secretary of Energy, in consultation with the Nuclear Regulatory Commission and the Environmental Protection Agency, shall prepare and submit to the Congress a report on whether current programs and plans for management of nuclear waste as mandated by the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101 et seq.) are adequate for management of any additional volumes or categories of nuclear waste that might be generated by any new nuclear power plants that might be constructed and licensed after the date of the enactment of this Act. The Secretary shall prepare the report for submission to the President and the Congress within 1 year after the date of the enactment of this Act. The report shall examine any new relevant issues related to management of spent nuclear fuel and high-level radioactive waste that might be raised by the addition of new nuclear-generated electric capacity, including anticipated increased volumes of spent nuclear fuel or high-level radioactive waste, any need for additional interim storage capacity prior to final disposal, transportation of additional volumes of waste, and any need for additional repositories for deep geologic disposal.

(b) OPPORTUNITY FOR PUBLIC COMMENT- In preparation of the report required under subsection

(a), the Secretary of Energy shall offer members of the public an opportunity to provide information and comment and shall solicit the views of the Nuclear Regulatory Commission, the Environmental Protection Agency, and other interested parties.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necessary to carry out this section.

TITLE IX--UNITED STATES ENRICHMENT CORPORATION

SEC. 901. ESTABLISHMENT OF THE UNITED STATES ENRICHMENT CORPORATION.

The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) is amended by adding at the end the following new title:

`TITLE II--UNITED STATES ENRICHMENT CORPORATION

`CHAPTER 22--GENERAL PROVISIONS

`SEC. 1201. DEFINITIONS.

`For purposes of this title:

`(1) The term `alternative technologies for uranium enrichment' means technologies to enrich uranium by methods other than the gaseous diffusion process.

`(2) The term `AVLIS' means atomic vapor laser isotope separation technology.

`(3) The term `Board' means the Board of Directors of the Corporation established under section 1304.

`(4) The term `Corporation' means the United States Enrichment Corporation.

`(5) The term `corrective actions' has the meaning given such term by the Administrator of the Environmental Protection Agency under section 3004(u) of the Solid Waste Disposal Act (42 U.S.C. 6924(u)).

`(6) The term `decontamination and decommissioning' means those activities, other than response actions or corrective actions, undertaken to decontaminate and decommission inactive uranium enrichment facilities that have residual radioactive or mixed radioactive and hazardous chemical contamination, including depleted tailings.

`(7) The term `Department' means the Department of Energy.

`(8) The term `highly enriched uranium' means uranium enriched to 20 percent or more of the uranium-235 isotope.

`(9) The term `low-enriched uranium' means uranium enriched to less than 20 percent of the uranium-235 isotope.

`(10) The term `releases' has the meaning given the term `release' in section 101(22) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601(22)).

`(11) The term `remedial action' has the meaning given such term in section 101(24) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601(24)).

`(12) The term `response actions' has the meaning given the term `response' in section 101(25) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601(25)).

`(13) The term `Secretary' means the Secretary of Energy.

`(14) The term `uranium enrichment' means the separation of uranium of a given isotopic content into 2 components, 1 having a higher percentage of a fissile isotope and 1 having a lower percentage.

`SEC. 1202. PURPOSES.

`The Corporation is created for the following purposes:

`(1) To operate as a business enterprise on a profitable and efficient basis.

`(2) To maximize the long-term value of the Corporation to the Treasury of the United States.

`(3) To lease Department uranium enrichment facilities, as needed.

`(4) To acquire uranium for uranium enrichment, low-enriched uranium for resale, and highly enriched uranium for conversion into low-enriched uranium, as needed.

`(5) To market and sell its enriched uranium and uranium enrichment and related services to--

`(A) the Department for governmental purposes; and

`(B) domestic and foreign persons, as provided in section 1303(6).

`(6) To conduct research and development as required to meet business objectives for the purposes of identifying, evaluating, improving, and testing alternative technologies for uranium enrichment.

`(7) To conduct the business as a self-financing corporation and eliminate the need for Federal Government appropriations or sources of Federal financing other than those provided in this title.

`(8) To help maintain a reliable and economical domestic source of uranium enrichment services.

`(9) To comply with laws, and regulations promulgated thereunder, to protect the public health, safety, and the environment.

`(10) To continue at all times to meet the objectives of ensuring the Nation's common defense and security, including abiding by United States laws and policies concerning special nuclear materials

and nonproliferation of atomic weapons and other nonpeaceful uses of atomic energy.

`(11) To take all other lawful actions in furtherance of these purposes.

`CHAPTER 23--ESTABLISHMENT, POWERS, AND ORGANIZATION OF CORPORATION

`SEC. 1301. ESTABLISHMENT OF THE CORPORATION.

`(a) IN GENERAL- There is established a body corporate to be known as the United States Enrichment Corporation.

`(b) GOVERNMENT CORPORATION- The Corporation shall be established as a wholly owned Government corporation subject to chapter 91 of title 31, United States Code (commonly referred to as the Government Corporation Control Act), except as otherwise provided in this title.

`(c) FEDERAL AGENCY- The Corporation shall be an agency and instrumentality of the United States.

`SEC. 1302. CORPORATE OFFICES.

`The Corporation shall maintain an office for the service of process and papers in the District of Columbia, and shall be deemed, for purposes of venue in civil actions, to be a resident thereof. The Corporation may establish offices in such other place or places as it may deem necessary or appropriate in the conduct of its business.

`SEC. 1303. POWERS OF THE CORPORATION.

`In order to accomplish its purposes, the Corporation--

`(1) shall, except as provided in this title or applicable Federal law, have all the powers of a private corporation incorporated under the District of Columbia Business Corporation Act;

`(2) shall have the priority of the United States with respect to the payment of debts out of bankrupt, insolvent, and decedents' estates;

`(3) may obtain from the Administrator of General Services the services the Administrator is authorized to provide agencies of the United States, on the same basis as those services are provided to other agencies of the United States;

`(4) shall enrich uranium, provide for uranium to be enriched by others, or acquire enriched uranium (including low-enriched uranium derived from highly enriched uranium provided under section 1408);

`(5) may conduct, or provide for conducting, those research and development activities related to uranium enrichment and related processes and activities the Corporation considers necessary or advisable to maintain the Corporation as a commercial enterprise operating on a profitable and efficient basis;

`(6) may enter into transactions regarding uranium, enriched uranium, or depleted uranium with--

`(A) persons licensed under section 53, 63, 103, or 104 in accordance with the licenses held by those persons;

`(B) persons in accordance with, and within the period of, an agreement for cooperation arranged under section 123; or

`(C) persons otherwise authorized by law to enter into such transactions;

`(7) may enter into contracts with persons licensed under section 53, 63, 103, or 104, for as long as the Corporation considers necessary or desirable, to provide uranium or uranium enrichment and related services;

`(8) may enter into contracts to provide uranium or uranium enrichment and related services in accordance with, and within the period of, an agreement for cooperation arranged under section 123 or as otherwise authorized by law; and

`(9) shall sell to the Department as provided in this title, without regard to section 57 e., the amounts of uranium enrichment and related services that the Department determines from time to time are required for it to--

`(A) carry out Presidential directions and authorizations under section 91; and

`(B) conduct other Department programs.

`SEC. 1304. BOARD OF DIRECTORS.

`(a) IN GENERAL- The powers of the Corporation are vested in the Board of Directors.

`(b) APPOINTMENT- The Board of Directors shall consist of 5 individuals, to be appointed by the President by and with the advice and consent of the Senate. The President shall designate a Chairman of the Board from among members of the Board.

`(c) QUALIFICATIONS- Members of the Board shall be citizens of the United States. No member of the Board shall be an employee of the Corporation or have any direct financial relationship with the Corporation other than that of being a member of the Board.

`(d) TERMS-

`(1) IN GENERAL- Except as provided in paragraph (2), members of the Board shall serve 5-year terms or until the election of a new Board of Directors under section 1704, whichever comes first.

`(2) INITIAL MEMBERS- Of the members first appointed to the Board--

`(A) 1 shall be appointed for a 1-year term;

`(B) 1 shall be appointed for a 2-year term;

`(C) 1 shall be appointed for a 3-year term; and

`(D) 1 shall be appointed for a 4-year term.

`(3) REAPPOINTMENT- Members of the Board may be reappointed by the President, by and with the advice and consent of the Senate.

`(e) VACANCIES- Upon the occurrence of a vacancy on the Board, the President by and with the advice and consent of the Senate shall appoint an individual to fill such vacancy for the remainder of the applicable term.

`(f) MEETINGS AND QUORUM- The Board shall meet at any time pursuant to the call of the Chairman and as provided by the bylaws of the Corporation, but not less than quarterly. Three voting members of the Board shall constitute a quorum. A majority of the Board shall adopt and from time to time may amend bylaws for the operation of the Board.

`(g) POWERS- The Board shall be responsible for general management of the Corporation and shall have the same authority, privileges, and responsibilities as the board of directors of a private corporation incorporated under the District of Columbia Business Corporation Act.

`(h) COMPENSATION- Members of the Board shall serve on a part-time basis and shall receive per diem, when engaged in the actual performance of Corporation duties, plus reimbursement for travel, subsistence, and other necessary expenses incurred in the performance of their duties.

`(i) MEMBERSHIP OF SECRETARY OF TREASURY- The President may appoint the Secretary of the Treasury or his designee to serve as a member of the Board or as a nonvoting, ex officio member of the Board.

`(j) CONFLICT OF INTEREST REQUIREMENTS- No director, officer, or other management level employee of the Corporation may have a financial interest in any customer, contractor, or competitor of the Corporation or in any business that may be adversely affected by the success of the Corporation.

`SEC. 1305. EMPLOYEES OF THE CORPORATION.

`(a) APPOINTMENT- The Board shall appoint such officers and employees as are necessary for the transaction of its business.

`(b) COMPENSATION, DUTIES, AND REMOVAL- The Board shall, without regard to section 5301 of title 5, United States Code, fix the compensation of all officers and employees of the Corporation, define their duties, and provide a system of organization to fix responsibility and promote efficiency. Any officer or employee of the Corporation may be removed in the discretion of the Board.

`(c) APPLICABLE CRITERIA- The Board shall ensure that the personnel function and organization is consistent with the principles of section 2301(b) of title 5, United States Code, relating to merit system principles. Officers and employees shall be appointed, promoted, and assigned on the basis of merit and fitness, and other personnel actions shall be consistent with the principles of fairness and due process but without regard to those provisions of title 5 of the United States Code governing appointments and other personnel actions in the competitive service.

`(d) TREATMENT OF PERSONS EMPLOYED PRIOR TO TRANSITION DATE- Compensation, benefits, and other terms and conditions of employment in effect immediately prior to the transition date, whether provided by statute or by rules of the Department or the executive branch, shall continue to apply to officers and employees who transfer to the Corporation from other Federal employment until changed by the Board.

`(e) PROTECTION OF EXISTING EMPLOYEES-

`(1) IN GENERAL- It is the purpose of this subsection to ensure that the establishment of the Corporation pursuant to this chapter shall not result in any adverse effects on the employment rights, wages, or benefits of employees at facilities that are operated, directly or under contract, in the performance of the functions vested in the Corporation.

`(2) APPLICABILITY OF EXISTING COLLECTIVE BARGAINING AGREEMENT- Any employer (including the Corporation) at a facility described in paragraph (1) shall abide by the terms of a collective bargaining agreement in effect on April 30, 1991, at each individual facility until--

`(A) the earlier of the date on which a new bargaining agreement is signed; or

`(B) the end of the 2-year period beginning on the date of the enactment of this title.

`(3) APPLICABILITY OF NLRA- Except as specifically provided in this subsection, the Corporation is subject to the provisions of the National Labor Relations Act (29 U.S.C. 151 et seq.).

`(4) BENEFITS OF TRANSFEREES AND DETAILEES- At the request of the Board and subject to the approval of the Secretary, an employee of the Department may be transferred or detailed as provided for in section 1315, to the Corporation without any loss in accrued benefits or standing within the Civil Service System. For those employees who accept transfer to the Corporation, it shall be their option as to whether to have any accrued retirement benefits transferred to a retirement system established by the Corporation or to retain their coverage under either the Civil Service Retirement System or the Federal Employees' Retirement System, as applicable, in lieu of coverage by the Corporation's retirement system. For those employees electing to remain with one of the Federal retirement systems, the Corporation shall withhold pay and make such payments as are required under the Federal retirement system. For those Department employees detailed, the Department shall offer those employees a position of like grade, compensation, and proximity to their official duty station after their services are no longer required by the Corporation.

`SEC. 1306. AUDITS.

`(a) INDEPENDENT AUDITS-

`(1) IN GENERAL- The financial statements of the Corporation shall be prepared in accordance with generally accepted accounting principles and shall be audited annually by an independent certified public accountant in accordance with auditing standards issued by the Comptroller General. Such auditing standards shall be consistent with the private sector's generally accepted auditing standards.

`(2) REVIEW BY GAO- The Comptroller General may review any audit of the Corporation's financial statements conducted under paragraph (1). The Comptroller General shall report to the Congress and the Corporation the results of any such review and shall include in such report appropriate recommendations.

`(b) GAO AUDITS-

`(1) IN GENERAL- The Comptroller General may audit the financial statements of the Corporation for any year in the manner provided in subsection (a)(1).

`(2) REIMBURSEMENT BY CORPORATION- The Corporation shall reimburse the Comptroller General for the full cost of any audit conducted under this subsection, as determined by the Comptroller General.

`(c) AVAILABILITY OF BOOKS AND RECORDS- All books, accounts, financial records, reports, files, papers, and other property belonging to or in use by the Corporation and its auditor that the Comptroller General considers necessary to the performance of any audit or review under this section shall be made available to the Comptroller General, subject to section 1314.

`(d) TREATMENT OF GAO AUDITS- Activities the Comptroller General conducts under this section shall be in lieu of any other audit of the financial transactions of the Corporation the Comptroller General is required to make under chapter 91 of title 31, United States Code, or other law.

`SEC. 1307. ANNUAL REPORTS.

`(a) IN GENERAL- The Corporation shall prepare and submit an annual report of its activities to the President and the Congress. This report shall contain--

`(1) a general description of the Corporation's operations;

`(2) a summary of the Corporation's operating and financial performance, including an explanation of the decision to pay or not pay dividends;

`(3) copies of audit reports prepared under section 1305;

`(4) the information required under regulations issued under section 13 of the Securities Exchange Act of 1934 (15 U.S.C. 78m); and

`(5) an identification and assessment of any impairment of capital or ability of the Corporation to comply with this title.

`(b) DEADLINE- The report shall be completed not later than 150 days following the close of each of the Corporation's fiscal years and shall accurately reflect the financial position of the Corporation at fiscal year end.

`SEC. 1308. ACCOUNTS.

`(a) ESTABLISHMENT OF UNITED STATES ENRICHMENT CORPORATION FUND- There is established in the Treasury of the United States a revolving fund, to be known as the `United States Enrichment Corporation Fund', which shall be available to the Corporation, without need for further appropriation and without fiscal year limitation, for carrying out its purposes, functions, and powers, and which shall not be subject to apportionment under subchapter II of chapter 15 of title 31, United States Code.

`(b) TRANSFER OF UNEXPENDED BALANCES- On the transfer date, the Secretary shall, without need of further appropriation, transfer to the Corporation the unexpended balance of appropriations and other monies available to the Department (inclusive of funds set aside for accounts payable), and

accounts receivable which are related to functions and activities acquired by the Corporation from the Department pursuant to this title, including all advance payments.

`SEC. 1309. OBLIGATIONS.

`(a) ISSUANCE-

`(1) IN GENERAL- The Corporation may issue and sell bonds, notes, and other evidences of indebtedness (collectively referred to in this title as `bonds'), except that the Corporation may not issue or sell bonds for the purpose of constructing new uranium enrichment facilities or conducting directly related preconstruction activities. Borrowing under this paragraph during any fiscal year ending before October 1, 1996, shall be subject to approval in appropriation Acts.

`(2) USE OF REVENUES- The Corporation may pledge and use its revenues for payment of the principal of and interest on its bonds, for their purchase or redemption, and for other purposes incidental to these functions, including creation of reserve funds and other funds that may be similarly pledged and used.

`(3) AGREEMENTS WITH HOLDERS AND TRUSTEES- The Corporation may enter into binding covenants with the holders and trustees of its bonds with respect to--

`(A) the establishment of reserve and other funds;

`(B) stipulations concerning the subsequent issuance of bonds; and

`(C) other matters not inconsistent with this title;

that the Corporation determines necessary or desirable to enhance the marketability of the bonds.

`(b) NOT OBLIGATIONS OF UNITED STATES- Bonds issued by the Corporation under this section shall not be obligations of, or guaranteed as to principal or interest by, the United States, and the bonds shall so plainly state.

`(c) TERMS AND CONDITIONS-

`(1) NEGOTIABLE; MATURITY- Bonds issued by the Corporation under this section shall be negotiable instruments unless otherwise specified in the bond and shall mature not more than 50 years after their date of issuance.

`(2) ROLE OF SECRETARY OF THE TREASURY-

`(A) RIGHT OF DISAPPROVAL- The Corporation may set the terms and conditions of bonds issued under this section, subject to disapproval of such terms and conditions by the Secretary of the Treasury within 5 days after the Secretary of the Treasury is notified of the following terms and conditions of the bonds:

`(i) Their forms and denominations.

`(ii) The times, amounts, and prices at which they are sold.

`(iii) Their rates of interest.

`(iv) The terms at which they may be redeemed by the Corporation before maturity.

`(v) The priority of their claims on the Corporation's net revenues with respect to principal and interest payments.

`(vi) Any other terms and conditions.

`(B) INAPPLICABILITY OF RIGHT TO PRESCRIBE TERMS- Section 9108(a) of title 31, United States Code, shall not apply to the Corporation.

`(d) INAPPLICABILITY OF SECURITIES REQUIREMENTS- The Corporation shall be considered an executive department of the United States for purposes of section 3(c) of the Securities Exchange Act of 1934 (15 U.S.C. 78c(c)).

`(e) INAPPLICABILITY OF FFB- The Corporation shall not issue or sell any bonds to the Federal Financing Bank.

`SEC. 1310. EXEMPTION FROM TAXATION AND PAYMENTS IN LIEU OF TAXES.

`(a) EXEMPTION FROM TAXATION- In order to render financial assistance to those States and localities in which the facilities of the Corporation are located, the Corporation shall, beginning in fiscal year 1998, make payments to State and local governments as provided in this section. These payments shall be in lieu of any and all State and local taxes on the real and personal property of the Corporation. All property of the Corporation is expressly exempted from taxation in any manner or form by any State, county, or other local government entity including State, county, or other local government sales tax.

`(b) PAYMENTS IN LIEU OF TAXES- Beginning in fiscal year 1998, the Corporation shall make annual payments, in amounts determined by the Corporation to be fair and reasonable, to the State and local governmental agencies having tax jurisdiction in any area where facilities of the Corporation are located. In making these determinations, the Corporation shall be guided by the following criteria:

`(1) The Corporation shall take into account the customs and practices prevailing in the area with respect to appraisal, assessment, and classification of industrial property and any special considerations extended to large-scale industrial operations.

`(2) The payment made to any taxing authority for any period shall not be less than the payments that would have been made to the taxing authority for the same period by the Department and its cost-type contractors on behalf of the Department with respect to property that has been transferred to the Corporation under section 1404 and that would have been attributable to the ownership, management, operation, and maintenance of the Department's uranium enrichment facilities, applying the laws and policies prevailing immediately prior to the transition date.

`(c) TIME OF PAYMENTS- Payments shall be made by the Corporation at the time when payments of taxes by taxpayers to each taxing authority are due and payable.

`(d) DETERMINATION OF AMOUNT DUE- The determination by the Corporation of the amounts due under this section shall be final and conclusive.

`SEC. 1311. COOPERATION WITH OTHER AGENCIES.

`The Corporation may request to use on a reimbursable basis the available services, equipment, personnel, and facilities of agencies of the United States, and on a similar basis may cooperate with such agencies in the establishment and use of services, equipment, and facilities of the Corporation. Further, the Corporation may confer with and avail itself of the cooperation, services, records, and facilities of State, territorial, municipal, or other local agencies.

`SEC. 1312. APPLICABILITY OF CERTAIN FEDERAL LAWS.

`(a) ANTITRUST LAWS- The Corporation shall conduct its activities in a manner consistent with the policies expressed in the following antitrust laws:

`(1) The Sherman Act (15 U.S.C. 1-7).

`(2) The Clayton Act (15 U.S.C. 12-27).

`(3) Sections 73 and 74 of the Wilson Tariff Act (15 U.S.C. 8 and 9).

`(b) ENVIRONMENTAL LAWS- The Corporation shall be subject to, and comply with, all Federal and State, interstate, and local environmental laws and requirements, both substantive and procedural, in the same manner, and to the same extent, as any person who is subject to such laws and requirements. For purposes of enforcing any such law or substantive or procedural requirements (including any injunctive relief, administrative order, or civil or administrative penalty or fine) against the Corporation, the United States expressly waives any immunity otherwise applicable to the Corporation. For the purposes of this subsection, the term `person' means an individual, trust, firm, joint stock company, corporation, partnership, association, State, municipality, or political subdivision of a State.

`(c) OSHA REQUIREMENTS- Notwithstanding sections 3(5), 4(b)(1), and 19 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 652(5), 653(b)(1), and 668)), the Corporation shall be subject to, and comply with, such Act and all regulations and standards promulgated thereunder in the same manner, and to the same extent, as an employer is subject to such Act. For the purposes of enforcing such Act (including any injunctive relief, administrative order, or civil, administrative, or criminal penalty or fine) against the Corporation, the United States expressly waives any immunity otherwise applicable to the Corporation.

`(d) LABOR STANDARDS- The Act of March 3, 1931 (known as the Davis-Bacon Act) (40 U.S.C. 276a et seq.) and the Service Contract Act of 1965 (41 U.S.C. 351 et seq.) shall apply to the Corporation. All laborers and mechanics employed on the construction, alteration, or repair of projects funded, in whole or in part, by the Corporation shall be paid wages at rates not less than those prevailing on projects of a similar character in the locality as determined by the Secretary of Labor in accordance with such Act of March 3, 1931. The Secretary of Labor shall have, with respect to the labor standards specified in this subsection, the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (15 F.R. 3176, 64 Stat. 1267) and the Act of June 13, 1934 (40 U.S.C. 276c).

`(e) ENERGY REORGANIZATION ACT REQUIREMENTS- The Corporation is subject to the provisions of section 210 of the Energy Reorganization Act of 1974 (42 U.S.C. 5850) to the same extent as an employer subject to such section, and, with respect to the operation of the facilities leased by the Corporation, section 206 of the Energy Reorganization Act of 1974 (42 U.S.C. 5846) shall apply to the directors and officers of the Corporation.

`(f) EXEMPTION FROM FEDERAL PROPERTY REQUIREMENTS- The Corporation shall not be subject to the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 471 et seq.).

`SEC. 1313. SECURITY.

`Any references to the term `Commission' or to the Department in sections 161k., 221a., and 230 shall be considered to include the Corporation.

`SEC. 1314. CONTROL OF INFORMATION.

`(a) IN GENERAL- Except as provided in subsection (b), the Corporation may protect trade secrets and commercial or financial information to the same extent as a privately owned corporation.

`(b) OTHER APPLICABLE LAWS- Section 552(d) of title 5, United States Code, shall apply to the Corporation, and such information shall be subject to the applicable provisions of law protecting the confidentiality of trade secrets and business and financial information, including section 1905 of title 18, United States Code.

`SEC. 1315. TRANSITION.

`(a) TRANSITION MANAGER- Within 30 days after the date of the enactment of this title, the President shall appoint a Transition Manager, who shall serve at the pleasure of the President until a quorum of the Board has been appointed and confirmed in accordance with section 1304.

`(b) POWERS-

`(1) IN GENERAL- Until a quorum of the Board has qualified, the Transition Manager shall exercise the powers and duties of the Board and shall be responsible for taking all actions needed to effect the transfer of the uranium enrichment enterprise from the Secretary to the Corporation on the transition date.

`(2) CONTINUATION UNTIL BOARD HAS QUORUM- In the event that a quorum of the Board has not qualified by the transition date, the Transition Manager shall continue to exercise the powers and duties of the Board until a quorum has qualified.

`(c) RATIFICATION OF TRANSITION MANAGER'S ACTIONS- All actions taken by the Transition Manager before the qualification of a quorum of the Board shall be subject to ratification by the Board.

`(d) RESPONSIBILITIES OF SECRETARY- Before the transition date, the Secretary shall--

`(1) continue to be responsible for the management and operation of the uranium enrichment plants;

`(2) provide funds, to the extent provided in appropriations Acts, to the Transition Manager to pay salaries and expenses;

`(3) delegate Department employees to assist the Transition Manager in meeting his responsibilities under this section; and

`(4) assist and cooperate with the Transition Manager in preparing for the transfer of the uranium enrichment enterprise to the Corporation on the transition date.

`(e) TRANSITION DATE- The transition date shall be July 1, 1993.

`(f) DETAIL OF PERSONNEL- For the purpose of continuity of operations, maintenance, and authority, the Department shall detail, for up to 18 months after the date of the enactment of this title, appropriate Department personnel as may be required in an acting capacity, until such time as a Board is confirmed and top officers of the Corporation are hired. The Corporation shall reimburse the Department and its contractors for the detail of such personnel.

`SEC. 1316. WORKING CAPITAL ACCOUNT.

`There shall be established within the Corporation a Working Capital Account in which the Corporation may retain all revenue necessary for legitimate business expenses, or investments, related to carrying out its purposes.

`CHAPTER 24--RIGHTS, PRIVILEGES, AND ASSETS OF THE CORPORATION

`SEC. 1401. MARKETING AND CONTRACTING AUTHORITY.

`(a) EXCLUSIVE MARKETING AGENT- The Corporation shall act as the exclusive marketing agent on behalf of the United States Government for entering into contracts for providing enriched uranium (including low-enriched uranium derived from highly enriched uranium) and uranium enrichment and related services. The Department may not market enriched uranium (including low-enriched uranium derived from highly enriched uranium), or uranium enrichment and related services, after the transition date.

`(b) TRANSFER OF CONTRACTS-

`(1) IN GENERAL- Except as provided in paragraph (2), all contracts, agreements, and leases with the Department, including all uranium enrichment contracts and power purchase contracts, that have been executed by the Department before the transition date and that relate to uranium enrichment and related services shall transfer to the Corporation.

`(2) EXCEPTIONS-

`(A) TVA SETTLEMENT- The rights and responsibilities of the Department under the settlement agreement with the Tennessee Valley Authority, filed on December 18, 1987, with the United States Claims Court, shall not transfer to the Corporation.

`(B) NONTRANSFERABLE POWER CONTRACTS- If the Secretary determines that a power purchase contract executed by the Department prior to the transition date cannot be transferred under its terms, the Secretary may continue to receive power under the contract and resell such power to the Corporation at cost.

`(C) NONPOWER APPLICATIONS- Contracts for enriched uranium and uranium services in existence as of the date of the enactment of this title for research and development or other nonpower applications shall remain with the Department. At the request of the Department, the Corporation, in consultation with the Department, may enter into such

contracts it determines to be appropriate.

`SEC. 1402. PRICING.

`(a) SERVICES PROVIDED TO COMMERCIAL CUSTOMERS- The Corporation shall establish prices for its products, materials, and services provided to customers other than the Department on a basis that will allow it to attain the normal business objectives of a profitmaking corporation.

`(b) SERVICES PROVIDED TO DOE- The Corporation shall charge prices to the Department for uranium enrichment services provided under section 1303(9) on a basis that will allow it to recover its costs, on a yearly basis, for providing products, materials, and services, and provide for a reasonable profit.

`SEC. 1403. LEASING OF GASEOUS DIFFUSION FACILITIES OF DEPARTMENT.

`(a) IN GENERAL- The Corporation shall lease the Paducah Gaseous Diffusion Plant in Paducah, Kentucky, the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio, and related property of the Department, for a period of 6 years from the transition date. Thereafter, the Corporation shall have the exclusive option to lease such facilities and related property for additional periods.

`(b) TERMS OF LEASE- The Corporation and the Department shall set mutually agreeable terms for a lease under subsection (a), including specifying annual payments to the Department by the Corporation to be made. The amount of annual payments shall be equal to the cost incurred by the Department in administering the lease and providing services related to the lease to the Corporation (excluding depreciation and imputed interest on original plant investments in the Department's gaseous diffusion plants and costs under subsection (d)).

`(c) EXCLUSION OF FACILITIES FOR PRODUCTION OF HIGHLY ENRICHED URANIUM- Subsection (a) shall not apply to Department facilities necessary for the production of highly enriched uranium. The Secretary may grant to the Corporation access to such facilities for purposes other than the production of highly enriched uranium.

`(d) DOE RESPONSIBILITY FOR PREEXISTING CONDITIONS- The payment of any costs of decontamination and decommissioning, response actions, or corrective actions with respect to conditions existing before the transition date, in connection with property of the Department leased under subsection (a), shall remain the sole responsibility of the Department.

`(e) ENVIRONMENTAL AUDIT- The Secretary, in consultation with the Administrator of the Environmental Protection Agency, shall conduct a comprehensive environmental audit identifying environmental conditions that will remain the responsibility of the Department pursuant to subsection (d) after the transition date. Such audit shall be completed no later than the transition date.

`(f) TREATMENT UNDER PRICE-ANDERSON PROVISIONS- Any lease executed between the Secretary and the Corporation under this section shall be deemed to be a contract for purposes of section 170 d.

`(g) WAIVER OF EIS REQUIREMENT- The execution of the lease by the Corporation and the Department shall not be considered a major Federal action significantly affecting the quality of the human environment for purposes of section 102 of the National Environmental Policy Act of 1969 (42 U.S.C. 4332).

`SEC. 1404. CAPITAL STRUCTURE OF CORPORATION.

`(a) CAPITAL STOCK-

`(1) ISSUANCE TO SECRETARY OF THE TREASURY- The Corporation shall issue capital stock representing an equity investment equal to the greater of--

`(A) $3,000,000,000; or

`(B) the book value of assets transferred to the Corporation, as reported in the Uranium Enrichment Annual Report for fiscal year 1991, modified to reflect continued depreciation and other usual changes that occur up to the transfer date.

The Secretary of the Treasury shall hold such stock for the United States, except that all rights and duties pertaining to management of the Corporation shall remain vested in the Board.

`(2) RESTRICTION ON TRANSFERS OF STOCK BY UNITED STATES- The capital stock of the Corporation shall not be sold, transferred, or conveyed by the United States, except to carry out the privatization of the Corporation under section 1502.

`(3) ANNUAL ASSESSMENT- The Secretary of the Treasury shall annually assess the value of the stock held by the Secretary under paragraph (1) and submit to the Congress a report setting forth such value. The annual assessment of the Secretary shall be subject to review by an independent auditor.

`(b) PAYMENT OF DIVIDENDS- The Corporation shall pay into miscellaneous receipts of the Treasury of the United States or such other fund as is provided by law, dividends on the capital stock, out of earnings of the Corporation, as a return on the investment represented by such stock. Until privatization occurs under section 1502, the Corporation shall pay as dividends to the Treasury of the United States all net revenues remaining at the end of each fiscal year not required for operating expenses or for deposit into the Working Capital Account established in section 1316.

`(c) PROHIBITION ON ADDITIONAL FEDERAL ASSISTANCE- Except as otherwise specifically provided in this title, the Corporation shall receive no appropriations, loans, or other financial assistance from the Federal Government.

`(d) SOLE RECOVERY OF UNRECOVERED COSTS- Receipt by the United States of the proceeds from the sale of stock issued by the Corporation under subsection (a)(1), and the dividends paid under subsection (b), shall constitute the sole recovery by the United States of previously unrecovered costs (including depreciation and imputed interest on original plant investments in the Department's gaseous diffusion plants) that have been incurred by the United States for uranium enrichment activities prior to the transition date.

`SEC. 1405. PATENTS AND INVENTIONS.

`The Corporation may at any time apply to the Department for a patent license for the use of an invention or discovery useful in the production or utilization of special nuclear material or atomic energy covered by a patent when the patent has not been declared to be affected with the public interest under section 153 a. and when use of the patent is within the Corporation's authority. An application shall constitute an application under section 153 c. subject to section 153 c., d., e., f., g., and h.

`SEC. 1406. LIABILITIES.

`(a) LIABILITIES BASED ON OPERATIONS BEFORE TRANSITION- Except as otherwise provided in this title, all liabilities attributable to operation of the uranium enrichment enterprise before the transition date shall remain direct liabilities of the Department.

`(b) JUDGMENTS BASED ON OPERATIONS BEFORE TRANSITION- Any judgment entered against the Corporation imposing liability arising out of the operation of the uranium enrichment enterprise before the transition date shall be considered a judgment against and shall be payable solely by the Department.

`(c) REPRESENTATION- With regard to any claim seeking to impose liability under subsection (a) or (b), the United States shall be represented by the Department of Justice.

`(d) JUDGMENTS BASED ON OPERATIONS AFTER TRANSITION- Any judgment entered against the Corporation arising from operations of the Corporation on or after the transition date shall be payable solely by the Corporation from its own funds. The Corporation shall not be considered a Federal agency for purposes of chapter 171 of title 28, United States Code.

`SEC. 1407. TRANSFER OF URANIUM INVENTORIES.

`The Secretary shall transfer to the Corporation without charge all raw and low-enriched uranium inventories of the Department necessary for the fulfillment of contracts transferred under section 1401 (b).

`SEC. 1408. PURCHASE OF HIGHLY ENRICHED URANIUM FROM FORMER SOVIET UNION.

`(a) IN GENERAL- The Corporation is authorized to negotiate the purchase of all highly enriched uranium made available by any State of the former Soviet Union under a government-to-government agreement or shall assume the obligations of the Department under any contractual agreement that has been reached with any such State or any private entity before the transition date. The Corporation may only purchase this material so long as the quality of the material can be made suitable for use in commercial reactors.

`(b) ASSESSMENT OF POTENTIAL USE- The Corporation shall prepare an assessment of the potential use of highly enriched uranium in the business operations of the Corporation.

`(c) PLAN FOR BLENDING AND CONVERSION- In the event that the agreement under subsection (a) provides for the Corporation to provide for the blending and conversion the assessment shall include a plan for such blending and conversion. The plan shall determine the least-cost approach to providing blending and conversion services, compatible with environmental, safety, security, and nonproliferation requirements. The plan shall include a competitive process that the Corporation shall use for selecting a provider of such services, including the public solicitation of proposals from the private sector to allow a determination of the least-cost approach.

`(d) MINIMIZATION OF IMPACT ON DOMESTIC INDUSTRIES- The Corporation shall seek to minimize the impact on domestic industries (including uranium mining) of the sale of low-enriched uranium derived from highly enriched uranium.

`CHAPTER 25--PRIVATIZATION OF THE CORPORATION

`SEC. 1501. STRATEGIC PLAN FOR PRIVATIZATION.

`(a) IN GENERAL- Within 2 years after the transition date, the Corporation shall prepare a strategic plan for transferring ownership of the Corporation to private investors. The Corporation shall revise the plan as needed.

`(b) CONSIDERATION OF ALTERNATIVE MEANS OF TRANSFERRING OWNERSHIP- The plan shall include consideration of alternative means for transferring ownership of the Corporation to private investors, including public stock offering, private placement, or merger or acquisition. The plan may call for the phased transfer of ownership or for complete transfer at a single point of time. If the plan calls for phased transfer of ownership, then--

> `(1) privatization shall be deemed to occur when 100 percent of ownership has been transferred to private investors;
>
> `(2) prior to privatization, such stock shall be nonvoting stock; and
>
> `(3) at the time of privatization, such stock shall convert to voting stock.

`(c) EVALUATION AND RECOMMENDATION- The plan shall evaluate the relative merits of the alternatives considered and the estimated return on the Government's investment in the Corporation achievable through each alternative. The plan shall include the Corporation's recommendation on its preferred means of privatization.

`(d) TRANSMITTAL- The Corporation shall transmit copies of the strategic plan for privatization to the President and Congress upon completion.

`SEC. 1502. PRIVATIZATION.

`(a) IMPLEMENTATION- Subsequent to transmitting a plan for privatization pursuant to section 1501, and subject to subsections (b) and (c), the Corporation may implement the privatization plan if the Corporation determines, in consultation with appropriate agencies of the United States, that privatization will--

> `(1) result in a return to the United States at least equal to the net present value of the Corporation;
>
> `(2) not result in the Corporation being owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government;
>
> `(3) not be inimical to the health and safety of the public or the common defense and security; and
>
> `(4) provide reasonable assurance that adequate enrichment capacity will remain available to meet the domestic electric utility industry.

`(b) REQUIREMENT OF PRESIDENTIAL APPROVAL- The Corporation may not implement the privatization plan without the approval of the President.

`(c) NOTIFICATION OF CONGRESS AND GAO EVALUATION- The Corporation shall notify the Congress of its intent to implement the privatization plan. Within 30 days of notification, the Comptroller General shall submit a report to Congress evaluating the extent to which--

`(1) the privatization plan would result in any ongoing obligation or undue cost to the Federal Government; and

`(2) the revenues gained by the Federal Government under the privatization plan would represent at least the net present value of the Corporation.

`(d) PERIOD FOR CONGRESSIONAL REVIEW- The Corporation may not implement the privatization plan less than 60 days after notification of the Congress.

`(e) DEPOSIT OF PROCEEDS- Proceeds from the sale of capital stock of the Corporation under this section shall be deposited in the general fund of the Treasury.

`CHAPTER 26--AVLIS AND ALTERNATIVE TECHNOLOGIES FOR URANIUM ENRICHMENT

`SEC. 1601. ASSESSMENT BY UNITED STATES ENRICHMENT CORPORATION.

`(a) IN GENERAL- The Corporation shall prepare an assessment of the economic viability of proceeding with the commercialization of AVLIS and alternative technologies for uranium enrichment in accordance with this chapter. The assessment shall include--

`(1) an evaluation of market conditions together with a marketing strategy;

`(2) an analysis of the economic viability of competing enrichment technologies;

`(3) an identification of predeployment and capital requirements for the commercialization of AVLIS and alternative technologies for uranium enrichment;

`(4) an estimate of potential earnings from the licensing of AVLIS and alternative technologies for uranium enrichment to a private government sponsored corporation;

`(5) an analysis of outstanding and potential patent and related claims with respect to AVLIS and alternative technologies for uranium enrichment, and a plan for resolving such claims; and

`(6) a contingency plan for providing enriched uranium and related services in the event that deployment of AVLIS and alternative technologies for uranium enrichment is determined not to be economically viable.

`(b) DETERMINATION BY CORPORATION TO PROCEED WITH COMMERCIALIZATION OF AVLIS OR ALTERNATIVE TECHNOLOGIES FOR URANIUM ENRICHMENT- The succeeding sections of this chapter shall apply only to the extent the Corporation determines in its business judgment, on the basis of the assessment prepared under subsection (a), to proceed with the commercialization of AVLIS or alternative technologies for uranium enrichment.

`SEC. 1602. TRANSFER OF RIGHTS AND PROPERTY TO UNITED STATES ENRICHMENT CORPORATION.

`(a) EXCLUSIVE RIGHT TO COMMERCIALIZE- The Corporation shall have the exclusive commercial right to deploy and use any AVLIS patents, processes, and technical information owned or controlled by the Government, upon completion of a royalty agreement with the Department.

`(b) TRANSFER OF RELATED PROPERTY TO CORPORATION-

`(1) IN GENERAL- To the extent requested by the Corporation, the President shall transfer without charge to the Corporation all of the Department's right, title, or interest in and to property owned by the Department, or by the United States but under control or custody of the Department, that is directly related to and materially useful in the performance of the Corporation's purposes regarding AVLIS and alternative technologies for uranium enrichment, including--

`(A) facilities, equipment, and materials for research, development, and demonstration activities; and

`(B) all other facilities, equipment, materials, processes, patents, technical information of any kind, contracts, agreements, and leases.

`(2) EXCEPTION- Facilities, real estate, improvements, and equipment related to the gaseous diffusion, and gas centrifuge, uranium enrichment programs of the Department shall not transfer under paragraph (1)(B).

`(3) EXPIRATION OF TRANSFER AUTHORITY- The President's authority to transfer property under this subsection shall expire upon privatization under section 1502.

`(c) LIABILITY FOR PATENT AND RELATED CLAIMS- With respect to any right, title, or interest provided to the Corporation under subsection (a) or (b), the Corporation shall have sole liability for any payments made or awards under section 157 b. (3), or any settlements or judgments involving claims for alleged patent infringement. Any royalty agreement under subsection (a) shall provide for a reduction of royalty payments to the Department to offset any payments, awards, settlements, or judgments under this subsection.

`SEC. 1603. PREDEPLOYMENT ACTIVITIES BY UNITED STATES ENRICHMENT CORPORATION.

`The Corporation may begin activities necessary to prepare AVLIS or alternative technologies for uranium enrichment for commercialization including--

`(1) completion of preapplication activities with the Nuclear Regulatory Commission;

`(2) preparation of a transition plan to move AVLIS or alternative technologies for uranium enrichment from the laboratory to the marketplace;

`(3) confirmation of technical performance;

`(4) validation of economic projections;

`(5) completion of feasibility and risk studies;

`(6) initiation of preliminary plant design and engineering; and

`(7) site selection, site characterization, and environmental documentation activities on the basis of site evaluations and recommendations prepared for the Department by the Argonne National Laboratory.

`SEC. 1604. UNITED STATES ENRICHMENT CORPORATION SPONSORSHIP OF PRIVATE FOR-PROFIT CORPORATION TO CONSTRUCT AVLIS AND ALTERNATIVE TECHNOLOGIES FOR URANIUM ENRICHMENT.

`(a) ESTABLISHMENT-

`(1) IN GENERAL- If the Corporation determines to proceed with the commercialization of AVLIS or alternative technologies for uranium enrichment under this chapter, the Corporation may provide for the establishment of a private for-profit corporation, which shall have as its initial purpose the construction of a uranium enrichment facility using AVLIS technology or alternative technologies for uranium enrichment.

`(2) PROCESS OF ORGANIZATION- For purposes of the establishment of the private corporation under paragraph (1), the Corporation shall appoint not less than 3 persons to be incorporators. The incorporators so appointed shall each sign the articles of incorporation and shall serve as the initial board of directors until the members of the 1st regular board of directors shall have been appointed and elected. Such incorporators shall take whatever actions are necessary or appropriate to establish the private corporation, including the filing of articles of incorporation in such jurisdiction as the incorporators determine to be appropriate. The incorporators shall also develop a plan for the issuance by the private corporation of voting common stock to the public, which plan shall be subject to the approval of the Secretary of the Treasury.

`(b) LEGAL STATUS OF PRIVATE CORPORATION-

`(1) NOT FEDERAL AGENCY- The private corporation established under subsection (a) shall not be an agency, instrumentality, or establishment of the United States Government and shall not be a Government corporation or Government controlled corporation.

`(2) NO RECOURSE AGAINST UNITED STATES- Obligations of the private corporation established under subsection (a) shall not be obligations of, or guaranteed as to principal or interest by, the Corporation or the United States, and the obligations shall so plainly state.

`(3) NO CLAIMS COURT JURISDICTION- No action under section 1491 of title 28, United States Code, shall be allowable against the United States based on the actions of the private corporation established under subsection (a).

`(c) TRANSACTIONS BETWEEN UNITED STATES ENRICHMENT CORPORATION AND PRIVATE CORPORATION-

`(1) GRANTS FROM USEC- The Corporation may make grants to the private corporation established under subsection (a) from amounts available in the AVLIS Commercialization Fund. Such grants shall be used by the private corporation to carry out any remaining predeployment activity assigned to the private corporation by the Corporation. Such grants may not be used for the costs of constructing an AVLIS, or alternative technologies for uranium enrichment, production facility or engaging in directly related preconstruction activities (other than such assigned predeployment activities). The aggregate amount of such grants shall not exceed $364,000,000.

`(2) LICENSING AGREEMENT- The Corporation shall license to the private corporation established under subsection (a) the rights, titles, and interests provided to the Corporation under

section 1602. The licensing agreement shall require the private corporation to make periodic payments to the Corporation in an amount that is not less than the aggregate amounts paid by the Corporation during the period involved under subsections (a) and (c) of section 1602.

`(3) PURCHASE AGREEMENT- The Corporation may enter into a commitment to purchase all enriched uranium produced at an AVLIS, or alternative technologies for uranium enrichment, facility of the private corporation established under subsection (a) at a price negotiated by the 2 corporations that--

`(A) provides the private corporation with a reasonable return on its investment; and

`(B) is less costly than enriched uranium available from other sources.

`(4) ADDITIONAL ASSISTANCE- The Corporation may provide to the private corporation established under subsection (a), on a reimbursable basis, such additional personnel, services, and equipment as the 2 corporations may determine to be appropriate.

`SEC. 1605. AVLIS COMMERCIALIZATION FUND WITHIN UNITED STATES ENRICHMENT CORPORATION.

`(a) ESTABLISHMENT- The Corporation may establish within the Corporation an AVLIS Commercialization Fund, which shall consist of not more than $364,000,000 paid into the Fund by the Corporation from amounts provided in appropriation Acts for such purposes and from the retained earnings of the Corporation.

`(b) EXPENDITURES FROM FUND- Amounts in the AVLIS Commercialization Fund shall be available for--

`(1) expenses of the Corporation in preparing the assessment under section 1601;

`(2) expenses of predeployment activities under section 1603; and

`(3) grants to the private corporation under section 1604.

`(c) LIMITATIONS-

`(1) EXCLUSIVE SOURCE OF FUNDS- The Corporation may not incur any obligation, or expend any amount, with respect to AVLIS or alternative technologies for uranium enrichment, except from amounts available in the AVLIS Commercialization Fund.

`(2) UNAVAILABLE FOR CONSTRUCTION COSTS- No amount may be used from the AVLIS Commercialization Fund for the costs of constructing an AVLIS, or alternative technologies for uranium enrichment, production facility or engaging in directly related preconstruction activities (other than activities specified in subsection (b)).

`(d) AUTHORIZATION OF APPROPRIATIONS- There is authorized to be appropriated $364,000,000 from the Uranium Enrichment Special Fund for purposes of this section.

`(e) COST REPORT- On the basis of the assessment under section 1601(a)(3), the Corporation shall submit to the Congress a report on the capital requirements for commercialization of AVLIS.

`SEC. 1606. DEPARTMENT RESEARCH AND DEVELOPMENT ASSISTANCE.

`If requested by the Corporation, the Secretary shall provide, on a reimbursable basis, research and development of AVLIS and alternative technologies for uranium enrichment.

`SEC. 1607. SITE SELECTION.

`This chapter shall not prejudice consideration of the site of an existing uranium enrichment facility as a candidate site for future expansion or replacement of uranium enrichment capacity through AVLIS or alternative technologies for uranium enrichment. Selection of a site for the AVLIS, or alternative technologies for uranium enrichment, facility shall be made on a competitive basis, taking into consideration economic performance, environmental compatibility, and use of any existing uranium enrichment facilities.

`SEC. 1608. EXCLUSION FROM PRICE-ANDERSON COVERAGE.

`Section 170 shall not apply to any license under section 53, 63, or 103 for a uranium enrichment facility constructed after the date of the enactment of this title.'.

SEC. 902. CONFORMING AMENDMENTS AND REPEALERS.

(a) ATOMIC ENERGY ACT OF 1954-

(1) The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) is amended--

(A) by inserting after `ATOMIC ENERGY ACT OF 1954' the 1st place it appears the following:

`TABLE OF CONTENTS

`TITLE I--ATOMIC ENERGY';

and

(B) by adding at the end of the table of contents the following:

`TITLE II--UNITED STATES ENRICHMENT CORPORATION

`Chapter 22--General Provisions

`Sec. 1201. Definitions.

`Sec. 1202. Purposes.

`Chapter 23--Establishment, Powers, and Organization of Corporation

`Sec. 1301. Establishment of the Corporation.

`Sec. 1501. Strategic plan for privatization.

`Sec. 1502. Privatization.

`Chapter 26--AVLIS and Alternative Technologies for Uranium Enrichment

`Sec. 1601. Assessment by United States Enrichment Corporation.

`Sec. 1602. Transfer of rights and property to United States Enrichment Corporation.

`Sec. 1603. Predeployment activities by United States Enrichment Corporation.

`Sec. 1604. United States Enrichment Corporation sponsorship of private for-profit corporation to construct AVLIS and alternative technologies for uranium enrichment.

`Sec. 1605. AVLIS Commercialization Fund within United States Enrichment Corporation.

`Sec. 1606. Department research and development assistance.

`Sec. 1607. Site selection.

`Sec. 1608. Exclusion from Price-Anderson coverage.'.

(2) Section 41 a. of the Atomic Energy Act of 1954 (42 U.S.C. 2061(a)) is amended--

(A) by striking `or';

(B) by striking `pursuant to under this Act' and inserting `under this title'; and

(C) by striking the period at the end and inserting `; or (3) are owned by the United States Enrichment Corporation.'.

(3) Section 53 c. (1) of the Atomic Energy Act of 1954 (42 U.S.C. 2073(c)(1)) is amended--

(A) by striking `grant,' and inserting `or grant'; and

(B) by striking `or through the provision of production or enrichment services' both places it appears.

(4) Section 161 v. of the Atomic Energy Act of 1954 (42 U.S.C. 2201(v)) is amended to read as follows:

`v. provide services in support of the United States Enrichment Corporation, except that the Secretary of Energy shall annually collect payments and other charges from the Corporation sufficient to ensure recovery of the costs (excluding depreciation and imputed interest on original plant investments in the Department's gaseous diffusion plants and costs under section 1403(d)) incurred by the Department of Energy after the date of the enactment of the Energy Policy Act of 1992 in performing such services;'.

(5) Section 161 w. of the Atomic Energy Act of 1954 (42 U.S.C. 2201(w)) is amended--

(A) by striking the comma after `104 b.' and inserting the following: `, or which operates any facility regulated or certified under section 1701 or 1702,'; and

(B) by inserting `or certificates' after `holders of, such licenses'.

(6) Section 274 c. (1) of the Atomic Energy Act of 1954 (42 U.S.C. 2021(c)(1)) is amended by inserting `or any uranium enrichment facility' before the semicolon at the end.

(7) Section 318(1) of the Atomic Energy Act of 1954 (42 U.S.C. 2286g(1)) is amended by striking `or' at the end of subparagraph (B), by striking the period at the end of subparagraph (C) and inserting `; or', and by adding at the end the following new subparagraph:

`(D) any facility owned by the United States Enrichment Corporation.'.

(8) The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) is amended by inserting before the chapter heading for chapter 1 the following new heading:

`TITLE I--ATOMIC ENERGY'.

(b) GOVERNMENT CORPORATION CONTROL PROVISIONS- Section 9101(3) of title 31, United States Code is amended by adding at the end the following:

`(N) the Uranium Enrichment Corporation.'.

(c) ENERGY AND WATER DEVELOPMENT APPROPRIATION ACT, 1988- Section 306 of the Energy and Water Development Appropriation Act, 1988 (Pub. L. 100-202; 101 Stat. 1329-126) is repealed.

(d) EXEMPTION FROM DEFICIT CONTROL ACT- Section 255(g)(1)(A) of the Balanced Budget and Emergency Deficit Control Act of 1985 (2 U.S.C. 905(g)(1)(A)) is amended by inserting after the item relating to the Tennessee Valley Authority fund the following new item:

`United States Enrichment Corporation;'.

SEC. 903. RESTRICTIONS ON NUCLEAR EXPORTS.

(a) FURTHER RESTRICTIONS-

(1) IN GENERAL- Chapter 11 of the Atomic Energy Act of 1954 (42 U.S.C. 2151 et seq.) is amended by adding at the end the following new section:

`SEC. 134. FURTHER RESTRICTIONS ON EXPORTS-

`a. The Commission may issue a license for the export of highly enriched uranium to be used as a fuel or target in a nuclear research or test reactor only if, in addition to any other requirement of this Act, the Commission determines that--

`(1) there is no alternative nuclear reactor fuel or target enriched in the isotope 235 to a lesser

percent than the proposed export, that can be used in that reactor;

`(2) the proposed recipient of that uranium has provided assurances that, whenever an alternative nuclear reactor fuel or target can be used in that reactor, it will use that alternative in lieu of highly enriched uranium; and

`(3) the United States Government is actively developing an alternative nuclear reactor fuel or target that can be used in that reactor.

`b. As used in this section--

`(1) the term `alternative nuclear reactor fuel or target' means a nuclear reactor fuel or target which is enriched to less than 20 percent in the isotope U-235;

`(2) the term `highly enriched uranium' means uranium enriched to 20 percent or more in the isotope U-235; and

`(3) a fuel or target `can be used' in a nuclear research or test reactor if--

`(A) the fuel or target has been qualified by the Reduced Enrichment Research and Test Reactor Program of the Department of Energy, and

`(B) use of the fuel or target will permit the large majority of ongoing and planned experiments and isotope production to be conducted in the reactor without a large percentage increase in the total cost of operating the reactor.'.

(2) CLERICAL AMENDMENT- The table of contents of the Atomic Energy Act of 1954 is amended by adding at the end of the items relating to chapter 11 the following new item:

`Sec. 134. Further restrictions on exports.'.

(b) REPORT TO CONGRESS-

(1) IN GENERAL- Not later than 90 days after the date of the enactment of this Act, the Chairman of the Nuclear Regulatory Commission, after consulting with other relevant agencies, shall submit to the Congress a report detailing the current disposition of previous United States exports of highly enriched uranium, including--

(A) their location;

(B) whether they are irradiated;

(C) whether they have been used for the purpose stated in their export license; and

(D) whether they have been used for an alternative purpose and, if so, whether such alternative purpose has been explicitly approved by the Commission.

(2) EXPORTS TO EURATOM- To the maximum extent possible, the report required by paragraph (1) shall include--

(A) exports of highly enriched uranium to EURATOM; and

(B) subsequent retransfers of such material within EURATOM, without regard to the extent of United States control over such retransfers.

SEC. 904. SEVERABILITY.

If any provision of this title, or the amendments made by this title, or the application of any provision to any entity, person, or circumstance, is for any reason adjudged by a court of competent jurisdiction to be invalid, the remainder of this title, and the amendments made by this title, or its application shall not be affected.

TITLE X--REMEDIAL ACTION AND URANIUM REVITALIZATION

Subtitle A--Remedial Action at Active Processing Sites

SEC. 1001. REMEDIAL ACTION PROGRAM.

(a) IN GENERAL- Except as provided in subsection (b), the costs of decontamination, decommissioning, reclamation, and other remedial action at an active uranium or thorium processing site shall be borne by persons licensed under section 62 or 81 of the Atomic Energy Act of 1954 (42 U.S.C. 2091, 2111) for any activity at such site which results or has resulted in the production of byproduct material.

(b) REIMBURSEMENT-

(1) IN GENERAL- The Secretary of Energy shall, subject to paragraph (2), reimburse at least annually a licensee described in subsection (a) for such portion of the costs described in such subsection as are--

(A) determined by the Secretary to be attributable to byproduct material generated as an incident of sales to the United States; and

(B) either--

(i) incurred by such licensee not later than December 31, 2002; or

(ii) placed in escrow not later than December 31, 2002, in accordance with a plan for subsequent decontamination, decommissioning, reclamation, and other remedial action approved by the Secretary.

(2) AMOUNT-

(A) TO INDIVIDUAL ACTIVE SITE URANIUM LICENSEES- The amount of reimbursement paid to any licensee under paragraph (1) shall be determined by the Secretary in accordance with regulations issued pursuant to section 1002 and, for uranium mill tailings only, shall not exceed an amount equal to $5.50 multiplied by the dry short tons of byproduct material located on the date of the enactment of this Act at the site of the activities of such licensee described in subsection (a), and generated as an incident of sales to the United States.

(B) TO ALL ACTIVE SITE URANIUM LICENSEES- Payments made under paragraph (1) to active site uranium licensees shall not in the aggregate exceed $270,000,000.

(C) TO THORIUM LICENSEES- Payments made under paragraph (1) to the licensee of the active thorium site shall not exceed $40,000,000, and may only be made for off-site disposal.

(D) INFLATION ESCALATION INDEX- The amounts in subparagraphs (A), (B), and (C) of this paragraph shall be increased annually based upon an inflation index. The Secretary shall determine the appropriate index to apply.

(E) ADDITIONAL REIMBURSEMENT-

(i) DETERMINATION OF EXCESS- The Secretary shall determine as of July 31, 2005, whether the amount authorized to be appropriated pursuant to section 1003, when considered with the $5.50 per dry short ton limit on reimbursement, exceeds the amount reimbursable to the licensees under subsection (b)(2).

(ii) IN THE EVENT OF EXCESS- If the Secretary determines under clause (i) that there is an excess, the Secretary may allow reimbursement in excess of $5.50 per dry short ton on a prorated basis at such sites where the costs reimbursable under subsection (b)(1) exceed the $5.50 per dry short ton limitation described in paragraph (2) of such subsection.

(3) BYPRODUCT LOCATION- Notwithstanding the requirement of paragraph (2)(A) that byproduct material be located at the site on the date of the enactment of this Act, byproduct material moved from the site of the Edgemont Mill to a disposal site as the result of the decontamination, decommissioning, reclamation, and other remedial action of such mill shall be eligible for reimbursement to the extent eligible under paragraph (1).

SEC. 1002. REGULATIONS.

Within 180 days of the date of the enactment of this Act, the Secretary shall issue regulations governing reimbursement under section 1001. An active uranium or thorium processing site owner shall apply for reimbursement hereunder by submitting a request for the amount of reimbursement, together with reasonable documentation in support thereof, to the Secretary. Any such request for reimbursement, supported by reasonable documentation, shall be approved by the Secretary and reimbursement therefor shall be made in a timely manner subject only to the limitations of section 1001.

SEC. 1003. AUTHORIZATION OF APPROPRIATIONS.

(a) IN GENERAL- There is authorized to be appropriated $310,000,000 to carry out this subtitle. The aggregate amount authorized in the preceding sentence shall be increased annually as provided in section 1001, based upon an inflation index to be determined by the Secretary.

(b) SOURCE- Funds described in subsection (a) shall be provided from the Fund established under section 1801 of the Atomic Energy Act of 1954.

SEC. 1004. DEFINITIONS.

For purposes of this subtitle:

(1) The term `active uranium or thorium processing site' means--

(A) any uranium or thorium processing site, including the mill, containing byproduct material for which a license (issued by the Nuclear Regulatory Commission or its predecessor agency under the Atomic Energy Act of 1954, or by a State as permitted under section 274 of such Act (42 U.S.C. 2021)) for the production at such site of any uranium or thorium derived from ore--

(i) was in effect on January 1, 1978;

(ii) was issued or renewed after January 1, 1978; or

(iii) for which an application for renewal or issuance was pending on, or after January 1, 1978; and

(B) any other real property or improvement on such real property that is determined by the Secretary or by a State as permitted under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021) to be--

(i) in the vicinity of such site; and

(ii) contaminated with residual byproduct material;

(2) The term `byproduct material' has the meaning given such term in section 11 e. (2) of the Atomic Energy Act of 1954, (42 U.S.C. 2014(e)(2)); and

(3) The term `decontamination, decommissioning, reclamation, and other remedial action' means work performed prior to or subsequent to the date of the enactment of this Act which is necessary to comply with all applicable requirements of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 7901 et seq.), or where appropriate, with requirements established by a State that is a party to a discontinuance agreement under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021).

Subtitle B--Uranium Revitalization

SEC. 1011. OVERFEED PROGRAM.

(a) URANIUM PURCHASES- To the maximum extent permitted by sound business practice, the Corporation shall purchase uranium in accordance with subsection (b) and overfeed it into the enrichment process to reduce the amount of power required to produce the enriched uranium ordered by enrichment services customers, taking into account costs associated with depleted tailings.

(b) USE OF DOMESTIC URANIUM- Uranium purchased by the Corporation for purposes of this section shall be of domestic origin and purchased from domestic uranium producers to the extent permitted under the General Agreement on Tariffs and Trade and the United States-Canada Free Trade Agreement.

SEC. 1012. NATIONAL STRATEGIC URANIUM RESERVE.

There is hereby established the National Strategic Uranium Reserve under the direction and control of the Secretary. The Reserve shall consist of natural uranium and uranium equivalents contained in stockpiles or inventories currently held by the United States for defense purposes. Effective on the date of the enactment of this Act and for 6 years thereafter, use of the Reserve shall be restricted to military purposes and government research. Use of the Department of Energy's stockpile of enrichment tails existing on the date of the enactment of this Act shall be restricted to military purposes for 6 years thereafter.

SEC. 1013. SALE OF REMAINING DOE INVENTORIES.

The Secretary, after making the transfer required under section 1407 of the Atomic Energy Act of 1954, may sell, from time to time, portions of the remaining inventories of raw or low-enriched uranium of the Department that are not necessary to national security needs, to the Corporation, at a fair market price. Sales under this section may be made only if such sales will not have a substantial adverse impact on the domestic uranium mining industry. Proceeds from sales under this subsection shall be deposited into the general fund of the United States Treasury.

SEC. 1014. RESPONSIBILITY FOR THE INDUSTRY.

(a) CONTINUING SECRETARIAL RESPONSIBILITY- The Secretary shall have a continuing responsibility for the domestic uranium industry to encourage the use of domestic uranium. The Secretary, in fulfilling this responsibility, shall not use any supervisory authority over the Corporation. The Secretary shall report annually to the appropriate committees of Congress on action taken with respect to the domestic uranium industry, including action to promote the export of domestic uranium pursuant to subsection (b).

(b) ENCOURAGE EXPORT- The Department, with the cooperation of the Department of Commerce, the United States Trade Representative and other governmental organizations, shall encourage the export of domestic uranium. Within 180 days after the date of the enactment of this Act, the Secretary shall develop recommendations and implement government programs to promote the export of domestic uranium.

SEC. 1015. ANNUAL URANIUM PURCHASE REPORTS.

(a) IN GENERAL- By January 1 of each year, the owner or operator of any civilian nuclear power reactor shall report to the Secretary, acting through the Administrator of the Energy Information Administration, for activities of the previous fiscal year--

(1) the country of origin and the seller of any uranium or enriched uranium purchased or imported into the United States either directly or indirectly by such owner or operator; and

(2) the country of origin and the seller of any enrichment services purchased by such owner or operator.

(b) CONGRESSIONAL ACCESS- The information provided to the Secretary pursuant to this section shall be made available to the Congress by March 1 of each year.

SEC. 1016. URANIUM INVENTORY STUDY.

Within 1 year after the date of the enactment of this Act, the Secretary shall submit to the Congress a

study and report that includes--

(1) a comprehensive inventory of all Government owned uranium or uranium equivalents, including natural uranium, depleted tailings, low-enriched uranium, and highly enriched uranium available for conversion to commercial use;

(2) a plan for the conversion of inventories of foreign and domestic highly enriched uranium to low-enriched uranium for commercial use;

(3) an estimation of the potential need of the United States for inventories of highly enriched uranium;

(4) an analysis and summary of technological requirements and costs associated with converting highly enriched uranium to low-enriched uranium, including the construction of facilities if necessary;

(5) an estimation of potential net proceeds from the conversion and sale of highly enriched uranium;

(6) recommendations for implementing a plan to convert highly enriched uranium to low-enriched uranium; and

(7) recommendations for the future use and disposition of such inventories.

SEC. 1017. REGULATORY TREATMENT OF URANIUM PURCHASES.

(a) ENCOURAGEMENT- The Secretary shall encourage States and utility regulatory authorities to take into consideration the achievement of the objectives and purposes of this subtitle, including the national need to avoid dependence on imports, when considering whether to allow the owner or operator of any electric power plant to recover in its rates and charges to customers any cost of purchase of domestic uranium, enriched uranium, or enrichment services from a non-affiliated seller greater than the cost of non-domestic uranium, enriched uranium or enrichment services.

(b) REPORT- Within 1 year after the date of the enactment of this Act, and annually thereafter, the Secretary shall report to the Congress on the progress of the Secretary in encouraging actions by State regulatory authorities pursuant to subsection (a). Such report shall include detailed information on programs initiated by the Secretary to encourage appropriate State regulatory action and recommendations, if any, on further action that could be taken by the Secretary, other Federal agencies, or the Congress in order to further the purposes of this subtitle.

(c) SAVINGS PROVISION- This section may not be construed to authorize the Secretary to take any action in violation of the General Agreement on Tariffs and Trade or the United States-Canada Free Trade Agreement.

SEC. 1018. DEFINITIONS.

For purposes of this subtitle:

(1) The term `Corporation' means the United States Enrichment Corporation established under section 1301 of the Atomic Energy Act of 1954, as added by this Act.

(2) The term `country of origin' means--

(A) with respect to uranium, that country where the uranium was mined;

(B) with respect to enriched uranium, that country where the uranium was mined and enriched; or

(C) with respect to enrichment services, that country where the enrichment services were performed.

(3) The term `domestic origin' refers to any uranium that has been mined in the United States including uranium recovered from uranium deposits in the United States by underground mining, open-pit mining, strip mining, in situ recovery, leaching, and ion recovery, or recovered from phosphoric acid manufactured in the United States.

(4) The term `domestic uranium producer' means a person or entity who produces domestic uranium and who has, to the extent required by State and Federal agencies having jurisdiction, licenses and permits for the operation, decontamination, decommissioning, and reclamation of sites, structures and equipment.

(5) The term `non-affiliated' refers to a seller who does not control, and is not controlled by or under common control with, the buyer.

(6) The term `overfeed' means to use uranium in the enrichment process in excess of the amount required at the transactional tails assay.

(7) The term `utility regulatory authority' means any State agency or Federal agency that has ratemaking authority with respect to the sale of electric energy by any electric utility or independent power producer. For purposes of this paragraph, the terms `electric utility', `State agency', `Federal agency', and `ratemaking authority' have the respective meanings given such terms in section 3 of the Public Utility Regulatory Policies Act of 1978.

Subtitle C--Remedial Action at Inactive Processing Sites

SEC. 1031. URANIUM MILL TAILINGS RADIATION CONTROL ACT EXTENSION.

Section 112(a) of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 7922(a)) is amended by striking `1994' and inserting `1996'.

TITLE XI--URANIUM ENRICHMENT HEALTH, SAFETY, AND ENVIRONMENT ISSUES

SEC. 1101. URANIUM ENRICHMENT HEALTH, SAFETY, AND ENVIRONMENT ISSUES.

The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended by title IX of this Act, is further amended by adding at the end of title II the following:

`CHAPTER 27--LICENSING AND REGULATION OF URANIUM ENRICHMENT FACILITIES

`SEC. 1701. GASEOUS DIFFUSION FACILITIES.

`(a) ISSUANCE OF STANDARDS- Within 2 years after the date of the enactment of this title, the Nuclear Regulatory Commission shall establish by regulation such standards as are necessary to govern the gaseous diffusion uranium enrichment facilities of the Department in order to protect the public health and safety from radiological hazard and provide for the common defense and security. Regulations promulgated pursuant to this subsection shall, among other things, require that adequate safeguards (within the meaning of section 147) are in place.

`(b) ANNUAL REPORT-

`(1) IN GENERAL- The Nuclear Regulatory Commission, in consultation with the Department and the Environmental Protection Agency, shall report at least annually to the Congress on the status of health, safety, and environmental conditions at the gaseous diffusion uranium enrichment facilities of the Department.

`(2) REQUIRED DETERMINATION- Such report shall include a determination regarding whether the gaseous diffusion uranium enrichment facilities of the Department are in compliance with the standards established under subsection (a) and all applicable laws.

`(c) CERTIFICATION PROCESS-

`(1) ESTABLISHMENT- The Nuclear Regulatory Commission shall establish a certification process to ensure that the Corporation complies with standards established under subsection (a).

`(2) ANNUAL APPLICATION FOR CERTIFICATE OF COMPLIANCE- The Corporation shall apply at least annually to the Nuclear Regulatory Commission for a certificate of compliance under paragraph (1). The Nuclear Regulatory Commission, in consultation with the Environmental Protection Agency, shall review any such application and any determination made under subsection (b)(2) shall be based on the results of any such review.

`(3) TREATMENT OF CERTIFICATE OF COMPLIANCE- The requirement for a certificate of compliance under paragraph (1) shall be in lieu of any requirement for a license for any gaseous diffusion facility of the Department leased by the Corporation.

`(4) NRC REVIEW-

`(A) IN GENERAL- The Nuclear Regulatory Commission, in consultation with the Environmental Protection Agency, shall review the operations of the Corporation with respect to any gaseous diffusion uranium enrichment facilities of the Department leased by the Corporation to ensure that public health and safety are adequately protected.

`(B) ACCESS TO FACILITIES AND INFORMATION- The Corporation and the Department shall cooperate fully with the Nuclear Regulatory Commission and the Environmental Protection Agency and shall provide the Nuclear Regulatory Commission and the Environmental Protection Agency with the ready access to the facilities, personnel, and information the Nuclear Regulatory Commission and the Environmental Protection Agency consider necessary to carry out their responsibilities under this subsection. A contractor operating a Corporation facility for the Corporation shall provide the Nuclear Regulatory Commission and the Environmental Protection Agency with ready access to the

facilities, personnel, and information of the contractor as the Nuclear Regulatory Commission and the Environmental Protection Agency consider necessary to carry out their responsibilities under this subsection.

`(C) LIMITATION- The Nuclear Regulatory Commission shall limit its finding under subsection (b)(2) to a determination of whether the facilities are in compliance with the standards established under subsection (a).

`(d) REQUIREMENT FOR OPERATION- The gaseous diffusion uranium enrichment facilities of the Department may not be operated by the Corporation unless the Nuclear Regulatory Commission, in consultation with the Environmental Protection Agency, makes a determination of compliance under subsection (b) or approves a plan prepared by the Department for achieving compliance required under subsection (b).

`SEC. 1702. LICENSING OF OTHER TECHNOLOGIES.

`(a) IN GENERAL- Corporation facilities using alternative technologies for uranium enrichment, other than AVLIS, shall be licensed under sections 53 and 63.

`(b) COSTS FOR DECONTAMINATION AND DECOMMISSIONING- The Corporation shall provide for the costs of decontamination and decommissioning of any Corporation facilities described in subsection (a) in accordance with the requirements of the amendments made by section 5 of the Solar, Wind, Waste, and Geothermal Power Production Act of 1990.

`SEC. 1703. REGULATION OF RESTRICTED DATA.

`The Corporation shall be subject to this Act with respect to the use of, or access to, Restricted Data to the same extent as any private corporation.

`CHAPTER 28--DECONTAMINATION AND DECOMMISSIONING

`SEC. 1801. URANIUM ENRICHMENT DECONTAMINATION AND DECOMMISSIONING FUND.

`(a) ESTABLISHMENT- There is established in the Treasury of the United States an account to be known as the Uranium Enrichment Decontamination and Decommissioning Fund (referred to in this chapter as the `Fund'). The Fund, and any amounts deposited in it, including any interest earned thereon, shall be available to the Secretary subject to appropriations for the exclusive purpose of carrying out this chapter.

`(b) ADMINISTRATION-

`(1) IN GENERAL- The Secretary of the Treasury shall hold the Fund and, after consultation with the Secretary, annually report to the Congress on the financial condition and operations of the Fund during the preceding fiscal year.

`(2) INVESTMENTS- The Secretary of the Treasury shall invest amounts contained within the Fund in obligations of the United States--

`(A) having maturities determined by the Secretary of the Treasury to be appropriate for what the Department determines to be the needs of the Fund; and

`(B) bearing interest at rates determined to be appropriate by the Secretary of the Treasury, taking into consideration the current average market yield on outstanding marketable obligations of the United States with remaining periods to maturity comparable to these obligations.

`SEC. 1802. DEPOSITS.

`(a) AMOUNT- The Fund shall consist of deposits in the amount of $480,000,000 per fiscal year (to be annually adjusted for inflation using the Consumer Price Index for all-urban consumers published by the Department of Labor) as provided in this section.

`(b) SOURCE- Deposits described in subsection (a) shall be from the following sources:

`(1) Sums collected pursuant to subsection (c).

`(2) Appropriations made pursuant to subsection (d).

`(c) SPECIAL ASSESSMENT- The Secretary shall collect a special assessment from domestic utilities. The total amount collected for a fiscal year shall not exceed $150,000,000 (to be annually adjusted for inflation using the Consumer Price Index for all-urban consumers published by the Department of Labor). The amount collected from each utility pursuant to this subsection for a fiscal year shall be in the same ratio to the amount required under subsection (a) to be deposited for such fiscal year as the total amount of separative work units such utility has purchased from the Department of Energy for the purpose of commercial electricity generation, before the date of the enactment of this title, bears to the total amount of separative work units purchased from the Department of Energy for all purposes (including units purchased or produced for defense purposes) before the date of the enactment of this title. For purposes of this subsection--

`(1) a utility shall be considered to have purchased a separative work unit from the Department if such separative work unit was produced by the Department, but purchased by the utility from another source; and

`(2) a utility shall not be considered to have purchased a separative work unit from the Department if such separative work unit was purchased by the utility, but sold to another source.

`(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Fund, for the period encompassing 15 years after the date of the enactment of this title, such sums as are necessary to ensure that the amount required under subsection (a) is deposited for each fiscal year.

`(e) TERMINATION OF ASSESSMENTS- The collection of amounts under subsection (c) shall cease after the earlier of--

`(1) 15 years after the date of the enactment of this title; or

`(2) the collection of $2,250,000,000 (to be annually adjusted for inflation using the Consumer Price Index for all-urban consumers published by the Department of Labor) under such subsection.

`(f) CONTINUATION OF DEPOSITS- Except as provided in subsection (e), deposits shall continue to be made into the Fund under subsection (d) for the period specified in such subsection.

`(g) TREATMENT OF ASSESSMENT- Any special assessment levied under this section on domestic utilities for the decontamination and decommissioning of the Department's gaseous diffusion enrichment facilities shall be deemed a necessary and reasonable current cost of fuel and shall be fully recoverable in rates in all jurisdictions in the same manner as the utility's other fuel cost.

`SEC. 1803. DEPARTMENT FACILITIES.

`(a) STUDY BY NATIONAL ACADEMY OF SCIENCES- The National Academy of Sciences shall conduct a study and provide recommendations for reducing costs associated with decontamination and decommissioning, and shall report its findings to the Congress within 3 years after the date of the enactment of this title. Such report shall include a determination of the decontamination and decommissioning required for each facility, shall identify alternative methods, using different technologies, shall include site-specific surveys of the actual contamination, and shall provide estimated costs of those activities.

`(b) PAYMENT OF DECONTAMINATION AND DECOMMISSIONING COSTS- The costs of all decontamination and decommissioning activities of the Department shall be paid from the Fund until such time as the Secretary certifies and the Congress concurs, by law, that such activities are complete.

`(c) PAYMENT OF REMEDIAL ACTION COSTS- The annual cost of remedial action at the Department's gaseous diffusion facilities shall be paid from the Fund to the extent the amount available in the Fund is sufficient. To the extent the amount in the Fund is insufficient, the Department shall be responsible for the cost of remedial action. No provision of this title may be construed to relieve in any way the responsibility or liability of the Department for remedial action under applicable Federal and State laws and regulations.

`SEC. 1804. EMPLOYEE PROVISIONS.

`All laborers and mechanics employed by contractors or subcontractors in the performance of decontamination or decommissioning of uranium enrichment facilities of the Department shall be paid wages at rates not less than those prevailing on projects of a similar character in the locality as determined by the Secretary of Labor in accordance with the Act of March 3, 1931 (known as the Davis-Bacon Act) (40 U.S.C. 276a et seq.). The Secretary of Labor shall have, with respect to the labor standards specified in this section, the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (15 F.R. 3176, 64 Stat. 1267) and the Act of June 13, 1934 (40 U.S.C. 276c). This section may not be construed to require the contracting out of activities associated with the decontamination or decommissioning of uranium enrichment facilities.

`SEC. 1805. REPORTS TO CONGRESS.

`Within 3 years after the date of the enactment of this title, and at least once every 3 years thereafter, the Secretary shall report to the Congress on progress under this chapter. The 5th report submitted under this section shall contain recommendations of the Secretary for the reauthorization of the program and Fund under this title.'.

SEC. 1102. LICENSING OF AVLIS.

The last sentence of section 11 v. of the Atomic Energy Act of 1954 (42 U.S.C. 2014(v)) is amended to read as follows: `Except with respect to the export of a uranium enrichment production facility or the construction and operation of a uranium enrichment production facility using Atomic Vapor Laser

Isotope Separation technology, such term as used in chapters 10 and 16 shall not include any equipment or device (or important component part especially designed for such equipment or device) capable of separating the isotopes of uranium or enriching uranium in the isotope 235.'.

SEC. 1103. TABLE OF CONTENTS.

The table of contents for title II of the Atomic Energy Act of 1954, as added by title IX of this Act, is amended by adding at the end the following:

`Chapter 27--Licensing and Regulation of Uranium Enrichment Facilities

`Chapter 28--Decontamination and Decommissioning

TITLE XII--RENEWABLE ENERGY

SEC. 1201. PURPOSES.

The purposes of this title are to promote--

(1) increases in the production and utilization of energy from renewable energy resources;

(2) further advances of renewable energy technologies; and

(3) exports of United States renewable energy technologies and services.

SEC. 1202. DEMONSTRATION AND COMMERCIAL APPLICATION PROJECTS FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY TECHNOLOGIES.

(a) DEMONSTRATION AND COMMERCIAL APPLICATION PROJECTS- Section 6 of the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12005) is amended to read as follows:

`SEC. 6. DEMONSTRATION AND COMMERCIAL APPLICATION PROJECTS.

`(a) PURPOSE- The purpose of this section is to direct the Secretary to further the commercialization of renewable energy and energy efficiency technologies through a five-year program.

`(b) DEMONSTRATION AND COMMERCIAL APPLICATION PROJECTS-

`(1) ESTABLISHMENT- (A) The Secretary shall solicit proposals for demonstration and commercial application projects for renewable energy and energy efficiency technologies pursuant to subsection (c). Such projects may include projects for--

`(i) the production and sale of electricity, thermal energy, or other forms of energy using a renewable energy technology;

`(ii) increasing the efficiency of energy use; and

`(iii) improvements in, or expansion of, facilities for the manufacture of renewable energy or energy efficiency technologies.

`(B) REQUIREMENTS- Each project selected under this section shall include at least one for-profit business. Activities supported under this section shall be performed in the United States. Each project under this section shall require the manufacture and reproduction substantially within the United States for commercial sale of any invention or product that may result from the project.

`(2) FORMS OF FINANCIAL ASSISTANCE- (A) In supporting projects selected under subsection (c), the Secretary may choose from among the forms of agreements described in section 3001 of the Energy Policy Act of 1992.

`(B) In supporting projects selected under subsection (c), the Secretary may also enter into agreements with private lenders to pay a portion of the interest on loans made for such projects.

`(3) COST SHARING- Cost sharing for projects under this section shall be conducted according to the procedures described in section 3002 (b) and (c) of the Energy Policy Act of 1992.

`(4) ADVISORY COMMITTEE- (A) The Secretary shall establish an Advisory Committee on Demonstration and Commercial Application of Renewable Energy and Energy Efficiency Technologies (in this Act referred to as the `Advisory Committee') to advise the Secretary on the development of the solicitation and evaluation criteria for projects under this section, and on otherwise carrying out his responsibilities under this section. The Secretary shall appoint members to the Advisory Committee, including at least one member representing--

`(i) the Secretary of Commerce;

`(ii) the National Laboratories of the Department of Energy;

`(iii) the Solar Energy Research Institute;

`(iv) the Electric Power Research Institute;

`(v) the Gas Research Institute;

`(vi) the National Institute of Building Sciences;

`(vii) the National Institute of Standards and Technology;

`(viii) associations of firms in the major renewable energy manufacturing industries; and

`(ix) associations of firms in the major energy efficiency manufacturing industries.

Nothing in this subparagraph shall be construed to require the Secretary to reestablish the Advisory Committee in place under this subsection as of the date of enactment of the Energy Policy Act of 1992, or to perform again any duties performed by such advisory committee before such date of enactment.

`(B) Not later than 18 months after the date of the enactment of the Energy Policy Act of 1992, the Advisory Committee shall provide the Secretary with a report assessing the implementation of the program under this section, including specific recommendations for improvements or changes to the program and solicitation process. The Secretary shall transmit such report and, if any, the Secretary's recommendations to the Congress.

`(c) SELECTION OF PROJECTS-

`(1) SOLICITATION- (A) Not later than 9 months after the date of the enactment of the Energy Policy Act of 1992, the Secretary shall solicit proposals for projects under this section. The Secretary may make additional solicitations for proposals if the Secretary determines that such solicitations are necessary to carry out this section.

`(B) A solicitation for proposals under this paragraph shall establish a closing date for receipt of proposals. The Secretary may, if necessary, extend the closing date for receipt of proposals for a period not to exceed 90 days.

`(C) Each solicitation under this paragraph shall include a description of the criteria, developed by the Secretary, according to which proposals will be evaluated. In developing such criteria, the Secretary shall consider--

`(i) the need for Federal involvement to commercialize the technology or speed commercialization of the technology;

`(ii) the potential for the technology to have significant market penetration;

`(iii) the potential energy efficiency gains or energy supply contributions of the technology;

`(iv) potential environmental improvements associated with the technology;

`(v) the export potential of the technology;

`(vi) the likelihood that the proposal is technically sufficient to achieve the objective of the solicitation;

`(vii) the degree to which non-Federal financial participation is involved in the proposal;

`(viii) the business and financial history of the proposer or proposers; and

`(ix) any other factor the Secretary considers appropriate.

`(2) PROJECT TECHNOLOGIES- Projects under this section may include the following technologies:

`(A) Conversion of cellulosic biomass to liquid fuels.

`(B) Ethanol and ethanol byproduct processes.

`(C) Direct combustion or gasification of biomass.

`(D) Biofuels energy systems.

`(E) Photovoltaics, including utility scale and remote applications.

`(F) Solar thermal, including solar water heating.

`(G) Wind energy.

`(H) High temperature and low temperature geothermal energy.

`(I) Fuel cells, including transportation and stationary applications.

`(J) Nondefense high-temperature superconducting electricity technology.

`(K) Source reduction technology.

`(L) Factory-made housing.

`(M) Advanced district cooling.

`(3) PROJECT SELECTION- The Secretary shall, within 120 days after the closing date established under paragraph (1)(B), select proposals to receive financial assistance under this section. In selecting proposals under this paragraph, the Secretary shall--

`(A) consider each proposal's ability to meet the criteria developed pursuant to paragraph (1)(C); and

`(B) attempt to achieve technological and geographic diversity.

`(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $50,000,000 for fiscal year 1994.

(b) NATIONAL GOALS AND MULTIYEAR FUNDING FOR ALCOHOL FROM BIOMASS- Section 4(a) of the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12003(a)) is amended--

(1) by redesignating paragraph (4) as paragraph (5);

(2) by inserting after paragraph (3) the following new paragraph:

`(4) ALCOHOL FROM BIOMASS- (A) In general, the goal of the Alcohol From Biomass Program shall be to advance research and development to a point where alcohol from biomass technology is cost-competitive with conventional hydrocarbon transportation fuels, and to promote the integration of this technology into the transportation fuel sector of the economy.

`(B)(i) Specific goals for producing ethanol from biomass shall be to--

`(I) reduce the cost of alcohol to 70 cents per gallon;

`(II) improve the overall biomass carbohydrate conversion efficiency to 91 percent;

`(III) reduce the capital cost component of the cost of alcohol to 23 cents per gallon; and

`(IV) reduce the operating and maintenance component of the cost of alcohol to 47 cents per gallon.

`(ii) Specific goals for producing methanol from biomass shall be to--

`(I) reduce the cost of alcohol to 47 cents per gallon; and

`(II) reduce the capital component of the cost of alcohol to 16 cents per gallon.'; and

(3) in paragraph (5), as so redesignated by paragraph (1) of this subsection, by inserting `Biodiesel Energy Systems,' after `Biofuels Energy Systems,'.

(c) NATIONAL RENEWABLE ENERGY AND ENERGY EFFICIENCY MANAGEMENT PLAN- Section 9(b) of the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12008(b)) is amended--

(1) in paragraph (1) by inserting `three-year' before `management plan'; and

(2) by striking paragraph (5) and inserting in lieu thereof the following new paragraphs:

`(5) In addition, the Plan shall--

`(A) contain a detailed assessment of program needs, objectives, and priorities for each of the programs authorized under section 6 of this Act;

`(B) use a uniform prioritization methodology to facilitate cost-benefit analyses of proposals in various program areas;

`(C) establish milestones for setting forth specific technology transfer activities under each program area;

`(D) include annual and five-year cost estimates for individual programs under this Act; and

`(E) identify program areas for which funding levels have been changed from the previous year's Plan.

`(6) Within one year after the date of the enactment of the Energy Policy Act of 1992, the Secretary shall submit a revised management plan under this section to Congress. Thereafter, the Secretary shall submit a management plan every three years at the time of submittal of the President's annual budget submission to the Congress.'.

(d) CONFORMING AMENDMENTS- The Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12001 et seq.) is further amended--

(1) in section 2(b)--

(A) by striking `authority contained in' and all that follows through `applicable to the Secretary' and inserting in lieu thereof `section 3001 of the Energy Policy Act of 1992'; and

(B) by striking `and demonstration' and inserting in lieu thereof `demonstration, and commercial application';

(2) in section 2(b)(4)--

(A) by striking `research and development'; and

(B) by striking `joint ventures' and inserting in lieu thereof `demonstration and commercial application projects';

(3) in section 2(c), by striking `the authority contained in' and all that follows and inserting in lieu thereof `section 3001 of the Energy Policy Act of 1992, is authorized and directed to--

`(1) pursue a program of research, development, demonstration, and commercial application with the private sector, to achieve the purpose of this Act, including the goals established under section 4; and

`(2) undertake demonstration and commercial application projects as provided in section 6.';

(4) in section 3--

(A) by striking paragraph (2);

(B) by redesignating paragraphs (3), (4), and (5) as paragraphs (2), (3), and (4), respectively;

(C) in paragraph (4), as so redesignated by subparagraph (B) of this paragraph--

(i) by striking `joint venture' and inserting in lieu thereof `demonstration and commercial application project';

(ii) by striking `venture' and inserting in lieu thereof `demonstration and commercial application project'; and

(iii) by striking `and' at the end thereof; and

(D) by inserting after paragraph (4), as so redesignated by subparagraph (B) of this paragraph, the following new paragraph:

`(5) the term `source reduction' means any practice which--

`(A) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment, including fugitive emissions, prior to recycling, treatment, or disposal; and

`(B) reduces the hazards to the public health and the environment associated with the release of such substances, pollutants, or contaminants,

including equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, and inventory control, but not including any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to and necessary for the production of a product or the providing of a service;'; and

(5) in section 9(a), by striking `, projects, and joint ventures' and inserting in lieu thereof `and projects'.

SEC. 1203. RENEWABLE ENERGY EXPORT TECHNOLOGY TRAINING.

(a) ESTABLISHMENT OF PROGRAM- The Secretary, through the Agency for International Development, shall establish a program for the training of individuals from developing countries in the operation and maintenance of renewable energy and energy efficiency technologies in accordance with this section. The Secretary and the Administrator of the Agency for International Development shall, within one year after the date of enactment of this Act, enter into a written agreement to carry out this program.

(b) PURPOSE- The purpose of the program established under this section shall be to train appropriate persons in the system design, operation, and maintenance of renewable energy and energy efficiency equipment manufactured in the United States, including equipment for water pumping, heating and purification, and the production of electric power in remote areas.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary $6,000,000 for each of the fiscal years 1994, 1995, and 1996, to carry out this section.

SEC. 1204. RENEWABLE ENERGY ADVANCEMENT AWARDS.

(a) AUTHORITY- The Secretary shall make Renewable Energy Advancement Awards in recognition of developments that advance the practical application of biomass, geothermal, hydroelectric, photovoltaic, solar thermal, ocean thermal, and wind technologies to consumer, utility, or industrial uses, in accordance with this section. Except as provided in subsection (f), Renewable Energy Advancement Awards shall include a cash award.

(b) SELECTION CRITERIA- The Secretary, in consultation with the Advisory Committee on Demonstration and Commercial Application of Renewable Energy and Energy Efficiency Technologies (in this section referred to as the `Advisory Committee'), under section 6 of the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989, shall develop criteria to be applied in the selection of award recipients under this section. Such criteria shall include the following:

(1) The degree to which the technological development increases the utilization of renewable energy.

(2) The degree to which the development will have a significant impact, by benefitting a large number of people, by reducing the costs of an important industrial process or commercial product or service, or otherwise.

(3) The ingenuity of the development.

(4) Whether the application has significant export potential.

(5) The environmental soundness of the development.

(c) SELECTION- Beginning in fiscal year 1994, and annually thereafter for a period of 10 years, the Secretary, in consultation with the Advisory Committee, shall select developments described in subsection (a) that are worthy of receiving an award under this section, and shall make such awards.

(d) ELIGIBILITY- Awards may be made under this section only to individuals who are United States nationals or permanent resident aliens, or to non-Federal organizations that are organized under the laws of the United States or the laws of a State of the United States.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary $50,000 for each of the fiscal years 1994, 1995, and 1996 for carrying out this section.

(f) AWARDS MADE IN ABSENCE OF APPROPRIATIONS- The Secretary shall make honorary awards under this section if sufficient funds are not available for financial awards in any fiscal year.

SEC. 1205. STUDY OF TAX AND RATE TREATMENT OF RENEWABLE ENERGY PROJECTS.

(a) The Secretary, in conjunction with State regulatory commissions, shall undertake a study to determine if conventional taxation and ratemaking procedures result in economic barriers to or incentives for renewable energy power plants compared to conventional power plants.

(b) Within 1 year after the date of the enactment of this Act, the Secretary shall submit a report to the Congress on the results of the study undertaken under subsection (a).

SEC. 1206. STUDY OF RICE MILLING ENERGY BY-PRODUCT MARKETING.

The Department of Energy shall conduct a study to facilitate the marketing of energy byproducts from rice milling.

SEC. 1207. DUTIES OF INTERAGENCY WORKING GROUP ON RENEWABLE ENERGY AND ENERGY EFFICIENCY EXPORTS.

(a) INTERAGENCY WORKING GROUP- Section 256(d) of the Energy Policy and Conservation Act (42 U.S.C. 6276(d)) is amended to read as follows:

`(d) INTERAGENCY WORKING GROUP-

`(1) ESTABLISHMENT- (A) There shall be established an interagency working group that, in

consultation with the representative industry groups and relevant agency heads, shall make recommendations to coordinate the actions and programs of the Federal Government affecting exports of renewable energy and energy efficiency products and services. The interagency working group shall establish a program to inform foreign countries of the benefits of policies that would increase energy efficiency or would allow facilities that use renewable energy to compete effectively with producers of energy from nonrenewable sources.

`(B) There shall be established an Interagency Working Subgroup on Renewable Energy and an Interagency Working Subgroup on Energy Efficiency that shall, in consultation with representative industry groups, nonprofit organizations, and relevant Federal agencies, make recommendations to coordinate the actions and programs of the Federal Government to promote the export of domestic renewable energy and energy efficiency products and services, respectively.

`(C) The Secretary of Energy, or the Secretary's designee, shall chair the interagency working group and each subgroup established under this paragraph. The Administrator of the Agency for International Development and the Secretary of Commerce, or their designees, shall be members of both subgroups established under this paragraph. The Secretary shall provide staff for carrying out the functions of the interagency working group and each subgroup established under this paragraph. The heads of appropriate agencies may detail such personnel and may furnish such services to such group and subgroups, with or without reimbursement, as may be necessary to carry out their functions.

`(2) DUTIES OF THE INTERAGENCY WORKING SUBGROUPS- (A) The interagency working subgroups established under paragraph (1)(B), through the member agencies of the interagency working group, shall promote the development and application in foreign countries of renewable energy and energy efficiency products and services, respectively, that--

> `(i) reduce dependence on unreliable sources of energy by encouraging the use of sustainable biomass, wind, small-scale hydroelectric, solar, geothermal, and other renewable energy and energy efficiency products and services; and
>
> `(ii) use hybrid fossil-renewable energy systems.

`(B) In addition, the interagency working subgroups shall explore mechanisms for assisting domestic firms, particularly small businesses, with the export of their renewable energy and energy efficiency products and services and with the identification of potential projects.

`(3) TRAINING AND ASSISTANCE- The interagency working subgroups shall encourage the member agencies of the interagency working group to--

> `(A) provide technical training and education for international development personnel and local users in their own country;
>
> `(B) provide financial and technical assistance to nonprofit institutions that support the marketing and export efforts of domestic companies that provide renewable energy and energy efficiency products and services;
>
> `(C) develop environmentally sustainable renewable energy and energy efficiency projects in foreign countries;

`(D) provide technical assistance and training materials to loan officers of the World Bank, international lending institutions, commercial and energy attaches at embassies of the United States and other appropriate personnel in order to provide information about renewable energy and energy efficiency products and services to foreign governments or other potential project sponsors;

`(E) support, through financial incentives, private sector efforts to commercialize and export renewable energy and energy efficiency products and services; and

`(F) augment budgets for trade and development programs in order to support pre-feasibility or feasibility studies for projects that utilize renewable energy and energy efficiency products and services.'.

(b) FUNCTIONS- Section 256(f) of the Energy Policy and Conservation Act (42 U.S.C. 6276(f)) is amended by inserting `and energy efficiency' after `renewable energy' each place it appears.

(c) DEFINITIONS- Section 256(g) of the Energy Policy and Conservation Act (42 U.S.C. 6276(g)) is repealed.

(d) AUTHORIZATION OF APPROPRIATIONS- Section 256(h) of the Energy Policy and Conservation Act (42 U.S.C. 6276(h)) is amended to read as follows:

`(h) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for purposes of carrying out the programs under subsections (d) and (e) $10,000,000, to be divided equitably between the interagency working subgroups based on program requirements, for each of the fiscal years 1993 and 1994, and such sums as may be necessary for fiscal year 1995 to carry out the purposes of this subtitle.'.

SEC. 1208. STUDY OF EXPORT PROMOTION PRACTICES.

Section 256(d) of the Energy Policy and Conservation Act (42 U.S.C. 6276(d)) as amended by section 1208 of this Act, is further amended by adding at the end the following new paragraph:

`(4) The interagency working group shall conduct a study of subsidies, incentives, and policies that foreign countries use to promote exports of their own renewable energy and energy efficiency technologies and products. Such study shall also identify foreign trade barriers to the import of renewable energy and energy efficiency technologies and products produced in the United States. The interagency working group shall report to the appropriate committees of the House of Representatives and the Senate the results of such study within 18 months after the date of the enactment of the Energy Policy Act of 1992.'.

SEC. 1209. DATA SYSTEM AND ENERGY TECHNOLOGY EVALUATION.

The Secretary of Commerce, in his or her role as a member of the interagency working group established under section 256 of the Energy Policy and Conservation Act (42 U.S.C. 6276), shall--

(1) develop a comprehensive data base and information dissemination system, using the National Trade Data Bank and the Commercial Information Management System of the Department of Commerce, that will provide information on the specific energy technology needs of foreign countries, and the technical and economic competitiveness of various renewable energy and

energy efficiency products and technologies;

(2) make such information available to industry, Federal and multilateral lending agencies, nongovernmental organizations, host-country and donor-agency officials, and such others as the Secretary of Commerce considers necessary; and

(3) prepare and transmit to the Congress not later than June 1, 1993, and biennially thereafter, a comprehensive report evaluating the full range of energy and environmental technologies necessary to meet the energy needs of foreign countries, including--

(A) information on the specific energy needs of foreign countries;

(B) an inventory of United States technologies and services to meet those needs;

(C) an update on the status of ongoing bilateral and multilateral programs which promote United States exports of renewable energy and energy efficiency products and technologies; and

(D) an evaluation of current programs (and recommendations for future programs) that develop and promote energy efficiency and sustainable use of indigenous renewable energy resources in foreign countries to reduce the generation of greenhouse gases.

SEC. 1210. OUTREACH.

(a) OUTREACH- The interagency working group established under section 256(d)(1)(A) of the Energy Policy and Conservation Act and the Secretary of Commerce shall select one individual who is experienced in renewable energy and energy efficiency products and technologies to be assigned by the Secretary of Commerce to an office of the United States and Foreign Commercial Service in the Pacific Rim, and one such individual to be assigned by the Secretary of Commerce to an office of the United States and Foreign Commercial Service in the Caribbean Basin, for the sole purpose of providing information concerning domestic renewable energy and energy efficiency products, technologies, and industries to territories, foreign governments, industries, and other appropriate persons.

(b) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for the purposes of this section $500,000 for each of the fiscal years 1993 and 1994, and such sums as may be necessary for fiscal year 1995.

SEC. 1211. INNOVATIVE RENEWABLE ENERGY TECHNOLOGY TRANSFER PROGRAM.

(a) ESTABLISHMENT OF PROGRAM- The Secretary, through the Agency for International Development, and in consultation with the other members of the interagency working group established under section 256(d) of Energy Policy and Conservation Act (in this section referred to as the `interagency working group'), shall establish a renewable energy technology transfer program to carry out the purposes described in subsection (b). Within 150 days after the date of the enactment of this Act, the Secretary and the Administrator of the Agency for International Development shall enter into a written agreement to carry out this section. The agreement shall establish a procedure for resolving any disputes between the Secretary and the Administrator regarding the implementation of specific projects. With respect to countries not assisted by the Agency for International Development, the Secretary may enter into agreements with other appropriate Federal agencies. If the Secretary and the Administrator, or the Secretary and an agency described in the previous sentence, are unable to reach an agreement, each

shall send a memorandum to the President outlining an appropriate agreement. Within 90 days after receipt of either memorandum, the President shall determine which version of the agreement shall be in effect. Any agreement entered into under this subsection shall be provided to the appropriate committees of the Congress and made available to the public.

(b) PURPOSES OF THE PROGRAM- The purposes of the technology transfer program under this section are to--

(1) reduce the United States balance of trade deficit through the export of United States renewable energy technologies and technological expertise;

(2) retain and create manufacturing and related service jobs in the United States;

(3) encourage the export of United States renewable energy technologies, including services related thereto, to those countries that have a need for developmentally sound facilities to provide energy derived from renewable resources;

(4) develop markets for United States renewable energy technologies to be utilized in meeting the energy and environmental requirements of foreign countries;

(5) better ensure that United States participation in energy-related projects in foreign countries includes participation by United States firms as well as utilization of United States technologies that have been developed or demonstrated in the United States through publicly or privately funded demonstration programs;

(6) ensure the introduction of United States firms and expertise in foreign countries;

(7) provide financial assistance by the Federal Government to foster greater participation by United States firms in the financing, ownership, design, construction, or operation of renewable energy technology projects in foreign countries;

(8) assist foreign countries in meeting their energy needs through the use of renewable energy in an environmentally acceptable manner, consistent with sustainable development policies; and

(9) assist United States firms, especially firms that are in competition with firms in foreign countries, to obtain opportunities to transfer technologies to, or undertake projects in, foreign countries.

(c) IDENTIFICATION- Pursuant to the agreements required by subsection (a), the Secretary, through the Agency for International Development, and after consultation with the interagency working group, United States firms, and representatives from foreign countries, shall develop mechanisms to identify potential energy projects in host countries, and shall identify a list of such projects within 240 days after the date of the enactment of this Act, and periodically thereafter.

(d) FINANCIAL MECHANISMS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, shall--

(A) establish appropriate financial mechanisms to increase the participation of United States firms in energy projects utilizing United States renewable energy technologies, and services related thereto, in developing countries;

(B) utilize available financial assistance authorized by this section to counterbalance assistance provided by foreign governments to non-United States firms; and

(C) provide financial assistance to support projects.

(2) The financial assistance authorized by this section may be--

(A) provided in combination with other forms of financial assistance, including non-United States funding that is available to the project; and

(B) utilized to assist United States firms in the development of innovative financing packages for renewable energy technology projects that utilize other financial assistance programs available through the Federal Government.

(3) United States obligations under the Arrangement on Guidelines for Officially Supported Export Credits established through the Organization for Economic Cooperation and Development shall be applicable to this section.

(e) SOLICITATIONS FOR PROJECT PROPOSALS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, within one year after the date of the enactment of this Act, and subsequently as appropriate thereafter, shall solicit proposals from United States firms for the design, construction, testing, and operation of the project or projects identified under subsection (c) which propose to utilize a United States renewable energy technology. Each solicitation under this section shall establish a closing date for receipt of proposals.

(2) The solicitation under this subsection shall, to the extent appropriate, be modeled after the RFP No. DE-PS01-90FE62271 Clean Coal Technology IV, as administered by the Department of Energy.

(3) Any solicitation made under this subsection shall include the following requirements:

(A) The United States firm that submits a proposal in response to the solicitation shall have an equity interest in the proposed project.

(B) The project shall utilize a United States renewable energy technology, including services related thereto, in meeting the applicable energy and environmental requirements of the host country.

(C) Proposals for projects shall be submitted by and undertaken with a United States firm, although a joint venture or other teaming arrangement with a non-United States manufacturer or other non-United States entity is permissible.

(f) ASSISTANCE TO UNITED STATES FIRMS- Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, and in consultation with the interagency working group, shall establish a procedure to provide financial assistance to United States firms under this section for a project identified under subsection (c) where solicitations for the project are being conducted by the host country or by a multilateral lending institution.

(g) OTHER PROGRAM REQUIREMENTS- Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, and in consultation with the working group, shall--

(1) establish eligibility criteria for host countries;

(2) periodically review the energy needs of such countries and export opportunities for United States firms for the development of projects in such countries;

(3) consult with government officials in host countries and, as appropriate, with representatives of utilities or other entities in host countries, to determine interest in and support for potential projects; and

(4) determine whether each project selected under this section is developmentally sound, as determined under the criteria developed by the Development Assistance Committee of the Organization for Economic Cooperation and Development.

(h) SELECTION OF PROJECTS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, shall, not later than 120 days after receipt of proposals in response to a solicitation under subsection (e), select one or more proposals under this section.

(2) In selecting a proposal under this section, the Secretary, through the Agency for International Development, shall consider--

(A) the ability of the United States firm, in cooperation with the host country, to undertake and complete the project;

(B) the degree to which the equipment to be included in the project is designed and manufactured in the United States;

(C) the long-term technical and competitive viability of the United States technology, and services related thereto, and the ability of the United States firm to compete in the development of additional energy projects using such technology in the host country and in other foreign countries;

(D) the extent of technical and financial involvement of the host country in the project;

(E) the extent to which the proposed project meets the purposes stated in section 1201(b);

(F) the extent of technical, financial, management, and marketing capabilities of the participants in the project, and the commitment of the participants to completion of a successful project in a manner that will facilitate acceptance of the United States technology for future application; and

(G) such other criteria as may be appropriate.

(3) In selecting among proposed projects, the Secretary shall seek to ensure that, relative to otherwise comparable projects in the host country, a selected project will meet 1 or more of the following criteria:

(A) It will reduce environmental emissions to an extent greater than required by applicable provisions of law.

(B) It will make greater use of indigenous renewable energy resources.

(C) It will be a more cost-effective technological alternative, based on life cycle capital and

operating costs per unit of energy produced and, where applicable, costs per unit of product produced.

Priority in selection shall be given to those projects which, in the judgment of the Secretary, best meet one or more of these criteria.

(i) UNITED STATES-ASIA ENVIRONMENTAL PARTNERSHIP- Activities carried out under this section shall be coordinated with the United States-Asia Environmental Partnership.

(j) BUY AMERICA- In carrying out this section, the Secretary, through the Agency for International Development, and pursuant to the agreements under subsection (a), shall ensure--

(1) the maximum percentage, but in no case less than 50 percent, of the cost of any equipment furnished in connection with a project authorized under this section shall be attributable to the manufactured United States components of such equipment; and

(2) the maximum participation of United States firms.

In determining whether the cost of United States components equals or exceeds 50 percent, the cost of assembly of such United States components in the host country shall not be considered a part of the cost of such United States component.

(k) REPORTS TO CONGRESS- The Secretary and the Administrator of the Agency for International Development shall report annually to the Committee on Energy and Natural Resources of the Senate and the appropriate committees of the House of Representatives on the progress being made to introduce renewable energy technologies into foreign countries.

(l) DEFINITIONS- For purposes of this section--

(1) the term `host country' means a foreign country which is--

(A) the participant in or the site of the proposed renewable energy technology project; and

(B) either--

(i) classified as a country eligible to participate in development assistance programs of the Agency for International Development pursuant to applicable law or regulation; or

(ii) a developing country.

(2) the term `developing country' includes, but is not limited to, countries in Central and Eastern Europe or in the independent states of the former Soviet Union.

(m) AUTHORIZATION FOR PROGRAM- There are authorized to be appropriated to the Secretary to carry out the program required by this section, $100,000,000 for each of the fiscal years 1993, 1994, 1995, 1996, 1997, and 1998.

SEC. 1212. RENEWABLE ENERGY PRODUCTION INCENTIVE.

(a) INCENTIVE PAYMENTS- For electric energy generated and sold by a qualified renewable energy

facility during the incentive period, the Secretary shall make, subject to the availability of appropriations, incentive payments to the owner or operator of such facility. The amount of such payment made to any such owner or operator shall be as determined under subsection (e). Payments under this section may only be made upon receipt by the Secretary of an incentive payment application which establishes that the applicant is eligible to receive such payment and which satisfies such other requirements as the Secretary deems necessary. Such application shall be in such form, and shall be submitted at such time, as the Secretary shall establish.

(b) QUALIFIED RENEWABLE ENERGY FACILITY- For purposes of this section, a qualified renewable energy facility is a facility which is owned by a State or any political subdivision of a State (or an agency, authority, or instrumentality of a State or a political subdivision), by any corporation or association which is wholly owned, directly or indirectly, by one or more of the foregoing, or by a nonprofit electrical cooperative and which generates electric energy for sale in, or affecting, interstate commerce using solar, wind, biomass, or geothermal energy, except that--

(1) the burning of municipal solid waste shall not be treated as using biomass energy; and

(2) geothermal energy shall not include energy produced from a dry steam geothermal reservoir which has--

(A) no mobile liquid in its natural state;

(B) steam quality of 95 percent water; and

(C) an enthalpy for the total produced fluid greater than or equal to 1200 Btu/lb (British thermal units per pound).

(c) ELIGIBILITY WINDOW- Payments may be made under this section only for electricity generated from a qualified renewable energy facility first used during the 10-fiscal year period beginning with the first full fiscal year occurring after the enactment of this section.

(d) PAYMENT PERIOD- A qualified renewable energy facility may receive payments under this section for a 10-fiscal year period. Such period shall begin with the fiscal year in which electricity generated from the facility is first eligible for such payments.

(e) AMOUNT OF PAYMENT-

(1) IN GENERAL- Incentive payments made by the Secretary under this section to the owner or operator of any qualified renewable energy facility shall be based on the number of kilowatt hours of electricity generated by the facility through the use of solar, wind, biomass, or geothermal energy during the payment period referred to in subsection (d). For any facility, the amount of such payment shall be 1.5 cents per kilowatt hour, adjusted as provided in paragraph (2).

(2) ADJUSTMENTS- The amount of the payment made to any person under this subsection as provided in paragraph (1) shall be adjusted for inflation for each fiscal year beginning after calendar year 1993 in the same manner as provided in the provisions of section 29(d)(2)(B) of the Internal Revenue Code of 1986, except that in applying such provisions the calendar year 1993 shall be substituted for calendar year 1979.

(f) SUNSET- No payment may be made under this section to any facility after the expiration of the 20-

fiscal year period beginning with the first full fiscal year occurring after the enactment of this section, and no payment may be made under this section to any facility after a payment has been made with respect to such facility for a 10-fiscal year period.

(g) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for fiscal years 1993, 1994, and 1995 such sums as may be necessary to carry out the purposes of this section.

TITLE XIII--COAL

Subtitle A--Research, Development, Demonstration, and Commercial Application

SEC. 1301. COAL RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIAL APPLICATION PROGRAMS.

(a) ESTABLISHMENT- The Secretary shall, in accordance with section 3001 and 3002 of this Act, conduct programs for research, development, demonstration, and commercial application on coal-based technologies. Such research, development, demonstration, and commercial application programs shall include the programs established under this subtitle, and shall have the goals and objectives of--

(1) ensuring a reliable electricity supply;

(2) complying with applicable environmental requirements;

(3) achieving the control of sulfur oxides, oxides of nitrogen, air toxics, solid and liquid wastes, greenhouse gases, or other emissions resulting from coal use or conversion at levels of proficiency greater than or equal to applicable currently available commercial technology;

(4) achieving the cost competitive conversion of coal into energy forms usable in the transportation sector;

(5) demonstrating the conversion of coal to synthetic gaseous, liquid, and solid fuels;

(6) demonstrating, in cooperation with other Federal and State agencies, the use of coal-derived fuels in mobile equipment, with opportunities for industrial cost sharing participation;

(7) ensuring the timely commercial application of cost-effective technologies or energy production processes or systems utilizing coal which achieve--

(A) greater efficiency in the conversion of coal to useful energy when compared to currently available commercial technology for the use of coal; and

(B) the control of emissions from the utilization of coal; and

(8) ensuring the availability for commercial use of such technologies by the year 2010.

(b) DEMONSTRATION AND COMMERCIAL APPLICATION PROGRAMS- (1) In selecting either a demonstration project or a commercial application project for financial assistance under this subtitle, the Secretary shall seek to ensure that, relative to otherwise comparable commercially available technologies or products, the selected project will meet one or more of the following criteria:

(A) It will reduce environmental emissions to an extent greater than required by applicable provisions of law.

(B) It will increase the overall efficiency of the utilization of coal, including energy conversion efficiency and, where applicable, production of products derived from coal.

(C) It will be a more cost-effective technological alternative, based on life cycle capital and operating costs per unit of energy produced and, where applicable, costs per unit of product produced.

Priority in selection shall be given to those projects which, in the judgment of the Secretary, best meet one or more of these criteria.

(2) In administering demonstration and commercial application programs authorized by this subtitle, the Secretary shall establish accounting and project management controls that will be adequate to control costs.

(3)(A) Not later than 180 days after the date of enactment of this Act, the Secretary shall establish procedures and criteria for the recoupment of the Federal share of each cost shared demonstration and commercial application project authorized pursuant to this subtitle. Such recoupment shall occur within a reasonable period of time following the date of completion of such project, but not later than 20 years following such date, taking into account the effect of recoupment on--

(i) the commercial competitiveness of the entity carrying out the project;

(ii) the profitability of the project; and

(iii) the commercial viability of the coal-based technology utilized.

(B) The Secretary may at any time waive or defer all or some portion of the recoupment requirement as necessary for the commercial viability of the project.

(4) Projects selected by the Secretary under this subtitle for demonstration or commercial application of a technology shall, in the judgment of the Secretary, be capable of enhancing the state of the art for such technology.

(c) REPORT- Within 240 days after the date of enactment of this Act, the Secretary shall transmit to the Committee on Energy and Commerce and the Committee on Science, Space, and Technology of the House of Representatives and to the Committee on Energy and Natural Resources of the Senate a report which shall include each of the following:

(1) A detailed description of ongoing research, development, demonstration, and commercial application activities regarding coal-based technologies undertaken by the Department of Energy, other Federal or State government departments or agencies and, to the extent such information is publicly available, other public or private organizations in the United States and other countries.

(2) A listing and analysis of current Federal and State government regulatory and financial incentives that could further the goals of the programs established under this subtitle.

(3) Recommendations regarding the manner in which any ongoing coal-based demonstration and

commercial application program might be modified and extended in order to ensure the timely demonstrations of advanced coal-based technologies so as to ensure that the goals established under this section are achieved and that such demonstrated technologies are available for commercial use by the year 2010.

(4) Recommendations, if any, regarding the manner in which the cost sharing demonstrations conducted pursuant to the Clean Coal Program established by Public Law 98-473 might be modified and extended in order to ensure the timely demonstration of advanced coal-based technologies.

(5) A detailed plan for conducting the research, development, demonstration, and commercial application programs to achieve the goals and objectives of subsection (a) of this section, which plan shall include a description of--

(A) the program elements and management structure to be utilized;

(B) the technical milestones to be achieved with respect to each of the advanced coal-based technologies included in the plan; and

(C) the dates at which further deadlines for additional cost sharing demonstrations shall be established.

(d) STATUS REPORTS- Within one year after transmittal of the report described in subsection (c), and every 2 years thereafter for a period of 6 years, the Secretary shall transmit to the Congress a report that provides a detailed description of the status of development of the advanced coal-based technologies and the research, development, demonstration, and commercial application activities undertaken to carry out the programs required by this subtitle.

(e) CONSULTATION- In carrying out research, development, demonstration, and commercial application activities under this subtitle, the Secretary shall consult with the National Coal Council and other representatives of the public and private sectors as the Secretary considers appropriate.

SEC. 1302. COAL-FIRED DIESEL ENGINES.

The Secretary shall conduct a program of research, development, demonstration, and commercial application for utilizing coal-derived liquid or gaseous fuels, including ultra-clean coal-water slurries, in diesel engines. The program shall address--

(1) required engine retrofit technology;

(2) coal-fuel production technology;

(3) emission control requirements;

(4) the testing of low-Btu highly reactive fuels;

(5) fuel delivery and storage systems requirements; and

(6) other infrastructure required to support commercial deployment.

SEC. 1303. CLEAN COAL, WASTE-TO-ENERGY.

The Secretary shall establish a program of research, development, demonstration, and commercial application with respect to the use of solid waste combined with coal as a fuel source for clean coal combustion technologies. The program shall address--

(1) the feasibility of cofiring coal and used vehicle tires in fluidized bed combustion units;

(2) the combined gasification of coal and municipal sludge using integrated gasification combined cycle technology;

(3) the creation of fuel pellets combining coal and material reclaimed from solid waste;

(4) the feasibility of cofiring, in fluidized bed combustion units, waste methane from coal mines, including ventilation air, together with coal or coal wastes; and

(5) other sources of waste and coal mixtures in other applications that the Secretary considers appropriate.

SEC. 1304. NONFUEL USE OF COAL.

(a) PROGRAM- The Secretary shall prepare a plan for and carry out a program of research, development, demonstration, and commercial application with respect to technologies for the nonfuel use of coal, including--

(1) production of coke and other carbon products derived from coal;

(2) production of coal-derived, carbon-based chemical intermediates that are precursors of value-added chemicals and polymers;

(3) production of chemicals from coal-derived synthesis gas;

(4) coal treatment processes, including methodologies such as solvent-extraction techniques that produce low ash, low sulfur, coal-based chemical feedstocks; and

(5) waste utilization, including recovery, processing, and marketing of products derived from sulfur, carbon dioxide, nitrogen, and ash from coal.

(b) PLAN CONTENTS- The plan described in subsection (a) shall address and evaluate--

(1) the known and potential processes for using coal in the creation of products in the chemical, utility, fuel, and carbon-based materials industries;

(2) the costs, benefits, and economic feasibility of using coal products in the chemical and materials industries, including value-added chemicals, carbon-based products, coke, and waste derived from coal;

(3) the economics of coproduction of products from coal in conjunction with the production of electric power, thermal energy, and fuel;

(4) the economics of the refining of coal and coal byproducts to produce nonfuel products;

(5) the economics of coal utilization in comparison with other feedstocks that might be used for the same purposes;

(6) the steps that can be taken by the public and private sectors to bring about commercialization of technologies developed under the program recommended; and

(7) the past development, current status, and future potential of coal products and processes associated with nonfuel uses of coal.

SEC. 1305. COAL REFINERY PROGRAM.

(a) PROGRAM- The Secretary shall conduct a program of research, development, demonstration, and commercial application for coal refining technologies.

(b) OBJECTIVES- The program shall include technologies for refining high sulfur coals, low sulfur coals, sub-bituminous coals, and lignites to produce clean-burning transportation fuels, compliance boiler fuels, fuel additives, lubricants, chemical feedstocks, and carbon-based manufactured products, either alone or in conjunction with the generation of electricity or process heat, or the manufacture of a variety of products from coal. The objectives of such program shall be to achieve--

(1) the timely commercial application of technologies, including mild gasification, hydrocracking and other hydropyrolysis processes, and other energy production processes or systems to produce coal-derived fuels and coproducts, which achieve greater efficiency and economy in the conversion of coal to electrical energy and coproducts than currently available technology;

(2) the production of energy, fuels, and products which, on a complete energy system basis, will result in environmental emissions no greater than those produced by existing comparable energy systems utilized for the same purpose;

(3) the capability to produce a range of coal-derived transportation fuels, including oxygenated hydrocarbons, boiler fuels, turbine fuels, and coproducts, which can reduce dependence on imported oil by displacing conventional petroleum in the transportation sector and other sectors of the economy;

(4) reduction in the cost of producing such coal-derived fuels and coproducts;

(5) the control of emissions from the combustion of coal-derived fuels; and

(6) the availability for commercial use of such technologies by the year 2000.

SEC. 1306. COALBED METHANE RECOVERY.

(a) STUDY OF BARRIERS AND ENVIRONMENTAL AND SAFETY ASPECTS- The Secretary, in consultation with the Administrator of the Environmental Protection Agency and the Secretary of the Interior, shall conduct a study of--

(1) technical, economic, financial, legal, regulatory, institutional, or other barriers to coalbed methane recovery, and of policy options for eliminating such barriers; and

(2) the environmental and safety aspects of flaring coalbed methane liberated from coal mines.

Within two years after the date of enactment of this Act, the Secretary shall submit a report to the Congress detailing the results of such study.

(b) INFORMATION DISSEMINATION- Beginning one year after the date of enactment of this Act, the Secretary, in consultation with the Administrator of the Environmental Protection Agency and the Secretary of the Interior, shall disseminate to the public information on state-of-the-art coalbed methane recovery techniques, including information on costs and benefits.

(c) DEMONSTRATION AND COMMERCIAL APPLICATION PROGRAM- The Secretary, in consultation with the Administrator of the Environmental Protection Agency and the Secretary of the Interior, shall establish a coalbed methane recovery demonstration and commercial application program, which shall emphasize gas enrichment technology. Such program shall address--

(1) gas enrichment technologies for enriching medium-quality methane recovered from coal mines to pipeline quality;

(2) technologies to use mine ventilation air in nearby power generation facilities, including gas turbines, internal combustion engines, or other coal fired powerplants;

(3) technologies for cofiring methane recovered from mines, including methane from ventilation systems and degasification systems, together with coal in conventional or clean coal technology boilers; and

(4) other technologies for producing and using methane from coal mines that the Secretary considers appropriate.

SEC. 1307. METALLURGICAL COAL DEVELOPMENT.

(a) The Secretary shall establish a research, development, demonstration, and commercial application program on metallurgical coal utilization for the purpose of developing techniques that will lead to the greater and more efficient utilization of the Nation's metallurgical coal resources.

(b) The program referred to in subsection (a) shall include the use of metallurgical coal--

(1) as a boiler fuel for the purpose of generating steam to produce electricity, including blending metallurgical coal with other coals in order to enhance its efficient application as a boiler fuel;

(2) as an ingredient in the manufacturing of steel; and

(3) as a source of pipeline quality coalbed methane.

SEC. 1308. UTILIZATION OF COAL WASTES.

(a) COAL WASTE UTILIZATION PROGRAM- The Secretary, in consultation with the Secretary of the Interior, shall establish a research, development, demonstration, and commercial application program on coal waste utilization for the purpose of developing techniques that will lead to the greater and more efficient utilization of coal wastes from mining and processing, other than coal ash.

(b) USE AS BOILER FUEL- The program referred to in subsection (a) shall include projects to facilitate the use of coal wastes from mining and processing as a boiler fuel for the purpose of generating steam to produce electricity.

SEC. 1309. UNDERGROUND COAL GASIFICATION.

(a) PROGRAM- The Secretary shall conduct a research, development, demonstration, and commercial application program for underground coal gasification technology for in-situ conversion of coal to a cleaner burning, easily transportable gaseous fuel. The goal and objective of this program shall be to accelerate the development and commercialization of underground coal gasification. In carrying out this program, the Secretary shall give equal consideration to all ranks of coal.

(b) DEMONSTRATION PROJECTS- As part of the program authorized in subsection (a), the Secretary may solicit proposals for underground coal gasification technology projects to fulfill the goal and objective of subsection (a).

SEC. 1310. LOW-RANK COAL RESEARCH AND DEVELOPMENT.

The Secretary shall pursue a program of research and development with respect to the technologies needed to expand the use of low-rank coals which take into account the unique properties of lignites and sub-bituminous coals, including, but not limited to, the following areas--

(1) high value-added carbon products;

(2) fuel cell applications;

(3) emissions control and combustion efficiencies;

(4) coal water fuels and underground coal gasification;

(5) distillates; and

(6) any other technologies which will assist in the development of niche markets for lignites and sub-bituminous coals.

SEC. 1311. MAGNETOHYDRODYNAMICS.

(a) PROGRAM- The Secretary shall carry out a research, development, demonstration, and commercial application program in magnetohydrodynamics. The purpose of this program shall be to determine the adequacy of the engineering and design information completed to date under Department of Energy contracts related to magnetohydrodynamics retrofit systems and to determine whether any further Federal investment in this technology is warranted.

(b) SOLICITATION OF PROPOSALS- In order to carry out the program authorized in subsection (a), the Secretary may solicit proposals from the private sector and seek to enter into an agreement with appropriate parties.

SEC. 1312. OIL SUBSTITUTION THROUGH COAL LIQUEFACTION.

(a) PROGRAM DIRECTION- The Secretary shall conduct a program of research, development, demonstration, and commercial application for the purpose of developing economically and environmentally acceptable advanced technologies for oil substitution through coal liquefaction.

(b) PROGRAM GOALS- The goals of the program established under subsection (a) shall include--

(1) improved resource selection and product quality;

(2) the development of technologies to increase net yield of liquid fuel product per ton of coal;

(3) an increase in overall thermal efficiency; and

(4) a reduction in capital and operating costs through technology improvements.

(c) PROPOSALS- Within 180 days after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

SEC. 1313. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary for carrying out this subtitle $278,139,000 for fiscal year 1993 and such sums as may be necessary for fiscal years 1994 through 1997.

Subtitle B--Clean Coal Technology Program

SEC. 1321. ADDITIONAL CLEAN COAL TECHNOLOGY SOLICITATIONS.

(a) PROGRAM DESIGN- Additional clean coal technology solicitations described in subsection (b) shall be designed to ensure the timely development of cost-effective technologies or energy production processes or systems utilizing coal that achieve greater efficiency in the conversion of coal to useful energy when compared to currently commercially available technology for the use of coal and the control of emissions from the combustion of coal. Such program shall be designed to ensure, to the greatest extent possible, the availability for commercial use of such technologies by the year 2010.

(b) ADDITIONAL SOLICITATIONS- In conducting the Clean Coal Program established by Public Law 98-473, the Secretary shall consider the potential benefits of conducting additional solicitations pursuant to such program and, based on the results of that consideration, may carry out such additional solicitations, which shall be similar in scope and percentage of Federal cost sharing as that provided by Public Law 101-121.

Subtitle C--Other Coal Provisions

SEC. 1331. CLEAN COAL TECHNOLOGY EXPORT PROMOTION AND INTERAGENCY COORDINATION.

(a) ESTABLISHMENT- There shall be established within the Trade Promotion Coordinating Committee (established by the President on May 23, 1990) a Clean Coal Technology Subgroup (in this subtitle referred to as the `CCT Subgroup') to focus interagency efforts on clean coal technologies. The CCT Subgroup shall seek to expand the export and use of clean coal technologies, particularly in those countries which can benefit from gains in the efficiency of, and the control of environmental emissions

from, coal utilization.

(b) MEMBERSHIP- The CCT Subgroup shall include 1 member from each agency represented on the Energy, Environment, and Infrastructure Working Group of the Trade Promotion Coordinating Committee as of the date of enactment of this Act. The Secretary shall serve as chair of the CCT Subgroup and shall be responsible for ensuring that the functions of the CCT Subgroup are carried out through its member agencies.

(c) CONSULTATION- (1) In carrying out this section, the CCT Subgroup shall consult with representatives from the United States coal industry, representatives of railroads and other transportation industries, organizations representing workers, the electric utility industry, manufacturers of equipment utilizing clean coal technology, members of organizations formed to further the goals of environmental protection or to promote the development and use of clean coal technologies that are developed, manufactured, or controlled by United States firms, and other appropriate interested members of the public.

(2) The CCT Subgroup shall maintain ongoing liaison with other elements of the Trade Promotion Coordinating Committee relating to clean coal technologies or regions where these technologies could be important, including Eastern Europe, Asia, and the Pacific.

(d) DUTIES- The Secretary, acting through the CCT Subgroup, shall--

(1) facilitate the establishment of technical training for the consideration, planning, construction, and operation of clean coal technologies by end users and international development personnel;

(2) facilitate the establishment of and, where practicable, cause to be established, consistent with the goals and objectives stated in section 1301(a), within existing departments and agencies--

(A) financial assistance programs (including grants, loan guarantees, and no interest and low interest loans) to support prefeasibility and feasibility studies for projects that will utilize clean coal technologies; and

(B) loan guarantee programs, grants, and no interest and low interest loans designed to facilitate access to capital and credit in order to finance such clean coal technology projects;

(3) develop and ensure the execution of programs, including the establishment of financial incentives, to encourage and support private sector efforts in exports of clean coal technologies that are developed, manufactured, or controlled by United States firms;

(4) encourage the training in, and understanding of, clean coal technologies by representatives of foreign companies or countries intending to use coal or clean coal technologies by providing technical or financial support for training programs, workshops, and other educational programs sponsored by United States firms;

(5) educate loan officers and other officers of international lending institutions, commercial and energy attaches of the United States, and such other personnel as the CCT Subgroup considers appropriate, for the purposes of providing information about clean coal technologies to foreign governments or potential project sponsors of clean coal technology projects;

(6) develop policies and practices to be conducted by commercial and energy attaches of the

United States, and such other personnel as the CCT Subgroup considers appropriate, in order to promote the exports of clean coal technologies to those countries interested in or intending to utilize coal resources;

(7) augment budgets for trade and development programs supported by Federal agencies for the purpose of financially supporting prefeasibility or feasibility studies for projects in foreign countries that will utilize clean coal technologies;

(8) review ongoing clean coal technology projects and review and advise Federal agencies on the approval of planned clean coal technology projects which are sponsored abroad by any Federal agency to determine whether such projects are consistent with the overall goals and objectives of this section;

(9) coordinate the activities of the appropriate Federal agencies in order to ensure that Federal clean coal technology export promotion policies are implemented in a timely fashion;

(10) work with CCT Subgroup member agencies to develop an overall strategy for promoting clean coal technology exports, including setting goals and allocating specific responsibilities among member agencies, consistent with applicable statutes; and

(11) coordinate with multilateral institutions to ensure that United States technologies are properly represented in their projects.

(e) DATA AND INFORMATION- (1) The CCT Subgroup, consistent with other applicable provisions of law, shall ensure the development of a comprehensive data base and information dissemination system, using the National Trade Data Bank and the Commercial Information Management System of the Department of Commerce, relating to the availability of clean coal technologies and the potential need for such technologies, particularly in developing countries and countries making the transition from nonmarket to market economies.

(2) The Secretary, acting through the CCT Subgroup, shall assess and prioritize foreign markets that have the most potential for the export of clean coal technologies that are developed, manufactured, or controlled by United States firms. Such assessment shall include--

(A) an analysis of the financing requirements for clean coal technology projects in foreign countries and whether such projects are dependent upon financial assistance from foreign countries or multilateral institutions;

(B) the availability of other fuel or energy resources that may be available to meet the energy requirements intended to be met by the clean coal technology projects;

(C) the priority of environmental considerations in the selection of such projects;

(D) the technical competence of those entities likely to be involved in the planning and operation of such projects;

(E) an objective comparison of the environmental, energy, and economic performance of each clean coal technology relative to conventional technologies;

(F) a list of United States vendors of clean coal technologies; and

(G) answers to commonly asked questions about clean coal technologies,

The Secretary, acting through the CCT Subgroup, shall make such information available to the House of Representatives and the Senate, and to the appropriate committees of each House of Congress, industry, Federal and international financing organizations, nongovernmental organizations, potential customers abroad, governments of countries where such clean coal technologies might be used, and such others as the CCT Subgroup considers appropriate.

(f) REPORT- Within 180 days after the Secretary submits the report to the Congress as required by section 409 of Public Law 101-549, the Secretary, acting through the CCT Subgroup, shall provide to the appropriate committees of the House of Representatives and the Committee on Energy and Natural Resources of the Senate, a plan which details actions to be taken in order to address those recommendations and findings made in the report submitted pursuant to section 409 of Public Law 101-549. As a part of the plan required by this subsection, the Secretary, acting through the CCT Subgroup, shall specifically address the adequacy of financial assistance available from Federal departments and agencies and international financing organizations to aid in the financing of prefeasibility and feasibility studies and projects that would use a clean coal technology in developing countries and countries making the transition from nonmarket to market economies.

SEC. 1332. INNOVATIVE CLEAN COAL TECHNOLOGY TRANSFER PROGRAM.

(a) ESTABLISHMENT OF PROGRAM- The Secretary, through the Agency for International Development, and in consultation with the other members of the CCT Subgroup, shall establish a clean coal technology transfer program to carry out the purposes described in subsection (b). Within 150 days after the date of enactment of this Act, the Secretary and the Administrator of the Agency for International Development shall enter into a written agreement to carry out this section. The agreement shall establish a procedure for resolving any disputes between the Secretary and the Administrator regarding the implementation of specific projects. With respect to countries not assisted by the Agency for International Development, the Secretary may enter into agreements with other appropriate United States agencies. If the Secretary and the Administrator, or the Secretary and an agency described in the previous sentence, are unable to reach an agreement, each shall send a memorandum to the President outlining an appropriate agreement. Within 90 days after receipt of either memorandum, the President shall determine which version of the agreement shall be in effect. Any agreement entered into under this subsection shall be provided to the appropriate committees of the Congress and made available to the public.

(b) PURPOSES OF THE PROGRAM- The purposes of the technology transfer program under this section are to--

(1) reduce the United States balance of trade deficit through the export of United States energy technologies and technological expertise;

(2) retain and create manufacturing and related service jobs in the United States;

(3) encourage the export of United States technologies, including services related thereto, to those countries that have a need for developmentally sound facilities to provide energy derived from coal resources;

(4) develop markets for United States technologies and, where appropriate, United States coal resources to be utilized in meeting the energy and environmental requirements of foreign

countries;

(5) better ensure that United States participation in energy-related projects in foreign countries includes participation by United States firms as well as utilization of United States technologies that have been developed or demonstrated in the United States through publicly or privately funded demonstration programs;

(6) provide for the accelerated deployment of United States technologies that will serve to introduce into foreign countries United States technologies intended to use coal resources in a more efficient, cost-effective, and environmentally acceptable manner;

(7) serve to ensure the introduction of United States firms and expertise in foreign countries;

(8) provide financial assistance by the Federal Government to foster greater participation by United States firms in the financing, ownership, design, construction, or operation of clean coal technology projects in foreign countries;

(9) assist foreign countries in meeting their energy needs through the use of coal in an environmentally acceptable manner, consistent with sustainable development policies; and

(10) assist United States firms, especially firms that are in competition with firms in foreign countries, to obtain opportunities to transfer technologies to, or undertake projects in, foreign countries.

(c) IDENTIFICATION- Pursuant to the agreements required by subsection (a), the Secretary, through the Agency for International Development, and after consultation with the CCT Subgroup, United States firms, and representatives from foreign countries, shall develop mechanisms to identify potential energy projects in host countries, and shall identify a list of such projects within 240 days after the date of enactment of this Act, and periodically thereafter.

(d) FINANCIAL MECHANISMS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, shall--

(A) establish appropriate financial mechanisms to increase the participation of United States firms in energy projects utilizing United States clean coal technologies, and services related thereto, in developing countries and countries making the transition from nonmarket to market economies;

(B) utilize available financial assistance authorized by this section to counterbalance assistance provided by foreign governments to non-United States firms; and

(C) provide financial assistance to support projects, including--

(i) financing the incremental costs of a clean coal technology project attributable only to expenditures to prevent or abate emissions;

(ii) providing the difference between the costs of a conventional energy project in the host country and a comparable project that would utilize a clean coal technology capable of achieving greater efficiency of energy products and improved environmental emissions compared to such conventional project; and

(iii) such other forms of financial assistance as the Secretary, through the Agency for International Development, considers appropriate.

(2) The financial assistance authorized by this section may be--

(A) provided in combination with other forms of financial assistance, including non-United States funding that is available to the project; and

(B) utilized to assist United States firms to develop innovative financing packages for clean coal technology projects that seek to utilize other financial assistance programs available through other Federal agencies.

(3) United States obligations under the Arrangement on Guidelines for Officially Supported Export Credits established through the Organization for Economic Cooperation and Development shall be applicable to this section.

(e) SOLICITATIONS FOR PROJECT PROPOSALS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, within one year after the date of enactment of this Act, and subsequently as appropriate thereafter, shall solicit proposals from United States firms for the design, construction, testing, and operation of the project or projects identified under subsection (c) which propose to utilize a United States technology. Each solicitation under this section shall establish a closing date for receipt of proposals.

(2) The solicitation under this subsection shall, to the extent appropriate, be modeled after the RFP No. DE-PS01-90FE62271 Clean Coal Technology IV as administered by the Department of Energy.

(3) Any solicitation made under this subsection shall include the following requirements:

(A) The United States firm that submits a proposal in response to the solicitation shall have an equity interest in the proposed project.

(B) The project shall utilize a United States clean coal technology, including services related thereto, and, where appropriate, United States coal resources, in meeting the applicable energy and environmental requirements of the host country.

(C) Proposals for projects shall be submitted by and undertaken with a United States firm, although a joint venture or other teaming arrangement with a non-United States manufacturer or other non-United States entity is permissible.

(f) ASSISTANCE TO UNITED STATES FIRMS- Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, and in consultation with the CCT Subgroup, shall establish a procedure to provide financial assistance to United States firms under this section for a project identified under subsection (c) where solicitations for the project are being conducted by the host country or by a multilateral lending institution.

(g) OTHER PROGRAM REQUIREMENTS- Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, and in consultation with the CCT Subgroup, shall--

(1) establish eligibility criteria for countries that will host projects;

(2) periodically review the energy needs of such countries and export opportunities for United States firms for the development of projects in such countries;

(3) consult with government officials in host countries and, as appropriate, with representatives of utilities or other entities in host countries, to determine interest in and support for potential projects; and

(4) determine whether each project selected under this section is developmentally sound, as determined under the criteria developed by the Development Assistance Committee of the Organization for Economic Cooperation and Development.

(h) SELECTION OF PROJECTS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, shall, not later than 120 days after receipt of proposals in response to a solicitation under subsection (e), select one or more proposals under this section.

(2) In selecting a proposal under this section, the Secretary, through the Agency for International Development, shall consider--

(A) the ability of the United States firm, in cooperation with the host country, to undertake and complete the project;

(B) the degree to which the equipment to be included in the project is designed and manufactured in the United States;

(C) the long-term technical and competitive viability of the United States technology, and services related thereto, and the ability of the United States firm to compete in the development of additional energy projects using such technology in the host country and in other foreign countries;

(D) the extent of technical and financial involvement of the host country in the project;

(E) the extent to which the proposed project meets the goals and objectives stated in section 1301 (a);

(F) the extent of technical, financial, management, and marketing capabilities of the participants in the project, and the commitment of the participants to completion of a successful project in a manner that will facilitate acceptance of the United States technology for future application; and

(G) such other criteria as may be appropriate.

(3) In selecting among proposed projects, the Secretary shall seek to ensure that, relative to otherwise comparable projects in the host country, a selected project will meet 1 or more of the following criteria:

(A) It will reduce environmental emissions to an extent greater than required by applicable provisions of law.

(B) It will increase the overall efficiency of the utilization of coal, including energy conversion efficiency and, where applicable, production of products derived from coal.

(C) It will be a more cost-effective technological alternative, based on life cycle capital and

operating costs per unit of energy produced and, where applicable, costs per unit of product produced.

Priority in selection shall be given to those projects which, in the judgment of the Secretary, best meet one or more of these criteria.

(i) UNITED STATES-ASIA ENVIRONMENTAL PARTNERSHIP- Activities carried out under this section shall be coordinated with the United States-Asia Environmental Partnership.

(j) BUY AMERICA- In carrying out this section, the Secretary, through the Agency for International Development, and pursuant to the agreements under subsection (a), shall ensure--

(1) the maximum percentage, but in no case less than 50 percent, of the cost of any equipment furnished in connection with a project authorized under this section shall be attributable to the manufactured United States components of such equipment; and

(2) the maximum participation of United States firms.

In determining whether the cost of United States components equals or exceeds 50 percent, the cost of assembly of such United States components in the host country shall not be considered a part of the cost of such United States component.

(k) REPORTS TO CONGRESS- The Secretary and the Administrator of the Agency for International Development shall report annually to the Committee on Energy and Natural Resources of the Senate and the appropriate committees of the House of Representatives on the progress being made to introduce clean coal technologies into foreign countries.

(l) DEFINITION- For purposes of this section, the term `host country' means a foreign country which is--

(1) the participant in or the site of the proposed clean coal technology project; and

(2) either--

(A) classified as a country eligible to participate in development assistance programs of the Agency for International Development pursuant to applicable law or regulation; or

(B) a developing country or country with an economy in transition from a nonmarket to a market economy.

(m) AUTHORIZATION FOR PROGRAM- There are authorized to be appropriated to the Secretary to carry out the program required by this section, $100,000,000 for each of the fiscal years 1993, 1994, 1995, 1996, 1997, and 1998.

SEC. 1333. CONVENTIONAL COAL TECHNOLOGY TRANSFER.

If the Secretary determines that the utilization of a clean coal technology is not practicable for a proposed project and that a United States conventional coal technology would constitute a substantial improvement in efficiency, costs, and environmental performance relative to the technology being used in a developing country or country making the transition from nonmarket to market economies, with

significant indigenous coal resources, such technology shall, for purposes of sections 1321 and 1322, be considered a clean coal technology. In the case of combustion technologies, only the retrofit, repowering, or replacement of a conventional technology shall constitute a substantial improvement for purposes of this section. In carrying out this section, the Secretary shall give highest priority to promoting the most environmentally sound and energy efficient technologies.

SEC. 1334. STUDY OF UTILIZATION OF COAL COMBUSTION BYPRODUCTS.

(a) DEFINITION- As used in this section, the term `coal combustion byproducts' means the residues from the combustion of coal including ash, slag, and flue gas desulfurization materials.

(b) STUDY AND REPORT TO CONGRESS- (1) The Secretary shall conduct a detailed and comprehensive study on the institutional, legal, and regulatory barriers to increased utilization of coal combustion byproducts by potential governmental and commercial users. Such study shall identify and investigate barriers found to exist at the Federal, State, or local level, which may have limited or may have the foreseeable effect of limiting the quantities of coal combustion byproducts that are utilized. In conducting this study, the Secretary shall consult with other departments and agencies of the Federal Government, appropriate State and local governments, and the private sector.

(2) Not later than one year after the date of enactment of this Act, the Secretary shall submit a report to the Congress containing the results of the study required by paragraph (1) and the Secretary's recommendations for action to be taken to increase the utilization of coal combustion byproducts. At a minimum, such report shall identify actions that would increase the utilization of coal combustion byproducts in--

(A) bridge and highway construction;

(B) stabilizing wastes;

(C) procurement by departments and agencies of the Federal Government and State and local governments; and

(D) federally funded or federally subsidized procurement by the private sector.

SEC. 1335. CALCULATION OF AVOIDED COST.

Nothing in section 210 of the Public Utility Regulatory Policies Act of 1978 (Public Law 95-617) requires a State regulatory authority or nonregulated electric utility to treat a cost reasonably identified to be incurred or to have been incurred in the construction or operation of a facility or a project which has been selected by the Department of Energy and provided Federal funding pursuant to the Clean Coal Program authorized by Public Law 98-473 as an incremental cost of alternative electric energy.

SEC. 1336. COAL FUEL MIXTURES.

Within one year following the date of enactment of this Act, the Secretary shall submit a report to the Committee on Energy and Commerce and the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate on the status of technologies for combining coal with other materials, such as oil or water fuel mixtures. The report shall include--

(1) a technical and economic feasibility assessment of such technologies;

(2) projected developments in such technologies;

(3) an assessment of the market potential of such technologies, including the potential to displace imported crude oil and refined petroleum products;

(4) identification of barriers to commercialization of such technologies; and

(5) recommendations for addressing barriers to commercialization.

SEC. 1337. NATIONAL CLEARINGHOUSE.

(a) FEASIBILITY- (1) The Secretary shall assess the feasibility of establishing a national clearinghouse for the exchange and dissemination of technical information on technology relating to coal and coal-derived fuels.

(2) In assessing the feasibility, the Secretary shall consider whether such a clearinghouse would be appropriate for purposes of--

(A) collecting information and data on technology relating to coal, and coal-derived fuels, which can be utilized to improve environmental quality and increase energy independence;

(B) disseminating to appropriate individuals, governmental departments, agencies, and instrumentalities, institutions of higher education, and other entities, information and data collected pursuant to this section;

(C) maintaining a library of technology publications and treatises relating to technology information and data collected pursuant to this section;

(D) organizing and conducting seminars for government officials, utilities, coal companies, and other entities or institutions relating to technology using coal and coal-derived fuels that will improve environmental quality and increase energy independence;

(E) gathering information on research grants made for the purpose of improving or enhancing technology relating to the use of coal, and coal-derived fuels, which will improve environmental quality and increase energy independence;

(F) translating into English foreign research papers, articles, seminar proceedings, test results that affect, or could affect, clean coal use technology, and other documents;

(G) encouraging, during the testing of technologies, the use of coal from a variety of domestic sources, and collecting or developing, or both, complete listings of test results using coals from all sources;

(H) establishing and maintaining an index or compilation of research projects relating to clean coal technology carried out throughout the world; and

(I) conducting economic modeling for feasibility of projects.

(b) AUTHORITY TO ESTABLISH CLEARINGHOUSE- Based upon the assessment under subsection (a), the Secretary may establish a clearinghouse.

SEC. 1338. COAL EXPORTS.

(a) PLAN- Within 180 days after the date of enactment of this Act, the Secretary of Commerce, in cooperation with the Secretary and other appropriate Federal agencies, shall submit to the appropriate committees of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a plan for expanding exports of coal mined in the United States.

(b) PLAN CONTENTS- The plan submitted under subsection (a) shall include--

(1) a description of the location, size, and projected growth in potential export markets for coal mined in the United States;

(2) the identification by country of the foreign trade barriers to the export of coal mined in the United States, including foreign coal production and utilization subsidies, tax treatment, labor practices, tariffs, quotas, and other nontariff barriers;

(3) recommendations and a plan for addressing any such trade barriers;

(4) an evaluation of existing infrastructure in the United States and any new infrastructure requirements in the United States to support an expansion of exports of coal mined in the United States, including ports, vessels, rail lines, and any other supporting infrastructure; and

(5) an assessment of environmental implications of coal exports and the identification of export opportunities for blending coal mined in the United States with coal indigenous to other countries to enhance energy efficiency and environmental performance.

SEC. 1339. OWNERSHIP OF COALBED METHANE.

(a) FEDERAL LANDS AND MINERAL RIGHTS- In the case of any deposit of coalbed methane where the United States is the owner of the surface estate or where the United States has transferred the surface estate but reserved the subsurface mineral estate, the Secretary of the Interior shall administer this section. This section and the definitions contained herein shall be applicable only on lands within Affected States.

(b) AFFECTED STATES- Not later than 180 days after the date of enactment of this Act, the Secretary of the Interior, with the participation of the Secretary of Energy, shall publish in the Federal Register a list of Affected States which shall be comprised of States--

(1) in which the Secretary of the Interior, with the participation of the Secretary of Energy, determines that disputes, uncertainty, or litigation exist, regarding the ownership of coalbed methane gas;

(2) in which the Secretary of the Interior, with the participation of the Secretary of Energy, determines that development of significant deposits of coalbed methane gas is being impeded by such existing disputes, uncertainty, or litigation regarding ownership of such coalbed methane;

(3) which do not have in effect a statutory or regulatory procedure or existing case law permitting

and encouraging the development of coalbed methane gas within that State; and

(4) which do not have extensive development of coalbed methane gas.

The Secretary of the Interior, with the participation of the Secretary of Energy, shall revise such list of Affected States from time to time. Any Affected State shall be deleted from the list of Affected States upon the receipt by the Secretary of the Interior of a Governor's petition requesting such deletion, a State law requesting such deletion, or a resolution requesting such deletion enacted by the legislative body of the State. A Governor intending to petition the Secretary of the Interior to delete a State from the list of Affected States shall provide the State's legislative body with 6 months notice of such petition during a legislative session. At the end of such 6-month period, the Governor may petition the Secretary of the Interior to delete a State from the list of Affected States, unless during such 6-month period, the State's legislative body has enacted a law or resolution disapproving the Governor's petition. Until the Secretary of the Interior, with the participation of the Secretary of Energy, publishes a different list, the States of West Virginia, Pennsylvania, Kentucky, Ohio, Tennessee, Indiana, and Illinois shall be the Affected States, effective on the date of the enactment of this Act. The States of Colorado, Montana, New Mexico, Wyoming, Utah, Virginia, Washington, Mississippi, Louisiana, and Alabama shall not be included on the Secretary of the Interior's list of Affected States or any extension or revision thereof.

(c) FAILURE TO ADOPT STATUTORY OR REGULATORY PROCEDURE- If an Affected State has not placed in effect, by statute or by regulation, a substantial program promoting the permitting, drilling and production of coalbed methane wells (including pooling arrangements) within that State within 3 years after becoming an Affected State, the Secretary of the Interior, with the participation of the Secretary of Energy, shall administer this section and shall promulgate such regulations as are necessary to carry out this section in that State.

(d) IMPLEMENTATION BY THE SECRETARY OF THE INTERIOR- In implementing this section, the Secretary of the Interior, with the participation of the Secretary of Energy, shall--

(A) consider existing and future coal mining plans,

(B) preserve the mineability of coal seams, and

(C) provide for the prevention of waste and maximization of recovery of coal and coalbed methane gas in a manner which will protect the rights of all entities owning an interest in such coalbed methane resource.

(e) SPACING- Except where State law in an Affected State contains existing spacing requirements regarding the minimum distance between coalbed methane wells and the minimum distance of a coalbed methane well from a property line, the Secretary of the Interior shall establish such requirements within 90 days after the assertion of jurisdiction pursuant to subsection (c) of this section.

(f) SPACING UNITS- Applications to establish spacing units for the drilling and operation of coalbed methane gas wells may be filed by any entity claiming a coalbed methane ownership interest within a proposed spacing unit. Upon receipt and approval of an application, the Secretary of the Interior shall issue an order establishing the boundaries of the coalbed methane spacing unit. Spacing units shall generally be uniform in size.

(g) DEVELOPMENT UNDER POOLING ARRANGEMENT- Following issuance of an order establishing a spacing unit under subsection (f), and pursuant to an application for pooling filed by the

entity claiming a coalbed methane ownership interest and proposing to drill a coalbed methane gas well, the Secretary of the Interior shall hold a hearing to consider the application for pooling and shall, if the criteria of this section are met, issue an order allowing the proposed pooling of acreage within the designated spacing unit for purposes of drilling and production of coalbed methane from the spacing unit. The pooling order shall not be issued before notice or a reasonable and diligent effort to provide notice has been made to each entity which may claim an ownership interest in the coalbed methane gas within such spacing unit and each such entity has been offered an opportunity to appear before the Secretary of the Interior at the hearing. Upon issuance of a pooling order, each owner or claimant of an ownership interest shall be allowed to make one of the following elections:

(1) An election to sell or lease its coalbed methane ownership interest to the unit operator at a rate determined by the Secretary of the Interior as set forth in the pooling order.

(2) An election to become a participating working interest owner by bearing a share of the risks and costs of drilling, completing, equipping, gathering, operating (including all disposal costs), plugging and abandoning the well, and receiving a share of production from the well.

(3) An election to share in the operation of the well as a nonparticipating working interest owner by relinquishing its working interest to participating working interest owners until the proceeds allocable to its share equal 300 percent of the share of such costs allocable to its interest. Thereafter, the nonparticipating working interest owner shall become a participating working interest owner.

The pooling order shall designate a unit operator who shall be authorized to drill and operate the spacing unit. The pooling order shall provide that any entity claiming an ownership interest in the coalbed methane within such spacing unit which does not make an election under the pooling order shall be deemed to have leased its coalbed methane interest to the unit operator under such terms and conditions as the pooling order may provide. No pooling order may be issued under this paragraph for any spacing unit if all entities claiming an ownership interest in the coalbed methane in the spacing unit have entered into a voluntary agreement providing for the drilling and operation of the coalbed methane gas well for the spacing unit.

(h) ESCROW ACCOUNT- (1) Each pooling order issued under subsection (g) shall provide for the establishment of an escrow account into which the payment of costs and proceeds attributable to the conflicting interests shall be deposited and held for the interest of the claimants as follows:

(A) Each participating working interest owner, except for the unit operator, shall deposit in the escrow account its proportionate share of the costs allocable to the ownership interest claimed by each such participating working interest owner as set forth in the pooling order issued by the Secretary of the Interior.

(B) The unit operator shall deposit in the escrow account all proceeds attributable to the conflicting interests of lessees, plus all proceeds in excess of ongoing operational expenses (including reasonable overhead costs) attributable to conflicting working interests.

(2) The Secretary of the Interior shall order payment of principal and accrued interest from the escrow account to all legally entitled entities within 30 days of receipt by the Secretary of the Interior of notification of the final legal determination of entitlement or upon agreement of all entities claiming an ownership interest in the coalbed methane gas. Upon such final determination--

(A) each legally entitled participating working interest owner shall receive a proportionate share of the proceeds attributable to the conflicting ownership interest;

(B) each legally entitled nonparticipating working interest owner shall receive a proportionate share of the proceeds attributable to the conflicting ownership interest, less the cost of being carried as a nonparticipating working interest owner (as determined by the election of the entity under the applicable pooling order);

(C) each entity leasing (or deemed to have leased) its coalbed methane ownership interest to the unit operator shall receive a share of the royalty proceeds (as set out in the applicable pooling order) attributable to the conflicting interests of lessees; and

(D) the unit operator shall receive the costs contributed to the escrow account by each legally entitled participating working interest owner.

The Secretary of the Interior shall enact rules and regulations for the administration and protection of funds delivered to the escrow accounts.

(i) APPROVAL OF THE SECRETARY OF THE INTERIOR- No entity may drill any well for the production of coalbed methane gas from a coal seam, subject to the provisions of subsection (g), in an Affected State unless the drilling of such well has been approved by the Secretary of the Interior.

(j) AUTHORIZATION TO STIMULATE A COAL SEAM- (1) No operator of a coalbed methane well may stimulate a coal seam without the written consent of each entity which, at the time that the coalbed methane operator applies for a drilling permit, is operating a coal mine, or has by virtue of his property rights in the coal the ability to operate a coal mine, located within a horizontal or vertical distance from the point of stimulation as established by the Secretary of the Interior pursuant to paragraph (3) of this subsection. In seeking the coal operator's consent, a coalbed methane well operator shall provide the coal operator with necessary information about such stimulation, including relevant information to ensure compliance with coal mine safety laws and rules.

(2) In the absence of a written consent pursuant to paragraph (1) and at the request of a coalbed methane operator, the Secretary of the Interior shall make a determination regarding stimulation of a coal seam. Such request shall include an affidavit which shall--

(A) state that an entity from which consent is required pursuant to paragraph (1) has refused to provide written consent;

(B) set forth in detail the efforts undertaken by the applicant to obtain such written consent;

(C) state the known reasons for the consent not being provided;

(D) set forth the conditions and compensation, if any, offered by the applicant as part of the efforts to obtain consent; and

(E) provide prima facie evidence that the method of stimulation proposed by the coalbed methane operator will not (i) cause unreasonable loss or damage to the coal seam considering all factors, including the prospect, taking into consideration the economics of the coal industry, that coal seams for which no actual or proposed mining plans exist will be mined at some future date, or (ii) violate mine safety requirements. If a denial of consent by a coal operator is based on reasons

related to safety, the Secretary of the Interior shall seek the views and recommendations of the appropriate State or Federal coal mine safety agency. Any determination by the Secretary of the Interior shall be in accordance with all applicable Federal and State coal mine safety laws and such views and recommendations. A determination by the Secretary of the Interior approving a method of stimulation may include reasonable conditions including, but not limited to, conditions to mitigate, to the extent practicable, economic damage to the coal seam. Any determination approving or denying a method of stimulation by the Secretary of the Interior shall be subject to appeal. Interested entities shall be allowed to participate in and comment on proceedings under this paragraph.

(3) The Secretary of the Interior shall by rule establish, for an Affected State, a region thereof, or a multi-State region comprised of Affected States, the boundaries within which a coalbed methane operator shall be required to obtain written consent from a coal operator pursuant to paragraph (1). Such boundaries shall be stated in terms of a horizontal and a vertical distance from the point of stimulation and shall be determined based on an evaluation of the maximum length, height and depth of fracture producible in a coal seam in such Affected State, region thereof, or multi-State region comprised of Affected States.

(4) The consent required under this subsection shall in no way be deemed to impair, abridge, or affect any contractual rights or objections arising out of a coalbed methane gas contract or coalbed methane gas lease in existence as of the effective date of this section between the coalbed methane operator and the coal operator, and the existence of such lease or contractual agreement and any extensions or renewals of such lease shall be deemed to fully meet the requirements of this section.

(5) Nothing in this subsection precludes either a coal operator or a coalbed methane operator from seeking in the appropriate State forum compensation for the consequences of a determination by the Secretary of the Interior pursuant to paragraph (2).

(k) NOTICE AND OBJECTION- (1) The Secretary of the Interior shall not approve the drilling of any coalbed methane well unless the unit operator has notified each entity which is operating, or has the ability, by virtue of his property rights in the coal, to operate, a coal mine in any portion of the coalbed that would be affected by such well within the distances established pursuant to the rules promulgated under subsection (j)(3). Any notified entity may object to the drilling of such well within 30 days after receipt of a notice. Upon receipt of a timely objection to the drilling of any coalbed methane gas well submitted by a notified entity, the Secretary of the Interior may refuse to approve the drilling of the well based on any of the following:

(A) The proposed activity, due to its proximity to any coal mine opening, shaft, underground workings, or to any proposed extension of the coal mine, would adversely affect any operating, inactive or abandoned coal mine, including any coal mine already surveyed and platted but not yet being operated.

(B) The proposed activity would not conform with a coal operator's development plan for an existing or proposed operation.

(C) There would be an unreasonable interference from the proposed activity with present or future coal mining operations, including the ability to comply with other applicable laws and regulations.

(D) The presence of evidence indicating that the proposed drilling activities would be unsafe, taking into consideration the dangers from creeps, squeezes or other disturbances due to the extraction of coal.

(E) The proposed activity would unreasonably interfere with the safe recovery of coal, oil and gas.

(2) In the event the Secretary of the Interior does not approve the drilling of a coalbed methane well pursuant to paragraph (1), the Secretary of the Interior shall consider whether such drilling could be approved if the unit operator modifies the proposed activities to take into account any of the following:

(A) The proposed activity could instead be reasonably done through an existing or planned pillar of coal, or in close proximity to an existing well or such pillar of coal, taking into consideration surface topography.

(B) The proposed activity could instead be moved to a mined-out area, below the coal outcrop or to some other feasible area.

(C) The unit operator agrees to a drilling moratorium of not more than two years in order to permit completion of coal mining operations.

(D) The practicality of locating the proposed spacing unit or well on a uniform pattern with other spacing units or wells.

(l) PLUGGING- All coalbed methane wells drilled after enactment of this Act that penetrate coal seams with remaining reserves shall provide for subsequent safe mining through the well in accordance with standards prescribed by the Secretary of the Interior, in consultation with any Federal and State agencies having authority over coal mine safety. Well plugging costs should be allocated in accordance with State law or private contractual arrangement, as the case may be.

(m) NOTICE AND OBJECTION BY OTHER PARTIES- The Secretary of the Interior shall not approve the drilling of any coalbed methane well unless such well complies with the spacing and other requirements established by the Secretary of the Interior and each of the following:

(1) The unit operator of such well has notified, or has made a reasonable and diligent effort to notify, all entities claiming ownership of coalbed methane to be drained by such well and provided an opportunity to object in accordance with requirements established by the Secretary of the Interior.

(2) Where conflicting interests exist, an order under subsection (g) establishing pooling requirements has been issued.

The notification requirements of this subsection shall be additional to the notification referred to in subsection (k). The Secretary of the Interior shall establish the conditions under which entities claiming ownership of coalbed methane may object to the drilling of a coalbed methane well.

(n) VENTING FOR SAFETY- Nothing in this section shall be construed to prevent or inhibit the entity which has the right to develop and mine coal in any mine from venting coalbed methane gas to ensure safe mine operations.

(o) OTHER LAWS- The Secretary of the Interior shall comply with all applicable Federal and State coal mine safety laws and regulations.

(p) DEFINITIONS- As used in this section--

(1) The term `Affected State' means a State listed by the Secretary of the Interior, with the participation of the Secretary of Energy, under subsection (b).

(2) The term `coalbed methane gas' means occluded natural gas produced (or which may be produced) from coalbeds and rock strata associated therewith.

(3) The term `unit operator' means the entity designated in a pooling order to develop a spacing unit by the drilling of one or more wells on the unit.

(4) The term `nonparticipating working interest owner' means a gas or oil owner of a tract included in a spacing unit which elects to share in the operation of the well on a carried basis by agreeing to have its proportionate share of the costs allocable to its interest charged against its share of production of the well in accordance with subsection (f)(3).

(5) The term `participating working interest owner' means a gas or oil owner which elects to bear a share of the risks and costs of drilling, completing, equipping, gathering, operating (including any and all disposal costs) plugging, and abandoning a well on a spacing unit and to receive a share of production from the well equal to the proportion which the acreage in the spacing unit it owns or holds under lease bears to the total acreage of the spacing unit.

(6) The term `coal seam' means any stratum of coal 20 inches or more in thickness, unless a stratum of less thickness is being commercially worked, or can in the judgment of the Secretary of the Interior forseeably be commercially worked and will require protection if wells are being drilled through it.

SEC. 1340. ESTABLISHMENT OF DATA BASE AND STUDY OF TRANSPORTATION RATES.

(a) DATA BASE- The Secretary shall review the information currently collected by the Federal Government and shall determine whether information on transportation rates for rail and pipeline transport of domestic coal, oil, and gas during the period of January 1, 1988, through December 31, 1997, is reasonably available. If he determines that such information is not reasonably available, the Secretary shall establish a data base containing, to the maximum extent practicable, information on all such rates. The confidentiality of contract rates shall be preserved. To obtain data pertaining to rail contract rates, the Secretary shall acquire such data in aggregate form only from the Interstate Commerce Commission, under terms and conditions that maintain the confidentiality of such rates.

(b) STUDY- The Energy Information Administration shall determine the extent to which any agency of the Federal Government is studying the rates and distribution patterns of domestic coal, oil, and gas to determine the impact of the Clean Air Act as amended by the Act entitled `An Act to amend the Clean Air Act to provide for attainment and maintenance of health protective national ambient air quality standards, and for other purposes.', enacted November 15, 1990 (Public Law 101-549), and other Federal policies on such rates and distribution patterns. If the Energy Information Administration finds that no such study is underway, or that reports of the results of such study will not be available to the Congress providing the information specified in this subsection and subsection (a) by the dates established in subsection (c), the Energy Information Administration shall initiate such a study.

(c) REPORTS TO CONGRESS- Within one year after the date of enactment of this Act, the Secretary shall report to the Congress on the determination the Energy Information Administration is required to make under subsection (b). Within three years after the date of enactment of this Act, the Secretary shall submit reports on any data base or study developed under this section. Any such reports shall be updated

and resubmitted to the Congress within eight years after such date of enactment. If the Energy Information Administration has determined pursuant to subsection (b) that another study or studies will provide all or part of the information called for in this section, the Secretary shall transmit the results of that study by the dates established in this subsection, together with his comments.

(d) CONSULTATION WITH OTHER AGENCIES- The Secretary and the Energy Information Administration shall consult with the Chairmen of the Federal Energy Regulatory Commission and the Interstate Commerce Commission in implementing this section.

SEC. 1341. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary for carrying out this subtitle, other than section 1322, such sums as may be necessary for fiscal years 1993 through 1998.

TITLE XIV--STRATEGIC PETROLEUM RESERVE

SEC. 1401. DRAWDOWN AND DISTRIBUTION OF THE RESERVE.

Section 161 of the Energy Policy and Conservation Act (42 U.S.C. 6241) is amended--

(1) in subsection (d)--

(A) by striking `(d)' and inserting `(d)(1)'; and

(B) by adding at the end the following new paragraph:

`(2) For purposes of this section, in addition to the circumstances set forth in section 3(8), a severe energy supply interruption shall be deemed to exist if the President determines that--

`(A) an emergency situation exists and there is a significant reduction in supply which is of significant scope and duration;

`(B) a severe increase in the price of petroleum products has resulted from such emergency situation; and

`(C) such price increase is likely to cause a major adverse impact on the national economy.'; and

(2) in subsection (h)(1)(A), by inserting `or international' after `domestic'.

SEC. 1402. EXPANSION OF RESERVE.

Section 154(a) of the Energy Policy and Conservation Act (42 U.S.C. 6234) is amended--

(1) by striking `(a)' and inserting `(a)(1)'; and

(2) by adding at the end the following:

`(2) Beginning on the date of the enactment of the Energy Policy Act of 1992, the President shall take actions to enlarge the Strategic Petroleum Reserve to 1,000,000,000 barrels as rapidly as possible. Such

actions may include--

`(A) petroleum acquisition, transportation, and injection activities at the highest practicable fill rate achievable, subject to the availability of appropriated funds;

`(B) contracting for petroleum product not owned by the United States as specified in part C;

`(C) contracting for petroleum product for storage in facilities not owned by the United States, except that no such product may be stored in such facilities unless petroleum product stored in facilities owned by the United States on the date such product is delivered for storage is at least 750,000,000 barrels;

`(D) carrying out the activities described in section 160(h);

`(E) the transferring of oil from the Naval Petroleum Reserve; and

`(F) other activities specified in this title.'.

SEC. 1403. AVAILABILITY OF FUNDING FOR LEASING.

Section 171 of the Energy Policy and Conservation Act (42 U.S.C. 6249) is amended by adding at the end the following new subsection:

`(f) AVAILABILITY OF FUNDS- The Secretary may utilize such funds as are available in the SPR Petroleum Account to carry out the activities described in subsection (a), and may obligate and expend such funds to carry out such activities, in advance of the receipt of petroleum products.'.

SEC. 1404. PURCHASE FROM STRIPPER WELL PROPERTIES.

(a) IN GENERAL- Section 160 of the Energy Policy and Conservation Act (42 U.S.C. 6240) is amended by adding at the end the following new subsection:

`(h)(1) If the President finds that declines in the production of oil from domestic resources pose a threat to national energy security, the President may direct the Secretary to acquire oil from domestic production of stripper well properties for storage in the Strategic Petroleum Reserve. Except as provided in paragraph (2), the Secretary may set such terms and conditions as he deems necessary for such acquisition.

`(2) Crude oil purchased by the Secretary pursuant to this subsection shall be by competitive bid. The price paid by the Secretary--

`(A) shall take into account the cost of production including costs of reservoir and well maintenance; and

`(B) shall not exceed the price that would have been paid if the Secretary had acquired petroleum products of a similar quality on the open market under competitive bid procedures without regard to the source of the petroleum products.'.

(b) TECHNICAL CORRECTIONS- Part B of title I of such Act is amended--

(1) in section 167(d), in the matter preceding paragraph (1), by striking `subsection (g)' and inserting `under subsection (g)'; and

(2) in section 160(d)(2)--

(A) by striking `(2)(A)' and inserting `(2)'; and

(B) by redesignating clauses (i), (ii), and (iii) as subparagraphs (A), (B), and (C), respectively.

SEC. 1405. REDESIGNATION OF ISLAND STATES.

Section 157(a) of the Energy Policy and Conservation Act (42 U.S.C. 6237(a)) is amended--

(1) by striking `(a)' and inserting `(a)(1)'; and

(2) by adding at the end the following new paragraph:

`(2) For the purpose of carrying out this section--

`(A) any State that is an island shall be considered to be a separate Federal Energy Administration Region, as defined in title 10, Code of Federal Regulations, as in effect on November 1, 1975;

`(B) determinations made with respect to Regions, other than States that are islands, shall be made as if the islands were not part of the Regions; and

`(C) with respect to determinations made for any State that is an island, the term `refined petroleum product' shall have the same meaning given the term `petroleum product' in section 3 (3).'.

SEC. 1406. INSULAR AREAS STUDY.

(a) IN GENERAL- The Secretary shall conduct a study of the implications of the unique vulnerabilities of the insular areas to an oil supply disruption. Such study shall outline how the insular areas shall gain access to vital oil supplies during times of national emergency. Such study shall be completed and submitted to the Congress not later than 9 months after the date of the enactment of this Act.

(b) DEFINITION- For purposes of this section, the term `insular areas' means the Virgin Islands, Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and Palau.

TITLE XV--OCTANE DISPLAY AND DISCLOSURE

SEC. 1501. CERTIFICATION AND POSTING OF AUTOMOTIVE FUEL RATINGS.

(a) COVERAGE OF ALL LIQUID AUTOMOTIVE FUELS- Section 201(6) of the Petroleum Marketing Practices Act (15 U.S.C. 2821(6)) is amended to read as follows:

`(6) The term `automotive fuel' means liquid fuel of a type distributed for use as a fuel in any motor vehicle.'.

(b) AUTOMOTIVE FUEL RATING- Section 201 of such Act (15 U.S.C. 2821) is amended by adding at the end the following new paragraphs:

`(17) The term `automotive fuel rating' means--

`(A) the octane rating of an automotive spark-ignition engine fuel; and

`(B) if provided for by the Federal Trade Commission by rule, the cetane rating of diesel fuel oils; or

`(C) another form of rating determined by the Federal Trade Commission, after consultation with the American Society for Testing and Materials, to be more appropriate to carry out the purposes of this title with respect to the automotive fuel concerned.

`(18)(A) The term `cetane rating' means a measure, as indicated by a cetane index or cetane number, of the ignition quality of diesel fuel oil and of the influence of the diesel fuel oil on combustion roughness.

`(B) The term `cetane index' and the term `cetane number' have the meanings determined in accordance with the test methods set forth in the American Society for Testing and Materials standard test methods--

`(i) designated D976 or D4737 in the case of cetane index; and

`(ii) designated D613 in the case of cetane number,

(as in effect on the date of the enactment of this Act) and shall apply to any grade or type of diesel fuel oils defined in the specification of the American Society for Testing and Materials entitled `Standard Specification for Diesel Fuel Oils' designated D975 (as in effect on such date).'.

(c) CONFORMING AMENDMENTS- (1) Section 201 of such Act (15 U.S.C. 2821) is amended--

(A) in paragraph (1), by striking out `gasoline' and inserting in lieu thereof `fuel';

(B) in paragraph (2)--

(i) by striking out `Standard Specifications for Automotive Gasoline' and inserting in lieu thereof `Standard Specification for Automotive Spark-Ignition Engine Fuel'; and

(ii) by striking out `D 439' and inserting in lieu thereof `D4814';

(C) in paragraph (4)--

(i) by striking out `gasoline' the first place it appears and inserting in lieu thereof `automotive fuel'; and

(ii) by striking out `gasoline' the second place it appears and inserting in lieu thereof `fuel';

(D) by striking out paragraph (5) and inserting in lieu thereof the following:

`(5) The term `refiner' means any person engaged in the production or importation of automotive fuel.';

(E) in paragraph (11)--

(i) by striking out `octane' each place it appears and inserting in lieu thereof `automotive fuel'; and

(ii) by striking out `gasoline' each place it appears and inserting in lieu thereof `fuel'; and

(F) in paragraph (16), by striking out `gasoline' each place it appears and inserting in lieu thereof `automotive fuel'.

(2) Section 202 of such Act (15 U.S.C. 2822) is amended--

(A) by striking out `octane rating' and `octane ratings' each place such terms appear and inserting in lieu thereof `automotive fuel rating' and `automotive fuel ratings', respectively;

(B) in subsections (a) and (b), by striking out `gasoline' each place it appears and inserting in lieu thereof `fuel';

(C) in subsection (c)--

(i) by striking out `gasoline' each place it appears (other than the second place it appears) and inserting in lieu thereof `automotive fuel'; and

(ii) by striking out `gasoline' the second place it appears and inserting in lieu thereof `fuel';

(D) in subsection (d), by striking out `octane' and inserting in lieu thereof `automotive fuel';

(E) in subsection (e)--

(i) by striking out `gasoline' each place it appears and inserting in lieu thereof `fuel'; and

(ii) by striking out `gasoline's' and inserting in lieu thereof `fuel's';

(F) in subsections (f), (g), and (h), by striking out `gasoline' each place it appears and inserting in lieu thereof `fuel';

(G) in subsection (h), by striking out `octane requirement' each place it appears and inserting in lieu thereof `automotive fuel requirement'; and

(H) in the section heading, by striking out `OCTANE' and inserting in lieu thereof `AUTOMOTIVE FUEL RATING'.

(3) Section 203 of such Act (15 U.S.C. 2823) is amended--

(A) by striking out `octane rating' and `octane ratings' each place such terms appear and inserting in lieu thereof `automotive fuel rating' and `automotive fuel ratings', respectively;

(B) in subsections (b) and (c), by striking out `gasoline' each place it appears and inserting in lieu thereof `fuel'; and

(C) in subsection (c)(3), by striking out `201(1)' and inserting in lieu thereof `201'.

(d) EFFECTIVE DATE- (1) The amendments made by this section shall become effective at the end of the one-year period beginning on the date of the enactment of this Act.

(2) The Federal Trade Commission shall, within 270 days after the date of the enactment of this Act, prescribe rules for the purpose of implementing the amendments made in this section.

SEC. 1502. INCREASED AUTHORITY FOR ENFORCEMENT.

(a) STATE LAW- Section 204 of the Petroleum Marketing Practices Act (15 U.S.C. 2824) is amended to read as follows:

`RELATIONSHIP OF THIS TITLE TO STATE LAW

`SEC. 204. (a) To the extent that any provision of this title applies to any act or omission, no State or any political subdivision thereof may adopt or continue in effect, except as provided in subsection (b), any provision of law or regulation with respect to such act or omission, unless such provision of such law or regulation is the same as the applicable provision of this title.

`(b) A State or political subdivision thereof may provide for any investigative or enforcement action, remedy, or penalty (including procedural actions necessary to carry out such investigative or enforcement actions, remedies, or penalties) with respect to any provision of law or regulation permitted by subsection (a).'.

(b) FTC ENFORCEMENT- Section 203(e) of such Act is amended by striking out `; except that' in the second sentence and all that follows through the period and inserting in lieu thereof a period.

(c) EPA ENFORCEMENT- Section 203(b)(1) of such Act is amended--

(1) in the matter preceding subparagraph (A), by striking out `shall';

(2) in subparagraph (A), by striking out `conduct' and inserting in lieu thereof `may conduct';

(3) in subparagraph (B), by striking out `certify' and inserting in lieu thereof `shall certify';

(4) in subparagraph (C), by striking out `notify' and inserting in lieu thereof `shall notify'; and

(5) in subparagraph (C), by striking out `discovered' and all that follows through `testing'.

SEC. 1503. STUDIES.

(a) IN GENERAL- For the purpose of making the findings, conclusions, and recommendations referred to in subsection (c)--

(1) the Administrator of the Environmental Protection Agency, in consultation with the Secretary

of Energy, shall carry out a study to determine whether, and if so, how, the anti-knock characteristics of nonliquid fuels usable as a fuel for a motor vehicle (as defined in section 201(7) of the Petroleum Marketing Practices Act) can be determined; and

(2) the Federal Trade Commission, in consultation with the Administrator of the Environmental Protection Agency, shall carry out a study--

(A) to determine the need for, and the desirability of, having a uniform national label on devices used to dispense automotive fuel to consumers that would consolidate information required by Federal law to be posted on such devices; and

(B) to determine the nature of such label if it is determined under subparagraph (A) that such a need exists.

(b) IMPLEMENTATION- (1) In carrying out studies under this section, each agency shall--

(A) publish general notice of each of the studies in the Federal Register; and

(B) give interested parties an opportunity to participate in such studies through submission of written data, views, or arguments.

(2) In carrying out the study to determine the nature of a uniform national label under subsection (a)(2)(B), the Federal Trade Commission shall--

(A) weigh the consumer, environmental, and energy saving benefits of any element of such label against the necessity for a concise, practical, and cost-efficient label; and

(B) consider as a possible element of such label a statement suggesting consumers check the vehicle's owner's manual regarding octane requirements.

(c) REPORTS- The Administrator of the Environmental Protection Agency, the Secretary of Energy, and the Chairman of the Federal Trade Commission shall transmit to the Congress, within one year after the date of the enactment of this Act, the findings, conclusions, and recommendations made as a result of the studies carried out by such officers under this section, together with a description of the administrative and legislative actions needed to implement such recommendations.

TITLE XVI--GLOBAL CLIMATE CHANGE

SEC. 1601. REPORT.

Not later than 2 years after the date of the enactment of this Act, the Secretary shall submit a report to the Congress that includes an assessment of--

(1) the feasibility and economic, energy, social, environmental, and competitive implications, including implications for jobs, of stabilizing the generation of greenhouse gases in the United States by the year 2005;

(2) the recommendations made in chapter 9 of the 1991 National Academy of Sciences report entitled `Policy Implications of Greenhouse Warming', including an analysis of the benefits and costs of each recommendation;

(3) the extent to which the United States is responding, compared with other countries, to the recommendations made in chapter 9 of the 1991 National Academy of Sciences report;

(4) the feasibility of reducing the generation of greenhouse gases;

(5) the feasibility and economic, energy, social, environmental, and competitive implications, including implications for jobs, of achieving a 20 percent reduction from 1988 levels in the generation of carbon dioxide by the year 2005 as recommended by the 1988 Toronto Scientific World Conference on the Changing Atmosphere;

(6) the potential economic, energy, social, environmental, and competitive implications, including implications for jobs, of implementing the policies necessary to enable the United States to comply with any obligations under the United Nations Framework Convention on Climate Change or subsequent international agreements.

SEC. 1602. LEAST-COST ENERGY STRATEGY.

(a) STRATEGY- The first National Energy Policy Plan (in this title referred to as the `Plan') under section 801 of the Department of Energy Organization Act (42 U.S.C. 7321) prepared and required to be submitted by the President to Congress after February 1, 1993, and each subsequent such Plan, shall include a least-cost energy strategy prepared by the Secretary. In developing the least-cost energy strategy, the Secretary shall take into consideration the economic, energy, social, environmental, and competitive costs and benefits, including costs and benefits for jobs, of his choices. Such strategy shall also take into account the report required under section 1601 and relevant Federal, State, and local requirements. Such strategy shall be designed to achieve to the maximum extent practicable and at least-cost to the Nation--

(1) the energy production, utilization, and energy conservation priorities of subsection (d);

(2) the stabilization and eventual reduction in the generation of greenhouse gases;

(3) an increase in the efficiency of the Nation's total energy use by 30 percent over 1988 levels by the year 2010;

(4) an increase in the percentage of energy derived from renewable resources by 75 percent over 1988 levels by the year 2005; and

(5) a reduction in the Nation's oil consumption from the 1990 level of approximately 40 percent of total energy use to 35 percent by the year 2005.

(b) ADDITIONAL CONTENTS- The least-cost energy strategy shall also include--

(1) a comprehensive inventory of available energy and energy efficiency resources and their projected costs, taking into account all costs of production, transportation, distribution, and utilization of such resources, including--

(A) coal, clean coal technologies, coal seam methane, and underground coal gasification;

(B) energy efficiency, including existing technologies for increased efficiency in production, transportation, distribution, and utilization of energy, and other technologies that are

anticipated to be available through further research and development; and

(C) other energy resources, such as renewable energy, solar energy, nuclear fission, fusion, geothermal, biomass, fuel cells, hydropower, and natural gas;

(2) a proposed two-year program for ensuring adequate supplies of the energy and energy efficiency resources and technologies described in paragraph (1), and an identification of administrative actions that can be undertaken within existing Federal authority to ensure their adequate supply;

(3) estimates of life-cycle costs for existing energy production facilities;

(4) basecase forecasts of short-term and long-term national energy needs under low and high case assumptions of economic growth; and

(5) an identification of all applicable Federal authorities needed to achieve the purposes of this section, and of any inadequacies in those authorities.

(c) SECRETARIAL CONSIDERATION- In developing the least-cost energy strategy, the Secretary shall give full consideration to--

(1) the relative costs of each energy and energy efficiency resource based upon a comparison of all direct and quantifiable net costs for the resource over its available life, including the cost of production, transportation, distribution, utilization, waste management, environmental compliance, and, in the case of imported energy resources, maintaining access to foreign sources of supply; and

(2) the economic, energy, social, environmental, and competitive consequences resulting from the establishment of any particular order of Federal priority as determined under subsection (d).

(d) PRIORITIES- The least-cost energy strategy shall identify Federal priorities, including policies that--

(1) implement standards for more efficient use of fossil fuels;

(2) increase the energy efficiency of existing technologies;

(3) encourage technologies, including clean coal technologies, that generate lower levels of greenhouse gases;

(4) promote the use of renewable energy resources, including solar, geothermal, sustainable biomass, hydropower, and wind power;

(5) affect the development and consumption of energy and energy efficiency resources and electricity through tax policy;

(6) encourage investment in energy efficient equipment and technologies; and

(7) encourage the development of energy technologies, such as advanced nuclear fission and nuclear fusion, that produce energy without greenhouse gases as a byproduct, and encourage the deployment of nuclear electric generating capacity.

(e) ASSUMPTIONS- The Secretary shall include in the least-cost energy strategy an identification of all of the assumptions used in developing the strategy and priorities thereunder, and the reasons for such assumptions.

(f) PREFERENCE- When comparing an energy efficiency resource to an energy resource, a higher priority shall be assigned to the energy efficiency resource whenever all direct and quantifiable net costs for the resource over its available life are equal to the estimated cost of the energy resource.

(g) PUBLIC REVIEW AND COMMENT- The Secretary shall provide for a period of public review and comment of the least-cost energy strategy, for a period of at least 30 days, to be completed at least 60 days before the issuance of such strategy. The Secretary shall also provide for public review and comment before the issuance of any update to the least-cost energy strategy required under this section.

SEC. 1603. DIRECTOR OF CLIMATE PROTECTION.

Within 6 months after the date of the enactment of this Act, the Secretary shall establish, within the Department of Energy, a Director of Climate Protection (in this section referred to as the `Director'). The Director shall--

(1) in the absence of the Secretary, serve as the Secretary's representative for interagency and multilateral policy discussions of global climate change, including the activities of the Committee on Earth and Environmental Sciences as established by the Global Change Research Act of 1990 (Public Law 101-606) and the Policy Coordinating Committee Working Group on Climate Change;

(2) monitor, in cooperation with other Federal agencies, domestic and international policies for their effects on the generation of greenhouse gases; and

(3) have the authority to participate in the planning activities of relevant Department of Energy programs.

SEC. 1604. ASSESSMENT OF ALTERNATIVE POLICY MECHANISMS FOR ADDRESSING GREENHOUSE GAS EMISSIONS.

Not later than 18 months after the date of the enactment of this Act, the Secretary shall transmit a report to Congress containing a comparative assessment of alternative policy mechanisms for reducing the generation of greenhouse gases. Such assessment shall include a short-run and long-run analysis of the social, economic, energy, environmental, competitive, and agricultural costs and benefits, including costs and benefits for jobs and competition, and the practicality of each of the following policy mechanisms:

(1) Various systems for controlling the generation of greenhouse gases, including caps for the generation of greenhouse gases from major sources and emissions trading programs.

(2) Federal standards for energy efficiency for major sources of greenhouse gases, including efficiency standards for power plants, industrial processes, automobile fuel economy, appliances, and buildings, and for emissions of methane.

(3) Various Federal and voluntary incentives programs.

SEC. 1605. NATIONAL INVENTORY AND VOLUNTARY REPORTING OF GREENHOUSE GASES.

(a) NATIONAL INVENTORY- Not later than one year after the date of the enactment of this Act, the Secretary, through the Energy Information Administration, shall develop, based on data available to, and obtained by, the Energy Information Administration, an inventory of the national aggregate emissions of each greenhouse gas for each calendar year of the baseline period of 1987 through 1990. The Administrator of the Energy Information Administration shall annually update and analyze such inventory using available data. This subsection does not provide any new data collection authority.

(b) VOLUNTARY REPORTING-

(1) ISSUANCE OF GUIDELINES- Not later than 18 months after the date of the enactment of this Act, the Secretary shall, after opportunity for public comment, issue guidelines for the voluntary collection and reporting of information on sources of greenhouse gases. Such guidelines shall establish procedures for the accurate voluntary reporting of information on--

(A) greenhouse gas emissions--

(i) for the baseline period of 1987 through 1990; and

(ii) for subsequent calendar years on an annual basis;

(B) annual reductions of greenhouse gas emissions and carbon fixation achieved through any measures, including fuel switching, forest management practices, tree planting, use of renewable energy, manufacture or use of vehicles with reduced greenhouse gas emissions, appliance efficiency, energy efficiency, methane recovery, cogeneration, chlorofluorocarbon capture and replacement, and power plant heat rate improvement;

(C) reductions in greenhouse gas emissions achieved as a result of--

(i) voluntary reductions;

(ii) plant or facility closings; and

(iii) State or Federal requirements; and

(D) an aggregate calculation of greenhouse gas emissions by each reporting entity.

Such guidelines shall also establish procedures for taking into account the differential radiative activity and atmospheric lifetimes of each greenhouse gas.

(2) REPORTING PROCEDURES- The Administrator of the Energy Information Administration shall develop forms for voluntary reporting under the guidelines established under paragraph (1), and shall make such forms available to entities wishing to report such information. Persons reporting under this subsection shall certify the accuracy of the information reported.

(3) CONFIDENTIALITY- Trade secret and commercial or financial information that is privileged or confidential shall be protected as provided in section 552(b)(4) of title 5, United States Code.

(4) ESTABLISHMENT OF DATA BASE- Not later than 18 months after the date of the enactment of this Act, the Secretary, through the Administrator of the Energy Information Administration, shall establish a data base comprised of information voluntarily reported under

this subsection. Such information may be used by the reporting entity to demonstrate achieved reductions of greenhouse gases.

(c) CONSULTATION- In carrying out this section, the Secretary shall consult, as appropriate, with the Administrator of the Environmental Protection Agency.

SEC. 1606. REPEAL.

Title III of the Energy Security Act (42 U.S.C. 7361 et seq.) is hereby repealed.

SEC. 1607. CONFORMING AMENDMENT.

The Secretary, through the Trade Promotion Coordinating Council, shall develop policies and programs to encourage the export and promotion of domestic energy resource technologies, including renewable energy, energy efficiency, and clean coal technologies, to developing countries.

SEC. 1608. INNOVATIVE ENVIRONMENTAL TECHNOLOGY TRANSFER PROGRAM.

(a) ESTABLISHMENT OF PROGRAM- The Secretary, through the Agency for International Development, and in consultation with the interagency working group established under section 256(d) of the Energy Policy and Conservation Act (in this section referred to as the `interagency working group', shall establish a technology transfer program to carry out the purposes described in subsection (b). Within 150 days after the date of the enactment of this Act, the Secretary and the Administrator of the Agency for International Development shall enter into a written agreement to carry out this section. The agreement shall establish a procedure for resolving any disputes between the Secretary and the Administrator regarding the implementation of specific projects. With respect to countries not assisted by the Agency for International Development, the Secretary may enter into agreements with other appropriate Federal agencies. If the Secretary and the Administrator, or the Secretary and an agency described in the previous sentence, are unable to reach an agreement, each shall send a memorandum to the President outlining an appropriate agreement. Within 90 days after receipt of either memorandum, the President shall determine which version of the agreement shall be in effect. Any agreement entered into under this subsection shall be provided to the appropriate committees of the Congress and made available to the public.

(b) PURPOSES OF THE PROGRAM- The purposes of the technology transfer program under this section are to--

(1) reduce the United States balance of trade deficit through the export of United States energy technologies and technological expertise;

(2) retain and create manufacturing and related service jobs in the United States;

(3) encourage the export of United States technologies, including services related thereto, to those countries that have a need for developmentally sound facilities to provide energy derived from technologies that substantially reduce environmental pollutants, including greenhouse gases;

(4) develop markets for United States technologies, including services related thereto, that substantially reduce environmental pollutants, including greenhouse gases, that meet the energy and environmental requirements of foreign countries;

(5) better ensure that United States participation in energy-related projects in foreign countries includes participation by United States firms as well as utilization of United States technologies;

(6) ensure the introduction of United States firms and expertise in foreign countries;

(7) provide financial assistance by the Federal Government to foster greater participation by United States firms in the financing, ownership, design, construction, or operation of technologies or services that substantially reduce environmental pollutants, including greenhouse gases; and

(8) assist United States firms, especially firms that are in competition with firms in foreign countries, to obtain opportunities to transfer technologies to, or undertake projects in, foreign countries.

(c) IDENTIFICATION- Pursuant to the agreements required by subsection (a), the Secretary, through the Agency for International Development, and after consultation with the interagency working group, United States firms, and representatives from foreign countries, shall develop mechanisms to identify potential energy projects in host countries that substantially reduce environmental pollutants, including greenhouse gases, and shall identify a list of such projects within 240 days after the date of the enactment of this Act, and periodically thereafter.

(d) FINANCIAL MECHANISMS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, shall--

(A) establish appropriate financial mechanisms to increase the participation of United States firms in energy projects, and services related thereto, that substantially reduce environmental pollutants, including greenhouse gases in foreign countries;

(B) utilize available financial assistance authorized by this section to counterbalance assistance provided by foreign governments to non-United States firms; and

(C) provide financial assistance to support projects.

(2) The financial assistance authorized by this section may be--

(A) provided in combination with other forms of financial assistance, including non-Federal funding that may be available for the project; and

(B) utilized in conjunction with financial assistance programs available through other Federal agencies.

(3) United States obligations under the Arrangement on Guidelines for Officially Supported Export Credits established through the Organization for Economic Cooperation and Development shall be applicable to this section.

(e) SOLICITATIONS FOR PROJECT PROPOSALS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, within one year after the date of the enactment of this Act, and subsequently as appropriate thereafter, shall solicit proposals from United States firms for the design, construction, testing, and operation of the project or projects identified under subsection (c) which propose to utilize a United States technology or service. Each solicitation under this section shall establish a closing date for receipt of proposals.

(2) The solicitation under this subsection shall, to the extent appropriate, be modeled after the RFP No. DE-PS01-90FE62271 Clean Coal Technology IV, as administered by the Department of Energy.

(3) Any solicitation made under this subsection shall include the following requirements:

(A) The United States firm that submits a proposal in response to the solicitation shall have an equity interest in the proposed project.

(B) The project shall utilize a United States technology, including services related thereto, that substantially reduce environmental pollutants, including greenhouse gases, in meeting the applicable energy and environmental requirements of the host country.

(C) Proposals for projects shall be submitted by and undertaken with a United States firm, although a joint venture or other teaming arrangement with a non-United States manufacturer or other non-United States entity is permissible.

(f) ASSISTANCE TO UNITED STATES FIRMS- Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, and in consultation with the interagency working group, shall establish a procedure to provide financial assistance to United States firms under this section for a project identified under subsection (c) where solicitations for the project are being conducted by the host country or by a multilateral lending institution.

(g) OTHER PROGRAM REQUIREMENTS- Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, and in consultation with the interagency working group, shall--

(1) establish eligibility criteria for countries that will host projects;

(2) periodically review the energy needs of such countries and export opportunities for United States firms for the development of projects in such countries;

(3) consult with government officials in host countries and, as appropriate, with representatives of utilities or other entities in host countries, to determine interest in and support for potential projects; and

(4) determine whether each project selected under this section is developmentally sound, as determined under the criteria developed by the Development Assistance Committee of the Organization for Economic Cooperation and Development.

(h) ELIGIBLE TECHNOLOGIES- Not later than 6 months after the date of the enactment of this Act, the Secretary shall prepare a list of eligible technologies and services under this section. In preparing such a list, the Secretary shall consider fuel cell powerplants, aeroderivitive gas turbines and catalytic combustion technologies for aeroderivitive gas turbines, ocean thermal energy conversion technology, anaerobic digester and storage tanks, and other renewable energy and energy efficiency technologies.

(i) SELECTION OF PROJECTS- (1) Pursuant to the agreements under subsection (a), the Secretary, through the Agency for International Development, shall, not later than 120 days after receipt of proposals in response to a solicitation under subsection (e), select one or more proposals under this section.

(2) In selecting a proposal under this section, the Secretary, through the Agency for International Development, shall consider--

(A) the ability of the United States firm, in cooperation with the host country, to undertake and complete the project;

(B) the degree to which the equipment to be included in the project is designed and manufactured in the United States;

(C) the long-term technical and competitive viability of the United States technology, and services related thereto, and the ability of the United States firm to compete in the development of additional energy projects using such technology in the host country and in other foreign countries;

(D) the extent of technical and financial involvement of the host country in the project;

(E) the extent to which the proposed project meets the purposes of this section;

(F) the extent of technical, financial, management, and marketing capabilities of the participants in the project, and the commitment of the participants to completion of a successful project in a manner that will facilitate acceptance of the United States technology or service for future application; and

(G) such other criteria as may be appropriate.

(3) In selecting among proposed projects, the Secretary shall seek to ensure that, relative to otherwise comparable projects in the host country, a selected project will meet the following criteria:

(A) It will reduce environmental emissions, including greenhouse gases, to an extent greater than required by applicable provisions of law.

(B) It will be a more cost-effective technological alternative, based on life cycle capital and operating costs per unit of energy produced and, where applicable, costs per unit of product produced.

(C) It will increase the overall efficiency of energy use.

Priority in selection shall be given to those projects which, in the judgment of the Secretary, best meet these criteria.

(j) UNITED STATES-ASIA ENVIRONMENTAL PARTNERSHIP- Activities carried out under this section shall be coordinated with the United States-Asia Environmental Partnership.

(k) BUY AMERICA- In carrying out this section, the Secretary, through the Agency for International Development, and pursuant to the agreements under subsection (a), shall ensure--

(1) the maximum percentage, but in no case less than 50 percent, of the cost of any equipment furnished in connection with a project authorized under this section shall be attributable to the manufactured United States components of such equipment; and

(2) the maximum participation of United States firms.

In determining whether the cost of United States components equals or exceeds 50 percent, the cost of assembly of such United States components in the host country shall not be considered a part of the cost of such United States component.

(l) REPORT TO CONGRESS- The Secretary and the Administrator of the Agency for International Development shall report annually to the Committee on Energy and Natural Resources of the Senate and the appropriate committees of the House of Representatives on the progress being made to introduce innovative energy technologies, and services related thereto, that substantially reduce environmental pollutants, including greenhouse gases, into foreign countries.

(m) DEFINITIONS- For purposes of this section--

(1) the term `host country' means a foreign country which is--

(A) the participant in or the site of the proposed innovative energy technology project; and

(B) either--

(i) classified as a country eligible to participate in development assistance programs of the Agency for International Development pursuant to applicable law or regulation; or

(ii) a developing country; and

(2) the term `developing country' includes, but is not limited to, countries in Central and Eastern Europe or in the independent states of the former Soviet Union.

(n) AUTHORIZATION FOR PROGRAM- There are authorized to be appropriated to the Secretary to carry out the program required by this section, $100,000,000 for each of the fiscal years 1993, 1994, 1995, 1996, 1997, and 1998.

SEC. 1609. GLOBAL CLIMATE CHANGE RESPONSE FUND.

(a) ESTABLISHMENT OF THE FUND- The Secretary of the Treasury, in consultation with the Secretary of State, shall establish a Global Climate Change Response Fund to act as a mechanism for United States contributions to assist global efforts in mitigating and adapting to global climate change.

(b) RESTRICTIONS ON DEPOSITS- No deposits shall be made to the Global Climate Change Response Fund until the United States has ratified the United Nations Framework Convention on Climate Change.

(c) USE OF THE FUND- Moneys deposited into the Fund shall be used by the President, to the extent authorized and appropriated under section 302 of the Foreign Assistance Act of 1961, solely for contributions to a financial mechanism negotiated pursuant to the United Nations Framework Convention on Climate Change, including all protocols or agreements related thereto.

(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated for deposit in the Fund to carry out the purposes of this section, $50,000,000 for fiscal year 1994 and such sums as may be necessary for fiscal years 1995 and 1996.

TITLE XVII--ADDITIONAL FEDERAL POWER ACT PROVISIONS

SEC. 1701. ADDITIONAL FEDERAL POWER ACT PROVISIONS.

(a) ANNUAL CHARGES FOR COSTS- (1) Section 10(e)(1) of the Federal Power Act is amended by striking the semicolon after `Part' and inserting the following: `, including any reasonable and necessary costs incurred by Federal and State fish and wildlife agencies and other natural and cultural resource agencies in connection with studies or other reviews carried out by such agencies for purposes of administering their responsibilities under this part;'.

(2) Section 10(e)(1) of such Act is further amended by inserting after `as conditions may require:' the following proviso: `*Provided*, That, subject to annual appropriations Acts, the portion of such annual charges imposed by the Commission under this subsection to cover the reasonable and necessary costs of such agencies shall be available to such agencies (in addition to other funds appropriated for such purposes) solely for carrying out such studies and reviews and shall remain available until expended:'.

(b) CLARIFICATION OF AUTHORITY REGARDING FISHWAYS- The definition of the term `fishway' contained in 18 C.F.R. 4.30(b)(9)(iii), as in effect on the date of enactment of this Act, is vacated without prejudice to any definition or interpretation by rule of the term `fishway' by the Federal Energy Regulatory Commission for purposes of implementing section 18 of the Federal Power Act: *Provided*, That any future definition promulgated by regulatory rulemaking shall have no force or effect unless concurred in by the Secretary of the Interior and the Secretary of Commerce: *Provided further*, That the items which may constitute a `fishway' under section 18 for the safe and timely upstream and downstream passage of fish shall be limited to physical structures, facilities, or devices necessary to maintain all life stages of such fish, and project operations and measures related to such structures, facilities, or devices which are necessary to ensure the effectiveness of such structures, facilities, or devices for such fish.

(c) EXTENSION OF DEADLINES- (1) Notwithstanding the time limitations of section 13 of the Federal Power Act, the Federal Energy Regulatory Commission, upon the request of the licensee for FERC Project No. 4031 (and after reasonable notice), is authorized, in accordance with the good faith, due diligence, and public interest requirements of such section 13 and the Commission's procedures under such section, to extend the time required for commencement of construction of such project for up to a maximum of 3 consecutive 2-year periods. This section shall take effect for such project upon the expiration of the extension (issued by the Commission under such section 13) of the period required for commencement of construction of such project.

(2) Notwithstanding the time limitations of section 13 of the Federal Power Act, the Federal Energy Regulatory Commission, upon the request of the licensee for FERC Project No. 6221 (and after reasonable notice), is authorized, in accordance with the good faith, due diligence, and public interest requirements of such section 13 and the Commission's procedures under such section, to extend the time required for commencement of construction of such project until July 29, 1995.

(3) Notwithstanding the time limitations of section 13 of the Federal Power Act, the Federal Energy Regulatory Commission, upon the request of the licensee for FERC project numbered 6641 (and after reasonable notice) is authorized, in accordance with the good faith, due diligence, and public interest requirements of section 13 and the Commission's procedures under such section, to extend until June 29, 1996, the time required for the licensee to acquire the required real property and commence the construction of project numbered 6641, and until June 29, 2000, the time required for completion of construction of such project.

(4) Notwithstanding the time limitations of section 13 of the Federal Power Act, the Federal Energy

Regulatory Commission, upon the request of the licensee of FERC project numbered 4656 (and after reasonable notice) is authorized, in accordance with the good faith, due diligence, and public interest requirements of section 13 and the Commission's procedures under such section, to extend until March 26, 1999, the time required for the licensee to acquire the required real property and commence the construction of project numbered 4656.

(5) The authorization for issuing extensions under paragraphs (1) through (4) shall terminate 3 years after the date of enactment of this section. To facilitate requests under such subsections, the Commission may consolidate the requests. The Commission shall provide at the beginning of each Congress a report on the status of all extensions granted by Congress regarding the requirements of section 13 of the Federal Power Act, including information about any delays by the Commission on the licensee and the reasons for such delays.

(d) EMINENT DOMAIN- Section 21 of the Federal Power Act is amended by striking the period at the end thereof and adding the following: `*Provided further*, That no licensee may use the right of eminent domain under this section to acquire any lands or other property that, prior to the date of enactment of the Energy Policy Act of 1992, were owned by a State or political subdivision thereof and were part of or included within any public park, recreation area or wildlife refuge established under State or local law. In the case of lands or other property that are owned by a State or political subdivision and are part of or included within a public park, recreation area or wildlife refuge established under State or local law on or after the date of enactment of such Act, no licensee may use the right of eminent domain under this section to acquire such lands or property unless there has been a public hearing held in the affected community and a finding by the Commission, after due consideration of expressed public views and the recommendations of the State or political subdivision that owns the lands or property, that the license will not interfere or be inconsistent with the purposes for which such lands or property are owned.'.

TITLE XVIII--OIL PIPELINE REGULATORY REFORM

SEC. 1801. OIL PIPELINE RATEMAKING METHODOLOGY.

(a) ESTABLISHMENT- Not later than 1 year after the date of the enactment of this Act, the Federal Energy Regulatory Commission shall issue a final rule which establishes a simplified and generally applicable ratemaking methodology for oil pipelines in accordance with section 1(5) of part I of the Interstate Commerce Act.

(b) EFFECTIVE DATE- The final rule to be issued under subsection (a) may not take effect before the 365th day following the date of the issuance of the rule.

SEC. 1802. STREAMLINING OF COMMISSION PROCEDURES.

(a) RULEMAKING- Not later than 18 months after the date of the enactment of this Act, the Commission shall issue a final rule to streamline procedures of the Commission relating to oil pipeline rates in order to avoid unnecessary regulatory costs and delays.

(b) SCOPE OF RULEMAKING- Issues to be considered in the rulemaking proceeding to be conducted under subsection (a) shall include the following:

(1) Identification of information to be filed with an oil pipeline tariff and the availability to the public of any analysis of such tariff filing performed by the Commission or its staff.

(2) Qualification for standing (including definitions of economic interest) of parties who protest oil pipeline tariff filings or file complaints thereto.

(3) The level of specificity required for a protest or complaint and guidelines for Commission action on the portion of the tariff or rate filing subject to protest or complaint.

(4) An opportunity for the oil pipeline to file a response for the record to an initial protest or complaint.

(5) Identification of specific circumstances under which Commission staff may initiate a protest.

(c) ADDITIONAL PROCEDURAL CHANGES- In conducting the rulemaking proceeding to carry out subsection (a), the Commission shall identify and transmit to Congress any other procedural changes relating to oil pipeline rates which the Commission determines are necessary to avoid unnecessary regulatory costs and delays and for which additional legislative authority may be necessary.

(d) WITHDRAWAL OF TARIFFS AND COMPLAINTS-

(1) WITHDRAWAL OF TARIFFS- If an oil pipeline tariff which is filed under part I of the Interstate Commerce Act and which is subject to investigation is withdrawn--

(A) any proceeding with respect to such tariff shall be terminated;

(B) the previous tariff rate shall be reinstated; and

(C) any amounts collected under the withdrawn tariff rate which are in excess of the previous tariff rate shall be refunded.

(2) WITHDRAWAL OF COMPLAINTS- If a complaint which is filed under section 13 of the Interstate Commerce Act with respect to an oil pipeline tariff is withdrawn, any proceeding with respect to such complaint shall be terminated.

(e) ALTERNATIVE DISPUTE RESOLUTION- To the maximum extent practicable, the Commission shall establish appropriate alternative dispute resolution procedures, including required negotiations and voluntary arbitration, early in an oil pipeline rate proceeding as a method preferable to adjudication in resolving disputes relating to the rate. Any proposed rates derived from implementation of such procedures shall be considered by the Commission on an expedited basis for approval.

SEC. 1803. PROTECTION OF CERTAIN EXISTING RATES.

(a) RATES DEEMED JUST AND REASONABLE- Except as provided in subsection (b)--

(1) any rate in effect for the 365-day period ending on the date of the enactment of this Act shall be deemed to be just and reasonable (within the meaning of section 1(5) of the Interstate Commerce Act); and

(2) any rate in effect on the 365th day preceding the date of such enactment shall be deemed to be just and reasonable (within the meaning of such section 1(5)) regardless of whether or not, with respect to such rate, a new rate has been filed with the Commission during such 365-day period;

if the rate in effect, as described in paragraph (1) or (2), has not been subject to protest, investigation, or complaint during such 365-day period.

(b) CHANGED CIRCUMSTANCES- No person may file a complaint under section 13 of the Interstate Commerce Act against a rate deemed to be just and reasonable under subsection (a) unless--

(1) evidence is presented to the Commission which establishes that a substantial change has occurred after the date of the enactment of this Act--

(A) in the economic circumstances of the oil pipeline which were a basis for the rate; or

(B) in the nature of the services provided which were a basis for the rate; or

(2) the person filing the complaint was under a contractual prohibition against the filing of a complaint which was in effect on the date of enactment of this Act and had been in effect prior to January 1, 1991, provided that a complaint by a party bound by such prohibition is brought within 30 days after the expiration of such prohibition.

If the Commission determines pursuant to a proceeding instituted as a result of a complaint under section 13 of the Interstate Commerce Act that the rate is not just and reasonable, the rate shall not be deemed to be just and reasonable. Any tariff reduction or refunds that may result as an outcome of such a complaint shall be prospective from the date of the filing of the complaint.

(c) LIMITATION REGARDING UNDULY DISCRIMINATORY OR PREFERENTIAL TARIFFS- Nothing in this section shall prohibit any aggrieved person from filing a complaint under section 13 or section 15(l) of the Interstate Commerce Act challenging any tariff provision as unduly discriminatory or unduly preferential.

SEC. 1804. DEFINITIONS.

For the purposes of this title, the following definitions apply:

(1) COMMISSION- The term `Commission' means the Federal Energy Regulatory Commission and, unless the context requires otherwise, includes the Oil Pipeline Board and any other office or component of the Commission to which the functions and authority vested in the Commission under section 402(b) of the Department of Energy Organization Act (42 U.S.C. 7172(b)) are delegated.

(2) OIL PIPELINE-

(A) IN GENERAL- Except as provided in subparagraph (B), the term `oil pipeline' means any common carrier (within the meaning of the Interstate Commerce Act) which transports oil by pipeline subject to the functions and authority vested in the Commission under section 402(b) of the Department of Energy Organization Act (42 U.S.C. 7172(b)).

(B) EXCEPTION- The term `oil pipeline' does not include the Trans-Alaska Pipeline authorized by the Trans-Alaska Pipeline Authorization Act (43 U.S.C. 1651 et seq.) or any pipeline delivering oil directly or indirectly to the Trans-Alaska Pipeline.

(3) OIL- The term `oil' has the same meaning as is given such term for purposes of the transfer of

functions from the Interstate Commerce Commission to the Federal Energy Regulatory Commission under section 402(b) of the Department of Energy Organization Act (42 U.S.C. 7172 (b)).

(4) RATE- The term `rate' means all charges that an oil pipeline requires shippers to pay for transportation services.

TITLE XIX--REVENUE PROVISIONS

SEC. 1901. AMENDMENT OF 1986 CODE.

Except as otherwise expressly provided, whenever in this title an amendment or repeal is expressed in terms of an amendment to, or repeal of, a section or other provision, the reference shall be considered to be made to a section or other provision of the Internal Revenue Code of 1986.

Subtitle A--Energy Conservation and Production Incentives

SEC. 1911. TREATMENT OF EMPLOYER-PROVIDED TRANSPORTATION BENEFITS.

(a) EXCLUSION- Subsection (a) of section 132 (relating to exclusion of certain fringe benefits) is amended by striking `or' at the end of paragraph (3), by striking the period at the end of paragraph (4) and inserting `, or', and by adding at the end thereof the following new paragraph:

`(5) qualified transportation fringe.'

(b) QUALIFIED TRANSPORTATION FRINGE- Section 132 is amended by redesignating subsections (f), (g), (h), (i), (j), and (k) as subsections (g), (h), (i), (j), (k), and (l), respectively, and by inserting after subsection (e) the following new subsection:

`(f) QUALIFIED TRANSPORTATION FRINGE-

`(1) IN GENERAL- For purposes of this section, the term `qualified transportation fringe' means any of the following provided by an employer to an employee:

`(A) Transportation in a commuter highway vehicle if such transportation is in connection with travel between the employee's residence and place of employment.

`(B) Any transit pass.

`(C) Qualified parking.

`(2) LIMITATION ON EXCLUSION- The amount of the fringe benefits which are provided by an employer to any employee and which may be excluded from gross income under subsection (a)(5) shall not exceed--

`(A) $60 per month in the case of the aggregate of the benefits described in subparagraphs (A) and (B) of paragraph (1), and

`(B) $155 per month in the case of qualified parking.

`(3) CASH REIMBURSEMENTS- For purposes of this subsection, the term `qualified transportation fringe' includes a cash reimbursement by an employer to an employee for a benefit described in paragraph (1). The preceding sentence shall apply to a cash reimbursement for any transit pass only if a voucher or similar item which may be exchanged only for a transit pass is not readily available for direct distribution by the employer to the employee.

`(4) BENEFIT NOT IN LIEU OF COMPENSATION- Subsection (a)(5) shall not apply to any qualified transportation fringe unless such benefit is provided in addition to (and not in lieu of) any compensation otherwise payable to the employee.

`(5) DEFINITIONS- For purposes of this subsection--

`(A) TRANSIT PASS- The term `transit pass' means any pass, token, farecard, voucher, or similar item entitling a person to transportation (or transportation at a reduced price) if such transportation is--

`(i) on mass transit facilities (whether or not publicly owned), or

`(ii) provided by any person in the business of transporting persons for compensation or hire if such transportation is provided in a vehicle meeting the requirements of subparagraph (B)(i).

`(B) COMMUTER HIGHWAY VEHICLE- The term `commuter highway vehicle' means any highway vehicle--

`(i) the seating capacity of which is at least 6 adults (not including the driver), and

`(ii) at least 80 percent of the mileage use of which can reasonably be expected to be--

`(I) for purposes of transporting employees in connection with travel between their residences and their place of employment, and

`(II) on trips during which the number of employees transported for such purposes is at least 1/2 of the adult seating capacity of such vehicle (not including the driver).

`(C) QUALIFIED PARKING- The term `qualified parking' means parking provided to an employee on or near the business premises of the employer or on or near a location from which the employee commutes to work by transportation described in subparagraph (A), in a commuter highway vehicle, or by carpool. Such term shall not include any parking on or near property used by the employee for residential purposes.

`(D) TRANSPORTATION PROVIDED BY EMPLOYER- Transportation referred to in paragraph (1)(A) shall be considered to be provided by an employer if such transportation is furnished in a commuter highway vehicle operated by or for the employer.

`(E) EMPLOYEE- For purposes of this subsection, the term `employee' does not include an individual who is an employee within the meaning of section 401(c)(1).

`(6) INFLATION ADJUSTMENT- In the case of any taxable year beginning in a calendar year

after 1993, the dollar amounts contained in paragraph (2) (A) and (B) shall be increased by an amount equal to--

`(A) such dollar amount, multiplied by

`(B) the cost-of-living adjustment determined under section 1(f)(3) for the calendar year in which the taxable year begins, determined by substituting `calendar year 1992' for `calendar year 1989' in subparagraph (B) thereof.

If any increase determined under the preceding sentence is not a multiple of $5, such increase shall be rounded to the next lowest multiple of $5.

`(7) COORDINATION WITH OTHER PROVISIONS- For purposes of this section, the terms `working condition fringe' and `de minimis fringe' shall not include any qualified transportation fringe (determined without regard to paragraph (2)).'

(c) CONFORMING AMENDMENT- Subsection (i) of section 132 (as redesignated by subsection (b)) is amended by striking paragraph (4) and redesignating the following paragraphs accordingly.

(d) EFFECTIVE DATE- The amendments made by this section shall apply to benefits provided after December 31, 1992.

SEC. 1912. EXCLUSION OF ENERGY CONSERVATION SUBSIDIES PROVIDED BY PUBLIC UTILITIES.

(a) GENERAL RULE- Part III of subchapter B of chapter 1 (relating to amounts specifically excluded from gross income) is amended by redesignating section 136 as section 137 and by inserting after section 135 the following new section:

`SEC. 136. ENERGY CONSERVATION SUBSIDIES PROVIDED BY PUBLIC UTILITIES.

`(a) EXCLUSION-

`(1) IN GENERAL- Gross income shall not include the value of any subsidy provided (directly or indirectly) by a public utility to a customer for the purchase or installation of any energy conservation measure.

`(2) LIMITATION ON EXCLUSION FOR NONRESIDENTIAL PROPERTY-

`(A) IN GENERAL- In the case of any subsidy provided with respect to any energy conservation measure referred to in subsection (c)(1)(B), only the applicable percentage of such subsidy shall be excluded from gross income under paragraph (1).

`(B) APPLICABLE PERCENTAGE- For purposes of subparagraph (A), the term `applicable percentage' means--

`(i) 40 percent in the case of subsidies provided during 1995,

`(ii) 50 percent in the case of subsidies provided during 1996, and

`(iii) 65 percent in the case of subsidies provided after 1996.

`(b) DENIAL OF DOUBLE BENEFIT- Notwithstanding any other provision of this subtitle, no deduction or credit shall be allowed for, or by reason of, any expenditure to the extent of the amount excluded under subsection (a) for any subsidy which was provided with respect to such expenditure. The adjusted basis of any property shall be reduced by the amount excluded under subsection (a) which was provided with respect to such property.

`(c) ENERGY CONSERVATION MEASURE-

`(1) IN GENERAL- For purposes of this section, the term `energy conservation measure' means any installation or modification primarily designed to reduce consumption of electricity or natural gas or to improve the management of energy demand--

`(A) with respect to a dwelling unit, and

`(B) on or after January 1, 1995, with respect to property other than dwelling units.

The purchase and installation of specially defined energy property shall be treated as an energy conservation measure described in subparagraph (B).

`(2) OTHER DEFINITIONS AND SPECIAL RULES- For purposes of this subsection--

`(A) SPECIALLY DEFINED ENERGY PROPERTY- The term `specially defined energy property' means--

`(i) a recuperator,

`(ii) a heat wheel,

`(iii) a regenerator,

`(iv) a heat exchanger,

`(v) a waste heat boiler,

`(vi) a heat pipe,

`(vii) an automatic energy control system,

`(viii) a turbulator,

`(ix) a preheater,

`(x) a combustible gas recovery system,

`(xi) an economizer,

`(xii) modifications to alumina electrolytic cells,

`(xiii) modifications to chlor-alkali electrolytic cells, or

`(xiv) any other property of a kind specified by the Secretary by regulations,

the principal purpose of which is reducing the amount of energy consumed in any existing industrial or commercial process and which is installed in connection with an existing industrial or commercial facility.

`(B) DWELLING UNIT- The term `dwelling unit' has the meaning given such term by section 280A(f)(1).

`(C) PUBLIC UTILITY- The term `public utility' means a person engaged in the sale of electricity or natural gas to residential, commercial, or industrial customers for use by such customers. For purposes of the preceding sentence, the term `person' includes the Federal Government, a State or local government or any political subdivision thereof, or any instrumentality of any of the foregoing.

`(d) EXCEPTION- This section shall not apply to any payment to or from a qualified cogeneration facility or qualifying small power production facility pursuant to section 210 of the Public Utility Regulatory Policy Act of 1978.'

(b) CLERICAL AMENDMENT- The table of sections for part III of subchapter B of chapter 1 is amended by striking the item relating to section 136 and inserting:

`Sec. 136. Energy conservation subsidies provided by public utilities.

`Sec. 137. Cross reference to other Acts.'

(c) EFFECTIVE DATE- The amendments made by this section shall apply to amounts received after December 31, 1992.

SEC. 1913. TREATMENT OF CLEAN-FUEL VEHICLES.

(a) DEDUCTION FOR CLEAN-FUEL VEHICLES AND CERTAIN REFUELING PROPERTY-

(1) IN GENERAL- Part VI of subchapter B of chapter 1 (relating to itemized deductions for individuals and corporations) is amended by adding after section 179 the following new section:

`SEC. 179A. DEDUCTION FOR CLEAN-FUEL VEHICLES AND CERTAIN REFUELING PROPERTY.

`(a) ALLOWANCE OF DEDUCTION-

`(1) IN GENERAL- There shall be allowed as a deduction an amount equal to the cost of--

`(A) any qualified clean-fuel vehicle property, and

`(B) any qualified clean-fuel vehicle refueling property.

The deduction under the preceding sentence with respect to any property shall be allowed for the

taxable year in which such property is placed in service.

`(2) INCREMENTAL COST FOR CERTAIN VEHICLES- If a vehicle may be propelled by both a clean-burning fuel and any other fuel, only the incremental cost of permitting the use of the clean-burning fuel shall be taken into account.

`(b) LIMITATIONS-

`(1) QUALIFIED CLEAN-FUEL VEHICLE PROPERTY-

`(A) IN GENERAL- The cost which may be taken into account under subsection (a)(1)(A) with respect to any motor vehicle shall not exceed--

`(i) in the case of a motor vehicle not described in clause (ii) or (iii), $2,000,

`(ii) in the case of any truck or van with a gross vehicle weight rating greater than 10,000 pounds but not greater than 26,000 pounds, $5,000, or

`(iii) $50,000 in the case of--

`(I) a truck or van with a gross vehicle weight rating greater than 26,000 pounds, or

`(II) any bus which has a seating capacity of at least 20 adults (not including the driver).

`(B) PHASEOUT- In the case of any qualified clean-fuel vehicle property placed in service after December 31, 2001, the limit otherwise applicable under subparagraph (A) shall be reduced by--

`(i) 25 percent in the case of property placed in service in calendar year 2002,

`(ii) 50 percent in the case of property placed in service in calendar year 2003, and

`(iii) 75 percent in the case of property placed in service in calendar year 2004.

`(2) QUALIFIED CLEAN-FUEL VEHICLE REFUELING PROPERTY-

`(A) IN GENERAL- The aggregate cost which may be taken into account under subsection (a)(1)(B) with respect to qualified clean-fuel vehicle refueling property placed in service during the taxable year at a location shall not exceed the excess (if any) of--

`(i) $100,000, over

`(ii) the aggregate amount taken into account under subsection (a)(1)(B) by the taxpayer (or any related person or predecessor) with respect to property placed in service at such location for all preceding taxable years.

`(B) RELATED PERSON- For purposes of this paragraph, a person shall be treated as related to another person if such person bears a relationship to such other person described

in section 267(b) or 707(b)(1).

`(C) ELECTION- If the limitation under subparagraph (A) applies for any taxable year, the taxpayer shall, on the return of tax for such taxable year, specify the items of property (and the portion of costs of such property) which are to be taken into account under subsection (a)(1)(B).

`(c) QUALIFIED CLEAN-FUEL VEHICLE PROPERTY DEFINED- For purposes of this section--

`(1) IN GENERAL- The term `qualified clean-fuel vehicle property' means property which is acquired for use by the taxpayer and not for resale, the original use of which commences with the taxpayer, with respect to which the environmental standards of paragraph (2) are met, and which is described in either of the following subparagraphs:

`(A) RETROFIT PARTS AND COMPONENTS- Any property installed on a motor vehicle which is propelled by a fuel which is not a clean-burning fuel for purposes of permitting such vehicle to be propelled by a clean-burning fuel--

`(i) if the property is an engine (or modification thereof) which may use a clean-burning fuel, or

`(ii) to the extent the property is used in the storage or delivery to the engine of such fuel, or the exhaust of gases from combustion of such fuel.

`(B) ORIGINAL EQUIPMENT MANUFACTURER'S VEHICLES- A motor vehicle produced by an original equipment manufacturer and designed so that the vehicle may be propelled by a clean-burning fuel, but only to the extent of the portion of the basis of such vehicle which is attributable to an engine which may use such fuel, to the storage or delivery to the engine of such fuel, or to the exhaust of gases from combustion of such fuel.

`(2) ENVIRONMENTAL STANDARDS- Property shall not be treated as qualified clean-fuel vehicle property unless--

`(A) the motor vehicle of which it is a part meets any applicable Federal or State emissions standards with respect to each fuel by which such vehicle is designed to be propelled, or

`(B) in the case of property described in paragraph (1)(A), such property meets applicable Federal and State emissions-related certification, testing, and warranty requirements.

`(3) EXCEPTION FOR QUALIFIED ELECTRIC VEHICLES- The term `qualified clean-fuel vehicle property' does not include any qualified electric vehicle (as defined in section 30(c)).

`(d) QUALIFIED CLEAN-FUEL VEHICLE REFUELING PROPERTY DEFINED- For purposes of this section, the term `qualified clean-fuel vehicle refueling property' means any property (not including a building and its structural components) if--

`(1) such property is of a character subject to the allowance for depreciation,

`(2) the original use of such property begins with the taxpayer, and

`(3) such property is--

`(A) for the storage or dispensing of a clean-burning fuel into the fuel tank of a motor vehicle propelled by such fuel, but only if the storage or dispensing of the fuel is at the point where such fuel is delivered into the fuel tank of the motor vehicle, or

`(B) for the recharging of motor vehicles propelled by electricity, but only if the property is located at the point where the motor vehicles are recharged.

`(e) OTHER DEFINITIONS AND SPECIAL RULES- For purposes of this section--

`(1) CLEAN-BURNING FUEL- The term `clean-burning fuel' means--

`(A) natural gas,

`(B) liquefied natural gas,

`(C) liquefied petroleum gas,

`(D) hydrogen,

`(E) electricity, and

`(F) any other fuel at least 85 percent of which is 1 or more of the following: methanol, ethanol, any other alcohol, or ether.

`(2) MOTOR VEHICLE- The term `motor vehicle' means any vehicle which is manufactured primarily for use on public streets, roads, and highways (not including a vehicle operated exclusively on a rail or rails) and which has at least 4 wheels.

`(3) COST OF RETROFIT PARTS INCLUDES COST OF INSTALLATION- The cost of any qualified clean-fuel vehicle property referred to in subsection (c)(1)(A) shall include the cost of the original installation of such property.

`(4) RECAPTURE- The Secretary shall, by regulations, provide for recapturing the benefit of any deduction allowable under subsection (a) with respect to any property which ceases to be property eligible for such deduction.

`(5) PROPERTY USED OUTSIDE UNITED STATES, ETC., NOT QUALIFIED- No deduction shall be allowed under subsection (a) with respect to any property referred to in section 50(b) or with respect to the portion of the cost of any property taken into account under section 179.

`(6) BASIS REDUCTION-

`(A) IN GENERAL- For purposes of this title, the basis of any property shall be reduced by the portion of the cost of such property taken into account under subsection (a).

`(B) ORDINARY INCOME RECAPTURE- For purposes of section 1245, the amount of the deduction allowable under subsection (a) with respect to any property which is of a character subject to the allowance for depreciation shall be treated as a deduction allowed

for depreciation under section 167.

`(g) TERMINATION- This section shall not apply to any property placed in service after December 31, 2004.'

(2) DEDUCTION FROM GROSS INCOME- Section 62(a) is amended by inserting after paragraph (13) the following new paragraph:

`(14) DEDUCTION FOR CLEAN-FUEL VEHICLES AND CERTAIN REFUELING PROPERTY- The deduction allowed by section 179A.'

(3) CONFORMING AMENDMENTS-

(A) Section 1016(a) is amended by striking `and' at the end of paragraph (23), by striking the period at the end of paragraph (24) and inserting `, and', and by adding at the end thereof the following new paragraph:

`(25) to the extent provided in section 179A(e)(6)(A).'

(B) The table of sections for part VI of subchapter B of chapter 1 is amended by inserting after the item relating to section 179 the following new item:

`Sec. 179A. Deduction for clean-fuel vehicles and certain refueling property.'

(b) CREDIT FOR QUALIFIED ELECTRIC VEHICLES-

(1) IN GENERAL- Subpart B of part IV of subchapter A of chapter 1 is amended by inserting after section 29 the following new section:

`SEC. 30. CREDIT FOR QUALIFIED ELECTRIC VEHICLES.

`(a) ALLOWANCE OF CREDIT- There shall be allowed as a credit against the tax imposed by this chapter for the taxable year an amount equal to 10 percent of the cost of any qualified electric vehicle placed in service by the taxpayer during the taxable year.

`(b) LIMITATIONS-

`(1) LIMITATION PER VEHICLE- The amount of the credit allowed under subsection (a) for any vehicle shall not exceed $4,000.

`(2) PHASEOUT- In the case of any qualified electric vehicle placed in service after December 31, 2001, the credit otherwise allowable under subsection (a) (determined after the application of paragraph (1)) shall be reduced by--

`(A) 25 percent in the case of property placed in service in calendar year 2002,

`(B) 50 percent in the case of property placed in service in calendar year 2003, and

`(C) 75 percent in the case of property placed in service in calendar year 2004.

`(3) APPLICATION WITH OTHER CREDITS- The credit allowed by subsection (a) for any taxable year shall not exceed the excess (if any) of--

`(A) the regular tax for the taxable year reduced by the sum of the credits allowable under subpart A and sections 27, 28, and 29, over--

`(B) the tentative minimum tax for the taxable year.

`(c) QUALIFIED ELECTRIC VEHICLE- For purposes of this section--

`(1) IN GENERAL- The term `qualified electric vehicle' means any motor vehicle--

`(A) which is powered primarily by an electric motor drawing current from rechargeable batteries, fuel cells, or other portable sources of electrical current,

`(B) the original use of which commences with the taxpayer, and

`(C) which is acquired for use by the taxpayer and not for resale.

`(2) MOTOR VEHICLE- For purposes of paragraph (1), the term `motor vehicle' means any vehicle which is manufactured primarily for use on public streets, roads, and highways (not including a vehicle operated exclusively on a rail or rails) and which has at least 4 wheels.

`(d) SPECIAL RULES-

`(1) BASIS REDUCTION- The basis of any property for which a credit is allowable under subsection (a) shall be reduced by the amount of such credit.

`(2) RECAPTURE- The Secretary shall, by regulations, provide for recapturing the benefit of any credit allowable under subsection (a) with respect to any property which ceases to be property eligible for such credit.

`(3) PROPERTY USED OUTSIDE UNITED STATES, ETC., NOT QUALIFIED- No credit shall be allowed under subsection (a) with respect to any property referred to in section 50(b) or with respect to the portion of the cost of any property taken into account under section 179.

`(e) TERMINATION- This section shall not apply to any property placed in service after December 31, 2004.'

(2) CONFORMING AMENDMENTS-

(A) The table of sections for subpart B of part IV of subchapter A of chapter 1 is amended by adding after the item relating to section 29 the following new item:

`Sec. 30. Credit for qualified electric vehicles.'

(B) Section 1016(a), as amended by subsection (a)(3), is amended by striking `and' at the end of paragraph (24), by striking the period at the end of paragraph (25) and inserting `, and', and by adding at the end thereof the following new paragraph:

`(26) to the extent provided in section 30(d)(1).'

(C) Section 53(d)(1)(B)(iii) is amended--

(i) by striking `section 29(b)(5)(B) or' and inserting `section 29(b)(6)(B),', and

(ii) by inserting `, or not allowed under section 30 solely by reason of the application of section 30(b)(3)(B)' before the period.

(D) Section 55(c)(2) is amended by striking `29(b)(5),' and inserting `29(b)(6), 30(b)(3),'.

(c) EFFECTIVE DATE- The amendments made by this section shall apply to property placed in service after June 30, 1993.

SEC. 1914. CREDIT FOR ELECTRICITY PRODUCED FROM CERTAIN RENEWABLE SOURCES.

(a) IN GENERAL- Subpart D of part IV of subchapter A of chapter 1 is amended by adding at the end thereof the following new section:

`SEC. 45. ELECTRICITY PRODUCED FROM CERTAIN RENEWABLE RESOURCES.

`(a) GENERAL RULE- For purposes of section 38, the renewable electricity production credit for any taxable year is an amount equal to the product of--

`(1) 1.5 cents, multiplied by

`(2) the kilowatt hours of electricity--

`(A) produced by the taxpayer--

`(i) from qualified energy resources, and

`(ii) at a qualified facility during the 10-year period beginning on the date the facility was originally placed in service, and

`(B) sold by the taxpayer to an unrelated person during the taxable year.

`(b) LIMITATIONS AND ADJUSTMENTS-

`(1) PHASEOUT OF CREDIT- The amount of the credit determined under subsection (a) shall be reduced by an amount which bears the same ratio to the amount of the credit (determined without regard to this paragraph) as--

`(A) the amount by which the reference price for the calendar year in which the sale occurs exceeds 8 cents, bears to

`(B) 3 cents.

`(2) CREDIT AND PHASEOUT ADJUSTMENT BASED ON INFLATION- The 1.5 cent amount in subsection (a) and the 8 cent amount in paragraph (1) shall each be adjusted by multiplying such

amount by the inflation adjustment factor for the calendar year in which the sale occurs. If any amount as increased under the preceding sentence is not a multiple of 0.1 cent, such amount shall be rounded to the nearest multiple of 0.1 cent.

`(3) CREDIT REDUCED FOR GRANTS, TAX-EXEMPT BONDS, SUBSIDIZED ENERGY FINANCING, AND OTHER CREDITS- The amount of the credit determined under subsection (a) with respect to any project for any taxable year (determined after the application of paragraphs (1) and (2)) shall be reduced by the amount which is the product of the amount so determined for such year and a fraction--

`(A) the numerator of which is the sum, for the taxable year and all prior taxable years, of--

`(i) grants provided by the United States, a State, or a political subdivision of a State for use in connection with the project,

`(ii) proceeds of an issue of State or local government obligations used to provide financing for the project the interest on which is exempt from tax under section 103,

`(iii) the aggregate amount of subsidized energy financing provided (directly or indirectly) under a Federal, State, or local program provided in connection with the project, and

`(iv) the amount of any other credit allowable with respect to any property which is part of the project, and

`(B) the denominator of which is the aggregate amount of additions to the capital account for the project for the taxable year and all prior taxable years.

The amounts under the preceding sentence for any taxable year shall be determined as of the close of the taxable year.

`(c) DEFINITIONS- For purposes of this section--

`(1) QUALIFIED ENERGY RESOURCES- The term `qualified energy resources' means--

`(A) wind, and

`(B) closed-loop biomass.

`(2) CLOSED-LOOP BIOMASS- The term `closed-loop biomass' means any organic material from a plant which is planted exclusively for purposes of being used at a qualified facility to produce electricity.

`(3) QUALIFIED FACILITY- The term `qualified facility' means any facility owned by the taxpayer which is originally placed in service after December 31, 1993 (December 31, 1992, in the case of a facility using closed-loop biomass to produce electricity), and before July 1, 1999.

`(d) DEFINITIONS AND SPECIAL RULES- For purposes of this section--

`(1) ONLY PRODUCTION IN THE UNITED STATES TAKEN INTO ACCOUNT- Sales shall

be taken into account under this section only with respect to electricity the production of which is within--

`(A) the United States (within the meaning of section 638(1)), or

`(B) a possession of the United States (within the meaning of section 638(2)).

`(2) COMPUTATION OF INFLATION ADJUSTMENT FACTOR AND REFERENCE PRICE-

`(A) IN GENERAL- The Secretary shall, not later than April 1 of each calendar year, determine and publish in the Federal Register the inflation adjustment factor and the reference price for such calendar year in accordance with this paragraph.

`(B) INFLATION ADJUSTMENT FACTOR- The term `inflation adjustment factor' means, with respect to a calendar year, a fraction the numerator of which is the GDP implicit price deflator for the preceding calendar year and the denominator of which is the GDP implicit price deflator for the calendar year 1992. The term `GDP implicit price deflator' means the most recent revision of the implicit price deflator for the gross domestic product as computed and published by the Department of Commerce before March 15 of the calendar year.

`(C) REFERENCE PRICE- The term `reference price' means, with respect to a calendar year, the Secretary's determination of the annual average contract price per kilowatt hour of electricity generated from the same qualified energy resource and sold in the previous year in the United States. For purposes of the preceding sentence, only contracts entered into after December 31, 1989, shall be taken into account.

`(3) PRODUCTION ATTRIBUTABLE TO THE TAXPAYER- In the case of a facility in which more than 1 person has an ownership interest, except to the extent provided in regulations prescribed by the Secretary, production from the facility shall be allocated among such persons in proportion to their respective ownership interests in the gross sales from such facility.

`(4) RELATED PERSONS- Persons shall be treated as related to each other if such persons would be treated as a single employer under the regulations prescribed under section 52(b). In the case of a corporation which is a member of an affiliated group of corporations filing a consolidated return, such corporation shall be treated as selling electricity to an unrelated person if such electricity is sold to such a person by another member of such group.

`(5) PASS-THRU IN THE CASE OF ESTATES AND TRUSTS- Under regulations prescribed by the Secretary, rules similar to the rules of subsection (d) of section 52 shall apply.'

(b) CREDIT TO BE PART OF GENERAL BUSINESS CREDIT- Subsection (b) of section 38 is amended by striking `plus' at the end of paragraph (6), by striking the period at the end of paragraph (7) and inserting `, plus', and by adding at the end thereof the following new paragraph:

`(8) the renewable electricity production credit under section 45(a).'

(c) LIMITATION ON CARRYBACK- Subsection (d) of section 39 is amended by redesignating the paragraph added by section 11511(b)(2) of the Revenue Reconciliation Act of 1990 as paragraph (1), by redesignating the paragraph added by section 11611(b)(2) of such Act as paragraph (2), and by adding at

the end thereof the following new paragraph:

`(3) NO CARRYBACK OF RENEWABLE ELECTRICITY PRODUCTION CREDIT BEFORE EFFECTIVE DATE- No portion of the unused business credit for any taxable year which is attributable to the credit determined under section 45 (relating to electricity produced from certain renewable resources) may be carried back to any taxable year ending before January 1, 1993 (before January 1, 1994, to the extent such credit is attributable to wind as a qualified energy resource).'

(d) CLERICAL AMENDMENT- The table of sections for subpart D of part IV of subchapter A of chapter 1 is amended by adding at the end thereof the following new item:

`Sec. 45. Electricity produced from certain renewable resources.'

(e) EFFECTIVE DATE- The amendments made by this section shall apply to taxable years ending after December 31, 1992.

SEC. 1915. REPEAL OF MINIMUM TAX PREFERENCES FOR DEPLETION AND INTANGIBLE DRILLING COSTS OF INDEPENDENT OIL AND GAS PRODUCERS AND ROYALTY OWNERS.

(a) DEPLETION-

(1) Paragraph (1) of section 57(a) (relating to depletion) is amended by adding at the end thereof the following new sentence: `Effective with respect to taxable years beginning after December 31, 1992, this paragraph shall not apply to any deduction for depletion computed in accordance with section 613A(c).'.

(2) Subparagraph (F) of section 56(g)(4) is amended to read as follows:

`(F) DEPLETION-

`(i) IN GENERAL- The allowance for depletion with respect to any property placed in service in a taxable year beginning after December 31, 1989, shall be cost depletion determined under section 611.

`(ii) EXCEPTION FOR INDEPENDENT OIL AND GAS PRODUCERS AND ROYALTY OWNERS- In the case of any taxable year beginning after December 31, 1992, clause (i) (and subparagraph (C)(i)) shall not apply to any deduction for depletion computed in accordance with section 613A(c).'

(b) INTANGIBLE DRILLING COSTS-

(1) Section 57(a)(2) is amended by adding at the end the following new subparagraph:

`(E) EXCEPTION FOR INDEPENDENT PRODUCERS- In the case of any oil or gas well--

`(i) IN GENERAL- In the case of any taxable year beginning after December 31, 1992, this paragraph shall not apply to any taxpayer which is not an integrated oil company (as defined in section 291(b)(4)).

`(ii) LIMITATION ON BENEFIT- The reduction in alternative minimum taxable income by reason of clause (i) for any taxable year shall not exceed 40 percent (30 percent in case of taxable years beginning in 1993) of the alternative minimum taxable income for such year determined without regard to clause (i) and the alternative tax net operating loss deduction under section 56(a)(4).'

(2) Clause (i) of section 56(g)(4)(D) is amended by adding at the end thereof the following new sentence: `In the case of a taxpayer other than an integrated oil company (as defined in section 291 (b)(4)), in the case of any oil or gas well, this clause shall not apply in the case of amounts paid or incurred in taxable years beginning after December 31, 1992.'.

(c) CONFORMING AMENDMENTS-

(1) Section 56 is amended by striking subsection (h).

(2) Section 56(d)(1)(A) is amended to read as follows:

`(A) the amount of such deduction shall not exceed 90 percent of alternate minimum taxable income determined without regard to such deduction, and'.

(3) Section 59(a)(2)(A)(ii) is amended by striking `and the alternative tax energy preference deduction under section 56(h)' and inserting `and section 57(a)(2)(E)'.

(4) Section 59A(b)(1) is amended by striking `or the alternative tax energy preference deduction under section 56(h)'.

(d) EFFECTIVE DATE- The amendments made by this section shall apply to taxable years beginning after December 31, 1992.

SEC. 1916. PERMANENT EXTENSION OF ENERGY INVESTMENT CREDIT FOR SOLAR AND GEOTHERMAL PROPERTY.

(a) GENERAL RULE- Paragraph (2) of section 48(a) (defining energy percentage) is amended--

(1) by striking `Except as provided in subparagraph (B), the' in subparagraph (A) and inserting `The',

(2) by striking subparagraph (B), and

(3) by redesignating subparagraph (C) as subparagraph (B).

(b) EFFECTIVE DATE- The amendments made by this section shall take effect on June 30, 1992.

SEC. 1917. NUCLEAR DECOMMISSIONING FUNDS.

(a) REPEAL OF INVESTMENT RESTRICTIONS- Subparagraph (C) of section 468A(e)(4) (relating to special rules for nuclear decommissioning funds) is amended by striking `described in section 501(c)(21) (B)(ii)'.

(b) REDUCTION IN RATE OF TAX- Paragraph (2) of section 468A(e) is amended--

(1) by striking `at the rate equal to the highest rate of tax specified in section 11(b)' in subparagraph (A) and inserting `at the rate set forth in subparagraph (B)', and

(2) by redesignating subparagraphs (B) and (C) as subparagraphs (C) and (D), respectively, and by inserting after subparagraph (A) the following new subparagraph:

`(B) RATE OF TAX- For purposes of subparagraph (A), the rate set forth in this subparagraph is--

`(i) 22 percent in the case of taxable years beginning in calendar year 1994 or 1995, and

`(ii) 20 percent in the case of taxable years beginning after December 31, 1995.'

(c) EFFECTIVE DATES-

(1) SUBSECTION (a)- The amendment made by subsection (a) shall apply to taxable years beginning after December 31, 1992.

(2) SUBSECTION (b)- The amendments made by subsection (b) shall apply to taxable years beginning after December 31, 1993. Section 15 of the Internal Revenue Code of 1986 shall not apply to any change in rate resulting from the amendment made by subsection (b).

SEC. 1918. EXTENSION OF SECTION 29 CREDIT FOR CERTAIN FACILITIES.

Section 29 (relating to credit for producing fuel from a nonconventional source) is amended by adding at the end thereof the following new subsection:

`(g) EXTENSION FOR CERTAIN FACILITIES-

`(1) IN GENERAL- In the case of a facility for producing qualified fuels described in subparagraph (B)(ii) or (C) of subsection (c)(1)--

`(A) for purposes of subsection (f)(1)(B), such facility shall be treated as being placed in service before January 1, 1993, if such facility is placed in service before January 1, 1997, pursuant to a binding written contract in effect before January 1, 1996, and

`(B) if such facility is originally placed in service after December 31, 1992, paragraph (2) of subsection (f) shall be applied with respect to such facility by substituting `January 1, 2008' for `January 1, 2003'.

`(2) SPECIAL RULE- Paragraph (1) shall not apply to any facility which produces coke or coke gas unless the original use of the facility commences with the taxpayer.'

SEC. 1919. TREATMENT UNDER LOCAL FURNISHING RULES OF CERTAIN ELECTRICITY TRANSMITTED OUTSIDE LOCAL AREA.

(a) IN GENERAL- Subsection (f) of section 142 (relating to local furnishing of electric energy or gas) is amended to read as follows:

`(f) LOCAL FURNISHING OF ELECTRIC ENERGY OR GAS- For purposes of subsection (a)(8)--

`(1) IN GENERAL- The local furnishing of electric energy or gas from a facility shall only include furnishing solely within the area consisting of--

`(A) a city and 1 contiguous county, or

`(B) 2 contiguous counties.

`(2) TREATMENT OF CERTAIN ELECTRIC ENERGY TRANSMITTED OUTSIDE LOCAL AREA-

`(A) IN GENERAL- A facility shall not be treated as failing to meet the local furnishing requirement of subsection (a)(8) by reason of electricity transmitted pursuant to an order of the Federal Energy Regulatory Commission under section 211 or 213 of the Federal Power Act (as in effect on the date of the enactment of this paragraph) if the portion of the cost of the facility financed with tax-exempt bonds is not greater than the portion of the cost of the facility which is allocable to the local furnishing of electric energy (determined without regard to this paragraph).

`(B) SPECIAL RULE FOR EXISTING FACILITIES- In the case of a facility financed with bonds issued before the date of an order referred to in subparagraph (A) which would (but for this subparagraph) cease to be tax-exempt by reason of subparagraph (A), such bonds shall not cease to be tax-exempt bonds (and section 150(b)(4) shall not apply) if, to the extent necessary to comply with subparagraph (A)--

`(i) an escrow to pay principal of, premium (if any), and interest on the bonds is established within a reasonable period after the date such order becomes final, and

`(ii) bonds are redeemed not later than the earliest date on which such bonds may be redeemed.'

(b) EFFECTIVE DATE- The amendment made by subsection (a) shall apply to obligations issued before, on, or after the date of the enactment of this Act.

SEC. 1920. ALCOHOL FUELS.

(a) REDUCED RATE OF TAX ON GASOLINE MIXED WITH ALCOHOL- Paragraph (1) of section 4081(c) (relating to gasoline mixed with alcohol at refinery, etc.) is amended to read as follows:

`(1) IN GENERAL- Under regulations prescribed by the Secretary, subsection (a) shall be applied by multiplying the otherwise applicable rate by a fraction the numerator of which is 10 and the denominator of which is--

`(A) 9 in the case of 10 percent gasohol,

`(B) 9.23 in the case of 7.7 percent gasohol, and

`(C) 9.43 in the case of 5.7 percent gasohol,

in the case of the removal or entry of any gasoline for use in producing gasohol at the time of such removal or entry. Subject to such terms and conditions as the Secretary may prescribe (including the application of section 4101), the treatment under the preceding sentence also shall apply to use in producing gasohol after the time of such removal or entry.'

(b) CONFORMING AMENDMENTS- Section 4081(c) is amended--

(1) by striking `6.1 cents a gallon' in paragraph (2) and inserting `an otherwise applicable rate', and

(2) by striking paragraph (4) and inserting the following new paragraph:

`(4) OTHERWISE APPLICABLE RATE- For purposes of this subsection--

`(A) IN GENERAL- In the case of the Highway Trust Fund financing rate, the term `otherwise applicable rate' means--

`(i) 6.1 cents a gallon for 10 percent gasohol,

`(ii) 7.342 cents a gallon for 7.7 percent gasohol, and

`(iii) 8.422 cents a gallon for 5.7 percent gasohol.

In the case of gasohol none of the alcohol in which consists of ethanol, clauses (i), (ii), and (iii) shall be applied by substituting `5.5 cents' for `6.1 cents', `6.88 cents' for `7.342 cents', and `8.08 cents' for `8.422 cents'.

`(B) 10 PERCENT GASOHOL- The term `10 percent gasohol' means any mixture of gasoline with alcohol if at least 10 percent of such mixture is alcohol.

`(C) 7.7 PERCENT GASOHOL- The term `7.7 percent gasohol' means any mixture of gasoline with alcohol if at least 7.7 percent, but not 10 percent or more, of such mixture is alcohol.

`(D) 5.7 PERCENT GASOHOL- The term `5.7 percent gasohol' means any mixture of gasoline with alcohol if at least 5.7 percent, but not 7.7 percent or more, of such mixture is alcohol.'

(c) EFFECTIVE DATE- The amendments made by this section shall apply to gasoline removed (as defined in section 4082 of the Internal Revenue Code of 1986) or entered after December 31, 1992.

SEC. 1921. TAX-EXEMPT FINANCING FOR ENVIRONMENTAL ENHANCEMENTS OF HYDROELECTRIC GENERATING FACILITIES.

(a) IN GENERAL- Subsection (a) of section 142 (relating to exempt facility bonds) is amended--

(1) by striking `or' at the end of paragraph (10),

(2) by striking the period at the end of paragraph (11) and inserting `, or', and

(3) by adding at the end the following new paragraph:

`(12) environmental enhancements of hydroelectric generating facilities.'

(b) DEFINITION AND SPECIAL RULES FOR ENVIRONMENTAL ENHANCEMENTS OF HYDROELECTRIC GENERATING FACILITIES-

(1) IN GENERAL- Section 142 is amended by adding at the end the following new subsection:

`(j) ENVIRONMENTAL ENHANCEMENTS OF HYDROELECTRIC GENERATING FACILITIES-

`(1) IN GENERAL- For purposes of subsection (a)(12), the term `environmental enhancements of hydroelectric generating facilities' means property--

`(A) the use of which is related to a federally licensed hydroelectric generating facility owned and operated by a governmental unit, and

`(B) which--

`(i) protects or promotes fisheries or other wildlife resources, including any fish by-pass facility, fish hatchery, or fisheries enhancement facility, or

`(ii) is a recreational facility or other improvement required by the terms and conditions of any Federal licensing permit for the operation of such generating facility.

`(2) USE OF PROCEEDS- A bond issued as part of an issue described in subsection (a)(12) shall not be considered an exempt facility bond unless at least 80 percent of the net proceeds of the issue of which it is a part are used to finance property described in paragraph (1)(B)(i).'

(2) FINANCED PROPERTY MUST BE GOVERNMENTALLY OWNED- Subparagraph (A) of section 142(b)(1) (relating to certain facilities must be governmentally owned) is amended by striking `(2) or (3)' and inserting `(2), (3), or (12)'.

(3) EXCLUSION FROM VOLUME CAP- Paragraph (3) of section 146(g) (relating to exception for certain bonds) is amended--

(A) by striking `or (2)' and inserting `, (2), or (12)', and

(B) by striking `and docks and wharves' and inserting `, docks and wharves, and environmental enhancements of hydroelectric generating facilities'.

(c) EFFECTIVE DATE- The amendments made by this section shall apply to bonds issued after the date of the enactment of this Act.

SEC. 1922. TRANS-ALASKA PIPELINE LIABILITY FUND INCOME TAX CREDIT.

(a) IN GENERAL- Section 4612 is amended by redesignating subsection (e) as subsection (f) and by inserting after subsection (d) the following new subsection:

`(e) INCOME TAX CREDIT FOR UNUSED PAYMENTS INTO TRANS-ALASKA PIPELINE LIABILITY FUND-

`(1) IN GENERAL- For purposes of section 38, the current year business credit shall include the credit determined under this subsection.

`(2) DETERMINATION OF CREDIT-

`(A) IN GENERAL- The credit determined under this subsection for any taxable year is an amount equal to the aggregate credit which would be allowed to the taxpayer under subsection (d) for amounts paid into the Trans-Alaska Pipeline Liability Fund had the Oil Spill Liability Trust Fund financing rate not ceased to apply.

`(B) LIMITATION-

`(i) IN GENERAL- The amount of the credit determined under this subsection for any taxable year with respect to any taxpayer shall not exceed the excess of--

`(I) the amount determined under clause (ii), over

`(II) the aggregate amount of the credit determined under this subsection for prior taxable years with respect to such taxpayer.

`(ii) OVERALL LIMITATION- The amount determined under this clause with respect to any taxpayer is the excess of--

`(I) the aggregate amount of credit which would have been allowed under subsection (d) to the taxpayer for periods before the termination date specified in section 4611(f)(1), if amounts in the Trans-Alaska Pipeline Liability Fund which are actually transferred into the Oil Spill Liability Fund were tranferred on January 1, 1990, and the Oil Spill Liability Trust Fund financing rate did not terminate before such termination date, over

`(II) the aggregate amount of the credit allowed under subsection (d) to the taxpayer.

`(3) COST OF INCOME TAX CREDIT BORNE BY TRUST FUND-

`(A) IN GENERAL- The Secretary shall from time to time transfer from the Oil Spill Liability Trust Fund to the general fund of the Treasury amounts equal to the credits allowed by reason of this subsection.

`(B) TRUST FUND BALANCE MAY NOT BE REDUCED BELOW $1,000,000,000- Transfers may be made under subparagraph (A) only to the extent that the unobligated balance of the Oil Spill Liability Trust Fund exceeds $1,000,000,000. If any transfer is not made by reason of the preceding sentence, such transfer shall be made as soon as permitted under such sentence.

`(4) NO CARRYBACK- No portion of the unused business credit for any taxable year which is attributable to the credit determined under this subsection may be carried to a taxable year beginning on or before the date of the enactment of this paragraph.'.

(b) EFFECTIVE DATE- The amendments made by this section shall apply to taxable years beginning

after the date of the enactment of this Act.

Subtitle B--Revenue Increases, Etc.

SEC. 1931. INCREASED BASE TAX AMOUNT ON OZONE-DEPLETING CHEMICALS.

(a) IN GENERAL- Subparagraph (B) of section 4681(b)(1) (relating to amount of tax) is amended to read as follows:

`(B) BASE TAX AMOUNT- The base tax amount for purposes of subparagraph (A) with respect to any sale or use during a calendar year before 1996 with respect to any ozone-depleting chemical is the amount determined under the following table for such calendar year:

--Base tax

`Calendar year:

--amount:

1993

--3.35

1994

--4.35

1995

--5.35.'

(b) RATES RETAINED FOR CHEMICALS USED IN RIGID FOAM INSULATION- The table in subparagraph (B) of section 4682(g)(2) (relating to chemicals used in rigid foam insulation) is amended by striking `10' and inserting `7.46'.

(c) FLOOR STOCKS- Subparagraph (C) of section 4682(h)(2) (relating to tax-increase dates) is amended by striking `of 1991, 1992, 1993, and 1994' and inserting `of any calendar year after 1991'.

(d) EFFECTIVE DATE- The amendments made by this section shall apply to taxable chemicals sold or used on or after January 1, 1993.

SEC. 1932. TREATMENT OF CERTAIN OZONE DEPLETING CHEMICALS.

(a) TREATMENT OF CERTAIN HALONS- The table contained in subparagraph (A) of section 4682 (g)(2) (relating to halons) is amended to read as follows:

--The applicable percentage

--in the case of sales or use

`In the case of:

--during 1993 is:

Halon-1211

--2.49

Halon-1301

--0.75

Halon-2402

--1.24.'

(b) CHEMICALS USED FOR STERILIZING MEDICAL INSTRUMENTS AND AS PROPELLANTS IN METERED-DOSE INHALERS- Subsection (g) of section 4682 (relating to phase-in of tax on certain substances) is amended by adding at the end thereof the following new paragraph:

`(4) CHEMICALS USED FOR STERILIZING MEDICAL INSTRUMENTS AND AS PROPELLANTS IN METERED-DOSE INHALERS-

`(A) RATE OF TAX-

`(i) IN GENERAL- In the case of--

`(I) any use during the applicable period of any substance to sterilize medical instruments or as propellants in metered-dose inhalers, or

`(II) any qualified sale during such period by the manufacturer, producer, or importer of any substance,

the tax imposed by section 4681 shall be equal to $1.67 per pound.

`(ii) QUALIFIED SALE- For purposes of clause (i), the term `qualified sale' means any sale by the manufacturer, producer, or importer of any substance--

`(I) for use by the purchaser to sterilize medical instruments or as propellants in metered-dose inhalers, or

`(II) for resale by the purchaser to a 2d purchaser for such use by the 2d purchaser.

The preceding sentence shall apply only if the manufacturer, producer, and importer, and the 1st and 2d purchasers (if any) meet such registration requirements as may be prescribed by the Secretary.

`(B) OVERPAYMENTS- If any substance on which tax was paid under this subchapter is used during the applicable period by any person to sterilize medical instruments or as propellants in metered-dose inhalers, credit or refund without interest shall be allowed to such person in an amount equal to the excess of--

`(i) the tax paid under this subchapter on such substance, or

`(ii) the tax (if any) which would be imposed by section 4681 if such substance were used for such use by the manufacture, producer, or importer thereof on the date of its use by such person.

Amounts payable under the preceding sentence with respect to uses during the taxable year shall be treated as described in section 34(a) for such year unless claim thereof has been timely filed under this subparagraph.

`(C) APPLICABLE PERIOD- For purposes of this paragraph, the term `applicable period' means--

`(i) 1993 in the case of substances to sterilize medical instruments, and

`(ii) any period after 1992 in the case of propellants in metered-dose inhalers.'

(c) TREATMENT OF METHYL CHLOROFORM- Subsection (g) of section 4682, as amended by subsection (b), is amended by adding at the end thereof the following new paragraph:

`(5) TREATMENT OF METHYL CHLOROFORM- The tax imposed by section 4681 during 1993 by reason of the treatment of methyl chloroform as an ozone-depleting chemical shall be 63.02 percent of the amount of such tax which would (but for this paragraph) be imposed.'

(d) EFFECTIVE DATE- The amendments made by this section shall apply to sales and uses on or after January 1, 1993.

SEC. 1933. INFORMATION REPORTING WITH RESPECT TO CERTAIN SELLER-PROVIDED FINANCING.

(a) GENERAL RULE- Section 6109 (relating to identifying numbers) is amended by adding at the end thereof the following new subsection:

`(h) IDENTIFYING INFORMATION REQUIRED WITH RESPECT TO CERTAIN SELLER-PROVIDED FINANCING-

`(1) PAYOR- If any taxpayer claims a deduction under section 163 for qualified residence interest on any seller-provided financing, such taxpayer shall include on the return claiming such deduction the name, address, and TIN of the person to whom such interest is paid or accrued.

`(2) RECIPIENT- If any person receives or accrues interest referred to in paragraph (1), such person shall include on the return for the taxable year in which such interest is so received or accrued the name, address, and TIN of the person liable for such interest.

`(3) FURNISHING OF INFORMATION BETWEEN PAYOR AND RECIPIENT- If any person

is required to include the TIN of another person on a return under paragraph (1) or (2), such other person shall furnish his TIN to such person.

`(4) SELLER-PROVIDED FINANCING- For purposes of this subsection, the term `seller-provided financing' means any indebtedness incurred in acquiring any residence if the person to whom such indebtedness is owed is the person from whom such residence was acquired.'.

(b) PENALTY- Paragraph (3) of section 6724(d) (relating to specified information reporting requirement) is amended by striking `and' at the end of subparagraph (C), by striking the period at the end of subparagraph (D) and inserting `, and', and by adding at the end thereof the following new subparagraph:

`(E) any requirement under section 6109(f) that--

`(i) a person include on his return the name, address, and TIN of another person, or

`(ii) a person furnish his TIN to another person.'

(c) EFFECTIVE DATE- The amendments made by this section shall apply to taxable years beginning after December 31, 1991.

SEC. 1934. INCREASED WITHHOLDING ON GAMBLING WINNINGS.

(a) IN GENERAL- Section 3402(q)(1) (relating to extension of withholding to certain gambling winnings) is amended by striking `20 percent' and inserting `28 percent'.

(b) EFFECTIVE DATE- The amendment made by this section applies to payments received after December 31, 1992.

SEC. 1935. INCREASE IN BACKUP WITHHOLDING RATE.

(a) IN GENERAL- Section 3406(a)(1) is amended by striking `20 percent' and inserting `31 percent'.

(b) EFFECTIVE DATE- The amendment made by subsection (a) shall apply to amounts paid after December 31, 1992.

SEC. 1936. CLASSIFICATION OF CERTAIN INTEREST AS STOCK OR INDEBTEDNESS.

(a) GENERAL RULE- Section 385 (relating to treatment of certain interests in corporations as stock or indebtedness) is amended by adding at the end thereof the following new subsection:

`(c) EFFECT OF CLASSIFICATION BY ISSUER-

`(1) IN GENERAL- The characterization (as of the time of issuance) by the issuer as to whether an interest in a corporation is stock or indebtedness shall be binding on such issuer and on all holders of such interest (but shall not be binding on the Secretary).

`(2) NOTIFICATION OF INCONSISTENT TREATMENT- Except as provided in regulations, paragraph (1) shall not apply to any holder of an interest if such holder on his return discloses that

he is treating such interest in a manner inconsistent with the characterization referred to in paragraph (1).

`(3) REGULATIONS- The Secretary is authorized to require such information as the Secretary determines to be necessary to carry out the provisions of this subsection.'

(b) EFFECTIVE DATE- The amendment made by subsection (a) shall apply to instruments issued after the date of the enactment of this Act.

SEC. 1937. RECOGNITION OF PRECONTRIBUTION GAIN IN CASE OF CERTAIN DISTRIBUTIONS TO CONTRIBUTING PARTNER.

(a) GENERAL RULE- Subpart C of part II of subchapter K of chapter 1 (relating to distributions by a partnership) is amended by adding at the end thereof the following new section:

`SEC. 737. RECOGNITION OF PRECONTRIBUTION GAIN IN CASE OF CERTAIN DISTRIBUTIONS TO CONTRIBUTING PARTNER.

`(a) GENERAL RULE- In the case of any distribution by a partnership to a partner, such partner shall be treated as recognizing gain in an amount equal to the lesser of--

`(1) the excess (if any) of (A) the fair market value of property (other than money) received in the distribution over (B) the adjusted basis of such partner's interest in the partnership immediately before the distribution reduced (but not below zero) by the amount of money received in the distribution, or

`(2) the net precontribution gain of the partner.

Gain recognized under the preceding sentence shall be in addition to any gain recognized under section 731. The character of such gain shall be determined by reference to the proportionate character of the net precontribution gain.

`(b) NET PRECONTRIBUTION GAIN- For purposes of this section, the term `net precontribution gain' means the net gain (if any) which would have been recognized by the distributee partner under section 704(c)(1)(B) if all property which--

`(1) had been contributed to the partnership by the distributee partner within 5 years of the distribution, and

`(2) is held by such partnership immediately before the distribution,

had been distributed by such partnership to another partner.

`(c) BASIS RULES-

`(1) PARTNER'S INTEREST- The adjusted basis of a partner's interest in a partnership shall be increased by the amount of any gain recognized by such partner under subsection (a). Except for purposes of determining the amount recognized under subsection (a), such increase shall be treated as occurring immediately before the distribution.

`(2) PARTNERSHIP'S BASIS IN CONTRIBUTED PROPERTY- Appropriate adjustments shall be made to the adjusted basis of the partnership in the contributed property referred to in subsection (b) to reflect gain recognized under subsection (a).

`(d) EXCEPTIONS-

`(1) DISTRIBUTIONS OF PREVIOUSLY CONTRIBUTED PROPERTY- If any portion of the property distributed consists of property which had been contributed by the distributee partner to the partnership, such property shall not be taken into account under subsection (a)(1) and shall not be taken into account in determining the amount of the net precontribution gain. If the property distributed consists of an interest in an entity, the preceding sentence shall not apply to the extent that the value of such interest is attributable to property contributed to such entity after such interest had been contributed to the partnership.

`(2) COORDINATION WITH SECTION 751- This section shall not apply to the extent section 751(b) applies to such distribution.'

(b) TECHNICAL AMENDMENTS-

(1) Subparagraph (B) of section 704(c)(1) is amended by striking out `is distributed' in the material preceding clause (i) and inserting `is distributed (directly or indirectly)'.

(2) Subsection (c) of section 731 is amended--

(A) by striking `and section 751' and inserting `, section 751', and

(B) by inserting before the period at the end thereof the following: `, and section 737 (relating to recognition of precontribution gain in case of certain distributions)'.

(3) The table of sections for subpart B of part II of subchapter K of chapter 1 is amended by adding at the end thereof the following new item:

`Sec. 737. Recognition of precontribution gain in case of certain distributions to contributing partner.'

(c) EFFECTIVE DATE- The amendments made by this section shall apply to distributions on or after June 25, 1992.

SEC. 1938. DEDUCTION FOR EXPENSES AWAY FROM HOME.

(a) IN GENERAL- Section 162(a) is amended by adding at the end the following new sentence: `For purposes of paragraph (2), the taxpayer shall not be treated as being temporarily away from home during any period of employment if such period exceeds 1 year.'

(b) EFFECTIVE DATE- The amendment made by subsection (a) shall apply to costs paid or incurred after December 31, 1992.

SEC. 1939. REPORTING REQUIREMENTS WITH RESPECT TO CERTAIN APPORTIONED REAL ESTATE TAXES.

(a) GENERAL RULE- Paragraph (4) of section 6045(e) is amended to read as follows:

`(4) ADDITIONAL INFORMATION REQUIRED- In the case of a real estate transaction involving a residence, the real estate reporting person shall include the following information on the return under subsection (a) and on the statement under subsection (b):

`(A) The portion of any real property tax which is treated as a tax imposed on the purchaser by reason of section 164(d)(1)(B).

`(B) Whether or not the financing (if any) of the seller was federally-subsidized indebtedness (as defined in section 143(m)(3)).'

(b) EFFECTIVE DATE- The amendment made by subsection (a) shall apply to transactions after December 31, 1992.

SEC. 1940. USE OF EXCESS ASSETS OF BLACK LUNG BENEFIT TRUSTS FOR HEALTH CARE BENEFITS.

(a) GENERAL RULE- Paragraph (21) of section 501(c) is amended to read as follows:

`(21)(A) A trust or trusts established in writing, created or organized in the United States, and contributed to by any person (except an insurance company) if--

`(i) the purpose of such trust or trusts is exclusively--

`(I) to satisfy, in whole or in part, the liability of such person for, or with respect to, claims for compensation for disability or death due to pneumoconiosis under Black Lung Acts,

`(II) to pay premiums for insurance exclusively covering such liability,

`(III) to pay administrative and other incidental expenses of such trust in connection with the operation of the trust and the processing of claims against such person under Black Lung Acts, and

`(IV) to pay accident or health benefits for retired miners and their spouses and dependents (including administrative and other incidental expenses of such trust in connection therewith) or premiums for insurance exclusively covering such benefits; and

`(ii) no part of the assets of the trust may be used for, or diverted to, any purpose other than--

`(I) the purposes described in clause (i),

`(II) investment (but only to the extent that the trustee determines that a portion of the assets is not currently needed for the purposes described in clause (i)) in qualified investments, or

`(III) payment into the Black Lung Disability Trust Fund established under section 9501, or into the general fund of the United States Treasury (other than in satisfaction of any tax or other civil or criminal liability of the person who established or

contributed to the trust).

`(B) No deduction shall be allowed under this chapter for any payment described in subparagraph (A)(i)(IV) from such trust.

`(C) Payments described in subparagraph (A)(i)(IV) may be made from such trust during a taxable year only to the extent that the aggregate amount of such payments during such taxable year does not exceed the lesser of--

`(i) the excess (if any) (as of the close of the preceding taxable year) of--

`(I) the fair market value of the assets of the trust, over

`(II) 110 percent of the present value of the liability described in subparagraph (A)(i)(I) of such person, or

`(ii) the excess (if any) of--

`(I) the sum of a similar excess determined as of the close of the last taxable year ending before the date of the enactment of this subparagraph plus earnings thereon as of the close of the taxable year preceding the taxable year involved, over

`(II) the aggregate payments described in subparagraph (A)(i)(IV) made from the trust during all taxable years beginning after the date of the enactment of this subparagraph.

The determinations under the preceding sentence shall be made by an independent actuary using actuarial methods and assumptions (not inconsistent with the regulations prescribed under section 192(c)(1)(A)) each of which is reasonable and which are reasonable in the aggregate.

`(D) For purposes of this paragraph:

`(i) The term `Black Lung Acts' means part C of title IV of the Federal Mine Safety and Health Act of 1977, and any State law providing compensation for disability or death due to that pneumoconiosis.

`(ii) The term `qualified investments' means--

`(I) public debt securities of the United States,

`(II) obligations of a State or local government which are not in default as to principal or interest, and

`(III) time or demand deposits in a bank (as defined in section 581) or an insured credit union (within the meaning of section 101(6) of the Federal Credit Union Act, 12 U.S.C. 1752(6)) located in the United States.

`(iii) The term `miner' has the same meaning as such term has when used in section 402(d) of the Black Lung Benefits Act (30 U.S.C. 902(d)).

`(iv) The term `incidental expenses' includes legal, accounting, actuarial, and trustee

expenses.'

(b) EXCEPTION FROM TAX ON SELF-DEALING- Section 4951(f) is amended by striking `clause (i) of section 501(c)(21)(A)' and inserting `subclause (I) or (IV) of section 501(c)(21)(A)(i)'.

(c) TECHNICAL AMENDMENT- Paragraph (4) of section 192(c) is amended by striking `clause (ii) of section 501(c)(21)(B)' and inserting `subclause (II) of section 501(c)(21)(A)(ii)'.

(d) EFFECTIVE DATE- The amendments made by this section shall apply to taxable years beginning after December 31, 1991.

SEC. 1941. TREATMENT OF PORTIONS OF PROPERTY UNDER MARITAL DEDUCTION.

(a) ESTATE TAX- Subsection (b) of section 2056 (relating to limitation in case of life estate or other terminable interest) is amended by adding at the end thereof the following new paragraph:

`(10) SPECIFIC PORTION- For purposes of paragraphs (5), (6), and (7)(B)(iv), the term `specific portion' only includes a portion determined on a fractional or percentage basis.'

(b) GIFT TAX-

(1) Subsection (e) of section 2523 is amended by adding at the end thereof the following new sentence: `For purposes of this subsection, the term `specific portion' only includes a portion determined on a fractional or percentage basis.'

(2) Paragraph (3) of section 2523(f) is amended by inserting before the period at the end thereof the following: `and the rules of section 2056(b)(10) shall apply'.

(c) EFFECTIVE DATES-

(1) SUBSECTION (a)-

(A) IN GENERAL- Except as provided in subparagraph (B), the amendment made by subsection (a) shall apply to the estates of decedents dying after the date of the enactment of this Act.

(B) EXCEPTION- The amendment made by subsection (a) shall not apply to any interest in property which passes (or has passed) to the surviving spouse of the decedent pursuant to a will (or revocable trust) in existence on the date of the enactment of this Act if--

(i) the decedent dies on or before the date 3 years after such date of enactment, or

(ii) the decedent was, on such date of enactment, under a mental disability to change the disposition of his property and did not regain his competence to dispose of such property before the date of his death.

The preceding sentence shall not apply if such will (or revocable trust) is amended at any time after such date of enactment in any respect which will increase the amount of the interest which so passes or alters the terms of the transfer by which the interest so passes.

(2) SUBSECTION (b)- The amendments made by subsection (b) shall apply to gifts made after the date of the enactment of this Act.

SEC. 1942. UNIFORM EXEMPTION AMOUNT FOR GAMBLING WINNINGS SUBJECT TO WITHHOLDING.

(a) IN GENERAL- Subparagraphs (A) and (C) of section 3402(q)(3) are each amended by striking `$1,000' and inserting `$5,000'.

(b) EFFECTIVE DATE- The amendments made by subsection (a) shall apply to payments of winnings after December 31, 1992.

Subtitle C--Health Care of Coal Miners

SEC. 19141. SHORT TITLE.

This subtitle may be cited as the `Coal Industry Retiree Health Benefit Act of 1992'.

SEC. 19142. FINDINGS AND DECLARATION OF POLICY.

(a) FINDINGS- The Congress finds that--

(1) the production, transportation, and use of coal substantially affects interstate and foreign commerce and the national public interest; and

(2) in order to secure the stability of interstate commerce, it is necessary to modify the current private health care benefit plan structure for retirees in the coal industry to identify persons most responsible for plan liabilities in order to stabilize plan funding and allow for the provision of health care benefits to such retirees.

(b) STATEMENT OF POLICY- It is the policy of this subtitle--

(1) to remedy problems with the provision and funding of health care benefits with respect to the beneficiaries of multiemployer benefit plans that provide health care benefits to retirees in the coal industry;

(2) to allow for sufficient operating assets for such plans; and

(3) to provide for the continuation of a privately financed self-sufficient program for the delivery of health care benefits to the beneficiaries of such plans.

SEC. 19143. COAL INDUSTRY HEALTH BENEFITS PROGRAM.

(a) IN GENERAL- The Internal Revenue Code of 1986 is amended by adding at the end the following new subtitle:

`Subtitle J--Coal Industry Health Benefits

`CHAPTER 99. Coal industry health benefits.

`CHAPTER 99--COAL INDUSTRY HEALTH BENEFITS

`Subchapter A--Definitions of General Applicability

`SEC. 9701. DEFINITIONS OF GENERAL APPLICABILITY.

`(a) PLANS AND FUNDS- For purposes of this chapter--

`(1) UMWA BENEFIT PLAN-

`(A) IN GENERAL- The term `UMWA Benefit Plan' means a plan--

`(i) which is described in section 404(c), or a continuation thereof; and

`(ii) which provides health benefits to retirees and beneficiaries of the industry which maintained the 1950 UMWA Pension Plan.

`(B) 1950 UMWA BENEFIT PLAN- The term `1950 UMWA Benefit Plan' means a UMWA Benefit Plan, participation in which is substantially limited to individuals who retired before 1976.

`(C) 1974 UMWA BENEFIT PLAN- The term `1974 UMWA Benefit Plan' means a UMWA Benefit Plan, participation in which is substantially limited to individuals who retired on or after January 1, 1976.

`(2) 1950 UMWA PENSION PLAN- The term `1950 UMWA Pension Plan' means a pension plan described in section 404(c) (or a continuation thereof), participation in which is substantially limited to individuals who retired before 1976.

`(3) 1974 UMWA PENSION PLAN- The term `1974 UMWA Pension Plan' means a pension plan described in section 404(c) (or a continuation thereof), participation in which is substantially limited to individuals who retired in 1976 and thereafter.

`(4) 1992 UMWA BENEFIT PLAN- The term `1992 UMWA Benefit Plan' means the plan referred to in section 9713A.

`(5) COMBINED FUND- The term `Combined Fund' means the United Mine Workers of America Combined Benefit Fund established under section 9702.

`(b) AGREEMENTS- For purposes of this section--

`(1) COAL WAGE AGREEMENT- The term `coal wage agreement' means--

`(A) the National Bituminous Coal Wage Agreement, or

`(B) any other agreement entered into between an employer in the coal industry and the United Mine Workers of America that required or requires one or both of the following:

`(i) the provision of health benefits to retirees of such employer, eligibility for which is based on years of service credited under a plan established by the settlors and described in section 404(c) or a continuation of such plan; or

`(ii) contributions to the 1950 UMWA Benefit Plan or the 1974 UMWA Benefit Plan, or any predecessor thereof.

`(2) SETTLORS- The term `settlors' means the United Mine Workers of America and the Bituminous Coal Operators' Association, Inc. (referred to in this chapter as the `BCOA').

`(3) NATIONAL BITUMINOUS COAL WAGE AGREEMENT- The term `National Bituminous Coal Wage Agreement' means a collective bargaining agreement negotiated by the BCOA and the United Mine Workers of America.

`(c) TERMS RELATING TO OPERATORS- For purposes of this section--

`(1) SIGNATORY OPERATOR- The term `signatory operator' means a person which is or was a signatory to a coal wage agreement.

`(2) RELATED PERSONS-

`(A) IN GENERAL- A person shall be considered to be a related person to a signatory operator if that person is--

`(i) a member of the controlled group of corporations (within the meaning of section 52(a)) which includes such signatory operator;

`(ii) a trade or business which is under common control (as determined under section 52(b)) with such signatory operator; or

`(iii) any other person who is identified as having a partnership interest or joint venture with a signatory operator in a business within the coal industry, but only if such business employed eligible beneficiaries, except that this clause shall not apply to a person whose only interest is as a limited partner.

A related person shall also include a successor in interest of any person described in clause (i), (ii), or (iii).

`(B) TIME FOR DETERMINATION- The relationships described in clauses (i), (ii), and (iii) of subparagraph (A) shall be determined as of July 20, 1992, except that if, on July 20, 1992, a signatory operator is no longer in business, the relationships shall be determined as

of the time immediately before such operator ceased to be in business.

`(3) 1988 AGREEMENT OPERATOR- The term `1988 agreement operator' means--

`(A) a signatory operator which was a signatory to the 1988 National Bituminous Coal Wage Agreement,

`(B) an employer in the coal industry which was a signatory to an agreement containing pension and health care contribution and benefit provisions which are the same as those contained in the 1988 National Bituminous Coal Wage Agreement, or

`(C) an employer from which contributions were actually received after 1987 and before July 20, 1992, by the 1950 UMWA Benefit Plan or the 1974 UMWA Benefit Plan in connection with employment in the coal industry during the period covered by the 1988 National Bituminous Coal Wage Agreement.

`(4) LAST SIGNATORY OPERATOR- The term `last signatory operator' means, with respect to a coal industry retiree, a signatory operator which was the most recent coal industry employer of such retiree.

`(5) ASSIGNED OPERATOR- The term `assigned operator' means, with respect to an eligible beneficiary defined in section 9703(f), the signatory operator to which liability under subchapter B with respect to the beneficiary is assigned under section 9706.

`(6) OPERATORS OF DEPENDENT BENEFICIARIES- For purposes of this chapter, the signatory operator, last signatory operator, or assigned operator of any eligible beneficiary under this chapter who is a coal industry retiree shall be considered to be the signatory operator, last signatory operator, or assigned operator with respect to any other individual who is an eligible beneficiary under this chapter by reason of a relationship to the retiree.

`(7) BUSINESS- For purposes of this chapter, a person shall be considered to be in business if such person conducts or derives revenue from any business activity, whether or not in the coal industry.

`(d) ENACTMENT DATE- For purposes of this chapter, the term `enactment date' means the date of the enactment of this chapter.

`Subchapter B--Combined Benefit Fund

`Part I--Establishment and Benefits

`Part II--Financing

`Part III--Enforcement

`Part IV--Other Provisions

`PART I--ESTABLISHMENT AND BENEFITS

`Sec. 9702. Establishment of the United Mine Workers of America Combined Benefit Fund.

`Sec. 9703. Plan benefits.

`SEC. 9702. ESTABLISHMENT OF THE UNITED MINE WORKERS OF AMERICA COMBINED BENEFIT FUND.

`(a) ESTABLISHMENT-

`(1) IN GENERAL- As soon as practicable (but not later than 60 days) after the enactment date, the persons described in subsection (b) shall designate the individuals to serve as trustees. Such trustees shall create a new private plan to be known as the United Mine Workers of America Combined Benefit Fund.

`(2) MERGER OF RETIREE BENEFIT PLANS- As of February 1, 1993, the settlors of the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan shall cause such plans to be merged into the Combined Fund, and such merger shall not be treated as an employer withdrawal for purposes of any 1988 coal wage agreement.

`(3) TREATMENT OF PLAN- The Combined Fund shall be--

`(A) a plan described in section 302(c)(5) of the Labor Management Relations Act, 1947 (29 U.S.C. 186(c)(5)),

`(B) an employee welfare benefit plan within the meaning of section 3(1) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1002(1)), and

`(C) a multiemployer plan within the meaning of section 3(37) of such Act (29 U.S.C. 1002 (37)).

`(4) TAX TREATMENT- For purposes of this title, the Combined Fund and any related trust shall be treated as an organization exempt from tax under section 501(a).

`(b) BOARD OF TRUSTEES-

`(1) IN GENERAL- For purposes of subsection (a), the board of trustees for the Combined Fund shall be appointed as follows:

`(A) one individual who represents employers in the coal mining industry shall be designated by the BCOA;

`(B) one individual shall be designated by the three employers, other than 1988 agreement operators, who have been assigned the greatest number of eligible beneficiaries under section 9706;

`(C) two individuals designated by the United Mine Workers of America; and

`(D) three persons selected by the persons appointed under subparagraphs (A), (B), and (C).

`(2) SUCCESSOR TRUSTEES- Any successor trustee shall be appointed in the same manner as

the trustee being succeeded. The plan establishing the Combined Fund shall provide for the removal of trustees.

`(3) SPECIAL RULES-

`(A) BCOA- If the BCOA ceases to exist, any trustee or successor under paragraph (1)(A) shall be designated by the 3 employers who were members of the BCOA on the enactment date and who have been assigned the greatest number of eligible beneficiaries under section 9706.

`(B) FORMER SIGNATORIES- The initial trustee under paragraph (1)(B) shall be designated by the 3 employers, other than 1988 agreement operators, which the records of the 1950 UMWA Benefit Plan and 1974 UMWA Benefit Plan indicate have the greatest number of eligible beneficiaries as of the enactment date, and such trustee and any successor shall serve until November 1, 1993.

`(c) PLAN YEAR- The first plan year of the Combined Fund shall begin February 1, 1993, and end September 30, 1993. Each succeeding plan year shall begin on October 1 of each calendar year.

`SEC. 9703. PLAN BENEFITS.

`(a) IN GENERAL- Each eligible beneficiary of the Combined Fund shall receive--

`(1) health benefits described in subsection (b), and

`(2) in the case of an eligible beneficiary described in subsection (f)(1), death benefits coverage described in subsection (c).

`(b) HEALTH BENEFITS-

`(1) IN GENERAL- The trustees of the Combined Fund shall provide health care benefits to each eligible beneficiary by enrolling the beneficiary in a health care services plan which undertakes to provide such benefits on a prepaid risk basis. The trustees shall utilize all available plan resources to ensure that, consistent with paragraph (2), coverage under the managed care system shall to the maximum extent feasible be substantially the same as (and subject to the same limitations of) coverage provided under the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan as of January 1, 1992.

`(2) PLAN PAYMENT RATES-

`(A) IN GENERAL- The trustees of the Combined Fund shall negotiate payment rates with the health care services plans described in paragraph (1) for each plan year which are in amounts which--

`(i) vary as necessary to ensure that beneficiaries in different geographic areas have access to a uniform level of health benefits; and

`(ii) result in aggregate payments for such plan year from the Combined Fund which do not exceed the total premium payments required to be paid to the Combined Fund under section 9704(a) for the plan year, adjusted as provided in subparagraphs (B) and

(C).

`(B) REDUCTIONS- The amount determined under subparagraph (A)(ii) for any plan year shall be reduced--

`(i) by the aggregate death benefit premiums determined under section 9704(c) for the plan year, and

`(ii) by the amount reserved for plan administration under subsection (d).

`(C) INCREASES- The amount determined under subparagraph (A)(ii) shall be increased--

`(i) by any reduction in the total premium payments required to be paid under section 9704(a) by reason of transfers described in section 9705,

`(ii) by any carryover to the plan year from any preceding plan year which--

`(I) is derived from amounts described in section 9704(e)(3)(B)(i), and

`(II) the trustees elect to use to pay benefits for the current plan year, and

`(iii) any interest earned by the Combined Fund which the trustees elect to use to pay benefits for the current plan year.

`(3) QUALIFIED PROVIDERS- The trustees of the Combined Fund shall not enter into an agreement under paragraph (1) with any provider of services which is of a type which is required to be certified by the Secretary of Health and Human Services when providing services under title XVIII of the Social Security Act unless the provider is so certified.

`(4) EFFECTIVE DATE- Benefits shall be provided under paragraph (1) on and after February 1, 1993.

`(c) DEATH BENEFITS COVERAGE-

`(1) IN GENERAL- The trustees of the Combined Fund shall provide death benefits coverage to each eligible beneficiary described in subsection (f)(1) which is identical to the benefits provided under the 1950 UMWA Pension Plan or 1974 UMWA Pension Plan, whichever is applicable, on July 20, 1992. Such coverage shall be provided on and after February 1, 1993.

`(2) TERMINATION OF COVERAGE- The 1950 UMWA Pension Plan and the 1974 UMWA Pension Plan shall each be amended to provide that death benefits coverage shall not be provided to eligible beneficiaries on and after February 1, 1993. This paragraph shall not prohibit such plans from subsequently providing death benefits not described in paragraph (1).

`(d) RESERVES FOR ADMINISTRATION- The trustees of the Combined Fund may reserve for each plan year, for use in payment of the administrative costs of the Combined Fund, an amount not to exceed 5 percent of the premiums to be paid to the Combined Fund under section 9704(a) during the plan year.

`(e) LIMITATION ON ENROLLMENT- The Combined Fund shall not enroll any individual who is not receiving benefits under the 1950 UMWA Benefit Plan or the 1974 UMWA Benefit Plan as of July 20,

1992.

`(f) ELIGIBLE BENEFICIARY- For purposes of this subchapter, the term `eligible beneficiary' means an individual who--

`(1) is a coal industry retiree who, on July 20, 1992, was eligible to receive, and receiving, benefits from the 1950 UMWA Benefit Plan or the 1974 UMWA Benefit Plan, or

`(2) on such date was eligible to receive, and receiving, benefits in either such plan by reason of a relationship to such retiree.

`PART II--FINANCING

`SEC. 9704. LIABILITY OF ASSIGNED OPERATORS.

`(a) ANNUAL PREMIUMS- Each assigned operator shall pay to the Combined Fund for each plan year beginning on or after February 1, 1993, an annual premium equal to the sum of the following three premiums--

`(1) the health benefit premium determined under subsection (b) for such plan year, plus

`(2) the death benefit premium determined under subsection (c) for such plan year, plus

`(3) the unassigned beneficiaries premium determined under subsection (d) for such plan year.

Any related person with respect to an assigned operator shall be jointly and severally liable for any premium required to be paid by such operator.

`(b) HEALTH BENEFIT PREMIUM- For purposes of this chapter--

`(1) IN GENERAL- The health benefit premium for any plan year for any assigned operator shall be an amount equal to the product of the per beneficiary premium for the plan year multiplied by the number of eligible beneficiaries assigned to such operator under section 9706.

`(2) PER BENEFICIARY PREMIUM- The Secretary of Health and Human Services shall calculate a per beneficiary premium for each plan year beginning on or after February 1, 1993, which is equal to the sum of--

`(A) the amount determined by dividing--

`(i) the aggregate amount of payments from the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan for health benefits (less reimbursements but including administrative costs) for the plan year beginning July 1, 1991, for all individuals

covered under such plans for such plan year, by

`(ii) the number of such individuals, plus

`(B) the amount determined under subparagraph (A) multiplied by the percentage (if any) by which the medical component of the Consumer Price Index for the calendar year in which the plan year begins exceeds such component for 1992.

`(3) ADJUSTMENTS FOR MEDICARE REDUCTIONS- If, by reason of a reduction in benefits under title XVIII of the Social Security Act, the level of health benefits under the Combined Fund would be reduced, the trustees of the Combined Fund shall increase the per beneficiary premium for the plan year in which the reduction occurs and each subsequent plan year by the amount necessary to maintain the level of health benefits which would have been provided without such reduction.

`(c) DEATH BENEFIT PREMIUM- The death benefit premium for any plan year for any assigned operator shall be equal to the applicable percentage of the amount, actuarially determined, which the Combined Fund will be required to pay during the plan year for death benefits coverage described in section 9703(c).

`(d) UNASSIGNED BENEFICIARIES PREMIUM- The unassigned beneficiaries premium for any plan year for any assigned operator shall be equal to the applicable percentage of the product of the per beneficiary premium for the plan year multiplied by the number of eligible beneficiaries who are not assigned under section 9706 to any person for such plan year.

`(e) PREMIUM ACCOUNTS; ADJUSTMENTS-

`(1) ACCOUNTS- The trustees of the Combined Fund shall establish and maintain 3 separate accounts for each of the premiums described in subsections (b), (c), and (d). Such accounts shall be credited with the premiums received and debited with expenditures allocable to such premiums.

`(2) ALLOCATIONS-

`(A) ADMINISTRATIVE EXPENSES- Administrative costs for any plan year shall be allocated to premium accounts under paragraph (1) on the basis of expenditures (other than administrative costs) from such accounts during the preceding plan year.

`(B) INTEREST- Interest shall be allocated to the account established for health benefit premiums.

`(3) SHORTFALLS AND SURPLUSES-

`(A) IN GENERAL- Except as provided in subparagraph (B), if, for any plan year, there is a shortfall or surplus in any premium account, the premium for the following plan year for each assigned operator shall be proportionately reduced or increased, whichever is applicable, by the amount of such shortfall or surplus.

`(B) EXCEPTION- Subparagraph (A) shall not apply to any surplus in the health benefit premium account or the unassigned beneficiaries premium account which is attributable to--

`(i) the excess of the premiums credited to such account for a plan year over the benefits (and administrative costs) debited to such account for the plan year, but such excess shall only be available for purposes of the carryover described in section 9703 (b)(2)(C)(ii) (relating to carryovers of premiums not used to provide benefits), or

`(ii) interest credited under paragraph (2)(B) for the plan year or any preceding plan year.

`(C) NO AUTHORITY FOR INCREASED PAYMENTS- Nothing in this paragraph shall be construed to allow expenditures for health care benefits for any plan year in excess of the limit under section 9703(b)(2).

`(f) APPLICABLE PERCENTAGE- For purposes of this section--

`(1) IN GENERAL- The term `applicable percentage' means, with respect to any assigned operator, the percentage determined by dividing the number of eligible beneficiaries assigned under section 9706 to such operator by the total number of eligible beneficiaries assigned under section 9706 to all such operators (determined on the basis of assignments as of October 1, 1993).

`(2) ANNUAL ADJUSTMENTS- In the case of any plan year beginning on or after October 1, 1994, the applicable percentage for any assigned operator shall be redetermined under paragraph (1) by making the following changes to the assignments as of October 1, 1993:

`(A) Such assignments shall be modified to reflect any changes during the period beginning October 1, 1993, and ending on the last day of the preceding plan year pursuant to the appeals process under section 9706(f).

`(B) The total number of assigned eligible beneficiaries shall be reduced by the eligible beneficiaries of assigned operators which (and all related persons with respect to which) had ceased business (within the meaning of section 9701(c)(6)) during the period described in subparagraph (A).

`(g) PAYMENT OF PREMIUMS-

`(1) IN GENERAL- The annual premium under subsection (a) for any plan year shall be payable in 12 equal monthly installments, due on the twenty-fifth day of each calendar month in the plan year. In the case of the plan year beginning February 1, 1993, the annual premium under subsection (a) shall be added to such premium for the plan year beginning October 1, 1993.

`(2) DEDUCTIBILITY- Any premium required by this section shall be deductible without regard to any limitation on deductibility based on the prefunding of health benefits.

`(h) INFORMATION- The trustees of the Combined Fund shall, not later than 60 days after the enactment date, furnish to the Secretary of Health and Human Services information as to the benefits and covered beneficiaries under the fund, and such other information as the Secretary may require to compute any premium under this section.

`(i) TRANSITION RULES-

`(1) 1988 AGREEMENT OPERATORS-

`(A) 1ST YEAR COSTS- During the plan year of the Combined Fund beginning February 1, 1993, the 1988 agreement operators shall make contributions to the Combined Fund in amounts necessary to pay benefits and administrative costs of the Combined Fund incurred during such year, reduced by the amount transferred to the Combined Fund under section 9705(a) on February 1, 1993.

`(B) DEFICITS FROM MERGED PLANS- During the period beginning February 1, 1993, and ending September 30, 1994, the 1988 agreement operators shall make contributions to the Combined Fund as are necessary to pay off the expenses accrued (and remaining unpaid) by the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan as of February 1, 1993, reduced by the assets of such plans as of such date.

`(C) FAILURE- If any 1988 agreement operator fails to meet any obligation under this paragraph, any contributions of such operator to the Combined Fund or any other plan described in section 404(c) shall not be deductible under this title until such time as the failure is corrected.

`(D) PREMIUM REDUCTIONS-

`(i) 1ST YEAR PAYMENTS- In the case of a 1988 agreement operator making contributions under subparagraph (A), the premium of such operator under subsection (a) shall be reduced by the amount paid under subparagraph (A) by such operator for the plan year beginning February 1, 1993.

`(ii) DEFICIT PAYMENTS- In the case a 1988 agreement operator making contributions under subparagraph (B), the premium of such operator under subsection (a) shall be reduced by the amounts which are paid to the Combined Fund by reason of claims arising in connection with the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan as of February 1, 1993, including claims based on the `evergreen clause' found in the language of the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan, and which are allocated to such operator under subparagraph (E).

`(iii) LIMITATION- Clause (ii) shall not apply to the extent the amounts paid exceed the contributions.

`(iv) PLAN YEARS- Premiums under subsection (a) shall be reduced for the first plan year for which amounts described in clause (i) or (ii) are available and for any succeeding plan year until such amounts are exhausted.

`(E) ALLOCATIONS OF CONTRIBUTIONS AND REFUNDS- Contributions under subparagraphs (A) and (B), and premium reductions under subparagraph (D)(ii), shall be made ratably on the basis of aggregate contributions made by such operators under the applicable 1988 coal wage agreements as of January 31, 1993.

`(2) 1ST PLAN YEAR- In the case of the plan year of the Combined Fund beginning February 1, 1993--

`(A) the premiums under subsections (a)(1) and (a)(3) shall be 67 percent of such premiums without regard to this paragraph, and

`(B) the premiums under subsection (a) shall be paid as provided in subsection (g).

`(3) STARTUP COSTS- The 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan shall pay the costs of the Combined Fund incurred before February 1, 1993. For purposes of this section, such costs shall be treated as administrative expenses incurred for the plan year beginning February 1, 1993.

`SEC. 9705. TRANSFERS.

`(a) TRANSFER OF ASSETS FROM 1950 UMWA PENSION PLAN-

`(1) IN GENERAL- From the funds reserved under paragraph (2), the board of trustees of the 1950 UMWA Pension Plan shall transfer to the Combined Fund--

`(A) $70,000,000 on February 1, 1993,

`(B) $70,000,000 on October 1, 1993, and

`(C) $70,000,000 on October 1, 1994.

`(2) RESERVATION- Immediately upon the enactment date, the board of trustees of the 1950 UMWA Pension Plan shall segregate $210,000,000 from the general assets of the plan. Such funds shall be held in the plan until disbursed pursuant to paragraph (1). Any interest on such funds shall be deposited into the general assets of the 1950 UMWA Pension Plan.

`(3) USE OF FUNDS- Amounts transferred to the Combined Fund under paragraph (1) shall--

`(A) in the case of the transfer on February 1, 1993, be used to proportionately reduce the premium of each assigned operator under section 9704(a) for the plan year of the Fund beginning February 1, 1993, and

`(B) in the case of any other such transfer, be used to proportionately reduce the unassigned beneficiary premium under section 9704(a)(3) and the death benefit premium under section 9704(a)(2) of each assigned operator for the plan year in which transferred and for any subsequent plan year in which such funds remain available.

Such funds may not be used to pay any amounts required to be paid by the 1988 agreement operators under section 9704(i)(1)(B).

`(4) TAX TREATMENT; VALIDITY OF TRANSFER-

`(A) NO DEDUCTION- No deduction shall be allowed under this title with respect to any transfer pursuant to paragraph (1), but such transfer shall not adversely affect the deductibility (under applicable provisions of this title) of contributions previously made by employers, or amounts hereafter contributed by employers, to the 1950 UMWA Pension Plan, the 1950 UMWA Benefit Plan, the 1974 UMWA Pension Plan, the 1974 UMWA Benefit Plan, the 1992 UMWA Benefit Plan, or the Combined Fund.

`(B) OTHER TAX PROVISIONS- Any transfer pursuant to paragraph (1)--

`(i) shall not be treated as an employer reversion from a qualified plan for purposes of section 4980, and

`(ii) shall not be includible in the gross income of any employer maintaining the 1950 UMWA Pension Plan.

`(5) TREATMENT OF TRANSFER- Any transfer pursuant to paragraph (1) shall not be deemed to violate, or to be prohibited by, any provision of law, or to cause the settlors, joint board of trustees, employers or any related person to incur or be subject to liability, taxes, fines, or penalties of any kind whatsoever.

`(b) TRANSFERS FROM ABANDONED MINE RECLAMATION FUND-

`(1) IN GENERAL- The Combined Fund shall include any amount transferred to the Fund under section 402(h) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1232(h)).

`(2) USE OF FUNDS- Any amount transferred under paragraph (1) for any fiscal year shall be used to proportionately reduce the unassigned beneficiary premium under section 9704(a)(3) of each assigned operator for the plan year in which transferred.

`SEC. 9706. ASSIGNMENT OF ELIGIBLE BENEFICIARIES.

`(a) IN GENERAL- For purposes of this chapter, the Secretary of Health and Human Services shall, before October 1, 1993, assign each coal industry retiree who is an eligible beneficiary to a signatory operator which (or any related person with respect to which) remains in business in the following order:

`(1) First, to the signatory operator which--

`(A) was a signatory to the 1978 coal wage agreement or any subsequent coal wage agreement, and

`(B) was the most recent signatory operator to employ the coal industry retiree in the coal industry for at least 2 years.

`(2) Second, if the retiree is not assigned under paragraph (1), to the signatory operator which--

`(A) was a signatory to the 1978 coal wage agreement or any subsequent coal wage agreement, and

`(B) was the most recent signatory operator to employ the coal industry retiree in the coal industry.

`(3) Third, if the retiree is not assigned under paragraph (1) or (2), to the signatory operator which employed the coal industry retiree in the coal industry for a longer period of time than any other signatory operator prior to the effective date of the 1978 coal wage agreement.

`(b) RULES RELATING TO EMPLOYMENT AND REASSIGNMENT UPON PURCHASE- For purposes of subsection (a)--

`(1) AGGREGATION RULES-

`(A) RELATED PERSON- Any employment of a coal industry retiree in the coal industry by a signatory operator shall be treated as employment by any related persons to such operator.

`(B) CERTAIN EMPLOYMENT DISREGARDED- Employment with--

`(i) a person which is (and all related persons with respect to which are) no longer in business, or

`(ii) a person during a period during which such person was not a signatory to a coal wage agreement,

shall not be taken into account.

`(2) REASSIGNMENT UPON PURCHASE- If a person becomes a successor of an assigned operator after the enactment date, the assigned operator may transfer the assignment of an eligible beneficiary under subsection (a) to such successor, and such successor shall be treated as the assigned operator with respect to such eligible beneficiary for purposes of this chapter. Notwithstanding the preceding sentence, the assigned operator transferring such assignment (and any related person) shall remain the guarantor of the benefits provided to the eligible beneficiary under this chapter. An assigned operator shall notify the trustees of the Combined Fund of any transfer described in this paragraph.

`(c) IDENTIFICATION OF ELIGIBLE BENEFICIARIES- The 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan shall, by the later of October 1, 1992, or the twentieth day after the enactment date, provide to the Secretary of Health and Human Services a list of the names and social security account numbers of each eligible beneficiary, including each deceased eligible beneficiary if any other individual is an eligible beneficiary by reason of a relationship to such deceased eligible beneficiary. In addition, the plans shall provide, where ascertainable from plan records, the names of all persons described in subsection (a) with respect to any eligible beneficiary or deceased eligible beneficiary.

`(d) COOPERATION BY OTHER AGENCIES AND PERSONS-

`(1) COOPERATION- The head of any department, agency, or instrumentality of the United States shall cooperate fully and promptly with the Secretary of Health and Human Services in providing information which will enable the Secretary to carry out his responsibilities under this section.

`(2) PROVIDING OF INFORMATION-

`(A) IN GENERAL- Notwithstanding any other provision of law, including section 6103, the head of any other agency, department, or instrumentality shall, upon receiving a written request from the Secretary of Health and Human Services in connection with this section, cause a search to be made of the files and records maintained by such agency, department, or instrumentality with a view to determining whether the information requested is contained in such files or records. The Secretary shall be advised whether the search disclosed the information requested, and, if so, such information shall be promptly transmitted to the Secretary, except that if the disclosure of any requested information would contravene national policy or security interests of the United States, or the confidentiality of census data, the information shall not be transmitted and the Secretary shall be so advised.

`(B) LIMITATION- Any information provided under subparagraph (A) shall be limited to information necessary for the Secretary to carry out his duties under this section.

`(3) TRUSTEES- The trustees of the Combined Fund, the 1950 UMWA Benefit Plan, the 1974 UMWA Benefit Plan, the 1950 UMWA Pension Plan, and the 1974 UMWA Pension Plan shall fully and promptly cooperate with the Secretary in furnishing, or assisting the Secretary to obtain, any information the Secretary needs to carry out the Secretary's responsibilities under this section.

`(e) NOTICE BY SECRETARY-

`(1) NOTICE TO FUND- The Secretary of Health and Human Services shall advise the trustees of the Combined Fund of the name of each person identified under this section as an assigned operator, and the names and social security account numbers of eligible beneficiaries with respect to whom he is identified.

`(2) OTHER NOTICE- The Secretary of Health and Human Services shall notify each assigned operator of the names and social security account numbers of eligible beneficiaries who have been assigned to such person under this section and a brief summary of the facts related to the basis for such assignments.

`(f) RECONSIDERATION BY SECRETARY-

`(1) IN GENERAL- Any assigned operator receiving a notice under subsection (e)(2) with respect to an eligible beneficiary may, within 30 days of receipt of such notice, request from the Secretary of Health and Human Services detailed information as to the work history of the beneficiary and the basis of the assignment.

`(2) REVIEW- An assigned operator may, within 30 days of receipt of the information under paragraph (1), request review of the assignment. The Secretary of Health and Human Services shall conduct such review if the Secretary finds the operator provided evidence with the request constituting a prima facie case of error.

`(3) RESULTS OF REVIEW-

`(A) ERROR- If the Secretary of Health and Human Services determines under a review under paragraph (2) that an assignment was in error--

`(i) the Secretary shall notify the assigned operator and the trustees of the Combined Fund and the trustees shall reduce the premiums of the operator under section 9704 by (or if there are no such premiums, repay) all premiums paid under section 9704 with respect to the eligible beneficiary, and

`(ii) the Secretary shall review the beneficiary's record for reassignment under subsection (a).

`(B) NO ERROR- If the Secretary of Health and Human Services determines under a review conducted under paragraph (2) that no error occurred, the Secretary shall notify the assigned operator.

`(4) DETERMINATIONS- Any determination by the Secretary of Health and Human Services

under paragraph (2) or (3) shall be final.

`(5) PAYMENT PENDING REVIEW- An assigned operator shall pay the premiums under section 9704 pending review by the Secretary of Health and Human Services or by a court under this subsection.

`(6) PRIVATE ACTIONS- Nothing in this section shall preclude the right of any person to bring a separate civil action against another person for responsibility for assigned premiums, notwithstanding any prior decision by the Secretary.

`(g) CONFIDENTIALITY OF INFORMATION- Any person to which information is provided by the Secretary of Health and Human Services under this section shall not disclose such information except in any proceedings related to this section. Any civil or criminal penalty which is applicable to an unauthorized disclosure under section 6103 shall apply to any unauthorized disclosure under this section.

`PART III--ENFORCEMENT

`Sec. 9707. Failure to pay premium.

`SEC. 9707. FAILURE TO PAY PREMIUM.

`(a) GENERAL RULE- There is hereby imposed a penalty on the failure of any assigned operator to pay any premium required to be paid under section 9704 with respect to any eligible beneficiary.

`(b) AMOUNT OF PENALTY- The amount of the penalty imposed by subsection (a) on any failure with respect to any eligible beneficiary shall be $100 per day in the noncompliance period with respect to any such failure.

`(c) NONCOMPLIANCE PERIOD- For purposes of this section, the term `noncompliance period' means, with respect to any failure to pay any premium or installment thereof, the period--

`(1) beginning on the due date for such premium or installment, and

`(2) ending on the date of payment of such premium or installment.

`(d) LIMITATIONS ON AMOUNT OF PENALTY-

`(1) IN GENERAL- No penalty shall be imposed by subsection (a) on any failure during any period for which it is established to the satisfaction of the Secretary of the Treasury that none of the persons responsible for such failure knew, or exercising reasonable diligence, would have known, that such failure existed.

`(2) CORRECTIONS- No penalty shall be imposed by subsection (a) on any failure if--

`(A) such failure was due to reasonable cause and not to willful neglect, and

`(B) such failure is corrected during the 30-day period beginning on the 1st date that any of the persons responsible for such failure knew, or exercising reasonable diligence would have known, that such failure existed.

`(3) WAIVER- In the case of a failure that is due to reasonable cause and not to willful neglect, the Secretary of the Treasury may waive all or part of the penalty imposed by subsection (a) for failures to the extent that the Secretary determines, in his sole discretion, that the payment of such penalty would be excessive relative to the failure involved.

`(e) LIABILITY FOR PENALTY- The person failing to meet the requirements of section 9704 shall be liable for the penalty imposed by subsection (a).

`(f) TREATMENT- For purposes of this title, the penalty imposed by this section shall be treated in the same manner as the tax imposed by section 4980B.

`PART IV--OTHER PROVISIONS

`SEC. 9708. EFFECT ON PENDING CLAIMS OR OBLIGATIONS.

`All liability for contributions to the Combined Fund that arises on and after February 1, 1993, shall be determined exclusively under this chapter, including all liability for contributions to the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan for coal production on and after February 1, 1993. However, nothing in this chapter is intended to have any effect on any claims or obligations arising in connection with the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan as of February 1, 1993, including claims or obligations based on the `evergreen' clause found in the language of the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan. This chapter shall not be construed to affect any rights of subrogation of any 1988 agreement operator with respect to contributions due to the 1950 UMWA Benefit Plan or the 1974 UMWA Benefit Plan as of February 1, 1993.

`Subchapter C--Health Benefits of Certain Miners

`PART I--INDIVIDUAL EMPLOYER PLANS

`SEC. 9711. CONTINUED OBLIGATIONS OF INDIVIDUAL EMPLOYER PLANS.

`(a) COVERAGE OF CURRENT RECIPIENTS- The last signatory operator of any individual who, as of February 1, 1993, is receiving retiree health benefits from an individual employer plan maintained pursuant to a 1978 or subsequent coal wage agreement shall continue to provide health benefits coverage to such individual and the individual's eligible beneficiaries which is substantially the same as (and subject to all the limitations of) the coverage provided by such plan as of January 1, 1992. Such coverage shall continue to be provided for as long as the last signatory operator (and any related person) remains in business.

`(b) COVERAGE OF ELIGIBLE RECIPIENTS-

`(1) IN GENERAL- The last signatory operator of any individual who, as of February 1, 1993, is not receiving retiree health benefits under the individual employer plan maintained by the last signatory operator pursuant to a 1978 or subsequent coal wage agreement, but has met the age and service requirements for eligibility to receive benefits under such plan as of such date, shall, at such time as such individual becomes eligible to receive benefits under such plan, provide health benefits coverage to such individual and the individual's eligible beneficiaries which is described in paragraph (2). This paragraph shall not apply to any individual who retired from the coal industry after September 30, 1994, or any eligible beneficiary of such individual.

`(2) COVERAGE- Subject to the provisions of subsection (d), health benefits coverage is described in this paragraph if it is substantially the same as (and subject to all the limitations of) the coverage provided by the individual employer plan as of January 1, 1992. Such coverage shall continue for as long as the last signatory operator (and any related person) remains in business.

`(c) JOINT AND SEVERAL LIABILITY OF RELATED PERSONS- Each related person of a last signatory operator to which subsection (a) or (b) applies shall be jointly and severally liable with the last signatory operator for the provision of health care coverage described in subsection (a) or (b).

`(d) MANAGED CARE AND COST CONTAINMENT- The last signatory operator shall not be treated as failing to meet the requirements of subsection (a) or (b) if benefits are provided to eligible beneficiaries under managed care and cost containment rules and procedures described in section 9712 (c) or agreed to by the last signatory operator and the United Mine Workers of America.

`(e) TREATMENT OF NONCOVERED EMPLOYEES- The existence, level, and duration of benefits provided to former employees of a last signatory operator (and their eligible beneficiaries) who are not otherwise covered by this chapter and who are (or were) covered by a coal wage agreement shall only be determined by, and shall be subject to, collective bargaining, lawful unilateral action, or other applicable law.

`(f) ELIGIBLE BENEFICIARY- For purposes of this section, the term `eligible beneficiary' means any individual who is eligible for health benefits under a plan described in subsection (a) or (b) by reason of the individual's relationship with the retiree described in such subsection (or to an individual who, based on service and employment history at the time of death, would have been so described but for such death).

`(g) RULES APPLICABLE TO THIS PART AND PART II- For purposes of this part and part II--

`(1) SUCCESSOR- The term `last signatory operator' shall include a successor in interest of such operator.

`(2) REASSIGNMENT UPON PURCHASE- If a person becomes a successor of a last signatory operator after the enactment date, the last signatory operator may transfer any liability of such operator under this chapter with respect to an eligible beneficiary to such successor, and such successor shall be treated as the last signatory operator with respect to such eligible beneficiary for purposes of this chapter. Notwithstanding the preceding sentence, the last signatory operator transferring such assignment (and any related person) shall remain the guarantor of the benefits provided to the eligible beneficiary under this chapter. A last signatory operator shall notify the trustees of the 1992 UMWA Benefit Plan of any transfer described in this paragraph.

`PART II--1992 UMWA BENEFIT PLAN

`Sec. 9712. Establishment and coverage of 1992 UMWA Benefit Plan.

`SEC. 9712. ESTABLISHMENT AND COVERAGE OF 1992 UMWA BENEFIT PLAN.

`(a) CREATION OF PLAN-

`(1) IN GENERAL- As soon as practicable after the enactment date, the settlors shall create a separate private plan which shall be known as the United Mine Workers of America 1992 Benefit Plan. For purposes of this title, the 1992 UMWA Benefit Plan shall be treated as an organization exempt from taxation under section 501(a). The settlors shall be responsible for designing the structure, administration and terms of the 1992 UMWA Benefit Plan, and for appointment and removal of the members of the board of trustees. The board of trustees shall initially consist of five members and shall thereafter be the number set by the settlors.

`(2) TREATMENT OF PLAN- The 1992 UMWA Benefit Plan shall be--

`(A) a plan described in section 302(c)(5) of the Labor Management Relations Act, 1947 (29 U.S.C. 186(c)(5)),

`(B) an employee welfare benefit plan within the meaning of section 3(1) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1002(1)), and

`(C) a multiemployer plan within the meaning of section 3(37) of such Act (29 U.S.C. 1002 (37)).

`(b) COVERAGE REQUIREMENT-

`(1) IN GENERAL- The 1992 UMWA Benefit Plan shall only provide health benefits coverage to any eligible beneficiary who is not eligible for benefits under the Combined Fund and shall not provide such coverage to any other individual.

`(2) ELIGIBLE BENEFICIARY- For purposes of this section, the term `eligible beneficiary' means an individual who--

`(A) but for the enactment of this chapter, would be eligible to receive benefits from the 1950 UMWA Benefit Plan or the 1974 UMWA Benefit Plan, based upon age and service earned as of February 1, 1993; or

`(B) with respect to whom coverage is required to be provided under section 9711, but who does not receive such coverage from the applicable last signatory operator or any related person,

and any individual who is eligible for benefits by reason of a relationship to an individual described in subparagraph (A) or (B). In no event shall the 1992 UMWA Benefit Plan provide health benefits coverage to any eligible beneficiary who is a coal industry retiree who retired from the coal industry after September 30, 1994, or any beneficiary of such individual.

`(c) HEALTH BENEFITS-

`(1) IN GENERAL- The 1992 UMWA Benefit Plan shall provide health care benefits coverage to

each eligible beneficiary which is substantially the same as (and subject to all the limitations of) coverage provided under the 1950 UMWA Benefit Plan and the 1974 UMWA Benefit Plan as of January 1, 1992.

`(2) MANAGED CARE- The 1992 UMWA Benefit Plan shall develop managed care and cost containment rules which shall be applicable to the payment of benefits under this subsection. Application of such rules shall not cause the plan to be treated as failing to meet the requirements of this subsection. Such rules shall preserve freedom of choice while reinforcing managed care network use by allowing a point of service decision as to whether a network medical provider will be used. Major elements of such rules may include, but are not limited to, elements described in paragraph (3).

`(3) MAJOR ELEMENTS OF RULES- Elements described in this paragraph are--

`(A) implementing formulary for drugs and subjecting the prescription program to a rigorous review of appropriate use,

`(B) obtaining a unit price discount in exchange for patient volume and preferred provider status with the amount of the potential discount varying by geographic region,

`(C) limiting benefit payments to physicians to the allowable charge under title XVIII of the Social Security Act, while protecting beneficiaries from balance billing by providers,

`(D) utilizing, in the claims payment function `appropriateness of service' protocols under title XVIII of the Social Security Act if more stringent,

`(E) creating mandatory utilization review (UR) procedures, but placing the responsibility to follow such procedures on the physician or hospital, not the beneficiaries,

`(F) selecting the most efficient physicians and state-of-the-art utilization management techniques, including ambulatory care techniques, for medical services delivered by the managed care network, and

`(G) utilizing a managed care network provider system, as practiced in the health care industry, at the time medical services are needed (point-of-service) in order to receive maximum benefits available under this subsection.

`(4) LAST SIGNATORY OPERATORS- The board of trustees of the 1992 UMWA Benefit Plan shall permit any last signatory operator required to maintain an individual employer plan under section 9711 to utilize the managed care and cost containment rules and programs developed under this subsection if the operator elects to do so.

`(5) STANDARDS OF QUALITY- Any managed care system or cost containment adopted by the board of trustees of the 1992 UMWA Benefit Plan or by a last signatory operator may not be implemented unless it is approved by, and meets the standards of quality adopted by, a medical peer review panel, which has been established--

`(A) by the settlors, or

`(B) by the United Mine Workers of America and a last signatory operator or group of

operators.

Standards of quality shall include accessibility to medical care, taking into account that accessibility requirements may differ depending on the nature of the medical need.

`(d) GUARANTEE OF BENEFITS-

`(1) IN GENERAL- All 1988 last signatory operators shall be responsible for financing the benefits described in subsection (c), in accordance with contribution requirements established in the 1992 UMWA Benefit Plan. Such contribution requirements, which shall be applied uniformly to each 1988 last signatory operator, on the basis of the number of eligible and potentially eligible beneficiaries attributable to each operator, shall include:

`(A) the payment of an annual prefunding premium for all eligible and potentially eligible beneficiaries attributable to a 1988 last signatory operator,

`(B) the payment of a monthly per beneficiary premium by each 1988 last signatory operator for each eligible beneficiary of such operator who is described in subsection (b)(2) and who is receiving benefits under the 1992 UMWA Benefit Plan, and

`(C) the provision of security (in the form of a bond, letter of credit or cash escrow) in an amount equal to a portion of the projected future cost to the 1992 UMWA Benefit Plan of providing health benefits for eligible and potentially eligible beneficiaries attributable to the 1988 last signatory operator. If a 1988 last signatory operator is unable to provide the security required, the 1992 UMWA Benefit Plan shall require the operator to pay an annual prefunding premium that is greater than the premium otherwise applicable.

`(2) ADJUSTMENTS- The 1992 UMWA Benefit Plan shall provide for--

`(A) annual adjustments of the per beneficiary premium to cover changes in the cost of providing benefits to eligible beneficiaries, and

`(B) adjustments as necessary to the annual prefunding premium to reflect changes in the cost of providing benefits to eligible beneficiaries for whom per beneficiary premiums are not paid.

`(3) ADDITIONAL LIABILITY- Any last signatory operator who is not a 1988 last signatory operator shall pay the monthly per beneficiary premium under paragraph (1)(B) for each eligible beneficiary described in such paragraph attributable to that operator.

`(4) JOINT AND SEVERAL LIABILITY- A 1988 last signatory operator or last signatory operator described in paragraph (3), and any related person to any such operator, shall be jointly and severally liable with such operator for any amount required to be paid by such operator under this section.

`(5) DEDUCTIBILITY- Any premium required by this section shall be deductible without regard to any limitation on deductibility based on the prefunding of health benefits.

`(6) 1988 LAST SIGNATORY OPERATOR- For purposes of this section, the term `1988 last signatory operator' means a last signatory operator which is a 1988 agreement operator.

`Subchapter D--Other Provisions

`Sec. 9721. Civil enforcement.

`Sec. 9722. Sham transactions.

`SEC. 9721. CIVIL ENFORCEMENT.

`The provisions of section 4301 of the Employee Retirement Income Security Act of 1974 shall apply to any claim arising out of an obligation to pay any amount required to be paid by this chapter in the same manner as any claim arising out of an obligation to pay withdrawal liability under subtitle E of title IV of such Act. For purposes of the preceding sentence, a signatory operator and related persons shall be treated in the same manner as employers.

`SEC. 9722. SHAM TRANSACTIONS.

`If a principal purpose of any transaction is to evade or avoid liability under this chapter, this chapter shall be applied (and such liability shall be imposed) without regard to such transaction.'

(b) AMENDMENTS TO SURFACE MINING ACT-

(1) EXTENSION OF FEE PROGRAM- Section 402(b) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1232(b)) is amended by striking `September 30, 1995' and inserting `September 30, 2004'.

(2) TRANSFER TO FUND- Section 402 of such Act (30 U.S.C. 1232) is amended by adding at the end the following new subsection:

`(h) TRANSFER OF FUNDS TO COMBINED FUND- (1) In the case of any fiscal year beginning on or after October 1, 1995, with respect to which fees are required to be paid under this section, the Secretary shall, as of the beginning of such fiscal year and before any allocation under subsection (g), make the transfer provided in paragraph (2).

`(2) The Secretary shall transfer from the fund to the United Mine Workers of America Combined Benefit Fund established under section 9702 of the Internal Revenue Code of 1986 for any fiscal year an amount equal to the sum of--

`(A) the amount of the interest which the Secretary estimates will be earned and paid to the Fund during the fiscal year, plus

`(B) the amount by which the amount described in subparagraph (A) is less than $70,000,000.

`(3)(A) The aggregate amount which may be transferred under paragraph (2) for any fiscal year shall not exceed the amount of expenditures which the trustees of the Combined Fund estimate will be debited against the unassigned beneficiaries premium account under section 9704(e) of the Internal Revenue Code of 1986 for the fiscal year of the Combined Fund in which the transfer is made.

`(B) The aggregate amount which may be transferred under paragraph (2)(B) for all fiscal years shall not exceed an amount equivalent to all interest earned and paid to the fund after September 30, 1992, and

before October 1, 1995.

`(4) If, for any fiscal year, the amount transferred is more or less than the amount required to be transferred, the Secretary shall appropriately adjust the amount transferred for the next fiscal year.'

(3) CONFORMING AMENDMENTS- (A) Section 401(c) of such Act (30 U.S.C. 1231(c)) is amended by striking `and' at the end of paragraph (11), by redesignating paragraph (12) as paragraph (13), and by adding after paragraph (11) the following new paragraph:

`(12) for the purpose described in section 402(h); and'.

(B) Section 402(g)(1) of such Act (30 U.S.C. 1232(g)) is amended by striking `Moneys' and inserting `Except as provided in subsection (h), moneys'.

TITLE XX--GENERAL PROVISIONS; REDUCTION OF OIL VULNERABILITY

SEC. 2001. GOALS.

It is the goal of the United States in carrying out energy supply and energy conservation research and development--

(1) to strengthen national energy security by reducing dependence on imported oil;

(2) to increase the efficiency of the economy by meeting future needs for energy services at the lowest total cost to the Nation, including environmental costs, giving comparable consideration to technologies that enhance energy supply and technologies that improve the efficiency of energy end uses;

(3) to reduce the air, water, and other environmental impacts (including emissions of greenhouse gases) of energy production, distribution, transportation, and utilization, through the development of an environmentally sustainable energy system;

(4) to maintain the technological competitiveness of the United States and stimulate economic growth through the development of advanced materials and technologies;

(5) to foster international cooperation by developing international markets for domestically produced sustainable energy technologies, and by transferring environmentally sound, advanced energy systems and technologies to developing countries to promote sustainable development;

(6) to consider the comparative environmental and public health impacts of the energy to be produced or saved by the specific activities;

(7) to consider the obstacles inherent in private industry's development of new energy technologies and steps necessary for establishing or maintaining technological leadership in the area of energy and energy efficiency resource technologies; and

(8) to consider the contribution of a given activity to fundamental scientific knowledge.

Subtitle A--Oil and Gas Supply Enhancement

SEC. 2011. ENHANCED OIL RECOVERY.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on technologies to increase the recoverability of domestic oil resources to--

(1) improve reservoir characterization;

(2) improve analysis and field verification;

(3) field test and demonstrate enhanced oil recovery processes, including advanced processes, in reservoirs the Secretary considers to be of high priority, ranked primarily on the basis of oil recovery potential and risk of abandonment;

(4) transfer proven recovery technologies to producers and operators of wells, including stripper wells, that would otherwise be likely to be abandoned in the near term due to declining production;

(5) improve enhanced oil recovery process technology for more economic and efficient oil production;

(6) identify and develop new recovery technologies;

(7) study reservoir properties and how they affect oil recovery from porous media;

(8) improve techniques for meeting environmental requirements;

(9) improve data bases of reservoir and environmental conditions; and

(10) lower lifting costs on stripper wells by utilizing advanced renewable energy technologies such as small wind turbines and others.

(b) PROGRAM GOALS-

(1) NEAR-TERM PRIORITIES- The near-term priorities of the program include preserving access to high potential reservoirs, identifying available technologies that can extend the lifetime of wells and of stripper well property, and developing environmental field operations for waste disposal and injection practices.

(2) MID-TERM PRIORITIES- The mid-term priorities of the program include developing and testing identified but unproven technologies, and transferring those technologies for widespread use.

(3) LONG-TERM PRIORITIES- The long-term priorities of the program include developing advanced techniques to recover oil not recoverable by other techniques.

(c) ACCELERATED PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a plan for carrying out under this section the accelerated field testing of technologies to achieve the priorities stated in subsection (b). In preparing the plan, the Secretary shall consult with appropriate representatives of industry, institutions of higher education, Federal agencies, including national laboratories, and professional and technical societies, and

with the Advisory Board established under section 2302.

(d) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

(e) CONSULTATION- In carrying out the provisions of this section, the Secretary shall consult representatives of the oil and gas industry with respect to innovative research and development proposals to improve oil and gas recovery and shall consider relevant technical data from industry and other research and information centers and institutes.

(f) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section, including advanced extraction and process technology, $57,250,000 for fiscal year 1993 and $70,000,000 for fiscal year 1994.

SEC. 2012. OIL SHALE.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on oil shale extraction and conversion, including research and development on both eastern and western shales, as provided in this section.

(b) PROGRAM GOALS- The goals of the program established under this section include--

(1) supporting the development of economically competitive and environmentally acceptable technologies to produce domestic supplies of liquid fuels from oil shale;

(2) increasing knowledge of environmentally acceptable oil shale waste disposal technologies and practices;

(3) increasing knowledge of the chemistry and kinetics of oil shale retorting;

(4) increasing understanding of engineering issues concerning the design and scale-up of oil shale extraction and conversion technologies;

(5) improving techniques for oil shale mining systems; and

(6) providing for cooperation with universities and other private sector entities.

(c) EASTERN OIL SHALE PROGRAM- (1) As part of the program authorized by this section, the Secretary shall carry out a program on oil shale that includes applied research, in cooperation with universities and the private sector, on eastern oil shale that may have the potential to decrease United States dependence on energy imports.

(2) As part of the program authorized by this subsection, the Secretary shall consider the potential benefits of including in that program applied research carried out in cooperation with universities and other private sector entities that are, as of the date of enactment of this Act, engaged in research on eastern oil shale retorting and associated processes.

(3) The program carried out under this subsection shall be cost-shared with universities and the private sector to the maximum extent possible.

(d) WESTERN OIL SHALE PROGRAM- As part of the program authorized by this section, the Secretary shall carry out a program on extracting oil from western oil shales that includes, if appropriate, establishment and utilization of at least one field testing center for the purpose of testing, evaluating, and developing improvements in oil shale technology at the field test level. In establishing such a center, the Secretary shall consider sites with existing oil shale mining and processing infrastructure and facilities. Sixty days prior to establishing any such field testing center, the Secretary shall submit a report to Congress on the center to be established.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $5,250,000 for fiscal year 1993 and $6,000,000 for fiscal year 1994.

SEC. 2013. NATURAL GAS SUPPLY.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, to increase the recoverable natural gas resource base including, but not limited to--

(1) more intensive recovery of natural gas from discovered conventional resources;

(2) the extraction of natural gas from tight gas sands and devonian shales or other unconventional sources;

(3) surface gasification of coal; and

(4) recovery of methane from biofuels including municipal solid waste.

(b) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

(c) COFIRING OF NATURAL GAS AND COAL-

(1) PROGRAM- The Secretary shall establish and carry out a 5-year program, in accordance with sections 3001 and 3002 of this Act, on cofiring natural gas with coal in utility and large industrial boilers in order to determine optimal natural gas injection levels for both environmental and operational benefits.

(2) FINANCIAL ASSISTANCE- The Secretary shall enter into agreements with, and provide financial assistance to, appropriate parties for application of cofiring technologies to boilers to demonstrate this technology.

(3) REPORT TO CONGRESS- The Secretary shall, before December 31, 1995, submit to the Congress a report on the progress made in carrying out this subsection.

(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section and sections 2014 and 2015, $29,745,000 for fiscal year 1993 and $45,000,000 for fiscal year 1994.

SEC. 2014. NATURAL GAS END-USE TECHNOLOGIES.

The Secretary shall carry out a 5-year program, in accordance with sections 3001 and 3002 of this Act, on new and advanced natural gas utilization technologies including, but not limited to--

(1) stationary source emissions control and efficiency improvements including combustion systems, industrial processes, cogeneration, and waste fuels; and

(2) natural gas storage including increased deliverability from existing gas storage facilities and new capabilities for storage near demand centers, and on-site storage at major energy consuming facilities.

SEC. 2015. MIDCONTINENT ENERGY RESEARCH CENTER.

(a) FINDING- Congress finds that petroleum resources in the midcontinent region of the United States are very large but are being prematurely abandoned.

(b) PURPOSES- The purposes of this section are to--

(1) improve the efficiency of petroleum recovery;

(2) increase ultimate petroleum recovery; and

(3) delay the abandonment of resources.

(c) ESTABLISHMENT- The Secretary may establish the Midcontinent Energy Research Center (referred to in this section as the `Center') to--

(1) conduct research in petroleum geology and engineering focused on improving the recovery of petroleum from existing fields and established plays in the upper midcontinent region of the United States; and

(2) ensure that the results of the research described in paragraph (1) are transferred to users.

(d) RESEARCH-

(1) IN GENERAL- In conducting research under this section, the Center shall, to the extent practicable, cooperate with agencies of the Federal Government, the States in the midcontinent region of the United States, and the affected industry.

(2) PROGRAMS- Research programs conducted by the Center may include--

(A) data base development and transfer of technology;

(B) reservoir management;

(C) reservoir characterization;

(D) advanced recovery methods; and

(E) development of new technology.

Subtitle B--Oil and Gas Demand Reduction and Substitution

SEC. 2021. GENERAL TRANSPORTATION.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on cost effective technologies to reduce the demand for oil in the transportation sector for all motor vehicles, including existing vehicles, through increased energy efficiency and the use of alternative fuels. Such program shall include a broad range of technological approaches, and shall include field demonstrations of sufficient scale and number in operating environments to prove technical and economic viability to meet the goals stated in section 2001. Such program shall include the activities required under sections 2022 through 2027, and ongoing activities of a similar nature at the Department of Energy.

(b) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a 5-year program plan to guide activities under this subtitle. In preparing the program plan, the Secretary shall consult with appropriate representatives of industry, utilities, institutions of higher education, Federal agencies, including national laboratories, and professional and technical societies.

(c) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

(d) DEFINITION- For purposes of this subtitle, the term `alternative fuels' includes natural gas, liquefied petroleum gas, hydrogen, fuels other than alcohol that are derived from biological materials, and any fuel the content of which is at least 85 percent by volume methanol, ethanol, or other alcohol.

(e) AUTHORIZATION OF APPROPRIATIONS- (1) There are authorized to be appropriated to the Secretary for carrying out this subtitle, including all transportation sector energy conservation research and development (other than activities under section 2025) and all transportation sector biofuels energy systems under solar energy, $119,144,000 for fiscal year 1993 and $160,000,000 for fiscal year 1994.

(2) There are authorized to be appropriated to the Secretary for carrying out section 2025--

(A) $60,300,000 for fiscal year 1993;

(B) $75,000,000 for fiscal year 1994;

(C) $80,000,000 for fiscal year 1995;

(D) $80,000,000 for fiscal year 1996;

(E) $90,000,000 for fiscal year 1997; and

(F) $100,000,000 for fiscal year 1998.

SEC. 2022. ADVANCED AUTOMOTIVE FUEL ECONOMY.

(a) PROGRAM DIRECTION- The Secretary shall conduct a program, in accordance with sections 3001 and 3002 of this Act, to supplement ongoing research activities of a similar nature at the Department of Energy, to accelerate the near-term and mid-term development of advanced technologies to improve the

fuel economy of light-duty passenger vehicles powered by a piston engine, and hybrid vehicles powered by a combination of piston engine and electric motor.

(b) PROGRAM GOAL- The goal of the program established under subsection (a) shall be to stimulate the development of emerging technologies with the potential to achieve significant improvements in fuel economy while reducing emissions of air pollutants.

(c) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section, making a special effort to involve small businesses in the program.

SEC. 2023. ALTERNATIVE FUEL VEHICLE PROGRAM.

(a) PROGRAM DIRECTION- The Secretary shall carry out a program, in accordance with sections 3001 and 3002 of this Act, on techniques related to improving natural gas and other alternative fuel vehicle technology, including--

(1) fuel injection;

(2) carburetion;

(3) manifolding;

(4) combustion;

(5) power optimization;

(6) efficiency;

(7) lubricants and detergents;

(8) engine durability;

(9) ignition, including fuel additives to assist ignition;

(10) multifuel engines;

(11) emissions control, including catalysts;

(12) novel gas compression concepts;

(13) advanced storage systems;

(14) advanced gaseous fueling technologies; and

(15) the incorporation of advanced materials in these areas.

(b) COOPERATIVE AGREEMENTS AND ASSISTANCE- The Secretary may enter into cooperative agreements with, and provide financial assistance to, public or private entities willing to provide 50

percent of the costs of a program to perform activities under subsection (a).

(c) DEFINITIONS- For purposes of this section--

(1) the term `alternative fuel vehicle' means a motor vehicle that operates on alternative fuels; and

(2) the term `motor vehicle' includes any automobile, truck, bus, van, or other on-road or off-road motor vehicle, including a boat.

SEC. 2024. BIOFUELS USER FACILITY.

(a) The Secretary shall establish a biofuels user facility to expedite industry adoption of biofuels technologies, including production of alcohol fuels from biomass.

(b) The Secretary, through such universities and colleges as the Secretary determines are qualified, shall establish a program, in accordance with sections 3001 and 3002 of this Act, with respect to the production and use of diesel fuels from vegetable oils or animal fats. The program shall investigate--

(1) the economic feasibility of production of oilseed crops for biofuels purposes; and

(2) the establishment of a mobile small-scale oilseed pressing and esterification unit and a stationary small-scale commercial oilseed pressing and esterification unit.

SEC. 2025. ELECTRIC MOTOR VEHICLES AND ASSOCIATED EQUIPMENT RESEARCH AND DEVELOPMENT.

(a) GENERAL- The Secretary shall conduct, pursuant to the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5901-5920), a research and development program on electric motor vehicles and associated equipment. Such program shall be conducted in cooperation with the electric utility industry, and automobile industry, battery manufacturers, and such other persons as the Secretary considers appropriate.

(b) COMPREHENSIVE PLAN- (1) The Secretary shall prepare a comprehensive 5-year program plan for carrying out the purposes of this section. Such comprehensive plan shall be updated annually for a period of not less than 10 years after the date of enactment of this Act.

(2) The comprehensive plan under paragraph (1) shall be prepared in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Transportation, the Secretary of Commerce, the heads of other appropriate Federal agencies, representatives of the electric utility industry, electric motor vehicle manufacturers, the United States automobile industry, and such other persons as the Secretary considers appropriate.

(3) The comprehensive plan shall include--

(A) a prioritization of research areas critical to the commercialization of electric motor vehicles, including advanced battery technology;

(B) the program elements, management structure, and activities, including program responsibilities, of Federal agencies;

(C) the program strategies, including technical milestones to be achieved toward specific goals during each fiscal year of the comprehensive plan for all major activities and projects;

(D) the estimated costs of individual program elements, including estimated costs for each of the fiscal years of the comprehensive plan for each of the participating Federal agencies;

(E) a description of the methods of technology transfer;

(F) a proposal for participation by non-Federal entities in the implementation of the comprehensive plan; and

(G) such other information as the Secretary considers appropriate.

(4) Not later than 180 days after the date of enactment of this Act, the Secretary shall transmit the comprehensive plan to the Congress. Annual updates shall be submitted to the Congress.

(c) COOPERATIVE AGREEMENTS- The Secretary, consistent with the comprehensive plan under subsection (b), may enter into cooperative agreements to conduct research and development projects with industry in such areas of technology development as--

(1) high efficiency electric power trains, including advanced motors, motor controllers, and hybrid power trains for electric motor vehicle range improvement;

(2) light-weight structures for electric motor vehicle weight reduction;

(3) advanced batteries with high energy density and power density, and improved range or recharging cycles for a given unit weight, for electric motor vehicle application;

(4) hybrid power trains incorporating an electric motor and recyclable battery charged by an onboard liquid fuel engine, designed to significantly improve fuel economies while maintaining acceleration characteristics comparable to a conventionally fueled vehicle;

(5) batteries and fuel cells for electric-hybrid vehicle application;

(6) fuel cells and fuel cell systems for primary electric motor vehicle power sources; and

(7) photovoltaics for use with electric motor vehicles.

(d) SOLICITATION OF PROPOSALS- (1) Within one year after the date of enactment of this Act, the Secretary shall solicit proposals for cooperative agreements for research and development under subsection (c).

(2) Thereafter, the Secretary may solicit additional proposals for cooperative agreements under subsection (c) if, in the judgment of the Secretary, such cooperative agreements could contribute to the development of electric motor vehicles and associated equipment.

(e) COST-SHARING- (1) The Secretary shall require at least 50 percent of the costs directly and specifically related to any cooperative agreement under this section, other than a cooperative agreement under subsection (j), to be from non-Federal sources. Such share may be in the form of cash, personnel, services, equipment, and other resources.

(2) The Secretary may reduce the amount of costs required to be provided by non-Federal sources under paragraph (1), if the Secretary determines that the reduction is necessary and appropriate--

(A) considering the technological risks involved in the project; and

(B) in order to meet the objectives of this section.

(f) DEPLOYMENT- (1) The Secretary shall conduct a program designed to accelerate deployment of advanced battery technologies for use with electric motor vehicles.

(2) In carrying out the program authorized by this subsection, the Secretary shall--

(A) undertake an inventory and assessment of advanced battery technologies and electric motor vehicle technologies and the commercial capability of such technologies; and

(B) develop a Federal industry information exchange program to improve the deployment or use of such technologies, which may consist of workshops, publications, conferences, and a data base for use by the public and private sectors.

(g) DOMESTIC PARTS MANUFACTURERS- In carrying out this section, the Secretary, in consultation with the Secretary of Commerce, shall issue regulations to ensure that the procurement practices of participating electric motor vehicle and associated equipment manufacturers do not discriminate against the United States manufacturers of vehicle parts.

(h) HOLD HARMLESS- Nothing in this section shall be construed to alter, affect, modify, or change any activities or agreements initiated prior to the date of enactment of this Act with domestic motor vehicle manufacturers through joint venture or consortium agreements regarding batteries for electric motor vehicles.

(i) CONSULTATION- The Secretary shall consult with the Administrator of the Environmental Protection Agency and the Secretary of Transportation in carrying out this section.

(j) FUEL CELLS FOR TRANSPORTATION- (1) The Secretary shall develop and implement a comprehensive program of research, development, and demonstration of fuel cells and related systems for transportation applications through the establishment of one or more cooperative programs among industry, government, and research institutions to develop and demonstrate the use of fuel cells as the primary power source for private and mass transit vehicles and other mobile applications.

(2) Research, development, and demonstration activities under this subsection shall be designed to incorporate one or more of the following priorities:

(A) The potential for near-term to mid-term commercialization.

(B) The ability of the systems to use a variety of renewable and nonfossil fuels.

(C) Emission reduction and energy conservation potential.

(D) The potential to utilize fuel cells and fuel cell systems developed under Department of Defense and National Aeronautics and Space Administration programs.

(E) The potential to take maximum practical advantage of advances made in electric motor vehicle research, stationary source fuel cell research, and other research activities authorized by this title.

(3)(A) Research, development, and demonstration projects selected by the Secretary under this subsection shall apply to--

(i) passenger vehicles;

(ii) vans and utility vehicles;

(iii) light rail systems and locomotives;

(iv) trucks, including long-haul trucks, dump trucks, and garbage trucks;

(v) passenger buses;

(vi) non-chlorofluorocarbon mobile refrigeration systems;

(vii) marine vessels, including recreational marine engines; or

(viii) mobile engines and power generation, including recreational generators, and industrial and construction equipment.

(B) The Secretary shall establish programs to undertake research, development, and demonstration activities for the applications listed in clauses (i) through (viii) of subparagraph (A) in each of fiscal years 1993, 1994, 1995, and 1996, based on the priorities established in paragraph (2), so that by the end of the period, research, development, and demonstration activities are under way for the applications under each such clause. The initiatives authorized and implemented pursuant to this subsection shall be in addition to any other fuel cell programs authorized in existing law.

(k) DEFINITIONS- For purposes of this section--

(1) the term `advanced battery technology' means electrochemical storage devices and systems, including fuel cells, and associated technology necessary to charge, discharge, recharge, or regenerate such devices, for use as a source of power for an electric motor vehicle and any other associated equipment;

(2) the term `associated equipment' means equipment necessary for the regeneration, refueling, or recharging of batteries or other forms of electric energy used to power an electric motor vehicle and, in the case of electric-hybrid vehicles, such term includes nonpetroleum-related equipment necessary for, and solely related to, the demonstration of such vehicles;

(3) the term `electric motor vehicle' means a motor vehicle primarily powered by an electric motor that draws current from rechargeable storage batteries, fuel cells, photovoltaic arrays, or other sources of electric current and may include an electric-hybrid vehicle; and

(4) the term `electric-hybrid vehicle' means vehicle primarily powered by an electric motor that draws current from rechargeable storage batteries, fuel cells, or other sources of electric current and also relies on a nonelectric source of power that also operates on or is capable of operating on a nonelectrical source of power.

SEC. 2026. RENEWABLE HYDROGEN ENERGY.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on renewable hydrogen energy systems. Such program shall be conducted in accordance with the Spark M. Matsunaga Hydrogen Research, Development, and Demonstration Act of 1990 (Public Law 101-566), to supplement ongoing activities of a similar nature at the Department of Energy, including--

(1) at least one program to generate hydrogen from renewable energy sources;

(2) at least one program to assess the feasibility of existing natural gas pipelines carrying hydrogen gas, including experimentation if needed, with a goal of determining those components of the natural gas distribution system that would have to be modified to carry--

(A) more than 20 percent hydrogen mixed with natural gas; and

(B) pure hydrogen gas;

(3) at least one program to develop a hydrogen storage system suitable for electric motor vehicles powered by fuel cells, with emphasis on--

(A) improved metal hydride hydrogen storage;

(B) activated carbon-based hydrogen storage;

(C) high pressure compressed hydrogen; or

(D) other novel hydrogen storage techniques;

(4) at least one program to develop a fuel cell suitable to power an electric motor vehicle; and

(5) such other programs as the Secretary considers necessary to carry out this section.

(b) PROPOSALS- Within 180 days after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

SEC. 2027. ADVANCED DIESEL EMISSIONS PROGRAM.

(a) PROGRAM DIRECTION- The Secretary shall initiate a 5-year program, in accordance with sections 3001 and 3002 of this Act, on diesel engine combustion and engine systems, related advanced materials, and fuels and lubricants to reduce emissions oxides of nitrogen and particulates. Activities conducted under this program shall supplement activities of a similar nature at the Department of Energy. Such program shall include field demonstrations of sufficient scale and number in operating environments to prove technical and economic viability to meet the goal stated in subsection (b).

(b) PROGRAM GOAL- The goal of the program established under subsection (a) shall be to accelerate the ability of United States diesel manufacturers to meet current and future oxides of nitrogen and particulate emissions requirements.

(c) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary, in consultation with appropriate representatives of industry, institutions of higher education, Federal agencies, including national laboratories, and professional and technical societies, shall prepare and submit to the Congress a 5-year program plan to guide the activities under this section. Such plan shall be included as part of the plan required by section 2021(b).

(d) SOLICITATION OF PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities consistent with the 5-year program plan.

SEC. 2028. TELECOMMUTING STUDY.

(a) STUDY- The Secretary, in consultation with the Secretary of Transportation, shall conduct a study of the potential costs and benefits to the energy and transportation sectors of telecommuting. The study shall include--

(1) an estimation of the amount and type of reduction of commuting by form of transportation type and numbers of commuters;

(2) an estimation of the potential number of lives saved;

(3) an estimation of the reduction in environmental pollution, in consultation with the Environmental Protection Agency;

(4) an estimation of the amount and type of reduction of energy use and savings by form of transportation type; and

(5) an estimation of the social impact of widespread use of telecommuting.

(b) This study shall be completed no more than one hundred and eighty days after the date of enactment of this Act. A report, summarizing the results of the study, shall be transmitted to the United States House of Representatives and the Committee on Energy and Natural Resources of the United States Senate no more than sixty days after completion of this study.

TITLE XXI--ENERGY AND ENVIRONMENT

Subtitle A--Improved Energy Efficiency

SEC. 2101. GENERAL IMPROVED ENERGY EFFICIENCY.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on cost effective technologies to improve energy efficiency and increase the use of renewable energy in the buildings, industrial, and utility sectors. Such program shall include a broad range of technological approaches, and shall include field demonstrations of sufficient scale and number to prove technical and economic viability to meet the goals stated in section 2001. Such program shall include the activities required under sections 2102, 2103, 2104, 2105, 2106, 2107, and 2108 and ongoing activities of a similar nature at the Department of Energy. Such program shall also include the activities conducted pursuant to the Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988 (Public Law 100-680) and the Department of Energy Metal Casting Competitiveness Research Act of 1990 (Public Law 101-425).

(b) PROGRAM GOALS- The goals of the program established under subsection (a) shall include--

(1) in the buildings sector--

(A) to accelerate the development of technologies that will increase energy efficiency;

(B) to increase the use of renewable energy; and

(C) to reduce environmental impacts;

(2) in the industrial sector--

(A) to accelerate the development of technologies that will increase energy efficiency in order to improve productivity;

(B) to increase the use of renewable energy; and

(C) to reduce environmental impacts; and

(3) in the utility sector--

(A) to accelerate the development of technologies that will increase energy efficiency; and

(B) to increase the use of integrated resource planning.

(c) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a 5-year program plan to guide activities under this subtitle. In preparing the program plan, the Secretary shall consult with appropriate representatives of industry, utilities, institutions of higher education, Federal agencies, including national laboratories, and professional and technical societies.

(d) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this subtitle, including all building, industry, and utility sectors energy conservation research and development, and inventions and innovation under energy conservation technical and financial assistance, $178,250,000 for fiscal year 1993 and $275,000,000 for fiscal year 1994.

SEC. 2102. NATURAL GAS AND ELECTRIC HEATING AND COOLING TECHNOLOGIES.

(a) PROGRAM DIRECTION- (1) The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on energy efficient natural gas and electric heating and cooling technologies for residential and commercial buildings.

(2) The natural gas heating and cooling program shall include activities on--

(A) thermally activated heat pumps, including absorption heat pumps and engine-driven heat pumps; and

(B) other advanced natural gas technologies, including fuel cells for residential and commercial applications.

(3) The electric heating and cooling program shall focus on--

(A) advanced heat pumps;

(B) thermal storage; and

(C) advanced electric HVAC (heating, ventilating, and air conditioning) and refrigeration systems that utilize replacements for chlorofluorocarbons.

(b) PROPOSALS- Within 180 days after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

SEC. 2103. PULP AND PAPER.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on advanced pulp and paper technologies. Such program shall include activities on energy generation technologies, boilers, combustion processes, pulping processes (excluding de-inking), chemical recovery, causticizing, source reduction processes, and other related technologies that can improve the energy efficiency of, and reduce the adverse environmental impacts of, pulp and papermaking operations. This section does not authorize projects involving the combustion of waste paper, other than gasification.

(b) PROPOSALS- Within 180 days after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

SEC. 2104. ADVANCED BUILDINGS FOR 2005.

(a) PROGRAM DIRECTION- The Secretary shall initiate a 5-year program, in accordance with sections 3001 and 3002 of this Act, to increase building energy efficiency, while maintaining affordability, by the year 2005. Such program shall include activities on--

(1) building design, design methods, and construction techniques;

(2) building materials, including recycled materials, and components;

(3) on-site energy supply conversion systems such as photovoltaics;

(4) automated energy management systems;

(5) methods of evaluating performance; and

(6) insulation products manufactured with nonozone depleting materials.

(b) PROPOSALS-

(1) SOLICITATION- Within 1 year after the date of enactment of this Act, the Secretary shall

solicit proposals for conducting activities under this section.

(2) CONTENTS OF PROPOSALS- Proposals submitted under this subsection shall include and be judged upon--

(A) evidence of knowledge of current building practices in the United States and in other countries;

(B) an explanation of how the proposal will encourage the commercialization of the technologies resulting from activities in subsection (a);

(C) evidence of consideration of collaboration with Department of Energy national laboratories;

(D) evidence of collaboration with relevant industry or other groups or organizations; and

(E) a demonstration of the ability of the proposers to undertake and complete the project proposed.

SEC. 2105. ELECTRIC DRIVES.

(a) PROGRAM- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, to increase the efficiency of electric drive technologies, including adjustable speed drives, high speed motors, and high efficiency motors.

(b) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for projects under this section.

SEC. 2106. STEEL, ALUMINUM, AND METAL RESEARCH.

(a) STEEL AMENDMENTS- The Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988 is amended--

(1) in section 4(b)(5), by striking `Industrial Programs' and inserting in lieu thereof `Industrial Technologies';

(2) in section 8, by inserting at the end the following new sentence: `The reports submitted at the close of fiscal years 1993, 1995, and 1997 shall also contain a complete summary of activities under the management plan and the research plan from the first year of their operation, along with an analysis of the extent to which they have succeeded in accomplishing the purposes of this Act.';

(3) in section 9(a)(1), by striking `and $25,000,000 for fiscal year 1991' and inserting in lieu thereof `$25,000,000 for fiscal year 1991, $17,968,000 for fiscal year 1992, and $18,091,000 for each of the fiscal years 1993 through 1997, to be derived from sums authorized under section 2101 (e) of the Energy Policy Act of 1992';

(4) in section 9(b), by striking `and 1991' and inserting in lieu thereof `1991, 1992, 1993, 1994, 1995, 1996, and 1997, to be derived from sums otherwise authorized to be appropriated to the Institute'; and

(5) in section 11(a), by striking `or fiscal year 1991' both places it appears and inserting in lieu thereof `fiscal year 1991, fiscal year 1992, fiscal year 1993, fiscal year 1994, fiscal year 1995, fiscal year 1996, and fiscal year 1997'.

(b) METAL CASTING AMENDMENT- Section 8 of the Department of Energy Metal Casting Competitiveness Research Act of 1990 (Public Law 101-425) is amended by striking `and 1993' and inserting in lieu thereof `1993, 1994, 1995, 1996, and 1997, to be derived from such sums as are otherwise authorized under section 2101(e) of the Energy Policy Act of 1992'.

SEC. 2107. IMPROVING EFFICIENCY IN ENERGY-INTENSIVE INDUSTRIES.

(a) SECRETARIAL ACTION- The Secretary, in accordance with sections 3001 and 3002 of this Act, shall--

(1) pursue a research, development, demonstration and commercial application program intended to improve energy efficiency and productivity in energy-intensive industries and industrial processes; and

(2) undertake joint ventures to encourage the commercialization of technologies developed under paragraph (1).

(b) JOINT VENTURES- (1) The Secretary shall--

(A) conduct a competitive solicitation for proposals from private firms and investors for such joint ventures under subsection (a)(2); and

(B) provide financial assistance to at least five such joint ventures.

(2) The purpose of the joint ventures shall be to design, test, and demonstrate changes to industrial processes that will result in improved energy efficiency and productivity. The joint ventures may also demonstrate other improvements of benefit to such industries so long as demonstration of energy efficiency improvements is the principal objective of the joint venture.

(3) In evaluating proposals for financial assistance and joint ventures under this section, the Secretary shall consider--

(A) whether the activities conducted under this section improve the quality and energy efficiency of industries or industrial processes;

(B) the regional distribution of the energy-intensive industries and industrial processes; and

(C) whether the proposed joint venture project would be located in the region which has the energy-intensive industry and industrial processes that would benefit from the project.

SEC. 2108. ENERGY EFFICIENT ENVIRONMENTAL PROGRAM.

(a) PROGRAM DIRECTION- The Secretary, in consultation with the Administrator of the Environmental Protection Agency, is authorized to continue to carry out a 5-year program to improve the energy efficiency and cost effectiveness of pollution prevention technologies and processes, including source reduction and waste minimization technologies and processes. The purposes of this section shall

be to--

(1) apply a systems approach to minimizing adverse environmental effects of industrial production in the most cost effective and energy efficient manner; and

(2) incorporate consideration of the entire materials and energy cycle with the goal of minimizing adverse environmental impacts.

(b) IDENTIFICATION OF OPPORTUNITIES- Within 9 months after the date of enactment of this Act, the Secretary, in consultation with the Administrator of the Environmental Protection Agency, shall identify opportunities for the demonstration of energy efficient pollution prevention technologies and processes.

(c) REPORT- Within 1 year after the date of enactment of this Act, the Secretary shall submit a report to Congress evaluating the opportunities identified under subsection (b). Such report shall include--

(1) an assessment of the technologies available to increase productivity and simultaneously reduce the consumption of energy and material resources and the production of wastes;

(2) an assessment of the current use of such technologies by industry in the United States;

(3) the status of any such technologies currently being developed, together with projected schedules of their commercial availability;

(4) the energy savings resulting from the use of such technologies;

(5) the environmental benefits of such technologies;

(6) the costs of such technologies;

(7) an evaluation of any existing Federal or State regulatory disincentives for the employment of such technologies; and

(8) an evaluation of any other barriers to the use of such technologies.

In preparing the report required by this subsection, the Secretary shall consult with the Administrator of the Environmental Protection Agency, any other Federal, State, or local official the Secretary considers necessary, representatives of appropriate industries, members of organizations formed to further the goals of environmental protection or energy efficiency, and other appropriate interested members of the public, as determined by the Secretary.

(d) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary, in consultation with the Administrator of the Environmental Protection Agency, shall solicit proposals for activities under this section. Proposals selected under this subsection shall demonstrate--

(1) technical viability and cost effectiveness; and

(2) procedures for technology transfer and information outreach during and after completion of the project.

Subtitle B--Electricity Generation and Use

SEC. 2111. RENEWABLE ENERGY.

(a) PROGRAM DIRECTION- The Secretary shall conduct a comprehensive 5-year program, in accordance with sections 3001 and 3002 of this Act, to provide cost-effective options for the generation of electricity from renewable energy sources for grid and nongrid application, including field demonstrations of sufficient scale and number in operating environments to prove technical and economic feasibility for providing cost effective generation and for meeting the goal stated in section 2001(3) and section 1602(a)(4).

(b) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a 5-year program plan to guide the activities under this section. In preparing the program plan, the Secretary shall consult with appropriate representatives of industry, institutions of higher education, Federal agencies, including national laboratories, and professional and technical societies.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section, including all solar energy programs (other than activities under section 2021), geothermal systems, electric energy systems, and energy storage systems, $208,975,000 for fiscal year 1993 and $275,000,000 for fiscal year 1994.

SEC. 2112. HIGH EFFICIENCY HEAT ENGINES.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, to improve the efficiency of heat engines. Such program shall--

(1) include field demonstrations of sufficient scale and number so as to demonstrate technical and economic feasibility;

(2) incorporate materials that increase engine efficiency; and

(3) cover advanced engine designs for electric and industrial power generation for a range of small-, mid-, and large-scale applications, including--

(A) mechanically recuperated gas turbines;

(B) intercooled gas turbines with steam injection or recuperation;

(C) gas turbines utilizing reformed fuels or hydrogen; and

(D) high efficiency, simple cycle gas turbines.

(b) PROGRAM GOAL- The goal of the program established under subsection (a) shall be to develop heat engines that can achieve over 50 percent efficiency in the mid-term.

(c) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a 5-year program plan, to be included in the plan required under section 2101(c), to guide the activities under this section. In preparing the program plan, the Secretary shall consult with appropriate representatives of industry, institutions of higher education, Federal

agencies, including the Environmental Protection Agency and national laboratories, and professional and technical societies.

(d) PROPOSALS- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities under this section.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section such sums as may be necessary to be derived from sums authorized under section 2101(e).

SEC. 2113. CIVILIAN NUCLEAR WASTE.

(a) STUDY- The Secretary shall conduct a study of the potential for minimizing the volume and toxic lifetime of nuclear waste, including an analysis of the viability of existing technologies and an assessment of the extent of research and development required for new technologies.

(b) PROGRAM- Based on the results of the study required under subsection (a), the Secretary shall prepare and submit to Congress a 5-year program plan for carrying out a program of research and development on new technologies for minimizing the volume and toxic lifetime of, and thereby mitigating hazards associated with, nuclear waste.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $4,700,000 for fiscal year 1993 and such sums as may be necessary for fiscal year 1994.

SEC. 2114. FUSION ENERGY.

(a) PROGRAM- The Secretary shall conduct a fusion energy 5-year program, in accordance with sections 3001 and 3002 of this Act, that by the year 2010 will result in a technology demonstration which verifies the practicability of commercial electric power production.

(b) PROGRAM GOALS- The goals of the program established under subsection (a) shall include--

(1) a broad based fusion energy program;

(2) United States participation in the Engineering Design Activity of the International Thermonuclear Experimental Reactor (ITER) program and in the related research and technology development efforts;

(3) the development of technology for fusion power and industrial participation in the development of such technology;

(4) the design and construction of a major new machine for fusion research and technology development consistent with paragraphs (2) and (3); and

(5) research and development for Inertial Confinement Fusion Energy and development of a Heavy Ion Inertial Confinement Fusion experiment.

(c) MANAGEMENT PLAN- (1) Within 180 days after the date of enactment of this Act, the Secretary shall prepare a comprehensive management plan for the fusion energy program. The plan shall include

specific program objectives, milestones and schedules for technology development, and cost estimates and program management resource requirements.

(2) The plan shall also include a description of--

(A) United States participation in the Engineering Design Activity of ITER, including industrial participation;

(B) potential United States participation in the construction and operation of an ITER facility; and

(C) the requirements needed to build and test an inertial fusion energy reactor for the purpose of power production.

(3) As part of the plan required under paragraph (1), the Secretary shall evaluate the status of international fusion programs and evaluate whether the Federal Government should initiate efforts to strengthen existing international cooperative agreements in fusion energy or enter into new cooperative agreements to accomplish the purposes of this section.

(4) The plan shall also evaluate the extent to which university or private sector participation is appropriate or necessary in order to carry out the purposes of this section.

(5) Within 1 year after the date of enactment of this Act, and every 2 years thereafter, the Secretary shall issue a report describing the progress made in meeting the program objectives, milestones, and schedules established in the management plan. Each such report shall also describe the organization of the program, the personnel assigned and funds committed to the program, and expenditures made in carrying out the program objectives. The report shall be submitted with the plan required under section 2304.

(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $339,710,000 for fiscal year 1993 and $380,000,000 for fiscal year 1994.

SEC. 2115. FUEL CELLS.

(a) PROGRAM DIRECTION- The Secretary shall conduct a 5-year program, in accordance with sections 3001 and 3002 of this Act, on efficient and environmentally benign power generation using fuel cells. The program may include activities on molten carbonate, solid oxide, including tubular, monolithic, and planar technologies, and advanced concepts.

(b) PROGRAM GOAL- The goal of the program established under subsection (a) is the development of cost-effective, efficient, and environmentally benign fuel cell systems which will operate on fossil fuels in multiple end use sectors.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $51,555,000 for fiscal year 1993 and $56,000,000 for fiscal year 1994.

SEC. 2116. ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT PROGRAM.

(a) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for fiscal year 1993 $70,000,000 for the Fast Flux Test Facility to maintain the operational

status of the reactor, such sums to be derived from amounts appropriated to the Secretary for the environmental restoration and waste management program.

(b) LONG-TERM MISSIONS- The Secretary shall aggressively pursue the development and implementation of long-term missions for the Fast Flux Test Facility. Within 6 months after the date of enactment of this Act, the Secretary shall submit to the Congress a report on the progress made in carrying out this subsection.

SEC. 2117. HIGH-TEMPERATURE SUPERCONDUCTIVITY PROGRAM.

(a) PROGRAM- The Secretary shall carry out a 5-year program, in accordance with sections 3001 and 3002 of this Act, on high-temperature superconducting electric power equipment technologies. Elements of the program shall include, but are not limited to--

(1) activities that address the development of high-temperature superconducting materials that have increased electrical current capacity, which shall be the emphasis of the program for the near-term;

(2) the development of prototypes, where appropriate, of the major elements of a superconducting electric power system such as motors, generators, transmission lines, transformers, and magnetic energy storage systems;

(3) activities that will improve the efficiency of materials performance of higher temperatures and at all magnetic field orientations;

(4) development of prototypes based on high-temperature superconducting wire, that operate at the highest temperature possible, and refrigeration systems using cryogenics such as nitrogen;

(5) activities that will assist the private sector with designs for more efficient electric power generation and delivery systems which are cost competitive with conventional energy systems; and

(6) development of prototypes that have application in both the commercial and defense sectors.

The Secretary is also encouraged to expedite government, laboratory, industry, and university collaborative agreements under existing mechanisms at the Department of Energy in coordination with other Federal agencies.

(b) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section $21,900,000 for fiscal year 1993 and such sums as may be necessary for subsequent fiscal years, to be derived from sums authorized under section 2111(c).

SEC. 2118. ELECTRIC AND MAGNETIC FIELDS RESEARCH AND PUBLIC INFORMATION DISSEMINATION PROGRAM.

(a) PROGRAM- The Secretary shall, in accordance with this section (including the agenda developed under subsection (d)(1)(A)) and within 2 months after the date of the enactment of this Act, establish a comprehensive program to--

(1) determine whether or not exposure to electric and magnetic fields produced by the generation, transmission, and use of electric energy affects human health;

(2) carry out research, development, and demonstration with respect to technologies to mitigate any adverse human health effects; and

(3) provide for dissemination of information described in subsection (b)(1) to the public.

(b) CONTENTS- The program shall provide for--

(1) collection, compilation, publication, and dissemination of scientifically valid information on--

(A) possible human health effects of electric and magnetic fields;

(B) the types and extent of human exposure to electric and magnetic fields in various occupational and residential settings;

(C) technologies to measure and characterize electric and magnetic fields; and

(D) methods to assess and manage exposure to electric and magnetic fields;

(2)(A) research on mechanisms by which electric and magnetic fields interact with biological systems; and

(B) epidemiological research on the possible human health effects of electric and magnetic fields; and

(3) research, development, and demonstration with respect to--

(A) technologies to improve the measurement and characterization of electric and magnetic fields; and

(B) techniques to assess and manage exposure to electric and magnetic fields.

(c) ROLE OF THE DIRECTOR-

(1) ROLE OF THE DIRECTOR- The Secretary of Health and Human Services, acting through the Director, shall have sole responsibility under the program for research on possible human health effects of electric and magnetic fields. The Director may delegate this responsibility to the extent the Director determines appropriate.

(2) AGREEMENT- Within 6 months after the date of the enactment of this Act, the Secretary shall enter into an agreement with the Secretary of Health and Human Services to carry out, through the Director, the information activities under subsection (b)(1)(A) and the research under subsection (b)(2).

(3) ACTIONS OF THE DIRECTOR- The actions of the Director in carrying out research and information responsibilities under this section shall not be subject to approval by the Secretary.

(4) TRANSFER OF FUNDS- The Secretary is authorized, subject to appropriations Acts, to transfer funds to the Director to carry out the Director's responsibilities under paragraph (2).

(5) REPORT- The Director shall report, by June 1, 1995, and by March 31, 1997, and as

appropriate, to the Interagency Committee established under subsection (d) and to Congress the findings and conclusions of the Director on the extent to which exposure to electric and magnetic fields produced by the generation, transmission, or use of electric energy affects human health.

(d) INTERAGENCY COMMITTEE-

(1) The President shall, within 2 months after the date of the enactment of this Act, establish the Electric and Magnetic Fields Interagency Committee to--

(A) develop within 8 months after the date of the enactment of this Act a comprehensive agenda for conducting research, development, and demonstration under the program, with particular emphasis on electric and magnetic fields of the 60 hertz frequency;

(B) develop recommendations, within 8 months after the date of the enactment of this Act, for guidelines for the coordination of activities of Federal agencies engaged in research on human health effects of electric and magnetic fields that ensure that such research advances the agenda under subparagraph (A) and is not unnecessarily duplicative of other research activities;

(C) develop recommendations, within 8 months after the date of the enactment of this Act, for mechanisms for communication of the results of the program to the public, including recommendations on the scope and nature of the information to be disseminated; and

(D) monitor, review and periodically evaluate the program.

(2)(A) The Interagency Committee shall be composed of 9 members with 1 member to be appointed from each of the following:

(i) The Department of Energy.

(ii) The National Institute of Environmental Health Sciences.

(iii) The Environmental Protection Agency.

(iv) The Department of Defense.

(v) The Occupational Safety and Health Administration.

(vi) The National Institute of Standards and Technology.

(vii) The Department of Transportation.

(viii) The Rural Electrification Administration.

(ix) The Federal Energy Regulatory Commission.

(B) The Interagency Committee shall elect a chairperson from among its members who shall be responsible for ensuring that the duties of the Interagency Committee are carried out.

(C) Agencies that have members on the Interagency Committee shall provide appropriate staff to

carry out the duties of the Interagency Committee.

(e) ADVISORY COMMITTEE-

(1) Not later than 2 months after the date of the enactment of this Act, the Secretary of Health and Human Services and the Secretary shall establish the National Electric and Magnetic Fields Advisory Committee in accordance with the Federal Advisory Committee Act and this section.

(2) The Advisory Committee shall make recommendations to the Interagency Committee with respect to the duties of the Interagency Committee under subsection (d)(1) and advise the Secretary and the Director with respect to the design and implementation of the program, including preparation of solicitations for proposals to conduct research under the program.

(3) The Advisory Committee shall be composed of 10 members, chosen from among experts in possible human health effects of electric and magnetic fields, experts in the measurement and characterization of electric and magnetic fields, experts in the assessment and management of electric and magnetic fields, State regulatory agencies, State health agencies, electric utilities, electric equipment manufacturers, labor unions and the public. Five members shall be chosen by the Secretary of Health and Human Services in consultation with the Director, and 5 members shall be chosen by the Secretary.

(4) The Advisory Committee shall elect a chairperson from among its members who shall be responsible for ensuring that the duties of the Advisory Committee are carried out.

(5) The Advisory Committee shall terminate not later than December 31, 1997.

(f) FINANCIAL ASSISTANCE-

(1) The Secretary and the Director may provide financial assistance and enter into contracts to conduct activities under the program.

(2) The Secretary shall solicit contributions from non-Federal sources to offset at least 50 percent of the total funding for all activities under the program. The Secretary shall adopt procedures, including a mechanism for collecting contributions, that ensures that no contributor of non-Federal funds may influence the program.

(3) The Secretary may not obligate funds under this section in any fiscal year unless funds received from non-Federal sources under paragraph (2) are available to offset at least 50 percent of the appropriations made under subsection (j) for such fiscal year.

(4) SOLICITATION AND SELECTION OF PROPOSALS-

(A) IN GENERAL- Within 15 months after the date of the enactment of this Act, and as often thereafter as appropriate, the Secretary and the Director shall, in consultation with the Interagency Committee, solicit and select proposals to conduct activities under the program.

(B) CONSULTATION WITH ADVISORY COMMITTEE- In preparing solicitations for proposals to conduct activities, the Secretary and the Director shall consult with the Advisory Committee.

(C) PEER REVIEW PANELS- Before a proposal to conduct activities under the program may be selected by the Secretary or the Director, such proposal must be submitted to, and evaluated by, at least one scientific and technical peer review panel.

(g) REPORTS-

(1) REPORT UPON COMPLETION OF ACTIVITY- Any person who conducts activities under the program shall, upon completion of the activity, submit to the National Academy of Sciences, the Interagency Committee, and the Advisory Committee a report summarizing the activities and results thereof.

(2) REPORT TO INTERAGENCY COMMITTEE AND ADVISORY COMMITTEE- The Secretary shall enter into appropriate arrangements with the National Academy of Sciences under which the Academy shall periodically submit to the Interagency Committee and the Advisory Committee a report that evaluates the research activities under the program. The report shall include recommendations to promote the effective transfer of information derived from such research projects, including the transfer to representatives of State regulatory agencies, State health agencies, electric utilities, electrical equipment manufacturers, labor unions, and the public. The Secretary shall be responsible for expenses incurred by the Academy in connection with the preparation of such reports.

(3) REPORT TO CONGRESS- The Interagency Committee, in consultation with the Advisory Committee, shall submit to the Secretary and the Congress--

(A) not later than December 31, 1995, a report summarizing the progress of the research program established under this subsection; and

(B) not later than September 30, 1997, a final report stating the Committee's findings and conclusions on the effects, if any, of electric and magnetic fields on human health and remedial actions, if any, that may be needed to minimize any such health effects.

(h) CONFLICTS OF INTEREST- The Secretary and the Director shall include conflict of interest provisions in any grant or other funding provided, or contract entered into, under the research program established under this section including provisions--

(1) that require any person conducting a project under such program to disclose any other source of funding received by the person to conduct other related projects, including funding received from consulting on issues relating to electric and magnetic fields; and

(2) that prohibit a person who has been awarded a grant or contract under this program from receiving compensation beyond expenses for testifying in a court of law as an expert on the specific research the person is conducting under such grant or contract.

(i) DEFINITIONS- For purposes of this section:

(1) The term `Advisory Committee' means the National Electric and Magnetic Fields Advisory Committee established under subsection (e).

(2) The term `Interagency Committee' means the Electric and Magnetic Fields Interagency Committee established under subsection (d).

(3) The term `Director' means the Director of the National Institute of Environmental Health Sciences.

(4) The term `program' means the electric and magnetic fields research and public information dissemination program established in subsection (a).

(5) The term `State' means each of the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, Guam, the Virgin Islands, American Samoa, the Trust Territory of the Pacific Islands, and any other commonwealth, territory, or possession of the United States.

(j) AUTHORIZATION OF APPROPRIATIONS-

(1) GENERAL AUTHORIZATION- There are authorized to be appropriated to the Secretary a total of $65,000,000 for the period encompassing fiscal years 1993 through 1997 to carry out the provisions of this section, except that not more than $1,000,000 may be expended in any such fiscal year for activities under subsection (b)(1). Any amounts appropriated pursuant to this paragraph shall remain available until expended.

(2) RESTRICTIONS ON USE OF FUNDS-

(A) ADMINISTRATIVE EXPENSES OF CERTAIN FUNDING RECIPIENTS- Of the total funds provided to any institution under this section, the amount of such funds that may be used for the administrative indirect costs of the institution may not exceed 26 percent of the modified direct costs of the project.

(B) ADMINISTRATIVE EXPENSES OF THE SECRETARY AND THE DIRECTOR- Of the total amount of funds made available under this section for any fiscal year, not more than 10 percent of such funds may be used for authorized administrative expenses of the Secretary and the Director in carrying out this section.

(C) CONSTRUCTION AND REHABILITATION OF FACILITIES AND EQUIPMENT- Funds made available under this section may not be used for the construction or rehabilitation of facilities or fixed equipment.

(k) SENSE OF CONGRESS- It is the sense of the Congress that remedial action taken by the Government on electric and magnetic fields, if and as necessary, should be based on, and consistent with, scientifically valid research such as the results and findings of the research authorized by this Act.

(l) SUNSET PROVISION- All authority under this section shall expire on December 31, 1997.

SEC. 2119. SPARK M. MATSUNAGA RENEWABLE ENERGY AND OCEAN TECHNOLOGY CENTER.

(a) FINDINGS- The Congress finds that--

(1) the late Spark M. Matsunaga, United States Senator from Hawaii, was a longstanding champion of research and development of renewable energy, particularly wind and ocean energy, photovoltaics, and hydrogen fuels;

(2) it was Senator Matsunaga's vision that renewable energy could provide a sustained source of

non-polluting energy and that such forms of alternative energy might ultimately be employed in the production of liquid hydrogen as a transportation fuel and energy storage medium available as an energy export;

(3) Senator Matsunaga also believed that research on other aspects of renewable energy and ocean resources, such as advanced materials, could be crucial to full development of energy storage and conversion systems; and

(4) Keahole Point, Hawaii is particularly well-suited as a site to conduct renewable energy and associated marine research.

(b) PURPOSE- It is the purpose of this section to establish the facilities and equipment located at Keahole Point, Hawaii as a cooperative research and development facility, to be known as the Spark M. Matsunaga Renewable Energy and Ocean Technology Center.

(c) ESTABLISHMENT- The facilities and equipment located at Keahole Point, Hawaii are established as the Spark M. Matsunaga Renewable Energy and Ocean Technology Center (in this section referred to as the `Center').

(d) ADMINISTRATION- (1) Not later than 180 days after the date of enactment of this Act, the Secretary may authorize a cooperative agreement with a qualified research institution to administer the Center.

(2) For the purpose of paragraph (1), a qualified research institution is a research institution located in the State of Hawaii that has demonstrated competence and will be the lead organization in the State in renewable energy and ocean technologies.

(e) ACTIVITIES- The Center may carry out research, development, educational, and technology transfer activities on--

(1) renewable energy;

(2) energy storage, including the production of hydrogen from renewable energy;

(3) materials applications related to energy and marine environments;

(4) other environmental and ocean research concepts, including sea ranching and global climate change; and

(5) such other matters as the Secretary may direct.

(f) MATCHING FUNDS- To be eligible for Federal funds under this section, the Center must provide funding in cash or in kind from non-Federal sources for each amount provided by the Secretary.

(g) AUTHORIZATION- There is authorized to be appropriated to the Secretary for carrying out this section such sums as may be necessary, to be derived from sums authorized under section 2111(c).

Subtitle C--Advanced Nuclear Reactors

SEC. 2121. PURPOSES AND DEFINITIONS.

(a) PURPOSES- The purposes of this subtitle are--

(1) to require the Secretary to carry out civilian nuclear programs in a way that will lead toward the commercial availability of advanced nuclear reactor technologies; and

(2) to authorize such activities to further the timely availability of advanced nuclear reactor technologies, including technologies that utilize standardized designs or exhibit passive safety features.

(b) DEFINITIONS- For purposes of this subtitle--

(1) the term `advanced nuclear reactor technologies' means--

(A) advanced light water reactors that may be commercially available in the near-term, including but not limited to mid-sized reactors with passive safety features for the generation of commercial electric power from nuclear fission; and

(B) other advanced nuclear reactor technologies that may require prototype demonstration prior to commercial availability in the mid- or long-term, including but not limited to high-temperature, gas-cooled reactors and liquid metal reactors, for the generation of commercial electric power from nuclear fission;

(2) the term `Commission' means the Nuclear Regulatory Commission;

(3) the term `standardized design' means a design for a nuclear power plant that may be utilized for a multiple number of units or a multiple number of sites; and

(4) the term `certification' means approval by the Commission of a standardized design.

SEC. 2122. PROGRAM, GOALS, AND PLAN.

(a) PROGRAM DIRECTION- The Secretary shall conduct a program to encourage the deployment of advanced nuclear reactor technologies that to the maximum extent practicable--

(1) are cost effective in comparison to alternative sources of commercial electric power of comparable availability and reliability, taking into consideration life cycle environmental costs;

(2) facilitate the design, licensing, construction, and operation of a nuclear powerplant using a standardized design;

(3) exhibit enhanced safety features; and

(4) incorporate features that advance the objectives of the Nuclear Non-Proliferation Act of 1978.

(b) PROGRAM GOALS- The goals of the program established under subsection (a) shall include--

(1) for the near-term--

(A) to facilitate the completion, by September 30, 1996, for certification by the Commission, of standardized advanced light water reactor technology designs that the

Secretary determines have the characteristics described in subsection (a) (1) through (4);

(B) to facilitate the completion of submissions, by September 30, 1996, for preliminary design approvals by the Commission of standardized designs for the modular high-temperature gas-cooled reactor technology and the liquid metal reactor technology; and

(C) to evaluate by September 30, 1996, actinide burn technology to determine if it can reduce the volume of long-lived fission byproducts;

(2) for the mid-term--

(A) to facilitate increased efficiency of enhanced safety, advanced light water reactors to produce electric power at the lowest cost to the customer;

(B) to develop advanced reactor concepts that are passively safe and environmentally acceptable; and

(C) to complete necessary research and development on high-temperature gas-cooled reactor technology and liquid metal reactor technology to support the selection, by September 30, 1998, of one or both of those technologies as appropriate for prototype demonstration; and

(3) for the long-term, to complete research and development and demonstration to support the design of advanced reactor technologies capable of providing electric power to a utility grid as soon as practicable but no later than the year 2010.

(c) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a 5-year program plan to guide the activities under this section. The program plan shall include schedule milestones, Federal funding requirements, and non-Federal cost sharing requirements. In preparing the program plan, the Secretary shall take into consideration--

(1) the need for, and the potential for future adoption by electric utilities or other entities of, advanced nuclear reactor technologies that are available, under development, or have the potential for being developed, for the generation of energy from nuclear fission;

(2) how the Federal Government, acting through the Secretary, can be effective in ensuring the availability of such technologies when they are needed;

(3) how the Federal Government can most effectively cooperate with the private sector in the accomplishment of the goals set forth in subsection (b); and

(4) potential alternative funding sources for carrying out this section.

In preparing the program plan, the Secretary shall consult with appropriate representatives of industry, institutions of higher education, Federal agencies, including national laboratories, and professional and technical societies. The Secretary shall update the program plan annually and submit such update to Congress. Each such update shall describe any activities that are behind schedule, any funding shortfalls, and any other circumstances that might affect the ability of the Secretary to meet the goals set forth in subsection (b).

SEC. 2123. COMMERCIALIZATION OF ADVANCED LIGHT WATER REACTOR TECHNOLOGY.

(a) CERTIFICATION OF DESIGNS- In order to achieve the goal of certification of completed standardized designs by the Commission by 1996 as set forth in section 2122(b), the Secretary shall conduct a 5-year program of technical and financial assistance to encourage the development and submission for certification of advanced light water reactor designs which, in the judgment of the Secretary, can be certified by the Commission by no later than the end of fiscal year 1996.

(b) FIRST-OF-A-KIND ENGINEERING-

(1) ESTABLISHMENT OF PROGRAM- The Secretary shall conduct a program of Federal financial and technical assistance for the first-of-a-kind engineering design of standardized commercial nuclear powerplants which are included, as of the date of enactment of this Act, in the Department of Energy's program for certification of advanced light water reactor designs.

(2) SELECTION CRITERIA- In order to be eligible for assistance under this subsection, an entity shall certify to the satisfaction of the Secretary that--

(A) the entity, or its members, are bona fide entities engaged in the design, engineering, manufacture, construction, or operation of nuclear reactors;

(B) the entity, or its members, have the financial resources necessary for, and fully intend to pursue the design, engineering, manufacture, construction, and operation in the United States of nuclear power plants through completion of construction and into operation;

(C) the design proposed is scheduled for certification by the Commission under the Department of Energy's program for certification of light water reactor designs; and

(D) at least 50 percent of the funding for the project shall be obtained from non-Federal sources, and a substantial portion of that non-Federal funding shall be obtained from utilities or entities whose primary purpose is the production of electrical power for public consumption.

(3) PROGRAM DOCUMENTS- The Secretary shall prepare and submit to the Congress a program document for each design selected under this subsection, specifying goals and objectives, major milestones for achieving those goals and objectives, and the work products to be provided to the Secretary or made available for inspection.

(4) FUNDING LIMITATIONS- (A) Before entering into an agreement with an entity under this subsection, the Secretary shall establish a cost ceiling for the contribution of the Federal Government for the project, and shall report such cost ceiling to the Congress.

(B) No entity shall receive assistance under this subsection for a period greater than 4 years.

(C) The aggregate funding provided by the Secretary for projects under this subsection shall not exceed $100,000,000 for the period encompassing fiscal years 1993 through 1997.

(5) STATUS REPORT- The Secretary shall annually submit to the Congress a status report on each project receiving assistance under this subsection.

SEC. 2124. PROTOTYPE DEMONSTRATION OF ADVANCED NUCLEAR REACTOR TECHNOLOGY.

(a) SOLICITATION OF PROPOSALS- Within 3 years after the date of enactment of this Act, the Secretary shall solicit proposals for carrying out the preliminary engineering design of not more than 2 prototype advanced nuclear reactor technologies developed by the Department of Energy, other than advanced light water reactor technologies, necessary to support a decision on whether to recommend construction of a prototype demonstration reactor with the characteristics described in section 2123(a). Proposals submitted under this subsection shall be for modular design concepts of sufficient size to address requirements related to the certification of a standardized design.

(b) RECOMMENDATION TO CONGRESS- (1) Not later than September 30, 1998, the Secretary shall submit to Congress recommendations on whether to build one or more prototype demonstration reactors under this section. Such recommendations shall--

(A) specify a preferred technology or technologies;

(B) include detailed information on milestones for construction and operation;

(C) include an estimate of the funding requirements; and

(D) specify the extent and type of non-Federal financial support anticipated.

In developing the recommendations under this paragraph, the Secretary shall provide for public notice and an opportunity for comment, and shall solicit the views of the Commission and other parties with technical expertise the Secretary considers useful in the development of such recommendations.

(2) The prototype demonstration program under this section shall be carried out to the maximum extent practicable with private sector funding. At least 50 percent of the funding for such program shall be non-Federal funding. The extent of non-Federal cost sharing proposed for any demonstration project shall be a criterion for the selection of the project.

(c) SELECTION OF TECHNOLOGY- Any technology selected by the Secretary for recommendation for prototype demonstration under this section shall to the maximum extent possible exhibit the characteristics set forth in section 2123(a).

SEC. 2125. REPEALS.

The Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 is amended--

(1) in section 4(c)(1)(C), by inserting `and' after `Program;';

(2) in section 4(c)(2)(C), by striking `Program; and' and inserting in lieu thereof `Program.';

(3) by striking section 4(c)(3);

(4) in section 5(1)(B), by inserting `and' after `program;';

(5) in section 5(2)(B), by striking `program; and' and inserting in lieu thereof `program.'; and

(6) by striking section 5(3).

SEC. 2126. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary for carrying out this subtitle $212,804,000 for fiscal year 1993 and such sums as may be necessary for fiscal year 1994. Amounts authorized or otherwise made available for program direction, space reactor power systems, advanced radioisotope power systems, and the space exploration initiative under nuclear energy research and development shall be in addition to the amounts authorized in the preceding sentence.

TITLE XXII--ENERGY AND ECONOMIC GROWTH

SEC. 2201. NATIONAL ADVANCED MATERIALS INITIATIVE.

(a) PROGRAM DIRECTION- The Secretary shall establish a 5-year National Advanced Materials Program, in accordance with sections 3001 and 3002 of this Act. Such program shall foster the commercialization of techniques for processing, synthesizing, fabricating, and manufacturing advanced materials and associated components. At a minimum, the Program shall expedite the private sector deployment of advanced materials for use in high performance energy efficient and renewable energy technologies in the industrial, transportation, and buildings sectors that can foster economic growth and competitiveness. The Program shall include field demonstrations of sufficient scale and number to prove technical and economic feasibility.

(b) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary, in consultation with appropriate representatives of industry, institutions of higher education, Department of Energy national laboratories, and professional and technical societies, shall prepare and submit to the Congress a 5-year program plan to guide activities under this section. The Secretary shall biennially update and resubmit the program plan to Congress.

(c) PROPOSALS-

(1) SOLICITATION- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities consistent with the 5-year program plan. Such proposals may be submitted by one or more parties.

(2) CONTENTS OF PROPOSALS- Proposals submitted under this subsection shall include--

(A) an explanation of how the proposal will expedite the commercialization of advanced materials in energy efficiency or renewable energy in the near-term to mid-term;

(B) evidence of consideration of whether the unique capabilities of Department of Energy national laboratories warrants collaboration with such laboratories, and the extent of such collaboration proposed;

(C) a description of the extent to which the proposal includes collaboration with relevant industry or other groups or organizations; and

(D) evidence of the ability of the proposers to undertake and complete the proposed project.

(d) GENERAL SERVICES ADMINISTRATION DEMONSTRATION PROGRAM- The Secretary, in consultation with the Administrator of General Services, shall establish a program to expedite the use, in goods and services acquired by the General Services Administration, of advanced materials technologies.

Such program shall include a demonstration of the use of advanced materials technologies as may be necessary to establish technical and economic feasibility. The Secretary shall transfer funds to the General Services Administration for carrying out this subsection.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section such sums as may be necessary, to be derived for energy efficient applications from section 2101(e) and for renewable applications from section 2111(c), including Department of Energy national laboratory participation in proposals submitted under subsection (c), and including transferring funds to the General Services Administration.

SEC. 2202. NATIONAL ADVANCED MANUFACTURING TECHNOLOGIES INITIATIVE.

(a) PROGRAM DIRECTION- The Secretary shall establish a 5-year National Advanced Manufacturing Technologies Program, in accordance with sections 3001 and 3002 of this Act. Such program shall foster the commercialization of advanced manufacturing technologies to improve energy efficiency and productivity in manufacturing. At a minimum, the Program shall expedite the private sector deployment of advanced manufacturing technologies to improve productivity, quality, and control in manufacturing processes that can foster economic growth, energy efficiency, and competitiveness. The program shall include field demonstrations of sufficient scale and number to prove technical and economic feasibility.

(b) PROGRAM PLAN- Within 180 days after the date of enactment of this Act, the Secretary, in consultation with appropriate representatives of industry, institutions of higher education, Department of Energy national laboratories, and professional and technical societies, shall prepare and submit to the Congress a 5-year program plan to guide activities under this section. The Secretary shall biennially update and resubmit the program plan to Congress.

(c) PROPOSALS-

(1) SOLICITATION- Within 1 year after the date of enactment of this Act, the Secretary shall solicit proposals for conducting activities consistent with the 5-year program plan. Such proposals may be submitted by one or more parties.

(2) CONTENTS OF PROPOSALS- Proposals submitted under this subsection shall include--

(A) an explanation of how the proposal will expedite the commercialization of advanced manufacturing technologies to improve energy efficiency in the building, industry, and transportation sectors;

(B) evidence of consideration of whether the unique capabilities of Department of Energy national laboratories warrants collaboration with such laboratories, and the extent of such collaboration proposed;

(C) a description of the extent to which the proposal includes collaboration with relevant industry or other groups or organizations; and

(D) evidence of the ability of the proposers to undertake and complete the proposed project.

(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for carrying out this section such sums as may be necessary, to be derived from sums authorized under section 2101(e), including Department of Energy national laboratory participation in

proposals submitted under subsection (c).

SEC. 2203. SUPPORTING RESEARCH AND TECHNICAL ANALYSIS.

(a) BASIC ENERGY SCIENCES-

(1) PROGRAM DIRECTION- The Secretary shall continue to support a vigorous program of basic energy sciences to provide basic research support for the development of energy technologies. Such program shall focus on the efficient production and use of energy, and the expansion of our knowledge of materials, chemistry, geology, and other related areas of advancing technology development.

(2) USER FACILITIES- (A) As part of the program referred to in paragraph (1), the Secretary shall carry out planning, construction, and operation of user facilities to provide special scientific and research capabilities, including technical expertise and support as appropriate, to serve the research needs of our Nation's universities, industry, private laboratories, Federal laboratories, and others. Research institutions or individuals from other nations shall be accommodated at such user facilities in cases where reciprocal accommodations are provided to United States research institutions and individuals or where the Secretary considers such accommodation to be in the national interest.

(B) The construction of the Advanced Photon Source at the Argonne National Laboratory is hereby authorized.

(C) The Secretary shall not change the user fee practice in effect as of October 1, 1991, with respect to user facilities unless the Secretary notifies Congress 90 days before the effective date of any change.

(D) The Secretary shall expedite the design for construction of the Advanced Neutron Source at the Oak Ridge National Laboratory, in order to provide critical research capabilities in support of our national research initiatives for advanced materials and biotechnology, as well as a broad range of research. Such action shall be consistent with the Basic Energy Sciences Advisory Committee's Technical Evaluation of accelerator and reactor neutron source technologies. Within 90 days after the date of enactment of this Act, the Secretary shall submit to the Congress a plan for such design, including a schedule for construction.

(3) COST SHARING- The Secretary shall not require cost sharing for research and development pursuant to this subsection, except--

(A) as otherwise provided for in cooperative research and development agreements or other agreements entered into under existing law;

(B) for fees for user facilities, as determined by the Secretary; or

(C) in the case of specific projects, where the Secretary determines that the benefits of such research and development accrue to a specific industry or group of industries, in which case cost sharing under section 3002 of this Act shall apply.

(b) UNIVERSITY AND SCIENCE EDUCATION- (1) The Secretary shall support programs for improvements and upgrading of university research reactors and associated instrumentation and

equipment. Within 1 year after the date of enactment of this Act, the Secretary shall submit to the Congress a report on the condition and status of university research reactors, which includes a 5-year plan for upgrading and improving such facilities, instrumentation capabilities, and related equipment.

(2) The Secretary shall develop a method to evaluate the effectiveness of science and mathematics education programs provided by the Department of Energy and its laboratories, including specific evaluation criteria.

(3)(A)(i) The Director of the Office of Energy Research shall operate an Experimental Program to Stimulate Competitive Research (in this paragraph referred to as `EPSCoR') as part of the Department of Energy's University and Science Education Programs.

(ii) The objectives of EPSCoR shall be--

> (I) to enhance the competitiveness of the peer-review process within academic institutions in eligible States; and
>
> (II) to increase the probability of long-term growth of competitive funding to investigators at institutions from eligible States.

(iii) In order to carry out the objectives stated in clause (ii), EPSCoR shall provide for activities which may include (but not be limited to) competitive research awards and graduate traineeships.

(iv) EPSCoR shall assist those States that--

> (I) historically have received relatively little Federal research and development funding; and
>
> (II) have demonstrated a commitment to develop their research bases and improve science and engineering research and education programs at their universities and colleges.

(B) For purposes of this paragraph, the term `eligible States' means States that received a Department-EPSCoR planning or traineeship grant in fiscal year 1991 or fiscal year 1992.

(C) No more than $5,000,000 of the funds appropriated to EPSCoR in any fiscal year, through fiscal year 1997, are authorized to be appropriated for graduate traineeships.

(c) TECHNOLOGY TRANSFER- The Secretary shall support technology transfer activities conducted by the National Laboratories. Within 1 year after the date of enactment of this Act, the Secretary shall submit to the Congress a report on the adequacy of funding for such activities, along with a proposal recommending ways to reduce the length of time required to consummate cooperative research and development agreements.

(d) FACILITIES SUPPORT FOR MULTIPROGRAM ENERGY LABORATORIES-

> (1) FACILITY POLICY- The Secretary shall develop and implement a least cost strategy for correcting facility problems, closing unneeded facilities, making facility modifications, and building new facilities at multiprogram energy laboratories.
>
> (2) FACILITY PLAN- Within 1 year after the date of enactment of this Act, the Secretary shall prepare and submit to the Congress a comprehensive plan for conducting future facility

maintenance, making repairs, modifications, and new additions, and constructing new facilities at multiprogram energy laboratories. Such plan shall provide for facilities work in accordance with the following priorities, listed in descending order of priority:

(A) Providing for the safety and health of employees, visitors, and the general public with regard to correcting existing structural, mechanical, electrical, and environmental deficiencies.

(B) Providing for the repair and rehabilitation of existing facilities to keep them in use and prevent deterioration.

(C) Providing engineering design and construction services for those facilities which require modification or additions in order to meet the needs of new or expanded programs.

Such plan shall include plans for new facilities and facility modifications which will be required to meet the Department of Energy's changing missions of the twenty-first century, including schedules and estimates for implementation, and including a section outlining long-term funding requirements consistent with anticipated budgets and annual authorization of appropriations. Such plan shall address the coordination of modernization and consolidation of facilities in order to meet changing mission requirements, and shall provide for annual reports to Congress on accomplishments, conformance to schedules, commitments, and expenditures.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Secretary for Supporting Research and Technical Analysis, including Basic Energy Sciences, Energy Research Analysis, University and Science Education, Technology Transfer, Advisory and Oversight Program Direction, and Facilities Support for Multiprogram Energy Laboratories, $966,804,000 for fiscal year 1993 and such sums as may be necessary for fiscal year 1994.

SEC. 2204. MATH AND SCIENCE EDUCATION PROGRAM.

(a) PROGRAM- The Secretary shall enter into contracts with existing qualified entities to conduct science and mathematics education programs that supplement the Special Programs for Students from Disadvantaged Backgrounds carried out by the Secretary of Education under sections 417A through 417F of Public Law 89-329, as amended (20 U.S.C. 1070d through 1070d-1d).

(b) PURPOSE- (1) The purpose of the programs shall be to provide support to Federal, State, and private programs designed to promote the participation of low-income and first generation college students as defined in section 417A of Public Law 89-329, as amended (20 U.S.C. 1070d-d), in post-secondary science and mathematics education.

(2) Support activities may include--

(A) the development of educational materials;

(B) the training of teachers and counselors;

(C) the establishment of student internships;

(D) the development of seminars on mathematics and science;

(E) tutoring in mathematics and science;

(F) academic counseling;

(G) the development of opportunities for research; and

(H) such other activities that may promote the participation of low-income and first generation college students in post-secondary science and mathematics education.

(c) SUPPORT- (1) In carrying out the purpose of this section, the entities may provide support under subsection (b)(2) to--

(A) low-income and first generation college students; and

(B) institutions of higher education, public and private agencies and organizations, and secondary and middle schools that principally benefit low-income students.

(2) The qualified entities shall, to the extent practicable, coordinate support activities under this section with the Secretary of Education and the Secretary.

(d) COOPERATION WITH QUALIFIED ENTITIES- The Secretary shall cooperate with qualified entities and, to the extent practicable, make available to the entities such personnel, facilities, and other resources of the Department of Energy as may be necessary to carry out the duties of the entities.

(e) REPORT- Not later than October 1 of each year, the entities shall report to the Secretary, the Secretary of Education, and the Congress on--

(1) progress made to promote the participation of low-income and first generation college students in post-secondary science and mathematics education by--

(A) the qualified entities;

(B) other mathematics and science education programs of the Department of Energy; and

(C) the Special Programs for Students from Disadvantaged Backgrounds of the Department of Education; and

(2) recommendations for such additional actions as may be needed to promote the participation of low-income students in post-secondary science and mathematics education.

(f) EFFECT ON EXISTING PROGRAMS- The programs in this section shall supplement and be developed in cooperation with the current mathematics and science education programs of the Department of Energy and the Department of Education but shall not supplant them.

(g) DEFINITION- For purposes of this section, the term `qualified entity' means a nonprofit corporation, association, or institution that has demonstrated special knowledge of, and experience with, the education of low-income and first generation college students and whose primary mission is the operation of national programs that focus on low-income students and provide training and other services to educators.

(h) AUTHORIZATION- There are authorized to be appropriated such sums as may be necessary, to be derived from section 2203(e) and the Environmental Restoration and Waste Management program, to carry out the purposes of this section.

SEC. 2205. INTEGRATION OF RESEARCH AND DEVELOPMENT.

Within 180 days after the date of enactment of this Act, the Secretary, in consultation with appropriate representatives of industry, institutions of higher education, Department of Energy national laboratories, and professional and technical societies, shall prepare and submit to Congress a 5-year program plan for improving the integration of basic energy research programs with other energy programs within the Department of Energy. Such program plan shall include--

(1) an evaluation of current procedures and mechanisms used to achieve such integration;

(2) an assessment of the role that the Department of Energy national laboratories play in such integration;

(3) an identification and evaluation of models that could enhance such integration;

(4) an identification and evaluation of new programs, mechanisms, and related policy options that could improve the integrating process, including--

(A) set aside funding for matching or leveraging basic and applied programs;

(B) more formal linkages; and

(C) program coordination;

(5) recommendations for expanded research and development and new technology areas; and

(6) budget estimates for activities under this section.

SEC. 2206. DEFINITIONS.

For purposes of this title--

(1) the term `advanced manufacturing technology' means processes, equipment, techniques, practices, and capabilities that are applied for the purpose of--

(A) improving the productivity, quality, or energy efficiency of the design, development, testing, or manufacture of a product; or

(B) expanding the technical capability to design, develop, test, or manufacture a product that is fundamentally different in character from existing products and that will result in improved energy efficiency;

(2) the term `advanced materials' means materials that are processed, synthesized, fabricated, and manufactured to develop high performance properties that exceed the corresponding properties of conventional materials for structural, electronic, magnetic, or photonic applications, or for joining,

welding, bonding, or packaging components into complex assemblies, including--

(A) advanced monolithic materials such as metals, ceramics, and polymers;

(B) advanced composite materials such as metal matrix (including intermetallics), polymer matrix, ceramic matrix, continuous fiber ceramic composite, and carbon matrix composites; and

(C) advanced electronic, magnetic, and photonic materials, including superconducting, semiconductor, electrooptic, magnetooptic, thin-film, and special purpose coating materials used in technologies for energy efficiency, renewable energy, or electric power applications; and

(3) the term `United States' means the 50 States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the United States Virgin Islands, Guam, the Northern Mariana Islands, and any other territory or possession of the United States.

TITLE XXIII--POLICY AND ADMINISTRATIVE PROVISIONS

SEC. 2301. POLICY ON MAJOR CONSTRUCTION PROJECTS.

(a) REPORT AND MANAGEMENT PLAN- The Secretary shall submit to the Congress a report and management plan for any major construction project involving $100,000,000 or more, prior to the expenditure of those funds.

(b) CONGRESSIONAL REVIEW- Expenditure of funds for a project described in subsection (a) may be made after a period of 30 calendar days (not including any day on which either House of Congress is not in session because of adjournment of more than 3 calendar days prior to a day certain) has passed after receipt of the report and management plan by Congress.

SEC. 2302. ENERGY RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIAL APPLICATION ADVISORY BOARD.

(a) ESTABLISHMENT- The Secretary shall establish an Energy Research, Development, Demonstration, and Commercial Application Advisory Board (hereafter in this section referred to as the `Advisory Board').

(b) RESPONSIBILITIES- The Advisory Board shall provide impartial technical advice to the Secretary to assist in the development of energy research, development, demonstration, and commercial application plans and reports under sections 6 and 15 of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5905 and 5914), under section 801 of the Department of Energy Organization Act (42 U.S.C. 7321), and as otherwise provided in titles XX through XXIII of this Act. The Advisory Board shall also periodically review such plans and reports and their implementation in relation to the goals stated in section 2001 of this Act, and report the results of such review to the Secretary and the Congress. Such report shall be included as part of the report required under section 15 of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5914).

(c) USE OF EXISTING ADVISORY BOARD- The Secretary may use an existing advisory board to carry out the responsibilities described in subsection (b).

SEC. 2303. AMENDMENTS TO EXISTING LAW.

(a) FEDERAL NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT ACT OF 1974 AMENDMENTS- Section 6 of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5905) is amended--

(1) in subsection (a)--

(A) by striking `the Administrator' and inserting `the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), and titles XX through XXIII of the Energy Policy Act of 1992, the Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992,';

(B) by striking `(to the early 1980's)' in paragraph (1) and inserting `(the period up to 5 years after submission of the plan or its annual revision)';

(C) by striking `(the early 1980's to 2000)' in paragraph (2) and inserting `(the period from 5 years to 10 years after submission of the plan or its annual revision)'; and

(D) by striking `(beyond 2000)' in paragraph (3) and inserting `(the period beyond 10 years after submission of the plan or its annual revision)';

(2) in subsection (b)--

(A) by striking `Administrator' in paragraphs (1) and (2) and inserting `Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992,';

(B) by inserting `Such program shall be updated and transmitted to the Congress annually as part of the report required under section 15.' at the end of paragraph (1);

(C) by striking `(to the early 1980's), middle-term (the early 1980's to 2000), and long-term (beyond 2000) time intervals' in paragraph (2) and inserting `, middle-term, and long-term time intervals described in subsection (a)(1) through (3)';

(D) by striking `and' at the end of paragraph (3)(P);

(E) by striking the period at the end of paragraph (3)(Q) and inserting a semicolon; and

(F) by adding at the end of paragraph (3) the following new subparagraphs:

`(R) to implement the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12001 et seq.); and

`(S) to implement titles XX through XXIII of the Energy Policy Act of 1992.'; and

(3) in subsection (c)--

(A) by striking `Administrator' and inserting `Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992,'; and

(B) by inserting `Such program shall be updated and transmitted to the Congress annually as part of the report required under section 15.' after `and demonstration plans.'.

(b) RENEWABLE ENERGY AND ENERGY EFFICIENCY TECHNOLOGY COMPETITIVENESS ACT OF 1989 AMENDMENT- Section 9(b)(4) of the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12006(b)(4)) is amended by inserting `and the plan developed under section 6 of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5905)' after `(42 U.S.C. 7321)'.

SEC. 2304. MANAGEMENT PLAN.

(a) PLAN PREPARATION- The Secretary, in consultation with the Advisory Board established under section 2302, shall prepare a management plan for the conduct of research, development, demonstration, and commercial application of energy technologies that is consistent with the goals stated in section 2001.

(b) CONTENTS OF PLAN- The management plan under subsection (a) shall provide for--

(1) investigation of promising energy and energy efficiency resource technologies that have been identified as potentially significant future contributors to national energy security;

(2) development of energy and energy efficiency resource technologies that have the potential to reduce energy supply vulnerability, and to minimize adverse impacts on the environment, the global climate, and the economy; and

(3) creation of opportunities for export of energy and energy efficiency resource technologies from the United States that can enhance the Nation's competitiveness.

(c) ENERGY TECHNOLOGY INVENTORY AND STATUS REPORT- As part of the management plan, the Secretary, with the advice of the Advisory Board established under section 2302 of this Act, shall develop an inventory and status report of technologies to enhance energy supply and to improve the efficiency of energy end uses. The inventory and status report shall include fossil, renewable, nuclear, and energy conservation technologies which have not yet achieved the status of fully reliable and cost-competitive commercial availability, but which the Secretary projects may become available with additional research, development, and demonstration. The inventory and status report shall provide, for each technology--

(1) an assessment of its--

(A) degree of technological maturity; and

(B) principal research, development, and demonstration issues, including--

(i) the barriers posed by capital, operating, and maintenance costs;

(ii) technical performance; and

(iii) potential environmental impacts;

(2) the projected time frame for commercial availability, specifying at a minimum whether the

technology will be commercially available in the near-term, mid-term, or long-term, whether there are too many uncertainties to project availability, or whether it is unlikely that the technology will ever be commercial; and

(3) a projection of the future cost-competitiveness of the technology in comparison with alternative technologies to provide the same energy service.

(d) PUBLIC COMMENT- The Secretary shall publish the proposed management plan for a written public comment period of at least 90 days. The Secretary shall consider such comments and include a summary thereof in the management plan.

(e) PLAN SUBMISSION- Within one year after the date of enactment of this Act, the Secretary shall submit the first management plan under this section to Congress. Thereafter, the Secretary shall submit a revised management plan biennially, at the time of submittal of the President's annual budget submission to the Congress.

SEC. 2305. COSTS RELATED TO DECOMMISSIONING AND THE STORAGE AND DISPOSAL OF NUCLEAR WASTE.

(a) AWARD OF CONTRACTS-

(1) PRIME CONTRACTORS- In awarding contracts to perform nuclear hot cell services, the Secretary, in evaluating bids for such contracts, shall exclude from consideration costs related to the decommissioning of nuclear facilities or the storage and disposal of nuclear waste, if--

(A) one or more of the parties bidding to perform such services is a United States company that is subject to such costs; and

(B) one or more of the parties bidding to perform such services is a foreign company that is not subject to comparable costs.

(2) SUBCONTRACTORS- Any person awarded a contract subject to the restrictions described in paragraph (1) who subcontracts with a person to perform the services described in such paragraph shall be subject to the same restrictions in evaluating bids among potential subcontractors, as the Secretary was subject to in evaluating bids among prime contractors.

(b) ISSUANCE OF REGULATIONS- The Secretary shall issue regulations not later than 90 days after the date of the enactment of this Act to carry out the requirements of subsection (a).

(c) DEFINITIONS- As used in this section--

(1) the term `costs related to decommissioning of nuclear facilities' means any cost associated with the compliance with regulatory requirements governing the decommissioning of nuclear facilities licensed by the Nuclear Regulatory Commission;

(2) the term `costs related to storage and disposal of nuclear waste' means any costs, whether required by regulation or incurred as a matter of prudent business practice, associated with the storage or disposal of nuclear waste;

(3) the term `nuclear hot cell services' means services related to the examination of, or

performance of various operations on, nuclear fuel rods, control assemblies, or other components that are emitting large quantities of ionizing radiation; and

(4) the term `nuclear waste' means any radioactive waste material subject to regulation by the Nuclear Regulatory Commission or the Department of Energy.

SEC. 2306. LIMITS ON PARTICIPATION BY COMPANIES.

A company shall be eligible to receive financial assistance under titles XX through XXIII of this Act only if--

(1) the Secretary finds that the company's participation in any program under such titles would be in the economic interest of the United States, as evidenced by investments in the United States in research, development, and manufacturing (including, for example, the manufacture of major components or subassemblies in the United States); significant contributions to employment in the United States; an agreement with respect to any technology arising from assistance provided under this section to promote the manufacture within the United States of products resulting from that technology (taking into account the goals of promoting the competitiveness of United States industry), and to procure parts and materials from competitive suppliers; and

(2) either--

(A) the company is a United States-owned company; or

(B) the Secretary finds that the company is incorporated in the United States and has a parent company which is incorporated in a country which affords to United States-owned companies opportunities, comparable to those afforded to any other company, to participate in any joint venture similar to those authorized under this Act; affords to United States-owned companies local investment opportunities comparable to those afforded to any other company; and affords adequate and effective protection for the intellectual property rights of United States-owned companies.

SEC. 2307. UNCOSTED OBLIGATIONS.

(a) REPORT- Along with the submission of each of the President's annual budget requests to Congress, the Secretary shall submit to Congress a report which--

(1) identifies the amount of Department of Energy funds that were, as of the end of the previous fiscal year--

(A) committed uncosted obligations; and

(B) uncommitted uncosted obligations;

(2) specifically describes the purposes for which all such funds are intended; and

(3) explains the effect that information contained in the report has had on the annual budget request for the Department of Energy being simultaneously submitted.

(b) DEFINITIONS- Within 90 days after the date of enactment of this Act, the Secretary shall submit a

report to the Congress containing definitions of the terms `uncosted obligation', `committed uncosted obligation', and `uncommitted uncosted obligation' for purposes of reports to be submitted under subsection (a).

TITLE XXIV--NON-FEDERAL POWER ACT HYDROPOWER PROVISIONS

SEC. 2401. RIGHTS-OF-WAY ON CERTAIN FEDERAL LANDS.

Section 501 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1761) is amended--

(1) by inserting in subsection (a) after `public lands' the following: `(including public lands, as defined in section 103(e) of this Act, which are reserved from entry pursuant to section 24 of the Federal Power Act (16 U.S.C. 818))';

(2) in paragraph (4) of subsection (a), by striking `Federal Power Commission under the Federal Power Act of 1935 (49 Stat. 847; 16 U.S.C. 791) and inserting in lieu thereof `Federal Energy Regulatory Commission under the Federal Power Act, including part 1 thereof (41 Stat. 1063, 16 U.S.C. 791a-825r).'; and

(3) by adding the following new subsection at the end thereof:

`(d) With respect to any project or portion thereof that was licensed pursuant to, or granted an exemption from, part I of the Federal Power Act which is located on lands subject to a reservation under section 24 of the Federal Power Act and which did not receive a permit, right-of-way or other approval under this section prior to enactment of this subsection, no such permit, right-of-way, or other approval shall be required for continued operation, including continued operation pursuant to section 15 of the Federal Power Act, of such project unless the Commission determines that such project involves the use of any additional public lands or National Forest lands not subject to such reservation.'.

SEC. 2402. DAMS IN NATIONAL PARK SYSTEM UNITS.

After the date of enactment of this Act, the Federal Energy Regulatory Commission may not issue an original license under Part I of the Federal Power Act (nor an exemption from such Part) for any new hydroelectric power project located within the boundaries of any unit of the National Park System that would have a direct adverse effect on Federal lands within any such unit. Nothing in this section shall be construed as repealing any existing provision of law (or affecting any treaty) explicitly authorizing a hydroelectric power project.

SEC. 2403. THIRD PARTY CONTRACTING BY FERC.

(a) ENVIRONMENTAL IMPACT STATEMENTS- Where the Federal Energy Regulatory Commission is required to prepare a draft or final environmental impact statement under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 and following) in connection with an application for a license under part I of the Federal Power Act, the Commission may permit, at the election of the applicant, a contractor, consultant or other person funded by the applicant and chosen by the Commission from among a list of such individuals or companies determined by the Commission to be qualified to do such work, to prepare such statement for the Commission. The contractor shall execute a disclosure statement prepared by the Commission specifying that it has no financial or other interest in the outcome of the project. The Commission shall establish the scope of work and procedures to assure that the contractor, consultant or other person has no financial or other potential conflict of interest in the outcome of the

proceeding. Nothing herein shall affect the Commission's responsibility to comply with the National Environmental Policy Act of 1969.

(b) ENVIRONMENTAL ASSESSMENTS- Where an environmental assessment is required under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 and following) in connection with an application for a license under part I of the Federal Power Act, the Commission may permit an applicant, or a contractor, consultant or other person selected by the applicant, to prepare such environmental assessment. The Commission shall institute procedures, including pre-application consultations, to advise potential applicants of studies or other information foreseeably required by the Commission. The Commission may allow the filing of such applicant-prepared environmental assessments as part of the application. Nothing herein shall affect the Commission's responsibility to comply with the National Environmental Policy Act of 1969.

(c) EFFECTIVE DATE- This section shall take effect with respect to license applications filed after the enactment of this Act.

SEC. 2404. IMPROVEMENT AT EXISTING FEDERAL FACILITIES.

(a) STUDIES OF OPPORTUNITIES FOR INCREASED HYDROELECTRIC GENERATION- The Secretary, in consultation with the Secretary of the Interior and the Secretary of the Army, shall perform reconnaissance level studies of cost effective opportunities to increase hydropower production at existing federally-owned or operated water regulation, storage, and conveyance facilities. Such studies shall be completed within 2 years after the date of enactment of this Act and transmitted to the Committee on Energy and Natural Resources and the Committee on Environment and Public Works of the United States Senate and to the Committee on Energy and Commerce, the Committee on Interior and Insular Affairs, and the Committee on Public Works and Transportation of the United States House of Representatives. An individual study shall be prepared for each of the Nation's principal river basins. Each such study shall identify and describe with specificity the following matters:

(1) opportunities to improve the efficiency of hydroelectric generation at such facilities through, but not limited to, mechanical, structural, or operational changes;

(2) opportunities to improve the efficiency of the use of water supplied or regulated by Federal projects where such improvement could, in the absence of legal or administrative constraints, make additional water supplies available for hydroelectric generation or reduce project energy use;

(3) opportunities to create additional generating capacity at existing facilities through, but not limited to, the construction of additional generating units, the uprating of generators and turbines, and the construction of pumped storage facilities; and

(4) preliminary assessment of the costs and the economic and environmental consequences of such measures.

(b) EXCEPTION FOR PREVIOUS STUDIES- In those cases where studies of the type required by this section have been prepared by any agency of the United States and published within the ten years prior to the date of enactment of this Act, the Secretary may choose not to perform new studies but incorporate the information developed by such studies into the study reports required by this section.

(c) AUTHORIZATION- There is authorized to be appropriated in each of the fiscal years 1993, 1994, and 1995 such sums as may be necessary to carry out the purposes of this section.

SEC. 2405. WATER CONSERVATION AND ENERGY PRODUCTION.

(a) STUDIES- The Secretary of the Interior, acting pursuant to the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388), and Acts supplementary thereto and amendatory thereof, is authorized and directed to conduct feasibility investigations of opportunities to increase the amount of hydroelectric energy available for marketing by the Secretary from Federal hydroelectric power generation facilities resulting from a reduction in the consumptive use of such power for Federal reclamation project purposes or as a result of an increase in the amount of water available for such generation because of water conservation efforts on Federal reclamation projects or a combination thereof. The Secretary of the Interior is further authorized and directed to conduct feasibility investigations of opportunities to mitigate damages to or enhance fish and wildlife as a result of increasing the amount of water available for such purposes because of water conservation efforts on Federal reclamation projects. Such feasibility investigations shall include, but not be limited to--

(1) an analysis of the technical, environmental, and economic feasibility of reducing the amount of water diverted upstream of such Federal hydroelectric power generation facilities by Federal reclamation projects;

(2) an estimate of the reduction, if any, of project power consumed as a result of the decreased amount of diversion;

(3) an estimate of the increase in the amount of electrical energy and related revenues which would result from the marketing of such power by the Secretary;

(4) an estimate of the fish and wildlife benefits which would result from the decreased or modified diversions;

(5) a finding by the Secretary of the Interior that the activities proposed in the feasibility study can be carried out in accordance with applicable Federal and State law, interstate compacts and the contractual obligations of the Secretary; and

(6) a finding by the affected Federal Power Marketing Administrator that the hydroelectric component of the proposed water conservation feature is cost-effective and that the affected Administrator is able to market the hydro-electric power expected to be generated.

(b) CONSULTATION- In preparing feasibility studies pursuant to this section, the Secretary of the Interior shall consult with, and seek the recommendations of, affected State, local and Indian tribal interests, and shall provide for appropriate public comment.

(c) AUTHORIZATION- There is hereby authorized to be appropriated to the Secretary of the Interior such sums as may be necessary to carry out this section.

SEC. 2406. FEDERAL PROJECTS IN THE PACIFIC NORTHWEST.

Without further appropriation and without fiscal year limitation, the Secretaries of the Interior and Army are authorized to plan, design, construct, operate and maintain generation additions, improvements and replacements, at their respective Federal projects in the Pacific Northwest Region as defined in the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act), Public Law 96-501 (16 U.S.C. 839a(14)), and to operate and maintain the respective Secretary's power facilities in the Region, that the respective Secretary determines necessary or appropriate and that the Bonneville

Power Administrator subsequently determines necessary or appropriate, with any funds that the Administrator determines to make available to the respective Secretary for such purposes. Each Secretary is authorized, without further appropriation, to accept and use such funds for such purposes: *Provided*, That, such funds shall continue to be exempt from sequestration pursuant to section 255(g)(1) of the Balanced Budget and Emergency Deficit Control Act of 1985: *Provided further*, That this section shall not modify or affect the applicability of any provision of the Northwest Power Act. This provision shall be effective on October 1, 1993.

SEC. 2407. CERTAIN PROJECTS IN ALASKA.

(a) AUTHORITY TO ISSUE EXEMPTIONS- Except as provided in subsection (b) or (c), upon receipt of an application under this section, the Federal Energy Regulatory Commission (hereinafter in this section referred to as the `Commission') may grant, notwithstanding the provisions of section 2402, an exemption in whole or in part from the requirements of part I of the Federal Power Act, including any license requirements contained in part I of the Federal Power Act, to the following facilities located in the State of Alaska:

(1) a project located at Sitka, Alaska, with application numbered UL89-08-000;

(2) a project located at Juneau, Alaska, with preliminary permit numbered 10681-000; and

(3) a project located near Nondalton, Alaska, with application numbered EL88-25-001.

(b) CAPACITY LIMITATIONS- No exemption under subsection (a) shall be applicable to any facility the installed capacity of which exceeds 5 megawatts.

(c) MANDATORY TERMS AND CONDITIONS- In making the determination under subsection (a), the Commission shall consult with the United States Fish and Wildlife Service, the National Marine Fisheries Service, and the State agency exercising administration over the fish and wildlife resources of the State of Alaska, in the manner provided by the Fish and Wildlife Coordination Act (16 U.S.C. 661, et seq.), and shall include in any such exemption--

(1) such terms and conditions as the Fish and Wildlife Service, National Marine Fisheries Service, and the State agency each determine are appropriate to prevent loss of, or damage to, such resources and to otherwise carry out the purposes of such Act, and

(2) such terms and conditions as the Commission deems appropriate to ensure that such facility continues to comply with the provisions of this section and terms and conditions included in any such exemption.

(d) ENFORCEMENT- Any violation of a term or condition of any exemption granted under subsection (a) shall be treated as a violation of a rule or order of the Commission under the Federal Power Act.

(e) FEES- The Commission may establish fees which shall be paid by an applicant for a license or exemption for a project that is required to meet terms and conditions set by fish and wildlife agencies under subsection (c). Such fees shall be adequate to reimburse the fish and wildlife agencies referred to in subsection (c) for any reasonable costs incurred in connection with any studies or other reviews carried out by such agencies for purposes of compliance with this section. The fees shall, subject to annual appropriations Acts, be transferred to such agencies by the Commission for use solely for purposes of carrying out such studies and shall remain available until expended.

(f) EXPEDITED PROCESSING- A completed application for an exemption under this section shall be acted on by the Commission in an expedited manner, in accordance with this section, within 6 months after the date on which the application for such exemption is applied for, or as promptly as practicable thereafter.

SEC. 2408. PROJECTS ON FRESH WATERS IN STATE OF HAWAII.

The Federal Energy Regulatory Commission, in consultation with the State of Hawaii, shall carry out a study of hydroelectric licensing in the State of Hawaii. For purposes of considering whether such licensing should be transferred to the State, within 18 months after the enactment of this Act, the Commission shall complete the study and submit a report containing the results of the study to the Committee on Energy and Commerce of the United States House of Representatives and to the Committee on Energy and Natural Resources of the United States Senate. The study shall examine, and the report shall at a minimum contain an analysis of, each of the following:

(1) The State regulatory programs applicable to hydroelectric power production and the extent to which such programs are suitable as a substitute for regulation of such projects under the Federal Power Act, taking into consideration all aspects of such regulation, including energy, environmental, and safety considerations.

(2) Any unique geographical, hydrological, or other characteristics of waterways in Hawaii or any other aspects of hydroelectric power development and natural resource protection in Hawaii that would justify or not justify the permanent transfer of Federal Energy Regulatory Commission jurisdiction over hydroelectric power projects to that State.

(3) The adequacy of mechanisms and procedures for consideration of fish and wildlife and other environmental values applicable in connection with hydroelectric power development in Hawaii under the State programs referred to in paragraph (1).

(4) Any national policy considerations that would justify or not justify the removal of Federal Energy Regulatory Commission jurisdiction over hydroelectric power projects in Hawaii.

(5) The precedent-setting effect, if any, of provisions of law adopted by the Congress removing Federal Energy Regulatory Commission jurisdiction over hydroelectric power projects in Hawaii.

SEC. 2409. EVALUATION OF DEVELOPMENT POTENTIAL.

The Act of August 30, 1935 (Public Law No. 409 of the 74th Congress), is amended by inserting `The Secretary shall undertake a demonstration project to evaluate the potential for hydropower development, utilizing tidal currents;' after `Document Numbered 15, Seventy-fourth Congress;'.

TITLE XXV--COAL, OIL, AND GAS

SEC. 2501. HOT DRY ROCK GEOTHERMAL ENERGY.

(a) USGS PROGRAM- The Secretary of the Interior, acting through the United States Geological Survey, and in consultation with the Secretary of Energy, shall establish a cooperative Government-private sector program with respect to hot dry rock geothermal energy resources on public lands (as such term is defined in section 103(e) of the Federal Land Policy and Management Act of 1976) and lands managed by the Department of Agriculture, other than any such public or other lands that are withdrawn

from geothermal leasing. Such program shall include, but shall not be limited to, activities to identify, select, and classify those areas throughout the United States that have a high potential for hot dry rock geothermal energy production and activities to develop and disseminate information regarding the utilization of such areas for hot dry rock energy production. Such information may include information regarding field test processes and techniques for assuring that hot dry rock geothermal energy development projects are developed in an economically feasible manner without adverse environmental consequences. Utilizing the information developed by the Secretary, together with information developed in connection with other related programs carried out by other Federal agencies, the Secretary, acting through the United States Geological Survey, may also enter into contracts and cooperative agreements with any public or private entity to provide assistance to any such entity to enable such entity to carry out additional projects with respect to the utilization of hot dry rock geothermal energy resources which will further the purposes of this section.

(b) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necesary to carry out this section.

SEC. 2502. HOT DRY ROCK GEOTHERMAL ENERGY IN EASTERN UNITED STATES.

The United States Geological Survey, in collaboration with the Secretary of Energy, shall convene a workshop of interested governmental and private parties to discuss the regional potential for hot dry rock geothermal energy in the Eastern United States. The purpose of the workshop shall be to review the status of recoverability of hot dry rock energy in the Eastern United States and to determine what geologic, technological, and economic obstacles need to be overcome to make the utilization of hot dry rock energy feasible. The workshop shall be convened within 6 months after enactment of this Act and the United States Geological Survey shall submit a report to Congress within 6 months after the workshop containing a summary of the findings and conclusions of the workshop.

SEC. 2503. COAL REMINING.

(a) MODIFICATION OF PROHIBITION- Section 510 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1260) is amended by adding the following new subsection at the end thereof:

`(e) MODIFICATION OF PROHIBITION- After the date of enactment of this subsection, the prohibition of subsection (c) shall not apply to a permit application due to any violation resulting from an unanticipated event or condition at a surface coal mining operation on lands eligible for remining under a permit held by the person making such application. As used in this subsection, the term `violation' has the same meaning as such term has under subsection (c). The authority of this subsection and section 515 (b)(20)(B) shall terminate on September 30, 2004.'.

(b) PERIOD OF RESPONSIBILITY- Section 515(b)(20) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1265(b)(20)) is amended as follows:

(1) Insert `(A)' after `(20)'.

(2) Add the following new subparagraph at the end thereof:

`(B) on lands eligible for remining assume the responsibility for successful revegetation for a period of two full years after the last year of augmented seeding, fertilizing, irrigation, or other work in order to assure compliance with the applicable standards, except in those areas or regions of the country where the annual average precipitation is twenty-six inches or less, then the

operator's assumption of responsibility and liability will be extended for a period of five full years after the last year of augmented seeding, fertilizing, irrigation, or other work in order to assure compliance with the applicable standards.'.

(c) DEFINITIONS- Section 701 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1291) is amended by striking the period at the end of paragraph (32) and inserting a semicolon in lieu thereof, and by adding the following new paragraphs at the end thereof:

`(33) the term `unanticipated event or condition' as used in section 510(e) means an event or condition encountered in a remining operation that was not contemplated by the applicable surface coal mining and reclamation permit; and

`(34) the term `lands eligible for remining' means those lands that would otherwise be eligible for expenditures under section 404 or under section 402(g)(4).'.

(d) ELIGIBILITY- Section 404 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1234) is amended by adding the following new sentence at the end thereof: `Surface coal mining operations on lands eligible for remining shall not affect the eligibility of such lands for reclamation and restoration under this title after the release of the bond or deposit for any such operation as provided under section 519. In the event the bond or deposit for a surface coal mining operation on lands eligible for remining is forfeited, funds available under this title may be used if the amount of such bond or deposit is not sufficient to provide for adequate reclamation or abatement, except that if conditions warrant the Secretary shall immediately exercise his authority under section 410.'.

(e) ABANDONED COAL REFUSE SITES- (1) Notwithstanding any other provision of the Surface Mining Control and Reclamation Act of 1977 to the contrary, the Secretary of the Interior shall, within one year after the enactment of this Act, publish proposed regulations in the Federal Register, and after opportunity for public comment publish final regulations, establishing environmental protection performance and reclamation standards, and separate permit systems applicable to operations for the on-site reprocessing of abandoned coal refuse and operations for the removal of abandoned coal refuse on lands that would otherwise be eligible for expenditure under section 404 and section 402(g)(4) of the Surface Mining Control and Reclamation Act of 1977.

(2) The standards and permit systems referred to in paragraph (1) shall distinguish between those operations which reprocess abandoned coal refuse on-site, and those operations which completely remove abandoned coal refuse from a site for the direct use of such coal refuse, or for the reprocessing of such coal refuse, at another location. Such standards and permit systems shall be premised on the distinct differences between operations for the on-site reprocessing, and operations for the removal, of abandoned coal refuse and other types of surface coal mining operations.

(3) The Secretary of the Interior may devise a different standard than any of those set forth in section 515 and section 516 of the Surface Mining Control and Reclamation Act of 1977, and devise a separate permit system, if he determines, on a standard-by-standard basis, that a different standard may facilitate the on-site reprocessing, or the removal, of abandoned coal refuse in a manner that would provide the same level of environmental protection as under section 515 and section 516.

(4) Not later than 30 days prior to the publication of the proposed regulations referred to in this subsection, the Secretary shall submit a report to the Committee on Interior and Insular Affairs of the United States House of Representatives, and the Committee on Energy and Natural Resources of the United States Senate containing a detailed description of any environmental protection performance and

reclamation standards, and separate permit systems, devised pursuant to this subsection.

SEC. 2504. SURFACE MINING ACT IMPLEMENTATION.

(a) SUBSIDENCE- (1) Title VII of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1291 and following) is amended by adding the following new section at the end thereof:

`SEC. 720. SUBSIDENCE.

`(a) REQUIREMENTS- Underground coal mining operations conducted after the date of enactment of this section shall comply with each of the following requirements:

`(1) Promptly repair, or compensate for, material damage resulting from subsidence caused to any occupied residential dwelling and structures related thereto, or non-commercial building due to underground coal mining operations. Repair of damage shall include rehabilitation, restoration, or replacement of the damaged occupied residential dwelling and structures related thereto, or non-commercial building. Compensation shall be provided to the owner of the damaged occupied residential dwelling and structures related thereto or non-commercial building and shall be in the full amount of the diminution in value resulting from the subsidence. Compensation may be accomplished by the purchase, prior to mining, of a noncancellable premium-prepaid insurance policy.

`(2) Promptly replace any drinking, domestic, or residential water supply from a well or spring in existence prior to the application for a surface coal mining and reclamation permit, which has been affected by contamination, diminution, or interruption resulting from underground coal mining operations.

Nothing in this section shall be construed to prohibit or interrupt underground coal mining operations.

`(b) REGULATIONS- Within one year after the date of enactment of this section, the Secretary shall, after providing notice and opportunity for public comment, promulgate final regulations to implement subsection (a).'.

(2)(A) The Secretary of the Interior shall review existing requirements related to underground coal mine subsidence and natural gas and petroleum pipeline safety. Such review shall consider the following with respect to subsidence: notification; mitigation; coordination; requirements of the Natural Gas Pipeline Safety Act and the Hazardous Liquid Pipeline Safety Act; and the status of Federal, State and local laws, as well as common law, with respect to prevention or mitigation of damage from subsidence.

(B) The review shall also include a survey of the status of Federal, State, and local laws, as well as common law, with respect to the responsibilities of the relevant parties for costs resulting from damage due to subsidence or from mitigation efforts undertaken to prevent damage from subsidence.

(C) In conducting the review, the Secretary of the Interior shall consult with the Secretary of Transportation, the Attorney General of the United States, appropriate officials of relevant States, and owners and representatives of natural gas and petroleum pipeline companies and coal companies.

(D) The Secretary of the Interior shall submit a report detailing the results of the review to the Committee on Energy and Natural Resources of the United States Senate and the Committee on Interior and Insular Affairs of the United States House of Representatives within 18 months of enactment of this

Act. Where appropriate, the Secretary of the Interior shall commence a rulemaking to address any deficiencies in existing law determined in the review under subparagraph (A) regarding notification, coordination and mitigation.

(b) VALID EXISTING RIGHTS- During the 1-year period following the enactment of this Act, in administering the provisions of the Surface Mining Control and Reclamation Act of 1977 regarding valid existing rights, the Secretary of the Interior shall continue in force and effect the policies of the Office of Surface Mining as set forth in the November 10, 1986 Statement of Policy published in 51 Federal Register 41952.

(c) RESEARCH- (1) Section 401(c)(6) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1231(c)(6)) is amended as follows:

(A) Insert `, research, and demonstration projects' after `studies'.

(B) Strike `to provide information, advice, and technical assistance, including research and demonstration projects'.

(2) Section 403(a) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1233) is amended by striking paragraph (4) and renumber the subsequent paragraphs accordingly.

(3) Title VII of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1291 and following) is amended by adding the following new section after section 720:

`SEC. 721. RESEARCH.

`The Office of Surface Mining Reclamation and Enforcement is authorized to conduct studies, research and demonstration projects relating to the implementation of, and compliance with, title V of this Act, and provide technical assistance to states for that purpose. Prior to approving any such studies, research or demonstration projects the Director, Office of Surface Mining Reclamation and Enforcement, shall first consult with the Director, Bureau of Mines, and obtain a determination from such Director that the Bureau of Mines is not already conducting like or similar studies, research or demonstration projects. Studies, research and demonstration projects for the purposes of title IV of this Act shall only be conducted in accordance with section 401(c)(6).'.

(d) COAL FORMATIONS- (1) In furtherance of the purposes of the Act of August 31, 1954 (30 U.S.C. 551-558) the Secretary of the Interior, acting through the Director of the Office of Surface Mining Reclamation and Enforcement, shall, upon application by a State, enter into a cooperative agreement with any such State that has an approved abandoned mine reclamation program pursuant to section 405 of the Surface Mining Control and Reclamation Act of 1977 to undertake the activities referred to in section 3(b) of the Act of August 31, 1954 (30 U.S.C. 553(b)). The Secretary shall immediately enter into such cooperative agreement upon application by a State. Any such cooperative agreement shall not be subject to review or approval by the Appalachian Regional Development Commission.

(2) For the purposes of the cooperative agreements entered into pursuant to paragraph (1), the requirements of section 5 of the Act of August 31, 1954 (30 U.S.C. 555) are hereby waived.

(3) Section 8 of the Act of August 31, 1954 (30 U.S.C. 558) is amended by striking `not to exceed $500,000 annually,'.

(e) TECHNICAL AMENDMENT- Section 403(b)(2) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1233(b)(2)) is amended by inserting `, or as the case may be, the dates (and under the criteria) set forth under section 402(g)(4)(B)' after `1977' in each instance such date appears.

SEC. 2505. FEDERAL LIGNITE COAL ROYALTIES.

(a) COAL IN FORT UNION REGION- Notwithstanding any other provision of law, or any regulation or guideline issued thereunder, the Secretary of the Interior may determine, with respect to lignite coal in the Fort Union region, a lesser royalty than the royalty specified under section 7 of the Mineral Leasing Act (30 U.S.C. 207). Any lesser royalty granted under this section, or under section 39 of the Mineral Leasing Act (30 U.S.C. 209) after March 29, 1990, for lignite coal in the Fort Union region shall continue for a term of at least 10 years from the effective date of such reduction.

(b) REVIEW AND EXTENSION- Within 10 years after the date of enactment of this Act, the Secretary of the Interior shall review the effect of any royalty reduction pursuant to subsection (a) on the production of coal. If the Secretary determines that such royalty reduction has had no significant adverse impact on coal production, upon a request by a lignite coal operator in the Fort Union region, the Secretary may grant an additional royalty reduction for a period of 10 years, provided that the total term of the reduced royalty granted pursuant to subsection (a) and this subsection for a tract or lease does not exceed a period of 20 years.

SEC. 2506. ACQUIRED FEDERAL LAND MINERAL RECEIPTS MANAGEMENT.

(a) MINERAL RECEIPTS UNDER ACQUIRED LANDS ACT- Section 6 of the Mineral Leasing Act for Acquired Lands (30 U.S.C. 355) is amended by inserting `(a)' before the first sentence and by adding the following new subsection at the end thereof:

`(b) Notwithstanding any other provision of law, any payment to a State under this section shall be made by the Secretary of the Interior and shall be made not later than the last business day of the month following the month in which such moneys or associated reports are received by the Secretary of the Interior, whichever is later. The Secretary shall pay interest to a State on any amount not paid to the State within that time at the rate prescribed under section 111 of the Federal Oil and Gas Royalty Management Act of 1982 from the date payment was required to be made under this subsection until the date payment is made.'.

(b) AUTHORITY TO MANAGE CERTAIN MINERAL LEASES- The Mineral Leasing Act for Acquired Lands (30 U.S.C. 351 and following) is amended by adding the following new section at the end thereof:

`SEC. 11. AUTHORITY TO MANAGE CERTAIN MINERAL LEASES.

`Each department, agency and instrumentality of the United States which administers lands acquired by the United States with one or more existing mineral lease shall transfer to the Secretary of the Interior the authority to administer such lease and to collect all receipts due and payable to the United States under the lease. In the case of lands acquired on or before the date of the enactment of this section, the authority to administer the leases and collect receipts shall be transferred to the Secretary of the Interior as expeditiously as practicable after the date of enactment of this section. In the case of lands acquired after the date of enactment of this section, such authority shall be vested with the Secretary at the time of acquisition. The provisions of section 6 of this Act shall apply to all receipts derived from such leases where such receipts are due and payable to the United States under the lease in the same manner as such

provisions apply to receipts derived from leases issued under the authority of this Act. For purposes of this section, the term `existing mineral lease' means any lease in existence at the time land is acquired by the United States. Nothing in this section shall be construed to affect the existing surface management authority of any Federal agency.'.

(c) CLARIFICATION- Section 7 of the Act of August 18, 1941, ch. 377 (33 U.S.C. 701c-3) is amended by adding the following sentence at the end thereof: `For the purposes of this section, the term `money' includes, but is not limited to, such bonuses, royalties and rentals (and any interest or other charge paid to the United States by reason of the late payment of any royalty, rent, bonus or other amount due to the United States) paid to the United States from a mineral lease issued under the authority of the Mineral Leasing Act for Acquired Lands or paid to the United States from a mineral lease in existence at the time of the acquisition of the land by the United States.'.

SEC. 2507. RESERVED OIL AND GAS.

(a) IN GENERAL- Section 17(b) of the Mineral Leasing Act (30 U.S.C. 226(b)) is amended as follows--

(1) In paragraph (1)(A), strike out `under paragraph (2)' and insert in lieu thereof `under paragraphs (2) and (3)'.

(2) Adding at the end thereof the following new paragraph:

`(3)(A) If the United States held a vested future interest in a mineral estate that, immediately prior to becoming a vested present interest, was subject to a lease under which oil or gas was being produced, or had a well capable of producing, in paying quantities at an annual average production volume per well per day of either not more than 15 barrels per day of oil or condensate, or not more than 60,000 cubic feet of gas, the holder of the lease may elect to continue the lease as a noncompetitive lease under subsection (c)(1).

`(B) An election under this paragraph is effective--

`(i) in the case of an interest which vested after January 1, 1990, and on or before the date of enactment of this paragraph, if the election is made before the date that is 1 year after the date of enactment of this paragraph;

`(ii) in the case of an interest which vests within 1 year after the date of enactment of this paragraph, if the election is made before the date that is 2 years after the date of enactment of this paragraph; and

`(iii) in any case other than those described in clause (i) or (ii), if the election is made prior to the interest becoming a vested present interest.

`(C) Notwithstanding the consent requirement referenced in section 3 of the Mineral Leasing Act for Acquired Lands (30 U.S.C. 352), the Secretary shall issue a noncompetitive lease under subsection (c)(1) to a holder who makes an election under subparagraph (A) and who is qualified to hold a lease under this Act. Such lease shall be subject to all terms and conditions under this Act that are applicable to leases issued under subsection (c)(1).

`(D) A lease issued pursuant to this paragraph shall continue so long as oil or gas continues to be produced in paying quantities.

`(E) This paragraph shall apply only to those lands under the administration of the Secretary of Agriculture where the United States acquired an interest in such lands pursuant to the Act of March 1, 1911 (36 Stat. 961 and following).'.

(b) EFFECTIVE DATE- The amendments made by subsection (a) apply with respect to those mineral estates in which the interest of the United States becomes a vested present interest after January 1, 1990.

SEC. 2508. CERTAIN OUTSTANDING OIL AND GAS.

(a) IN GENERAL- Section 17 of the Mineral Leasing Act (30 U.S.C. 226) is amended by adding the following new subsection after subsection (n):

`(o) CERTAIN OUTSTANDING OIL AND GAS- (1) Prior to the commencement of surface-disturbing activities relating to the development of oil and gas deposits on lands described under paragraph (5), the Secretary of Agriculture shall require, pursuant to regulations promulgated by the Secretary, that such activities be subject to terms and conditions as provided under paragraph (2).

`(2) The terms and conditions referred to in paragraph (1) shall require that reasonable advance notice be furnished to the Secretary of Agriculture at least 60 days prior to the commencement of surface disturbing activities.

`(3) Advance notice under paragraph (2) shall include each of the following items of information:

`(A) A designated field representative.

`(B) A map showing the location and dimensions of all improvements, including but not limited to, well sites and road and pipeline accesses.

`(C) A plan of operations, of an interim character if necessary, setting forth a schedule for construction and drilling.

`(D) A plan of erosion and sedimentation control.

`(E) Proof of ownership of mineral title.

Nothing in this subsection shall be construed to affect any authority of the State in which the lands concerned are located to impose any requirements with respect to such oil and gas operations.

`(4) The person proposing to develop oil and gas deposits on lands described under paragraph (5) shall either--

`(A) permit the Secretary to market merchantable timber owned by the United States on lands subject to such activities; or

`(B) arrange to purchase merchantable timber on lands subject to such surface disturbing activities from the Secretary of Agriculture, or otherwise arrange for the disposition of such merchantable timber, upon such terms and upon such advance notice of the items referred to in subparagraphs (A) through (E) of paragraph (3) as the Secretary may accept.

`(5)(A) The lands referred to in this subsection are those lands referenced in subparagraph (B) which are

under the administration of the Secretary of Agriculture where the United States acquired an interest in such lands pursuant to the Act of March 1, 1911 (36 Stat. 961 and following), but does not have an interest in oil and gas deposits that may be present under such lands. This subsection does not apply to any such lands where, under the provisions of its acquisition of an interest in the lands, the United States is to acquire any oil and gas deposits that may be present under such lands in the future but such interest has not yet vested with the United States.

`(B) This subsection shall only apply in the Allegheny National Forest.'.

(b) REGULATIONS- Within 90 days after the enactment of this Act the Secretary of Agriculture shall promulgate regulations to implement the amendment made by subsection (a).

SEC. 2509. FEDERAL ONSHORE OIL AND GAS LEASING.

The first sentence of section 17(e) of the Mineral Leasing Act (30 U.S.C. 226(e)) is amended by striking the phrase starting with `Competitive leases' and ending with `ten years: *Provided, however,*' and inserting in lieu thereof the following: `Competitive and noncompetitive leases issued under this section shall be for a primary term of 10 years: *Provided, however,*'.

SEC. 2510. OIL PLACER CLAIMS.

Notwithstanding any other provision of law, in furtherance of the purposes of the Act of February 11, 1897, commonly referred to as the Oil Placer Act, and section 37 of the Mineral Leasing Act, the Secretary of the Interior is authorized and directed to, within 90 days after the enactment of this Act, (1) convey by quit-claim deed to the owner or owners, or (2) separately and as an alternative, disclaim and relinquish by a document in any form suitable for recordation in the county within which the lands are situated, all right, title and interest or claim of interest of the United States to those lands in the counties of Hot Springs, Park and Washakie in the State of Wyoming, held pursuant to the Act of February 11, 1897, and which are currently producing covered substances under a cooperative or unit plan of development.

SEC. 2511. OIL SHALE CLAIMS.

(a) NOTICE- Notwithstanding any other provision of law, within 60 days from the date of enactment of this Act, the Secretary of the Interior shall provide notice to each holder of an unpatented oil shale mining claim of the requirements of this Act. Such notice shall be made by registered mail and by publication in a newspaper of general circulation in the areas in which such claims are located.

(b) FULL PATENT- The holder of a valid oil shale mining claim who has filed a patent application and received first half final certificate for patent by date of enactment of this Act, may obtain a patent pursuant to the general mining laws of the United States.

(c) PATENT- (1) Notwithstanding any other provision of law, the holder of a valid oil shale mining claim who has filed a patent application which has been accepted for processing by the Department of the Interior by the date of enactment of this Act but has not received first half final certificate for patent by the date of enactment of this Act may receive only a patent limited to the oil shale and associated minerals, upon payment of $2.50 per acre. Title to the surface and to all other minerals, including, but not limited to, oil, gas, and coal, shall remain in the United States. Patents issued pursuant to this subsection shall provide for surface use to the same extent as is provided under applicable law prior to enactment of this Act with respect to oil shale mining claims, subject to the requirements of subsection

(f).

(2) Maintenance of claims referred to in this subsection prior to patent issuance shall be in accordance with the requirements of applicable law prior to enactment of this Act.

(3) Any holder of a valid oil shale mining claim referred to in this subsection may maintain such claim in accordance with the requirements set forth in subsection (e)(2) in lieu of receiving a patent under this section.

(4) Notwithstanding any other provision of law, any person referred to in paragraph (1) who obtains compensation from the United States as a result of the application of this section being declared to be a taking of property within the meaning of the Fifth Amendment to the United States Constitution, may obtain a full patent upon tender to the Secretary of the amount of such compensation, not including interest, and upon the receipt of such amount, the Secretary shall convey to such person a patent in the form and manner provided under the general mining laws of the United States. Such tender may only be made within 3 years of obtaining such compensation.

(d) ELECTION- (1) Notwithstanding any other provision of law, within 180 days from the date of which the Secretary provided notice under subsection (a), a holder of a valid oil shale mining claim for which a patent application was not filed and accepted for processing by the Department of the Interior prior to the date of enactment of this Act shall file with the Secretary a notice of election to--

(A) proceed to limited patent as provided in subsection (e)(1); or

(B) maintain the unpatented claim as provided for in subsection (e)(2).

(2) Failure to file the notice of election as required by paragraph (1) shall be deemed conclusively to constitute an abandonment of the claim by operation of law.

(3) Any claim holder who elects to proceed under paragraph (1)(A) must apply for a patent within 2 years from the date of election or notify the Secretary in writing prior to expiration of the 2-year period of a decision to maintain such claim as provided in paragraph (1)(B) or such claim shall be deemed conclusively to have been abandoned by operation of law.

(4) The provisions of this subsection shall be in addition to the requirements of section 314 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1744).

(e) EFFECT OF ELECTION- (1) Notwithstanding any other provisions of law, a claim holder subject to the election requirements of subsection (d) who elects to receive a limited patent shall receive title only to the oil shale associated minerals, upon payment of fair market value for the oil shale and associated minerals. Title to the surface and to all other minerals, including, but not limited to oil, gas, and coal, shall remain in the United States. Patents issued pursuant to this subsection shall provide for surface use to the same extent as is provided under applicable law prior to the enactment of this Act with respect to oil shale mining claims, subject to the requirements of subsection (f).

(2) Notwithstanding any other provision of law, a claim holder referred to in subsection (c) or a claim holder subject to the election requirements of subsection (d) who maintains or elects to maintain an unpatented claim shall maintain such claim by complying with the general mining laws of the United States, and with the provisions of this section, except that the claim holder shall no longer be required to perform annual labor, and instead shall pay to the Secretary $550 per claim per year for deposit as

miscellaneous receipts in the general fund of the Treasury, commencing with calendar year 1993. Such fee shall accompany the filing made by the claim holder with the Bureau of Land Management pursuant to section 314(a)(2) of the Federal Land Policy and Management Act (43 U.S.C. 1744(a)(2)).

(f) RECLAMATION- In addition to other applicable requirements, any person who holds a limited patent or maintains a claim pursuant to this section shall be required to carry out reclamation as prescribed by the Secretary and to furnish a bond or other appropriate financial guarantee in an amount sufficient to ensure adequate reclamation of the lands to be disturbed by any aspect of the proposed mining activities.

(g) REAFFIRMATION OF REQUIREMENTS- Without comment on the adequacy of current or former standards for determining validity of oil shale claims, Congress reaffirms the requirements of law that a patent may issue only to persons who hold valid claims and the need for careful review of any applications.

(h) ISSUANCE OF PATENTS- Notwithstanding any other provision of law, with respect to any oil shale mining claim located under the general mining laws of the United States, no patent for such claim shall be issued except as provided by this section.

SEC. 2512. HEALTH, SAFETY, AND MINING TECHNOLOGY RESEARCH PROGRAM.

(a) HEALTH, SAFETY, AND MINING TECHNOLOGY RESEARCH PLAN- (1) Every 5 years, the Secretary of the Interior, acting through the Director of the Bureau of Mines (hereinafter in this section referred to as the `Director'), shall develop a Plan for Health, Safety, and Mining Technology Research (hereinafter in this subsection referred to as the `Plan').

(2) The Plan shall identify the goals and objectives of the Health, Safety, and Mining Technology program of the Bureau of Mines, and shall guide research and technology development under such program, over each 5-year period.

(3) In preparing the proposed Plan referred to in paragraph (1), the Director shall solicit suggestions, comments and proposals for research and technology development projects from the mining industry, labor, academia and other concerned groups and individuals.

(b) TECHNICAL AMENDMENT- For the purposes of section 501(b) of Public Law 91-173, as amended, activities in the field of coal or other mine health under such section shall also be carried out by the Secretary of the Interior acting through the Director of the Bureau of Mines. Nothing in this subsection is intended to preclude or duplicate the ongoing research activities of the Bureau of Mines on health hazards safety technology or research conducted by the National Institute of Occupational Safety and Health on coal mine safety and health effects.

SEC. 2513. ASSISTANCE TO SMALL COAL OPERATORS.

(a) ASSISTANCE- Section 507(c) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1257(c)) is amended to read as follows:

`(c) ASSISTANCE TO SMALL COAL OPERATORS- (1) If the regulatory authority finds that the probable total annual production at all locations of a coal surface mining operator will not exceed 300,000 tons, the cost of the following activities, which shall be performed by a qualified public or private laboratory or such other public or private qualified entity designated by the regulatory authority,

shall be assumed by the regulatory authority upon the written request of the operator in connection with a permit application:

`(A) The determination of probable hydrologic consequences required by subsection (b)(11), including the engineering analyses and designs necessary for the determination.

`(B) The development of cross-section maps and plans required by subsection (b)(14).

`(C) The geologic drilling and statement of results of test borings and core samplings required by subsection (b)(15).

`(D) The collection of archaeological information required by subsection (b)(13) and any other archaeological and historical information required by the regulatory authority, and the preparation of plans necessitated thereby.

`(E) Pre-blast surveys required by section 515(b)(15)(E).

`(F) The collection of site-specific resource information and production of protection and enhancement plans for fish and wildlife habitats and other environmental values required by the regulatory authority under this Act.

`(2) The Secretary shall provide or assume the cost of training coal operators that meet the qualifications stated in paragraph (1) concerning the preparation of permit applications and compliance with the regulatory program, and shall ensure that qualified coal operators are aware of the assistance available under this subsection.'.

(b) REIMBURSEMENT OF COSTS- Section 507 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1257) is amended by adding at the end thereof the following new subsection:

`(h) REIMBURSEMENT OF COSTS- A coal operator that has received assistance pursuant to subsection (c) (1) or (2) shall reimburse the regulatory authority for the cost of the services rendered if the program administrator finds that the operator's actual and attributed annual production of coal for all locations exceeds 300,000 tons during the 12 months immediately following the date on which the operator is issued the surface coal mining and reclamation permit.'.

SEC. 2514. SURFACE MINING REGULATIONS.

Section 710 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1300) is amended by adding at the end the following new subsection:

`(i) GRANTS- The Secretary shall make grants to the Navajo, Hopi, Northern Cheyenne, and Crow tribes to assist such tribes in developing regulations and programs for regulating surface coal mining and reclamation operations on Indian lands, except that nothing in this subsection may be construed as providing such tribes with the authorities set forth under section 503. Grants made under this subsection shall be used to establish an office of surface mining regulation for each such tribe. Each such office shall--

`(1) develop tribal regulations and program policies with respect to surface mining;

`(2) assist the Office of Surface Mining Reclamation and Enforcement established by section 201

in the inspection and enforcement of surface mining activities on Indian lands, including, but not limited to, permitting, mine plan review, and bond release; and

`(3) sponsor employment training and education in the area of mining and mineral resources.'.

SEC. 2515. AMENDMENT TO SURFACE MINING ACT.

Section 402(b) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1232(b)) is amended by striking `1995' and inserting in lieu thereof `2004, after which time the fee shall be established at a rate to continue to provide for the deposit referred to in subsection (h)'.

TITLE XXVI--INDIAN ENERGY RESOURCES

SEC. 2601. DEFINITIONS.

For purposes of this title--

(1) the term `Indian tribe' means any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601 et seq.), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; and

(2) the term `Indian reservation' includes Indian reservations; public domain Indian allotments; former Indian reservations in Oklahoma; land held by incorporated Native groups, regional corporations, and village corporations under the provisions of the Alaska Native Claims Settlement Act (43 U.S.C. 1601 et seq.); and dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a State.

SEC. 2602. TRIBAL CONSULTATION.

In implementing the provisions of this Act, the Secretary of Energy shall involve and consult with Indian tribes to the maximum extent possible and where appropriate and shall do so in a manner that is consistent with the Federal trust and the Government-to-Government relationships between Indian tribes and the Federal Government.

SEC. 2603. PROMOTING ENERGY RESOURCE DEVELOPMENT AND ENERGY VERTICAL INTEGRATION ON INDIAN RESERVATIONS.

(a) DEMONSTRATION PROGRAMS- The Secretary of Energy, in consultation with the Secretary of the Interior, shall establish and implement a demonstration program to assist Indian tribes in pursuing energy self-sufficiency and to promote the development of a vertically integrated energy industry on Indian reservations, in order to increase development of the substantial energy resources located on such Indian reservations. Such program shall include, but not be limited to, the following components:

(1) The Secretary shall provide development grants to Indian tribes or to joint ventures which are 51 percent or more controlled by an Indian tribe to assist Indian tribes in obtaining the managerial and technical capability needed to develop the energy resources on Indian reservations. Such grants shall include provisions for management training for tribal or village members, improving

the technical capacity of the Indian tribe, and the reduction of tribal unemployment. Each grant shall be for a period of 3 years.

(2) The Secretary shall provide grants, not to exceed 50 percent of the project costs, for vertical integration projects. For purposes of this paragraph, the term `vertical integration project' means a project that promotes the vertical integration of the energy resources on an Indian reservation, so that the energy resources are used or processed on such Indian reservation. Such term includes, but is not limited to, projects involving solar and wind energy, oil refineries, the generation and transmission of electricity, hydroelectricity, cogeneration, natural gas distribution, and clean, innovative uses of coal.

(3) The Secretary shall provide technical assistance (and such other assistance as is appropriate) to Indian tribes for energy resource development and to promote the vertical integration of energy resources on Indian reservations.

(b) LOW INTEREST LOANS-

(1) IN GENERAL- The Secretary shall establish a program for making low interest loans to Indian tribes. Such loans shall be used exclusively by Indian tribes in the promotion of energy resource development and vertical integration on Indian reservations.

(2) TERMS- The Secretary shall establish reasonable terms for loans made under this section which are to be used to carry out the purposes of this section.

(c) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated--

(1) $10,000,000 for each of the fiscal years 1994, 1995, 1996, and 1997 to carry out the purposes of subsection (a)(1);

(2) $10,000,000 for each of the fiscal years 1994, 1995, 1996, and 1997 to carry out the purposes of subsection (a)(2); and

(3) $10,000,000 for each of the fiscal years 1994, 1995, 1996, and 1997 to carry out the purposes of subsection (b).

SEC. 2604. INDIAN ENERGY RESOURCE REGULATION.

(a) GRANTS- The Secretary of the Interior is authorized to make annual grants to Indian tribes for the purpose of assisting Indian tribes in the development, administration, implementation, and enforcement of tribal laws and regulations governing the development of energy resources on Indian reservations.

(b) PURPOSE- The purposes for which funds provided under a grant awarded under subsection (a) may be used include, but are not limited to--

(1) the training and education of employees responsible for enforcing or monitoring compliance with Federal and tribal laws and regulations;

(2) the development of tribal inventories of energy resources;

(3) the development of tribal laws and regulations;

(4) the development of tribal legal and governmental infrastructure to regulate environmental quality pursuant to Federal and tribal laws; and

(5) the enforcement and monitoring of Federal and tribal laws and regulations.

(c) OTHER ASSISTANCE- The Secretary of the Interior and the Secretary of Energy shall cooperate with and provide assistance to Indian tribes for the purpose of assisting Indian tribes in the development, administration, and enforcement of tribal programs. Such cooperation and assistance shall include the following:

(1) Technical assistance and training, including the provision of necessary circulars and training materials.

(2) Assistance in the preparation and maintenance of a continuing inventory of information on tribal energy resources and tribal operations. In providing assistance under this paragraph, Federal departments and agencies shall make available to Indian tribes all relevant data concerning tribal energy resource development consistent with applicable laws regarding disclosure of proprietary and confidential information.

(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated $10,000,000 for each of the fiscal years 1994, 1995, 1996, and 1997 to carry out the purposes of this section.

SEC. 2605. INDIAN ENERGY RESOURCE COMMISSION.

(a) ESTABLISHMENT- There is hereby established the Indian Energy Resource Commission (hereafter in this section referred to as the `Commission').

(b) MEMBERSHIP- The Commission shall consist of--

(1) 8 members appointed by the Secretary of the Interior from recommendations submitted by Indian tribes with developable energy resources, at least 4 of whom shall be elected tribal leaders;

(2) 3 members appointed by the Secretary of the Interior from recommendations submitted by the Governors of States that have Indian reservations with developable energy resources;

(3) 2 members appointed by the Secretary of the Interior from among individuals in the private sector with expertise in tribal and State taxation of energy resources;

(4) 2 members appointed by the Secretary of the Interior from individuals with expertise in oil and gas royalty management administration, including auditing and accounting;

(5) 2 members appointed by the Secretary of the Interior from individuals in the private sector with expertise in energy development;

(6) 1 member appointed by the Secretary of the Interior from recommendations submitted by National environmental organizations;

(7) the Secretary of the Interior, or his designee; and

(8) the Secretary of Energy, or his designee.

(c) APPOINTMENTS- Members of the Commission shall be appointed not later than 60 days after the date of the enactment of this title.

(d) VACANCIES- A vacancy in the Commission shall be filled in the same manner as the original appointment was made. A vacancy in the Commission shall not affect the powers of the Commission.

(e) CHAIRPERSON- The members of the Commission shall elect a Chairperson from among the members of the Commission.

(f) QUORUM- Eleven members of the Commission shall constitute a quorum, but a lesser number may hold hearings.

(g) ORGANIZATIONAL MEETING- The Commission shall hold an organizational meeting to establish the rules and procedures of the Commission not later than 30 days after the members are first appointed to the Commission.

(h) COMPENSATION- Each member of the Commission who is not an officer or employee of the United States shall be compensated at a rate established by the Commission, not to exceed the rate of basic pay payable for level IV of the Executive Schedule under section 5315 of title 5, United States Code, for each day (including travel time) during which such member is engaged in the actual performance of duties as a member of the Commission. Each member of the Commission who is an officer or employee of the United States shall receive no additional compensation.

(i) TRAVEL- While away from their homes or regular places of business in the performance of duties for the Commission, all members of the Commission shall be allowed travel expenses, including per diem in lieu of subsistence, at a rate established by the Commission not to exceed the rates authorized for employees under sections 5702 and 5703 of title 5, United States Code.

(j) COMMISSION STAFF-

(1) EXECUTIVE DIRECTOR- The Commission shall appoint an Executive Director who shall be compensated at a rate established by the Commission not to exceed the rate of basic pay payable for level V of the Executive Schedule under section 5316 of title 5, United States Code.

(2) ADDITIONAL PERSONNEL- With the approval of the Commission, the Executive Director may appoint and fix the compensation of such additional personnel as the Executive Director considers necessary to carry out the duties of the Commission. Such appointments shall be made in accordance with the provisions of title 5, United States Code, governing appointments in the competitive service, but at rates not to exceed the rate of basic pay payable for level 15 of the General Schedule.

(3) EXPERTS AND CONSULTANTS- Subject to such rules as may be issued by the Commission, the Chairperson may procure temporary and intermittent services of experts and consultants to the same extent as is authorized by section 3109 of title 5, United States Code, but at rates not to exceed $200 a day for individuals.

(4) PERSONNEL DETAIL AUTHORIZED- Upon the request of the Chairperson, the head of any Federal agency is authorized to detail, on a reimbursable basis, any of the personnel of such agency to the Commission to assist the Commission in carrying out its duties under this title. Such detail shall be without interruption or loss of civil service status or privilege.

(k) DUTIES OF THE COMMISSION- The Commission shall--

(1) develop proposals to address the dual taxation by Indian tribes and States of the extraction of mineral resources on Indian reservations;

(2) make recommendations to improve the management, administration, accounting and auditing of royalties associated with the production of oil and gas on Indian reservations;

(3) develop alternatives for the collection and distribution of royalties associated with production of oil and gas on Indian reservations;

(4) develop proposals on incentives to foster the development of energy resources on Indian reservations;

(5) identify barriers or obstacles to the development of energy resources on Indian reservations, and make recommendations designed to foster the development of energy resources on Indian reservations and promote economic development;

(6) develop proposals for the promotion of vertical integration of the development of energy resources on Indian reservations; and

(7) develop proposals on taxation incentives to foster the development of energy resources on Indian reservations including, but not limited to, investment tax credits and enterprise zone credits.

(l) POWERS OF THE COMMISSION- The powers of the Commission shall include the following:

(1) For the purpose of carrying out its duties under this section, the Commission may hold hearings, take testimony, and receive evidence at such times and places as the Commission considers appropriate. The Commission may administer oaths or affirmations to witnesses appearing before the Commission.

(2) Any member or employee of the Commission may, if authorized by the Commission, take any action which the Commission is authorized to take by this section.

(3) The Commission may secure directly from any Federal agency such information as may be necessary to enable the Commission to carry out its duties under this section.

(m) COMMISSION REPORT-

(1) IN GENERAL- The Commission shall, within 12 months after funds are made available to carry out this section, prepare and transmit to the President, the Committee on Interior and Insular Affairs of the House of Representatives, the Select Committee on Indian Affairs of the Senate, and the Committee on Energy and Natural Resources of the Senate, a report containing the recommendations and proposals specified in subsection (k).

(2) REVIEW AND COMMENT- Prior to submission of the report required under this section, the Chairman shall circulate a draft of the report to Indian tribes and States that have Indian reservations with developable energy resources and other interested tribes and States for review and comment.

(n) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to the Commission $1,000,000 to carry out this section. Such sum shall remain available, without fiscal year limitation, until expended.

(o) TERMINATION- The Commission shall terminate 30 days after submitting the final report required by subsection (m).

SEC. 2606. TRIBAL GOVERNMENT ENERGY ASSISTANCE PROGRAM.

(a) FINANCIAL ASSISTANCE- The Secretary may grant financial assistance to Indian tribal governments, or private sector persons working in cooperation with Indian tribal governments, to carry out projects to evaluate the feasibility of, develop options for, and encourage the adoption of energy efficiency and renewable energy projects on Indian reservations. Such grants may include the costs of technical assistance in resource assessment, feasibility analysis, technology transfer, and the resolution of other technical, financial, or management issues identified by the applicants for such grants.

(b) CONDITIONS- Any applicant for financial assistance under this section must evidence coordination and cooperation with, and support from, local educational institutions and the affected local energy institutions.

(c) CONSIDERATIONS- In determining the amount of financial assistance to be provided for a proposed project, the Secretary shall consider--

(1) the extent of involvement of local educational institutions and local energy institutions;

(2) the ease and costs of operation and maintenance of any project contemplated as a part of the project;

(3) whether the measure will contribute significantly to the development, or the quality of the environment, of the affected Indian reservations; and

(4) any other factors which the Secretary may determine to be relevant to a particular project.

(d) COST-SHARE- With the exception of grants awarded for the purpose of feasibility studies, the Secretary shall require at least 20 percent of the costs of any project under this section to be provided from non-Federal sources, unless the grant recipient is a for-profit private sector institution, in which case the Secretary shall require at least 50 percent of the costs of any project to be provided from non-Federal sources.

(e) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as are necessary for the development and implementation of the program established by this section.

TITLE XXVII--INSULAR AREAS ENERGY SECURITY

SEC. 2701. INSULAR AREAS ENERGY ASSISTANCE PROGRAM.

Section 604 of the Act entitled `An Act to authorize appropriations for certain insular areas of the United States, and for other purposes', Public Law 96-597, as amended by Public Law 98-213 (48 U.S.C. 1492), is amended by adding at the end the following new subsection:

`(g) FINANCIAL ASSISTANCE- (1) The Secretary of Energy may grant financial assistance, not to exceed $2,000,000 annually, to insular area governments or private sector persons working in cooperation with insular area governments to carry out projects to evaluate the feasibility of, develop options for, and encourage the adoption of energy efficiency and renewable energy measures which reduce the dependency of the insular areas on imported fuels, improve the quality of the environment, and promote development in the insular areas.

`(2) Any applicant for financial assistance under this subsection must evidence coordination and cooperation with, and support from, the affected local energy institutions.

`(3) In determining the amount of financial assistance to be provided for a proposed project, the Secretary shall consider--

`(A) whether the measure will reduce the relative dependence of the insular area on imported fuels;

`(B) the ease and costs of operation and maintenance of any facilities contemplated as a part of the project;

`(C) whether the project will rely on the use of conservation measures or indigenous, renewable energy resources that were identified in the 1982 Territorial Energy Assessment or that are identified by the Secretary as consistent with the purposes of this subsection;

`(D) whether the measure will contribute significantly to development and the quality of the environment in the insular area; and

`(E) any other factors which the Secretary may determine to be relevant to a particular project.

`(4) Notwithstanding the requirements of section 501(d) of Public Law 95-134 (48 U.S.C. 1469a(d)), the Secretary shall require at least 20 percent of the costs of any project under this subsection to be provided from non-Federal sources. Such cost sharing may be in the form of in-kind services, donated equipment, or any combination thereof.

`(5) For the purposes of this subsection--

`(A) the term `insular area' means American Samoa, the Commonwealth of the Northern Mariana Islands, the Commonwealth of Puerto Rico, the Federated States of Micronesia, Guam, the Republic of the Marshall Islands, the Republic of Palau, and the Virgin Islands; and

`(B) the term `1982 Territorial Energy Assessment' means the comprehensive energy plan prepared by the Secretary of Energy pursuant to subsection (c).'.

SEC. 2702. DEFINITION.

For amendment of the definition of the term `State' for purposes of the nuclear waste negotiation provisions of title IV of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10241 et seq.), see section 802 (b).

SEC. 2703. ELECTRICITY REQUIREMENTS IN TRUST TERRITORY OF THE PACIFIC ISLANDS.

Not later than 3 months after the completion of the Palau National Master Development Plan developed

pursuant to the Department of the Interior Secretary's Order No. 3142, the Secretary of the Interior shall, in consultation with the Government of Palau, submit a plan to the Committee on Energy and Natural Resources of the Senate and the Committee on Interior and Insular Affairs of the House of Representatives to provide electric service in Palau that is consistent with determinations made in developing the Palau National Master Development Plan, with regard to the need for and financing and scheduling of the availability of such service.

SEC. 2704. PCB CLEANUP IN MARSHALL ISLANDS AND FEDERATED STATES OF MICRONESIA.

Section 105(h) of Public Law 99-239 is amended by adding at the end the following new paragraph:

`(5) The programs and services of the Environmental Protection Agency regarding PCB's shall, to the extent applicable, as appropriate, and in accordance with applicable law, be construed to be made available to such islands.'.

TITLE XXVIII--NUCLEAR PLANT LICENSING

SEC. 2801. COMBINED LICENSES.

Section 185 of the Atomic Energy Act of 1954 (42 U.S.C. 2235) is amended--

(1) in the heading for such section by adding `and Operating Licenses' after `Permits';

(2) by adding a subsection designator `a.' before `All applicants for licenses'; and

(3) by adding at the end the following new subsection:

`b. After holding a public hearing under section 189 a. (1)(A), the Commission shall issue to the applicant a combined construction and operating license if the application contains sufficient information to support the issuance of a combined license and the Commission determines that there is reasonable assurance that the facility will be constructed and will operate in conformity with the license, the provisions of this Act, and the Commission's rules and regulations. The Commission shall identify within the combined license the inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that, if met, are necessary and sufficient to provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of this Act, and the Commission's rules and regulations. Following issuance of the combined license, the Commission shall ensure that the prescribed inspections, tests, and analyses are performed and, prior to operation of the facility, shall find that the prescribed acceptance criteria are met. Any finding made under this subsection shall not require a hearing except as provided in section 189 a. (1)(B).'.

SEC. 2802. POST-CONSTRUCTION HEARINGS ON COMBINED LICENSES.

Section 189 a. (1) of the Atomic Energy Act of 1954 (42 U.S.C. 2239(a)(1)) is amended--

(1) by adding a subparagraph designator `(A)' before `In any proceeding under this Act,'; and

(2) by adding after subparagraph (A) the following new subparagraph:

`(B)(i) Not less than 180 days before the date scheduled for initial loading of fuel into a plant by a

licensee that has been issued a combined construction permit and operating license under section 185 b., the Commission shall publish in the Federal Register notice of intended operation. That notice shall provide that any person whose interest may be affected by operation of the plant, may within 60 days request the Commission to hold a hearing on whether the facility as constructed complies, or on completion will comply, with the acceptance criteria of the license.

`(ii) A request for hearing under clause (i) shall show, prima facie, that one or more of the acceptance criteria in the combined license have not been, or will not be met, and the specific operational consequences of nonconformance that would be contrary to providing reasonable assurance of adequate protection of the public health and safety.

`(iii) After receiving a request for a hearing under clause (i), the Commission expeditiously shall either deny or grant the request. If the request is granted, the Commission shall determine, after considering petitioners' prima facie showing and any answers thereto, whether during a period of interim operation, there will be reasonable assurance of adequate protection of the public health and safety. If the Commission determines that there is such reasonable assurance, it shall allow operation during an interim period under the combined license.

`(iv) The Commission, in its discretion, shall determine appropriate hearing procedures, whether informal or formal adjudicatory, for any hearing under clause (i), and shall state its reasons therefor.

`(v) The Commission shall, to the maximum possible extent, render a decision on issues raised by the hearing request within 180 days of the publication of the notice provided by clause (i) or the anticipated date for initial loading of fuel into the reactor, whichever is later. Commencement of operation under a combined license is not subject to subparagraph (A).'.

SEC. 2803. RULEMAKING.

The Nuclear Regulatory Commission shall modify part 52 of title 10, Code of Federal Regulations, to conform with sections 185 b. and 189 a. (1)(B) of the Atomic Energy Act of 1954, as added by sections 2801 and 2802 of this Act, not later than 1 year after the date of the enactment of this Act.

SEC. 2804. AMENDMENT OF A COMBINED LICENSE PENDING A HEARING.

Section 189 a. (2) of the Atomic Energy Act of 1954 (42 U.S.C. 2239(a)(2)) is amended by inserting `or any amendment to a combined construction and operating license' after `any amendment to an operating license' each time it occurs.

SEC. 2805. JUDICIAL REVIEW.

Section 189 b. of the Atomic Energy Act of 1954 (42 U.S.C. 2239(b)) is amended by inserting `or any final order allowing or prohibiting a facility to begin operating under a combined construction and operating license' before `shall be subject to judicial review'.

SEC. 2806. EFFECT ON PENDING PROCEEDINGS.

Sections 185 b. and 189 a. (1)(B) of the Atomic Energy Act of 1954, as added by sections 2801 and 2802 of this Act, shall apply to all proceedings involving a combined license for which an application was filed after May 8, 1991, under such sections.

SEC. 2807. CONFORMING AMENDMENT.

The table of contents of the Atomic Energy Act of 1954 is amended by amending the item related to section 185 to read as follows:

`Sec. 185. Construction Permits and Operating Licenses.'.

TITLE XXIX--ADDITIONAL NUCLEAR ENERGY PROVISIONS

SEC. 2901. STATE AUTHORITY TO REGULATE RADIATION BELOW LEVEL OF NRC REGULATORY CONCERN.

(a) IN GENERAL- The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) is amended by inserting after section 275 the following new section:

`SEC. 276. STATE AUTHORITY TO REGULATE RADIATION BELOW LEVEL OF REGULATORY CONCERN OF NUCLEAR REGULATORY COMMISSION.

`(a) IN GENERAL- No provision of this Act, or of the Low-Level Radioactive Waste Policy Act, may be construed to prohibit or otherwise restrict the authority of any State to regulate, on the basis of radiological hazard, the disposal or off-site incineration of low-level radioactive waste, if the Nuclear Regulatory Commission, after the date of the enactment of the Energy Policy Act of 1992 exempts such waste from regulation.

`(b) RELATION TO OTHER STATE AUTHORITY- This section may not be construed to imply preemption of existing State authority. Except as expressly provided in subsection (a), this section may not be construed to confer on any State any additional authority to regulate activities licensed by the Nuclear Regulatory Commission.

`(c) DEFINITIONS- For purposes of this section:

`(1) The term `low-level radioactive waste' means radioactive material classified by the Nuclear Regulatory Commission as low-level radioactive waste on the date of the enactment of the Energy Policy Act of 1992.

`(2) The term `off-site incineration' means any incineration of radioactive materials at a facility that is located off the site where such materials were generated.

`(3) The term `State' means each of the several States, the District of Columbia, and any commonwealth, territory, or possession of the United States.'.

(b) REVOCATION OF RELATED NRC POLICY STATEMENTS- The policy statements of the Nuclear Regulatory Commission published in the Federal Register on July 3, 1990 (55 Fed. Reg. 27522) and August 29, 1986 (51 Fed. Reg. 30839), relating to radioactive waste below regulatory concern, shall have no effect after the date of the enactment of this Act.

(c) CONFORMING AMENDMENT- The table of contents of the Atomic Energy Act of 1954 (42 U.S.C. 2011 prec.) is amended by inserting after the item relating to section 275 the following new item:

`Sec. 276. State authority to regulate radiation below level of regulatory concern of Nuclear

Regulatory Commission.'.

SEC. 2902. EMPLOYEE PROTECTION FOR NUCLEAR WHISTLEBLOWERS.

(a) INTERNAL WHISTLEBLOWERS; EMPLOYERS- Section 210(a) of the Energy Reorganization Act of 1974 (42 U.S.C. 5851(a)) is amended--

(1) by inserting `(1)' after `SEC. 210. (a)';

(2) by striking `, including' and all that follows through `licensee or applicant,';

(3) by inserting after the dash the following new subparagraphs:

`(A) notified his employer of an alleged violation of this Act or the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.);

`(B) refused to engage in any practice made unlawful by this Act or the Atomic Energy Act of 1954, if the employee has identified the alleged illegality to the employer;

`(C) testified before Congress or at any Federal or State proceeding regarding any provision (or proposed provision) of this Act or the Atomic Energy Act of 1954;';

(4) by redesignating paragraphs (1) through (3) as subparagraphs (D) through (F), respectively; and

(5) by adding at the end the following new paragraph:

`(2) For purposes of this section, the term `employer' includes--

`(A) a licensee of the Commission or of an agreement State under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021);

`(B) an applicant for a license from the Commission or such an agreement State;

`(C) a contractor or subcontractor of such a licensee or applicant; and

`(D) a contractor or subcontractor of the Department of Energy that is indemnified by the Department under section 170 d. of the Atomic Energy Act of 1954 (42 U.S.C. 2210(d)), but such term shall not include any contractor or subcontractor covered by Executive Order No. 12344.'.

(b) TIME PERIOD FOR FILING COMPLAINT- Section 210(b)(1) of the Energy Reorganization Act of 1974 (42 U.S.C. 5851(b)(1)) is amended by striking `thirty days' and inserting `180 days'.

(c) INTERIM RELIEF- Section 210(b)(2)(A) of the Energy Reorganization Act of 1974 (42 U.S.C. 5851 (b)(2)(A)) is amended by inserting before the last sentence the following: `Upon the conclusion of such hearing and the issuance of a recommended decision that the complaint has merit, the Secretary shall issue a preliminary order providing the relief prescribed in subparagraph (B), but may not order compensatory damages pending a final order.'.

(d) AVOIDANCE OF FRIVOLOUS COMPLAINTS- Section 210(b) of the Energy Reorganization Act

of 1974 (42 U.S.C. 5851(b)) is amended by adding at the end the following new paragraph:

`(3)(A) The Secretary shall dismiss a complaint filed under paragraph (1), and shall not conduct the investigation required under paragraph (2), unless the complainant has made a prima facie showing that any behavior described in subparagraphs (A) through (F) of subsection (a)(1) was a contributing factor in the unfavorable personnel action alleged in the complaint.

`(B) Notwithstanding a finding by the Secretary that the complainant has made the showing required by subparagraph (A), no investigation required under paragraph (2) shall be conducted if the employer demonstrates, by clear and convincing evidence, that it would have taken the same unfavorable personnel action in the absence of such behavior.

`(C) The Secretary may determine that a violation of subsection (a) has occurred only if the complainant has demonstrated that any behavior described in subparagraphs (A) through (F) of subsection (a)(1) was a contributing factor in the unfavorable personnel action alleged in the complaint.

`(D) Relief may not be ordered under paragraph (2) if the employer demonstrates by clear and convincing evidence that it would have taken the same unfavorable personnel action in the absence of such behavior.'.

(e) NONPREEMPTION- Section 210 of the Energy Reorganization Act of 1974 (42 U.S.C. 5851) is amended by adding at the end the following new subsection:

`(h) This section may not be construed to expand, diminish, or otherwise affect any right otherwise available to an employee under Federal or State law to redress the employee's discharge or other discriminatory action taken by the employer against the employee.'.

(f) POSTING REQUIREMENT- Section 210 of the Energy Reorganization Act of 1974 (42 U.S.C. 5851) is further amended by adding at the end the following new subsection:

`(i) The provisions of this section shall be prominently posted in any place of employment to which this section applies.'.

(g) DUTY OF NRC TO INVESTIGATE SUBSTANTIVE ALLEGATIONS- Section 210 of the Energy Reorganization Act of 1974 (42 U.S.C. 5851) is further amended by adding at the end the following new subsection:

`(j)(1) The Commission or the Department of Energy shall not delay taking appropriate action with respect to an allegation of a substantial safety hazard on the basis of--

> `(A) the filing of a complaint under subsection (b)(1) arising from such allegation; or
>
> `(B) any investigation by the Secretary, or other action, under this section in response to such complaint.

`(2) A determination by the Secretary under this section that a violation of subsection (a) has not occurred shall not be considered by the Commission or the Department of Energy in its determination of whether a substantial safety hazard exists.'.

(h) TECHNICAL AND CONFORMING AMENDMENTS-

(1) The title heading of title II of the Energy Reorganization Act of 1974 (42 U.S.C. 5841 et seq.) is amended to read as follows:

`TITLE II--NUCLEAR REGULATORY COMMISSION; NUCLEAR WHISTLEBLOWER PROTECTION'.

(2) Section 210(b)(1) of the Energy Reorganization Act of 1974 (42 U.S.C. 5851(b)(1)) is amended--

(A) by striking `(hereinafter in this subsection referred to as the `Secretary')' and inserting `(in this section referred to as the `Secretary')'; and

(B) by striking `and the Commission' and inserting `, the Commission, and the Department of Energy'.

(3) The second of the two sections of the Energy Reorganization Act of 1974 that is numbered 210 (42 U.S.C. 5851) is redesignated as section 211.

(i) APPLICABILITY- The amendments made by this section shall apply to claims filed under section 211(b)(1) of the Energy Reorganization Act of 1974 (42 U.S.C. 5851(b)(1)) on or after the date of the enactment of this Act.

SEC. 2903. EXEMPTION OF CERTAIN RESEARCH AND EDUCATIONAL LICENSEES FROM ANNUAL CHARGES.

(a) IN GENERAL- Section 6101(c) of the Omnibus Budget Reconciliation Act of 1990 (42 U.S.C. 2214 (c)) is amended--

(1) in paragraph (1), by striking `Any licensee' and inserting `Except as provided in paragraph (4), any licensee'; and

(2) by adding at the end the following new paragraph:

`(4) EXEMPTION-

`(A) IN GENERAL- Paragraph (1) shall not apply to the holder of any license for a federally owned research reactor used primarily for educational training and academic research purposes.

`(B) RESEARCH REACTOR- For purposes of subparagraph (A), the term `research reactor' means a nuclear reactor that--

`(i) is licensed by the Nuclear Regulatory Commission under section 104 c. of the Atomic Energy Act of 1954 (42 U.S.C. 2134(c)) for operation at a thermal power level of 10 megawatts or less; and

`(ii) if so licensed for operation at a thermal power level of more than 1 megawatt, does not contain--

`(I) a circulating loop through the core in which the licensee conducts fuel

experiments;

`(II) a liquid fuel loading; or

`(III) an experimental facility in the core in excess of 16 square inches in cross-section.'.

(b) APPLICABILITY- The amendments made subsection (a) shall apply to annual charges assessed under section 6101(c) of the Omnibus Budget Reconciliation Act of 1990 for fiscal year 1992 or any succeeding fiscal year.

(c) POLICY REVIEW- The Nuclear Regulatory Commission shall review its policy for assessment of annual charges under section 6101(c) of the Omnibus Budget Reconciliation Act of 1990, solicit public comment on the need for changes to such policy, and recommend to the Congress such changes in existing law as the Commission finds are needed to prevent the placement of an unfair burden on certain licensees of the Commission, in particular those that hold licenses to operate federally owned research reactors used primarily for educational training and academic research purposes.

SEC. 2904. STUDY AND IMPLEMENTATION PLAN ON SAFETY OF SHIPMENTS OF PLUTONIUM BY SEA.

(a) STUDY- The President, in consultation with the Nuclear Regulatory Commission, shall conduct a study on the safety of shipments of plutonium by sea. The study shall consider the following:

(1) The safety of the casks containing the plutonium.

(2) The safety risks to the States of such shipments.

(3) Upon the request of any State, the adequacy of that State's emergency plans with respect to such shipments.

(4) The Federal resources needed to assist the States on account of such shipments.

(b) REPORT- The President shall, not later than 60 days after the date of the enactment of this Act, transmit to the Congress a report on the study conducted under subsection (a), together with his recommendations based on the study.

(c) IMPLEMENTATION PLAN- The President, in consultation with the Nuclear Regulatory Commission, shall establish a plan to implement the recommendations contained in the study conducted under subsection (a) and shall, not later than 90 days after transmitting the report to the Congress under subsection (b), transmit to the Congress that implementation plan.

(d) DEFINITION- As used in this section, the term `State' includes the District of Columbia and any commonwealth, territory, or possession of the United States.

TITLE XXX--MISCELLANEOUS

Subtitle A--General Provisions

SEC. 3001. RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIAL APPLICATION

ACTIVITIES.

(a) RESEARCH, DEVELOPMENT, AND DEMONSTRATION- (1) Except as otherwise provided in this Act, research, development, and demonstration activities under this Act may be carried out under the procedures of the Federal Nonnuclear Research and Development Act of 1974 (42 U.S.C. 5901-5920), the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), or any other Act under which the Secretary is authorized to carry out such activities, but only to the extent the Secretary is authorized to carry out such activities under each such Act. An objective of any demonstration program under this Act shall be to determine the technical and commercial feasibility of energy technologies.

(2) Except as otherwise provided in this Act, in carrying out research, development, and demonstration programs and activities under this Act, the Secretary may use, to the extent authorized under applicable provisions of law, contracts, cooperative agreements, cooperative research and development agreements under the Stevenson-Wydler Technology Innovation Act of 1980, grants, joint ventures, and any other form of agreement available to the Secretary.

(b) COMMERCIAL APPLICATION- Except as otherwise provided in this Act, in carrying out commercial application programs and commercial application activities under this Act, the Secretary may use, to the extent authorized under applicable provisions of law, contracts, cooperative agreements, cooperative research and development agreements under the Stevenson-Wydler Technology Innovation Act of 1980, grants, joint ventures, and any other form of agreement available to the Secretary. An objective of any commercial application program under this Act shall be to accelerate the transition of technologies from the research and development stage.

(c) DEFINITION- For purposes of this section, the term `joint venture' has the meaning given the term `joint research and development venture' under section 2(a)(6) and (b) of the National Cooperative Research Act of 1984 (15 U.S.C. 4301(a)(6) and (b)), except that such term may apply under this section to research, development, demonstration, and commercial application joint ventures.

(d) PROTECTION OF INFORMATION- Section 12(c)(7) of the Stevenson-Wydler Technology Innovation Act of 1980, relating to the protection of information, shall apply to research, development, demonstration, and commercial application programs and activities under this Act.

(e) GUIDELINES AND PROCEDURES- The Secretary shall provide guidelines and procedures for the transition, where appropriate, of energy technologies from research through development and demonstration under subsection (a) to commercial application under subsection (b). Nothing in this section shall preclude the Secretary from--

(1) entering into a contract, cooperative agreement, cooperative research and development agreement under the Stevenson-Wydler Technology Innovation Act of 1980, grant, joint venture, or any other form of agreement available to the Secretary under this section that relates to research, development, demonstration, and commercial application; or

(2) extending a contract, cooperative agreement, cooperative research and development agreement under the Stevenson-Wydler Technology Innovation Act of 1980, grant, joint venture, or any other form of agreement available to the Secretary that relates to research, development, and demonstration to cover commercial application.

(f) APPLICATION OF SECTION- This section shall not apply to any contract, cooperative agreement, cooperative research and development agreement under the Stevenson-Wydler Technology Innovation

Act of 1980, grant, joint venture, or any other form of agreement available to the Secretary that is in effect as of the date of the enactment of this Act.

SEC. 3002. COST SHARING.

(a) RESEARCH AND DEVELOPMENT- Except as otherwise provided in this Act, for research and development programs carried out under this Act, the Secretary shall require a commitment from non-Federal sources of at least 20 percent of the cost of the project. The Secretary may reduce or eliminate the non-Federal requirement under this subsection if the Secretary determines that the research and development is of a basic or fundamental nature.

(b) DEMONSTRATION AND COMMERCIAL APPLICATION- Except as otherwise provided in this Act, the Secretary shall require at least 50 percent of the costs directly and specifically related to any demonstration or commercial application project under this Act to be provided from non-Federal sources. The Secretary may reduce the non-Federal requirement under this subsection if the Secretary determines that the reduction is necessary and appropriate considering the technological risks involved in the project and is necessary to meet the objectives of this Act.

(c) CALCULATION OF AMOUNT- In calculating the amount of the non-Federal commitment under paragraph (1) or (2), the Secretary shall include cash, personnel, services, equipment, and other resources.

(d) TENNESSEE VALLEY AUTHORITY- Funds derived by the Tennessee Valley Authority from its power program may be used for all or part of any cost sharing requirements under this section, except to the extent that such funds are provided by annual appropriation Acts.

Subtitle B--Other Miscellaneous Provisions

SEC. 3011. POWERPLANT AND INDUSTRIAL FUEL USE ACT OF 1978 REPEAL.

Section 403(c) of the Powerplant and Industrial Fuel Use Act of 1978 (42 U.S.C. 8373(c)) is repealed.

SEC. 3012. ALASKA NATURAL GAS TRANSPORTATION ACT OF 1976 REPEAL.

(a) REPEAL- Section 7(a)(5) of the Alaska Natural Gas Transportation Act of 1976 (15 U.S.C. 719e(a)(5)) is repealed.

(b) ABOLITION OF OFFICE OF FEDERAL INSPECTOR OF CONSTRUCTION- The Office of Federal Inspector of Construction for the Alaska Natural Gas Transportation System, created pursuant to the paragraph repealed by subsection (a) of this section, is abolished. All functions and authority vested in the Inspector are hereby transferred to the Secretary of Energy.

(c) REVOCATION OF CERTAIN OFI REGULATIONS- Regulations applicable to the Office of Federal Inspector of the Alaska Natural Gas Transportation System, as set forth in chapter 15 of title 10, Code of Federal Regulations, are hereby revoked.

SEC. 3013. GEOTHERMAL HEAT PUMPS.

The Secretary shall--

(1) encourage States, municipalities, counties, and townships to consider allowing the installation of geothermal heat pumps, and, where applicable, and consistent with public health and safety, to permit public and private water recipients to utilize the flow of water from, and back into, public and private water mains for the purpose of providing sufficient water supply for the operation of residential and commercial geothermal heat pumps; and

(2) not discourage any local authority which allows the use of geothermal heat pumps from--

(A) inspecting, at any reasonable time, geothermal heat pump connections to the water system to ensure the exclusive use of the public or private water supply to the geothermal heat pump system; and

(B) requiring that geothermal heat pump systems be designed and installed in a manner that eliminates any risk of contamination to the public water supply.

SEC. 3014. USE OF ENERGY FUTURES FOR FUEL PURCHASES.

(a) FUEL STUDY- The Secretary shall conduct a study--

(1) to ascertain if the use of energy futures and options contracts could provide cost-effective protection for Government entities (including Government purchases for military purposes and for the Strategic Petroleum Reserve) and consumer cooperatives (or any organization whose purpose is to purchase fuel in bulk) from unanticipated surges in the price of fuel; and

(2) to ascertain how such Government entities or consumer cooperatives may be educated in the prudent use of energy futures and options contracts to maximize their purchasing effectiveness, protect themselves against unanticipated surges in the price of fuel, and minimize fuel costs.

(b) REPORT- The Secretary, no later than 12 months after the date of the enactment of this Act, shall transmit the study required in this section to the Committee on Energy and Commerce of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

(c) PILOT PROGRAM- The Secretary shall conduct a pilot program, commencing not later than 30 days after the transmission of the study required in subsection (b), to educate such governmental entities, consumer cooperatives, or other organizations on the prudent and cost-effective use of energy futures and options contracts to increase their protection against unanticipated surges in the price of fuel and thereby increase the efficiency of their fuel purchase or assistance programs.

(d) AUTHORIZATION- There are authorized to be appropriated such sums as may be necessary to carry out this section.

SEC. 3015. ENERGY SUBSIDY STUDY.

(a) IN GENERAL- The Secretary shall contract with the National Academy of Sciences to conduct a study of energy subsidies that--

(1) are in effect on the date of the enactment of this Act; or

(2) have been in effect prior to the date of the enactment of this Act.

(b) REPORT TO CONGRESS- Not later than 18 months after the date of the enactment of this Act, the Secretary shall transmit to the Congress, the results of such study to be accompanied by recommendations for legislation, if any.

(c) CONTENTS-

(1) IN GENERAL- The study shall identify and quantify the direct and indirect subsidies and other legal and institutional factors that influence decisions in the marketplace concerning fuels and energy technologies.

(2) TOPICS FOR EXAMINATION- The study shall examine--

(A) fuel and technology choices that are--

(i) available on the date of the enactment of this Act; or

(ii) reasonably foreseeable on the date of the enactment of this Act;

(B) production subsidies for the extraction of raw materials;

(C) subsidies encouraging investment in large capital projects;

(D) indemnification;

(E) fuel cycle subsidies, including waste disposal;

(F) government research and development support; and

(G) other relevant incentives and disincentives.

(d) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated to carry out this section $500,000 for each of the fiscal years 1993 and 1994.

SEC. 3016. TAR SANDS.

(a) POLICY- It is the policy of the United States to promote the development and production, by all means consistent with sound engineering, economic, and environmental practices, of deposits of tar sands.

(b) DEFINITION- (1) For purposes of this section, the term `tar sands' means any consolidated or unconsolidated rock (other than coal, oil shale, or gilsonite) that either--

(A) contains a hydrocarbonaceous material with a gas-free viscosity, at original reservoir temperature, greater than 10,000 centipoise; or

(B) contains a hydrocarbonaceous material and is produced by mining or quarrying.

(2) Nothing in this section is intended or shall be construed to affect in any way the definition of the term tar sands under any other provision of Federal law.

(c) STUDY- The Secretary, in consultation with the Secretary of the Interior, shall submit a study to the House of Representatives and the Committee on Energy and Natural Resources of the Senate within one year after the date of enactment of this Act. Such study shall identify and evaluate the development potential of sources of tar sands in the United States. The study shall also identify and evaluate processes for extracting oil from the identified tar sand sources, including existing tar sands waste tailings, and evaluate the environmental benefits of, and the potential for co-production of minerals and metals from, such processes.

(d) AUTHORIZATION- There are authorized to be appropriated such sums as may be necessary for each of the fiscal years 1993 and 1994 to carry out this section.

SEC. 3017. AMENDMENTS TO TITLE 11 OF THE UNITED STATES CODE.

(a) DEFINITION- Section 101 of title 11, United States Code, is amended by inserting after paragraph (21) the following:

`(21A) `farmout agreement' means a written agreement in which--

`(A) the owner of a right to drill, produce, or operate liquid or gaseous hydrocarbons on property agrees or has agreed to transfer or assign all or a part of such right to another entity; and

`(B) such other entity (either directly or through its agents or its assigns), as consideration, agrees to perform drilling, reworking, recompleting, testing, or similar or related operations, to develop or produce liquid or gaseous hydrocarbons on the property;'.

(b) PROPERTY OF THE ESTATE- Section 541(b) of title 11, United States Code, is amended--

(1) in paragraph (2) by striking `or' at the end,

(2) in paragraph (3) by striking the period at the end and inserting `or', and

(3) by adding at the end the following:

`(4) any interest of the debtor in liquid or gaseous hydrocarbons to the extent that--

`(A) the debtor has transferred or has agreed to transfer such interest pursuant to a farmout agreement or any written agreement directly related to a farmout agreement; and

`(B) but for the operation of this paragraph, the estate could include such interest only by virtue of section 365 or 544(a)(3) of this title.

Paragraph (4) shall not be construed to exclude from the estate any consideration the debtor retains, receives, or is entitled to receive for transferring an interest in liquid or gaseous hydrocarbons pursuant to a farmout agreement.'.

(c) EFFECTIVE DATE; APPLICATION OF AMENDMENTS- (1) Except as provided in paragraph (2), the amendments made by this section shall take effect on the date of the enactment of this Act.

(2) The amendments made by this section shall not apply with respect to cases commenced under title 11

of the United States Code before the date of the enactment of this Act.

SEC. 3018. RADIATION EXPOSURE COMPENSATION.

Section 6 of the Radiation Exposure Compensation Act (42 U.S.C. 2210 note) is amended by adding at the end the following new subsection:

`(l) JUDICIAL REVIEW- An individual whose claim for compensation under this Act is denied may seek judicial review solely in a district court of the United States. The court shall review the denial on the administrative record and shall hold unlawful and set aside the denial if it is arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.'.

SEC. 3019. STRATEGIC DIVERSIFICATION.

The Office of Barter within the United States Department of Commerce and the Interagency Group on Countertrade shall within six months from the date of enactment report to the President and the Congress on the feasibility of using barter, countertrade and other self-liquidating finance methods to facilitate the strategic diversification of United States oil imports through cooperation with the former Soviet Union in the development of its energy resources. The report shall consider among other relevant topics the feasibility of trading American grown food for Soviet produced oil, minerals or energy.

SEC. 3020. CONSULTATIVE COMMISSION ON WESTERN HEMISPHERE ENERGY AND ENVIRONMENT.

(a) FINDINGS- The Congress finds that--

(1) there is growing mutual economic interdependence among the countries of the Western Hemisphere;

(2) energy and environmental issues are intrinsically linked and must be considered together when formulating policy on the broader issue of sustainable economic development for the Western Hemisphere as a whole;

(3) when developing their respective energy infrastructures, countries in the Western Hemisphere must consider existing and emerging environmental constraints, and do so in a way that results in sustainable long-term economic growth;

(4) the coordination of respective national energy and environmental policies of the governments of the Western Hemisphere could be substantially improved through regular consultation among these countries;

(5) the development, production and consumption of energy can affect environmental quality, and the environmental consequences of energy-related activities are not confined within national boundaries, but are regional and global in scope;

(6) although the Western Hemisphere is richly endowed with indigenous energy resources, an insufficient energy supply would severely constrain future opportunities for sustainable economic development and growth in each of these member countries; and

(7) the energy markets of the United States are linked with those in other countries of the Western

Hemisphere and the world.

(b) DEFINITION- For purposes of this section, the term `Commission' means the Consultative Commission on Western Hemisphere Energy and Environment.

(c) NEGOTIATIONS- The President is authorized to direct the United States representative to the Organization of American States to initiate negotiations with the Organization of American States for the establishment of a Consultative Commission on Western Hemisphere Energy and Environment under the auspices of the Organization of American States.

(d) THE COMMISSION- In the course of the negotiations, the following shall be pursued:

(1) OBJECTIVES- The objectives of the Commission shall be--

(A) to evaluate from the viewpoint of the Western Hemisphere as a whole the energy and environmental situations, trends, and policies of the countries of the participating governments necessary to support sustainable economic development;

(B) to recommend to the participating governments actions, policies, and institutional arrangements that will enhance cooperation and policy coordination among their respective countries in the future development and use of indigenous energy resources and technologies, and in the future development and implementation of measures to protect the environment of the Western Hemisphere; and

(C) to recommend to the participating governments actions and policies that will enhance energy and environmental cooperation and coordination among the countries of the Western Hemisphere and the world.

(2) COMPOSITION OF THE COMMISSION- The Commission shall include representatives of--

(A) the respective foreign energy and environmental ministries or departments of the participating governments;

(B) the parliamentary or legislative bodies with legislative responsibilities for energy and environmental matters; and

(C) other governmental and non-governmental observers appointed by the heads of each participating government on the basis of their experience and expertise.

(3) SECRETARIAT- A small secretariat shall be chosen by the participating governments for their expertise in the areas of energy and the environment.

(4) SUNSET PROVISION- The Commission's authority--

(A) shall terminate five years from the date of the agreement under which it was created; and

(B) may be extended for a five-year term at the expiration of the previous term by agreement of the participating governments.

(e) REPORT- The President shall, within one year after the date of enactment of this Act, report to the Committee on Energy and Commerce and the Committee on Foreign Affairs of the House of Representatives, and to the Committee on Energy and Natural Resources and the Committee on Foreign Relations of the Senate, on the progress toward the establishment of the Commission and achievement of the purposes of this section.

SEC. 3021. DISADVANTAGED BUSINESS ENTERPRISES.

(a) GENERAL RULE- To the extent practicable, the head of each agency shall provide that the obligation of not less than 10 percent of the total combined amounts obligated for contracts and subcontracts by each agency under this Act and amendments made by this Act pursuant to competitive procedures within the meaning of either the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 251 et seq.), or chapter 137 of title 10, United States Code, shall be expended either with--

(1) small business concerns controlled by socially and economically disadvantaged individuals or women;

(2) historically Black colleges and universities; or

(3) colleges and universities having a student body in which more than 20 percent of the students are Hispanic Americans or Native Americans.

(b) DEFINITIONS- For purposes of this section, the following definitions shall apply:

(1) The term `small business concern' has the meaning such term has under section 3 of the Small Business Act (15 U.S.C. 632). However, for purposes of contracts and subcontracts requiring engineering services the applicable size standard shall be that established for military and aerospace equipment and military weapons.

(2) The term `socially and economically disadvantaged individuals' has the meaning such term has under section 8(d) of the Small Business Act (15 U.S.C. 637(d)) and relevant subcontracting regulations promulgated pursuant thereto.

Speaker of the House of Representatives.

Vice President of the United States and

President of the Senate.

END

October 25, 2002

COMMISSION VOTING RECORD

DECISION ITEM: SECY-02-0133

TITLE: CONTROL OF SOLID MATERIALS: OPTIONS AND RECOMMENDATIONS FOR PROCEEDING

The Commission (with Chairman Meserve and Commissioners Diaz, McGaffigan, and Merrifield agreeing) approved the subject paper as recorded in the Staff Requirements Memorandum (SRM) of October 25, 2002. Commissioner Dicus disapproved the paper.

This Record contains a summary of voting on this matter together with the individual vote sheets, views and comments of the Commission.

Annette L. Vietti-Cook
Secretary of the Commission

Attachments:
1. Voting Summary
2. Commissioner Vote Sheets

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
OGC
EDO
PDR

VOTING SUMMARY - SECY-02-0133

RECORDED VOTES

	APRVD	DISAPRVD	ABSTAIN	NOT PARTICIP	COMMENTS	DATE
CHRM. MESERVE	X				X	8/14/02
COMR. DICUS		X			X	9/16/02
COMR. DIAZ	X				X	8/21/02
COMR. McGAFFIGAN	X				X	10/1/02
COMR. MERRIFIELD	X				X	9/5/02

COMMENT RESOLUTION

In their vote sheets, Chairman Meserve and Commissioners Diaz, McGaffigan, and Merrifield approved the staff's recommendation and provided some additional comments. Commissioner Dicus disapproved the paper. Subsequently, the comments of the Commission were incorporated into the guidance to staff as reflected in the SRM issued on October 25, 2002.

Commissioner Comments on SECY-02-0133

Chairman Meserve

In SECY-02-0133, the staff requests Commission approval to proceed with an enhanced participatory rulemaking concerning the control of solid materials (Option 3b). The staff makes this recommendation after reviewing the report issued by the National Academy of Sciences (NAS) on the release of materials by NRC licensees. National Academy of Sciences, Board on Energy and Environmental Systems, The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities (Mar. 21, 2002). I approve the staff's recommendation because I believe it is important to maintain momentum on this issue, to provide a consistent, risk-informed basis for the release of solid material in the near term, and to prepare the underpinnings for the future decommissioning of the current population of U.S. power reactors.

The NAS report describes some of the functional weaknesses in NRC's existing practice of releasing solid material on a case-by-case basis. Perhaps the chief flaw is that the NRC's current approach is not based on potential health risk. Rather, the existing process is largely measurement-based, allowing materials from civilian reactors to be released if no radioactivity beyond background levels can be detected.[1] As the NAS report notes, this measurement-based approach does not relate regulatory requirements to the potential health risk that might be associated with release. Id. at 2-15. Other weaknesses include inconsistent application of the approach, a lack of transparency in the approval process, and concern as to whether the existing approach is sufficiently flexible to meet the demands arising from multiple requests for the release of large volumes of solid material that would come about with the eventual decommissioning of the current population of civilian nuclear reactors. Like the NAS and staff, I conclude that the weaknesses of the current approach warrant consideration of alternative approaches to the control of solid material, even though the current efforts are protective of public health and safety. The NAS recommends that, in considering release or conditional release, a standardized dose-based approach be applied. Id. at 10-7. Such an approach could bring needed consistency, transparency, and predictability to the decision process -- factors that are in the best interests of both the NRC and its stakeholders. Consequently, I approve moving forward with an enhanced participatory rulemaking that is fair and open, allows consideration of the range of alternatives, and does not duplicate the information-collection efforts already undertaken by the NAS and the staff.

The NAS report observes that there is considerable institutional distrust of the NRC among some stakeholder groups. The NAS recommends that the NRC seek to overcome this distrust by encouraging stakeholder participation and involvement in consideration of alternative approaches (including the current case-by-case approach, clearance, a conditional clearance approach, and a policy of no-release). Id. at ES-9 . This recommendation should be followed. But, in approaching stakeholders on this issue, it would not be appropriate to mask the Commission's continuing support for the release of solid material when there are no significant health consequences. Any other approach would only further ingrain distrust in some stakeholders. Nonetheless, all

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[1] As noted in the NAS report, reactor licensees can apply to the NRC for approval to release solid materials with small but detectable levels of radioactivity pursuant to Section 2002 of 10 C.F.R. Part 20.

alternatives should be given fair consideration in developing a proposed rule so that a broad range of alternatives is identified and can be weighed by the Commission.

In carrying out the rulemaking, the staff should seek to use information arising from its past efforts and those of the NAS so as to be cost-effective. Substantial information currently exists on many of the issues. As a result, I believe that the staff's resource estimates for the rulemaking are excessive. See SECY-02-0133 at 11. For example, the NRC has had workshops on this topic in the past. Workshops are resource-intensive and expensive for both the NRC and its stakeholders and additional workshops should be limited to areas where substantial new input is needed. For issues which may not warrant a workshop, the staff should explore increased use of web-based methods for interacting with stakeholders.

Finally, the NAS report, although not prescribing a particular outcome for the rulemaking process, goes to considerable lengths to document the benefits of conditional clearance. Id. at 9-7. Staff should specifically explore and document the feasibility of conditional clearance.

Commissioner Dicus

In SECY-02-0133, the staff proposes several options for proceeding with a path forward for controlling the release of slightly-contaminated radioactive solid materials. While I agree with the staff that the acceptability of any standards-setting action depends on a variety of factors, including both the process to move discussions forward, as well as the technical basis to support any criteria that might be established, I do not agree with proceeding with an enhanced participatory rulemaking (EPR) (Option 3b) at this time.

One important factor affecting any decision as to how best to proceed with a proposed rulemaking is the safety significance of the matter under consideration. As noted in the March 2002 National Academy of Sciences (NAS) report, "The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities," the current approach for releasing this type of material is considered to provide a sufficient level of safety. The NAS report also notes that one of the potential criteria of 10 µSv/yr (1 mrem/yr) discussed in the NRC Issues Paper (as well as proposed by the ANSI/HPS N13.12 standard) is a "reasonable starting point" regarding levels of risk when considering alternatives for controlling solid material. Both of these statements call into question whether significant resources should be devoted to a rulemaking or other processes that might have minimal impact on maintaining health and safety. In addition, because the levels associated with the potential release of solid materials will be extremely low, it does not appear to be the best expenditure of staff resources. This is a time in which the NRC, as well as many other Federal agencies in this country have increased its resources by moving quickly to enhance the accessibility, controls, and restrictions already associated with the safe use of radioactive materials, in order to ensure that radioactive material will not be obtained by terrorists.

More than 800 "extensive and wide-ranging" public comment letters were received from various stakeholders (including the metals and concrete industries, citizen groups and individuals, licensees and licensee representatives, and other organizations) in public meetings over the past few years. Despite NRC efforts to engage stakeholders on the Clearance Issues Paper and in public workshops on the subject, the staff correctly states in SECY-02-0133 that there is "significant distrust and lack of confidence in NRC and obtaining it [in future rulemaking efforts on

this subject] will be a difficult process."

This is a very difficult policy decision, and although I agree with the staff that this rulemaking is needed, it just does not appear to be the right time to initiate such an intensive EPR effort. I do believe, however, that there is merit in continuing our work with stakeholders and licensees. In addition, it is prudent to continue our dialogue with national and international agencies to develop a more solid consensus before embarking on a separate independent rulemaking. There are several reasons why I believe we must obtain greater stakeholder involvement before proceeding. These are:

1. I am involved with discussions with the National Council on Radiation Protection and Measurements (NCRP) regarding a proposed symposium on this topic which is currently planned for May 2003. Although still in the initial planning stages, this symposium will be open to the public and will include interested members of the public and public interest groups, Federal agencies, State governments, professional associations, industrial groups, scientists, and representatives from national and international organizations. One goal of the symposium will be to develop an encompassing statement on this important issue. I believe that the NRC will benefit from such a product. I will continue to keep the Commission informed about the symposium as it is being finalized.

2. EPA has responsibility for setting generally-applicable environmental standards under the Atomic Energy Act and currently does not plan to have a program to set standards on control of solids materials in the U.S. Instead, EPA has decided to focus its efforts on <u>control</u> of sources and radioactive materials, not its release. It would be beneficial to all our stakeholders if NRC were to work with EPA, as well as other Federal and State Agencies on developing a standard <u>before</u> initiating our own separate rulemaking effort. Failure to do so, would be reminiscent of NRC's failure of the earlier BRC Policy in the 1990s.

3. The NCRP report and ANS statement on clearance will be out next year with each of these organizations perspectives. Because these additional reports will only serve to provide more valuable information from another set of stakeholders, I believe that it would be beneficial for staff to explore the recommendations provided by these organizations before moving forward.

4. ANSI N13.12 selected 10 µSv/yr (1 mrem/yr) as the primary dose standard for clearance, which is consistent with international values and contains useful information, including an implementation protocol. Under the Public Law 104-113, "National Technology and Transfer Act of 1995", and OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards, "Federal agencies are required to use this type of technical standard unless its use is inconsistent with applicable law, or otherwise impractical. The NRC has yet to issue a rule in this area, so before going forward, the staff should weigh the pros and cons of either implementing or endorsing this standard per Public Law 104-113.

5. The NAS report states that relatively little solid materials will arise from nuclear power plant decommissioning during the 2006-2020 period, so it would be prudent to wait and obtain a consensus from the international and national community before moving ahead with a resource-intensive EPR process.

6. The proposed EPR effort for Option 3b is estimated to be a large expenditure of resources (10-15 FTE and over $1 million in contract support) for at least a 3-4 year period. Are these resources warranted for an initiative with low associated risk?

7. Lastly, I note that several international organizations (IAEA and the EC) have selected 10 µSv/yr (1 mrem/yr) as a starting point for release of cleared materials. And, since 1993, both NRC and EPA staff have participated with the IAEA Member States on the development of assumptions and parameters used to derive these clearance levels. Although there are still concerns amongst both national (NRC, EPA and DOE) and international organizations (i.e., IAEA, EC, ILO, NEA, WHO and FAO) regarding the accuracy of the parameters and modeling associated with the criterion for commodities (and thus the release of solid materials), NRC's limited resources would be better spent in continuing this coordination process in order to be able to try to ensure a sound technical basis and approach in resolving this global issue.

Commissioner Diaz

I approve staff's recommended Option 3b, i.e., to proceed with a rulemaking process for developing national standards for the control of solid materials from nuclear facilities. Staff should use the normal rulemaking process, rather than spend additional resources on a participatory rulemaking. As noted in my earlier vote on this issue, a decision to initiate rulemaking does not mean that the Commission has made a decision on the scope or details of the regulation and in no way predetermines the outcome. In fact, it ensures just the opposite. The rulemaking process not only allows, but requires, solicitation and consideration of the public's views, concerns, and recommendations. It also calls for open evaluation of all risks, including actual and perceived risks, as well as impacts on health, safety, and the environment.

The issues related to the release of slightly radioactive solid materials have been extensively debated in the United States for over 15 years. There is a very significant body of information from the debates, covering every possible aspect of the issue. The agency has already expended significant resources on public workshops to obtain a range of stakeholders' views. In addition, we also contracted with the National Academies' National Research Council to provide a report on alternatives for control of solids, and with several other contractors to develop the required technical information base to support decision-making. Staff should use the information and data from all of these efforts, as well as information from related national (e.g., ANSI and DOE) and international (e.g., IAEA and EC) efforts.

There has been significant progress made in the development of the technical information base necessary to support a policy decision on how to continue to ensure adequate protection of public health and safety in regulating the control of solid materials, including estimating potential exposures if soil is cleared from NRC-licensed facilities; estimating the inventory of materials at NRC-licensed facilities which are potentially available for release; performing an analysis of potential exposures of individuals to multiple sources from recycled materials; and examining alternative methods for performing radiation surveys to control solid materials. We have a formidable data base from which rulemaking can be conducted, with all the appropriate checks and balances.

Let's remember that the NRC began this process with the publication in 1982 of rulemaking "Licensing Requirements for Land Disposal of Radioactive Waste." We continued with the "clearance" work by having numerous meetings and, in 1988, hosting an international workshop at the Pan American Health Organization. Nearly 10 years after first addressing the issue, the agency issued a policy statement for Below Regulatory Concern (i.e., "clearance") that established a consistent risk framework for regulatory exemption decisions and that ensured an adequate and consistent level of protection of the public. (In hindsight the term BRC was an unfortunate choice of words because the agency was <u>very</u> concerned, but these materials had no discernable public health and safety consequences.) Discussions continued and a year later the Commission unanimously approved an implementation plan for the policy statement. Not satisfied with the numerous discussions the staff had nationally and internationally, the Commission agreed in mid-1991 to an enhanced participatory rulemaking with the expectation of a "fairly quick" agreed-upon rule. In 1995, with no agreed-upon participatory rulemaking in sight, the Commission was told of the increased costs of such a rulemaking. The Commission then began to rethink the participatory rulemaking approach. Discussions continued and a paper came to the Commission in 1998 on regulatory options for setting standards on "clearance" of materials and equipment having residual radioactivity.

Many papers and discussions later, the Commission, once again, is being asked , among other options, whether it supports an enhanced participatory or a normal rulemaking. The history of this endeavor shows that all due care and consideration has been given to this issue and the time to act is now. Inconsistent application of <u>de facto</u> standards should not continue to be part of our regulatory framework. The American people deserve better.

<u>Commissioner McGaffigan</u>

I approve the staff's recommended Option 3b to proceed with a rulemaking concerning the control of solid materials, subject to the following comments.

I have long supported this rulemaking, as is demonstrated by my voting record on papers such as SECY-00-0070, COMRAM-00-0001, SECY-99-0214, and SECY-98-0028. I have also long recognized that this will be a difficult rulemaking because of the general public fear of radioactivity, the willingness of some interest groups to fan that fear through grossly exaggerated claims of health effects due to potential exposure to minimally radioactive solid materials, and some in the media's gullibility in giving credence to the interest groups' exaggerations. As soon as this paper and its voting record are made public, we can expect that there will be attempts to get the media to publish sensationalist stories about radioactive automobiles, forks, dental braces and hip replacements. I can only beg the media to check facts before publishing such drivel.

The onus on the staff and the Commission as we go forward will be to accurately and forthrightly communicate what we are proposing, why we are proposing it, what alternative options we have considered, and why on balance we have chosen not to pursue those alternatives.

The National Academy of Sciences (NAS) Report has told us that an individual dose standard of 1 mrem/year is a "reasonable starting point" for a dose-based standard. We already knew this, of course, and indeed the law requires that we consider the ANSI standard. Nevertheless, that was a useful recommendation. The NAS Report has told us that the overall conceptual plan of draft NUREG-1640 is "the best of all the studies that it reviewed" and that the estimates in draft

NUREG-1640 are “traceable and a formal uncertainty analysis has been performed for each dose factor.” These again are useful comments because they show how strong the technical basis for moving forward really is. The NAS Report has emphasized the need to consider a conditional release option, something the Commission was clearly willing to do before the NAS Report was commissioned (see, for example, my comments on SECY-00-0070). The NAS Report, however, is weak when it makes process recommendations and I agree with the staff’s analysis on why we should not pursue NAS’s recommended Option 3a.

With regard to the details of Option 3b, I do not support an Advance Notice of Proposed Rulemaking (ANPR). I think that there is little that we would learn that we don’t already know as a result of ANPR responses. Instead, I would advocate a transparent process for developing a rulemaking plan and a proposed rule. By transparent I mean that we should continue to share all of our technical basis documents with the public, including seeking comments on those documents. We should flesh out the feasibility of a conditional release option for metals, as the Chairman recommends, possibly using a public workshop to discuss such an option. I agree with the Chairman that the staff’s resource estimates for the Option 3b rulemaking are excessive, but those estimates probably reflect a conservative judgment on the staff’s part as to what Option 3b might cost, including an ANPR and numerous workshops. Disposing of the ANPR step, limiting workshops to where they are really needed, and making use of web-based methods for interacting with stakeholders should all help to keep costs under control. I believe that we should aim to complete this rulemaking within three years, with a rulemaking plan to be submitted in about one year and a proposed rule six months after the rulemaking plan. The rulemaking process which I describe would still be an “enhanced participatory” rather than a “normal” rulemaking because clearly we will be making an extra effort throughout the process to engage stakeholders. On this matter, I believe that the Commission and the staff have no choice but to be fully engaged throughout the process or our efforts will unfortunately most certainly be distorted.

Commissioner Merrifield

I approve, as modified in the following paragraphs, staff recommendation 3b (proceed with an enhanced participatory rulemaking process) in SECY-02-0133, “Control of Solid Materials: Options and Recommendations for Proceeding”. However, before I provide my comments on the option to be followed by the staff, I want to emphasize two points.

First, as stated in the paper, all three options provided by the staff, if properly carried out, would maintain health and safety. I agree that continuing the current process with some slight modifications (option 1) is practical and convenient in the short term but is not a long term solution. The current practice requires decisions on a case-by-case basis and often involves determining minimum levels of detectability of radiation by existing equipment, which would change as new, more sensitive detection equipment becomes available. However, the current approach is inconsistently applied, is not explicitly risk-based, has no guidelines for volume-contaminated material, and is subject to second-guessing once more sensitive radiation detection equipment becomes available. Therefore, there is a need to develop and implement a longer term solution through rulemaking.

Second, the report on release of solid materials provided by the National Academy of Sciences was not responsive to the contractual arrangements or the needs of the Commission. The Commission was and is clearly aware that proposed rulemaking in this area is both complex and

controversial. The Commission requested the scientific recommendation of the National Academy of Sciences for an appropriate and reasonable standard to apply for the potential release of solid materials with minimal levels of detectable radioactive contamination. The Commission was well aware that it would need to make significant policy decisions to address the controversial aspects of this issue; and the Commission wanted, but did not receive, the appropriate scientific input from the Academy as a technical foundation for future decisions. Instead, the National Academy limited the scope of their recommendations mainly to procedures for conducting a rulemaking process for a controversial issue. The end product is not beneficial to the Commission in addressing the specific technical aspects of this issue. This lack of performance by the National Academy will influence future decisions on my part on whither or not the advice of the National Academy should be solicited.

This comment is not meant to imply that the observations of the National Academy are totally without merit. For example, the observation that documents used to support public meetings inappropriately focused on one solution and thus gave a false impression that a final position had already been established. Staff should use the National Academy's observations as lessons learned for future meetings involving any controversial issue. However, future staff efforts to establish standards for control of solid materials should not focus on the National Academy of Science's specific recommendations but should focus on what is needed to complete the task.

As indicated in the first paragraph, I support an enhanced participatory rulemaking effort for this particular task. However, there are several issues associated with this tasking which should be addressed before the rulemaking begins: specifically, timing of the initiation of this rulemaking and the focus of the enhanced effort.

The first issue is timing of the actual commencement of the rulemaking. The rulemaking effort should not begin until late 2003 or 2004 and we should continue our current practice until the rulemaking is completed. First, the Commission is heavily involved in a resource intensive effort to increase security over appropriate radioactive material. This rulemaking would open the issue of potentially releasing radioactive material (admittedly with low levels of radioactivity) for unrestricted use when both the Commission and the public are concerned about potential terrorist use of any hazardous material. We need time for the security concern to be fully addressed, which should include clearly defining the scope of radioactive materials of concern from a terrorist perspective, before initiating this unrelated rulemaking on material which <u>should be</u> outside the scope of the security concern. Also, as indicated in the paper, the staff expects to complete in the 2003 - 2004 time frame several important technical reviews directly associated with this rulemaking; and there are some international efforts which should be completed or nearly completed by then as well. It would be appropriate to wait until this work is complete or nearly complete before publically announcing initiation of this rulemaking effort. Finally, before proceeding with rulemaking, the staff should further develop the concept of conditional or restricted release to support the rulemaking. I will provide further comments on restricted release in the last paragraph of this vote. While I do favor delaying the public initiation of the rulemaking effort until at least 2003, I do not support an undefined date for initiating the rulemaking. Staff should submit for Commission approval a proposed schedule for the rulemaking effort.

The second issue is defining the focus or scope of the rulemaking effort. The term "enhanced participatory rulemaking" means different things to different people and I want to clarify specifically what I mean for this rulemaking effort. My clarification may already be the intent of the staff for this effort, but the paper was not clear in this area. As discussed in Commissioner Diaz's vote, the

staff has spent years investigating different technical and regulatory issues associated with the potential unrestricted release of solid material with either no detectable radioactivity or only trace amounts of radioactive contamination. In 1999, my first full year on the Commission, the staff held four major stakeholder meetings on control of solid materials. I personally read the transcripts and meeting summaries from all four meetings and invited selected participants to discuss the issues directly with me. My personal observation is that after the second public meeting, the staff already had a clear understanding of all the technical and policy issues that need to be addressed. At this point, the problems have been defined and the staff should focus on potential solutions. The enhanced participatory rulemaking should utilize this important background information as a starting point and public workshops, if necessary, should focus on specific issues where more detailed discussions are necessary to develop reasonable solutions.

One additional observation is that the staff efforts appear to focus on either no release or unrestricted release. I fully understand that from a technical perspective it would be ideal to define a level of radioactivity below which regulatory controls are not necessary to provide adequate protection of the public health and safety. I believe technically that we could define such a standard. In fact, the Commission has already established similar criteria for the release of gaseous and liquid material with small amounts of radioactivity. Gaseous and liquid releases are somewhat unique in that once the release occurs, <u>generally</u> the material becomes even more diluted by the environment. There are a few exceptions to this generalization about liquid releases, particularly when dealing with water treatment facilities, but the exceptions are addressed on a case specific basis. Recycled solid material is different in that there is a potential that the radioactive component may be concentrated in the recycling process or that the material will be recycled in a form resulting in more actual contact with the general public. There is a general lack of public understanding or acceptance of our technical basis for developing a standard for the release of solid material. This general lack of public acceptance can have a tangible effect on other industries, such as the steel industry's use of recycled material, and could easily have considerable political implications. As clearly seen in our past history for this complex and controversial issue, public reactions to the potential release of such material are very strong and vocal. To address public concerns, we need a reasonable alternative to unrestricted release.

Therefore, the staff should investigate the concept of conditional or restricted release in more detail and determine if such a concept is implementable. For example, restricted release could involve continued regulatory control by the NRC, another federal agency, or a State agency. Another alternative could be a graduated level of regulatory control over the "released" material depending on the level of radioactivity in the material. It would be nice to have a separate industry devoted to the recycling of radioactive material; but the development of such facilities must be an initiative either by private industry or the Department of Energy. The purpose of these examples is not to restrict the staff, but to allow the staff sufficient latitude to address multiple scenarios in discussions with the stakeholders in order to develop a form of restricted release that (1) is effective, (2) is reasonably possible to implement, and (3) would increase public confidence in the process. This effort could be the focus of one or more of the workshops for the rulemaking.

TABLE 2.—UNIT RATES—Continued

Service [1,3]	Rough rice	Brown rice for processing	Milled rice
Interpretive line samples: [2]			
(a) Milling degree (per set)	....	....	94.00
(b) Parboiled light (per sample)	....	....	23.00
Extra copies of certificates (per copy)	3.00	3.00	3.00

[1] Fees apply to determinations (original or appeals) for kind, class, grade, factor analysis, equal to type, milling yield, or any other quality designation as defined in the U.S. Standards for Rice or applicable instructions, whether performed singly or in combination at other than at the applicant's facility.
[2] Interpretive line samples may be purchased from the U.S. Department of Agriculture, GIPSA, FGIS, Technical Services Division, 10383 North Ambassador Drive, Kansas City, Missouri 64153–1394. Interpretive line samples also are available for examination at selected FGIS field offices. A list of field offices may be obtained from the Director, Field Management Division, USDA, GIPSA, FGIS, 1400 Independence Avenue, SW., STOP 3630, Washington, DC 20250–3630. The interpretive line samples illustrate the lower limit for milling degrees only and the color limit for the factor "Parboiled Light" rice.
[3] Fees for other services not referenced in Table 2 will be based on the noncontract hourly rate listed in § 868.90, Table 1.

Dated: February 24, 2003.

Donna Reifschneider,

Administrator, Grain Inspection, Packers and Stockyards Administration.

[FR Doc. 03–4689 Filed 2–27–03; 8:45 am]

BILLING CODE 3410–EN–P

NUCLEAR REGULATORY COMMISSION

10 CFR Part 20

Rulemaking on Controlling the Disposition of Solid Materials: Scoping Process for Environmental Issues and Notice of Workshop

AGENCY: Nuclear Regulatory Commission.

ACTION: Request for comments on scope of proposed rulemaking and notice of workshop.

SUMMARY: The Nuclear Regulatory Commission (NRC) is conducting an enhanced participatory rulemaking on alternatives for controlling the disposition of solid materials that originate in restricted or impacted areas of NRC-licensed facilities, and that have no, or very small amounts of, radioactivity resulting from licensed operations. The NRC is seeking stakeholder participation and involvement in identifying alternatives and their environmental impacts that should be considered as part of the rulemaking. Considerable information collection effort has been conducted in this area and the Commission is building on existing information to focus on potential solutions. To assist in this process, the NRC is holding a workshop to solicit new input with a focus on the feasibility of alternatives identified in this notice that would limit where solid material can go. The NRC has not made a decision on the scope or details of a regulation and is continuing to develop a solid technical basis for the rulemaking.

DATES: Submit comments by June 30, 2003. Comments received after this date will be considered if it is practicable to do so, but the Commission is able to assure consideration only for comments received on or before this date.

In addition to providing opportunity for written (and electronic) comments, a workshop to solicit comments on alternatives, with a focus on the feasibility of alternatives identified in this notice that would limit where solid materials can go, will be held on May 21–22, 2003 from 8:30 a.m.–5 p.m. in the NRC Auditorium, 11545 Rockville Pike, Rockville, Maryland.

ADDRESSES: Submit comments to: Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Attention: Rulemaking and Adjudications Staff.

Deliver comments to 11555 Rockville Pike, Rockville, Maryland, between 7:30 a.m. and 4:15 p.m. on Federal workdays.

You may also provide comments via the NRC's rulemaking Web site at *http://ruleforum.llnl.gov* (then select "Information/Comment Requests" from left-hand column). This site provides the capability to upload comments as files (any format), if your web browser supports that function. For information about the interactive rulemaking web page, contact Ms. Carol Gallagher, (301) 415–5905 (*cag@nrc.gov*).

Copies of any comments received may be examined at the NRC Public Document Room, 11555 Rockville Pike, Rockville, Maryland.

FOR FURTHER INFORMATION CONTACT: Frank Cardile, telephone: (301) 415–6185; e-mail: *fpc@nrc.gov,* Office of Nuclear Material Safety and Safeguards, USNRC, Washington, DC 20555–0001. Specific comments on the public meeting process should be directed to Chip Cameron; e-mail *fxc@nrc.gov*, telephone: (301) 415–1642; Office of the General Counsel, USNRC, Washington, DC 20555–0001. Specific comments on the environmental scoping process discussed in Section VI should be directed to Phyllis Sobel; e-mail *pas@nrc.gov,* telephone: (301) 415–6714; Office of Nuclear Material Safety and Safeguards, USNRC, Washington, DC 20555–0001.

SUPPLEMENTARY INFORMATION:

I. Introduction

The NRC is conducting a rulemaking to evaluate alternatives for controlling the disposition of solid materials with no, or very small amounts of, radioactivity resulting from licensed operations. This **Federal Register** Notice (FRN) provides information on this effort as follows:

(1) *Sections II.1–II–7:* These sections provide background information about why we are conducting this effort and what are some alternatives for controlling the disposition of solid materials.

(2) *Sections III.1–III.2:* These sections discuss the considerable information collection efforts we have conducted to date in this area and what we have learned about the alternatives.

(3) *Sections IV and V:* These sections discuss our current effort to build on information previously collected in this area. The NRC has not made a decision on any alternatives for controlling the disposition of solid materials and invites stakeholders to present new information on alternatives. In particular, Section IV asks specific questions about the feasibility of alternatives that would limit where solid material can go, and Section V announces a workshop scheduled for May 21–22, 2003.

(4) *Section VI:* This section announces a re-opening of the scoping process and requests input on environmental impacts of alternatives.

To further assist stakeholders, the staff is also placing on its website an

information packet which discusses ways in which stakeholders can review the alternatives and issues involved, provide comments to the NRC, and link to other documents (Go to *http://www.nrc.gov/materials.html* and select ''Controlling the Disposition of Solid Materials.'').

II. Background

The information below in Sections II.1–II.7 has been discussed in various NRC documents and public meetings.[1] It is provided here in summary form as background information on the issues involved and on alternatives for controlling the disposition of solid materials.

1. Solid Materials Being Considered

Just as is the case for many industrial operations (or in a home), there are ''solid materials'' that are no longer needed or useful at facilities licensed by NRC. This can occur, for example, during normal facility operations when: (a) Metal equipment and tools become surplus, obsolete or worn; (b) glass, plastic, paper, or other trash-like materials are no longer useful; or (c) concrete from a building being renovated or soil being excavated from a site is no longer needed. This can also occur at the end of facility operations when a licensee seeks to terminate its NRC license. At such times, NRC's licensees seek disposition alternatives for solid material that are protective of public health and safety and are economical.

NRC licensees fall into broad categories that include: (a) Academic—university laboratories and small reactors that use radioactivity for research and teaching purposes; (b) medical—hospitals and clinics that use radioactivity for diagnostic and therapeutic medical purposes; (c) manufacturing—facilities and labs that manufacture products that use radioactivity, *e.g.*, smoke detectors, certain types of gauges; and (d) power production—reactor facilities and fuel cycle facilities that handle radioactivity as part of the generation of electricity.

2. The Nature of These Solid Materials

This effort is focused on controlling the disposition of solid materials that are present in areas in NRC-licensed facilities where radioactive materials are used or stored. These areas of the facilities are generally referred to as either ''restricted[2]'' or ''impacted[3]'' areas. Despite their location in these restricted or impacted areas, much of this solid material has no, or very small amounts of, radioactivity resulting from licensed operations either because the material was exposed to radioactivity in the facility to only a limited extent or because it has been cleaned. These solid materials can include furniture and ventilation ducts in buildings; metal equipment and pipes; wood, paper, and glass; laboratory materials (gloves, beakers, etc); routine trash; site fences; concrete; soil; or other similar materials.

Other solid materials in these restricted or impacted areas can contain more appreciable levels of radioactivity. However, these are separated from those materials with no, or very small amounts of, radioactivity at the licensed facility and are required to be disposed of at licensed low-level waste (LLW) disposal sites under NRC's existing regulations in 10 CFR part 61. Solid materials containing appreciable levels of radioactivity are not the subject of this NRC rulemaking.

Solid materials not located in restricted or impacted areas, and considered to be free of radioactivity resulting from licensed operations, are not currently required to be part of a disposition radiological survey program. Such materials can include furniture, glass bottles, paper, equipment, or trash in administrative buildings or office areas. This rulemaking does not propose to alter this approach, and therefore, these materials are also not the subject of this NRC effort.

The remainder of this FRN discusses those solid materials from restricted or impacted areas of an NRC-licensed facility that have no, or very small amounts of, radioactivity resulting from licensed operations. For ease of reference, these are referred to as ''solid materials.''

3. The NRC's Current Approach for Controlling the Disposition of Solid Materials

Currently, the NRC has requirements in its regulations in 10 CFR part 20 that require that solid materials that have been in restricted or impacted areas be surveyed before leaving the site. Solid materials can currently be released for any unrestricted use if the survey does not detect radioactivity from licensed operations on the material or, if it does detect radioactivity, the amount is below a level that is considered to be protective of public health and safety and the environment.

However, 10 CFR part 20 does not currently specify the level below which the material can be released. Decisions on disposition of solid materials are currently made using levels contained in a set of existing guidelines that are based primarily on the ability of survey meters to measure the radioactivity level on, or in, the solid material.[4]

4. Why NRC Is Examining This ''Current Approach''

A report by the National Academies indicates that NRC's current approach for controlling the disposition of solid materials protects public health and does not need immediate revamping.

However, the National Academies report also indicates that the current approach is incomplete and inconsistent and that NRC's approach should be based more directly on a risk basis. As a result, the National Academies study states that NRC should conduct a process to evaluate alternatives to provide clear risk-informed direction on controlling the disposition of solid materials.

5. Why NRC Is Conducting a Rulemaking to Potentially Revise its Current Approach

The NRC agrees with the findings in the National Academies report regarding the need to consider modifying its current approach to provide specific direction on controlling the disposition of solid materials.

The generally accepted process that Federal Agencies use to examine or replace an approach that needs improvement is to conduct a rulemaking to amend the Code of Federal Regulations (CFR). A rulemaking is an open process that evaluates the advantages and disadvantages of a range of alternatives and that invites public input on the alternatives early on and throughout the process.

6. NRC's Guiding Policy in Conducting a Rulemaking To Develop a Regulation

NRC's overall policy, as discussed in NUREG–1614 entitled ''U.S. Nuclear Regulatory Commission Strategic Plan, Fiscal Year 2000–2005,'' is that the nation's use of radioactive material be conducted in a manner that protects

[1] Many of the documents, as well as summaries of public meetings and other background information, discussed in this paper are available via the NRC's web page at *http://nrc.gov/materials.html*.

[2] A restricted area is defined in the NRC's regulations in 10 CFR 20.1003.

[3] An impacted area is defined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) which was jointly prepared by the U.S. Environmental Protection Agency, the U.S. Department of Energy, the U.S. Department of Defense, and the NRC. An impacted area is defined in MARSSIM as an area with a possibility of containing residual radioactivity in excess of natural background or fallout levels.

[4] These guidelines are discussed in the June 1999 Issues Paper and in an All-Agreement States letter (STP–00–070), dated August 22, 2000.

public health and safety and the environment. In carrying out this policy, the NRC is guided by broad ''performance goals'' that include:

(1) Maintain safety, protection of the environment, and the common defense and security;

(2) Increase public confidence in our regulatory process;

(3) Make NRC's activities and decisions effective, efficient, and realistic;

(4) Reduce unnecessary regulatory burden on stakeholders.

As discussed in NUREG–1614, protection of public health and safety is paramount among the NRC goals and it is likewise our principal goal in controlling the disposition of solid materials. We also recognize that, in considering alternatives in this area, our decision-making process needs to provide stakeholders with clear and accurate information about, and a meaningful role in, the process. In addition, any requirements we promulgate in this area must not impose unnecessary regulatory burdens beyond what is necessary and sufficient for providing reasonable assurance that public health and safety will be protected.

7. Alternatives for Controlling the Disposition of Solid Materials

Paths by which solid materials with no, or very small amounts of, radioactivity could leave a licensed facility fall into general disposition categories of ''release'' or ''disposal.'' A set of preliminary alternatives for controlling the disposition of solid materials along these paths was first described in an NRC Issues Paper published for public comment in the **Federal Register** (FR) on June 30, 1999 (64 FR 35090); these alternatives are summarized here:

A. Release: In this disposition path, solid materials could be released into general commerce if a radiation survey verifies that public health and safety is protected and if the materials have some benefit in either a recycled or re-used product. Alternatives for control include:

(1) *Unrestricted use:* Unrestricted use means that solid materials could be released for any use in general commerce after a radiation survey verifies that an allowable level has been met.[5] Two unrestricted use alternatives are:

Alternative 1: Continue NRC's current approach (see Section II.3) which allows unrestricted use based on existing guidance on survey capabilities;

Alternative 2: Amend the NRC's regulations to include a dose based criterion for unrestricted use.

(2) *Conditional use (Alternative 3):* In this alternative, solid material could be released but its further use would be restricted to only certain authorized uses with limited public exposures such as use in controlled or low exposure environments. Examples might include industrial uses such as metals in bridges, sewer lines, or industrial components in a factory, or concrete in road fill.[6]

B. Disposal: In this disposition path, solid materials would be prohibited from general commerce and isolated from the public. Alternatives[7] for control include:

(1) *Landfill disposal (Alternative 4):* In this alternative, solid material would be prohibited from general commerce by requiring it to be placed in an EPA-regulated landfill;

(2) *NRC/Agreement State (AS)-licensed low-level waste (LLW) disposal site (Alternative 5):* In this alternative, solid material would be prohibited from general commerce by requiring it to be placed in an NRC/AS-licensed LLW disposal site and regulated under the NRC's regulations in 10 CFR Part 61.

III. Summary of Efforts to Date and What NRC Has Learned About Alternatives

1. Efforts to Date To Examine Alternatives

The NRC's Issues Paper, published in the FR for public comment in June 1999, indicated that NRC was examining its alternatives for controlling the disposition of solid materials. To provide further opportunity for public input, NRC held a series of four public meetings during the fall of 1999.

The NRC received over 800 public comment letters from stakeholders representing the metals, metal scrap, and concrete industries; citizens groups; licensees and licensee organizations; landfill operators; Federal and State agencies; and Tribal governments. Comments were also received from stakeholders at the four public meetings. Comments were sharply diverse in the views expressed, and there was support and rationale provided by commenters for a range of alternatives for controlling the disposition of solid materials.

On March 23, 2000, the NRC staff provided the Commission with a paper (SECY–00–0070) on the diversity of views expressed in public comments received on the Issues Paper. Attachment 2 of SECY–00–0070 provides a summary of views and comments received; summaries of the comments can also be viewed in NUREG/CR–6682, ''Summary and Categorization of Public Comments on the Control of Solid Materials'' (September 2000). SECY–00–0070 also provided the status of the staff's technical analyses being developed as support for making decisions in this area and noted the related actions of international and national organizations and agencies that could be factors in NRC's decision-making.

To solicit additional input, the Commission held a public meeting on May 9, 2000, at which stakeholder groups presented their views and discussed alternatives for controlling the disposition of solid materials.

On August 18, 2000, the Commission decided to defer a final decision on whether to proceed with rulemaking and directed the staff to request that the National Academies conduct a study of alternatives for controlling the disposition of solid materials. The Commission also directed the staff to continue to develop technical information and to stay informed of international and U.S. agency activities in this area.

The National Academies study of alternatives for controlling the disposition of solid materials was initiated in August 2000. As part of the study, the National Academies held three information gathering meetings in January, March, and June of 2001, at which it obtained input from various stakeholder groups similar to those that presented information to the NRC earlier. Based on these meetings, and on its deliberations on this topic, the National Academies submitted a report to the NRC in March 2002. The report contains nine recommendations on the decision-making process, potential approaches for controlling the disposition of solid materials, and additional technical information needed. In particular, the National Academies report indicates that NRC's current approach for controlling the disposition of solid materials protects public health and does not need immediate revamping. However, the National Academies report also states that NRC's current approach is

[5] The term ''clearance'' is also used by various organizations and in various documents to mean removal from regulatory control of material that meets certain release criteria.

[6] Other terms have been used for this alternative, including ''conditional clearance'' and ''restricted use.'' However, the term ''Conditional use'' is deemed more appropriate and is used throughout the remainder of this document.

[7] Other terms have been used for this alternative, including ''prohibition'' and ''no release.'' The alternatives listed here are considered to be clearer in that they provide more information as to the destination of the material and hence are used throughout the remainder of this document.

incomplete and inconsistent and concludes that NRC should therefore conduct a process to evaluate a broad range of alternatives to provide clear risk-informed direction on controlling the disposition of solid materials. The report notes that broad stakeholder involvement and participation in the NRC's decision-making process on the alternatives is critical as the process moves forward. The report also notes that an individual dose standard of 10 μSv/yr (1 mrem/yr) provides a reasonable starting point for the process of considering alternatives for a dose-based standard. A summary of the National Academies report can be found in an NRC staff paper, SECY–02–0133, and a link to the National Academies report, itself, is contained in the Background section of the NRC's web page.

As noted above, the NRC has been conducting technical studies to provide additional analyses to better understand and evaluate the alternatives for controlling the disposition of solid materials. These studies are examining potential impacts of alternatives on human health and the environment; costs to licensees, other industries, and the public resulting from the alternatives; and the ability of radiation detectors to verify the radioactivity level on any solid material so that a licensee can verify compliance with an alternative. The results of some of these studies have been issued for public comment and are available on NRC's web page; additional results will be provided for public comment when they are available.

In addition to NRC efforts in this area, other scientific organizations are engaged in similar processes. Recognized radiation protection standards organizations like the National Council on Radiation Protection and Measurements (NCRP), International Commission on Radiological Protection (ICRP), and American National Standards Institute (ANSI) have issued findings about possible criteria for controlling the disposition of solid materials. The U.S. Department of Energy (DOE) is preparing a Programmatic Environmental Impact Statement on alternatives for disposition of DOE scrap metals. The U.S. Environmental Protection Agency (EPA) sets radiation protection standards in the general environment although they do not currently have a program on controlling the disposition of solid materials from licensed facilities. International agencies (such as the International Atomic Energy Agency and the European Commission) as well as other individual nations, are in the process of establishing standards for controlling the disposition of solid materials. These efforts are significant for the NRC because inconsistency in standards between the U.S. and other nations can result in confusion regarding international trade, in particular if materials released under other nations' regulations arrive as imports in the U.S.

2. Summary of Information and Comments Received to Date on Alternatives

As discussed in Section III.1, NRC has obtained information from public comments, from efforts by scientific organizations, and from various technical studies, including that done by the National Academies. The following sections summarize the information and views obtained about potential alternatives for controlling the disposition of solid materials, as well as the process for examining our approach. This material reflects the NRC performance goals noted in Section III.6, above.

A. Alternative 1—No Action: Retain Current Approach of Allowing Unrestricted Use Using Measurement-based Guidelines

All rulemakings include consideration of a no-action alternative that would continue NRC's current approach. As discussed in Section II.3, above, Alternative 1 permits solid materials that are in restricted or impacted areas to be released for unrestricted use if a radiation survey does not detect radioactivity from licensed operations on the material or, if it does detect radioactivity, the amount is below a level that is considered to be protective of public health and safety. NRC's regulations do not specify the level below which the material can be released; decisions are currently made using levels contained in a set of existing guidelines based primarily on the ability of survey meters to measure the radioactivity level on, or in, the solid material.

The advantages and disadvantages of Alternative 1 were discussed in SECY–02–0133 based on the public comments received on the June 1999 Issues Paper and on the National Academies report. As discussed in SECY–02–0133, advantages of Alternative 1 are that NRC's current approach: (a) Is sufficiently protective of public health and does not need immediate revamping; (b) is workable and familiar to licensees; and (c) requires no staff resources to amend regulations at this time which would allow NRC to focus on other higher-priority safety issues, whereas decommissionings on a large scale are not expected for some time. Disadvantages of Alternative 1 include: (a) Lack of an overall risk basis or consistent approach; (b) use of outdated measurement bases; (c) international consistency issues; (d) issues of regulatory finality caused by lack of regulation as the basis for the current approach; (e) licensees problems using the current approach when dealing with materials day-to-day, and (f) expenditure of NRC staff resources on case-specific reviews under the current approach, which are anticipated to possibly increase due to expanded use of radiation monitors for detecting solid materials with small amounts of radioactivity outside NRC-licensed facilities.

B. Alternative 2: Dose-Based Regulation on Unrestricted Use

As noted in Section II.7, Alternative 2 would allow solid materials to be released for use in general commerce if a radiation survey verifies that the level of radioactivity is protective of public health and safety and if there is some benefit in the materials' recycle or re-use. The June 1999 Issues Paper discussed a range of potential options for values for an allowable dose level, including 0, 1, 10, and 100 μSv/yr (0, 0.1, 1.0, and 10 mrem/yr). The National Academies recommended in their study that a value of 10 μSv/yr (1 mrem/yr) was a good starting point for discussion for a dose-based release standard.

(1) *Summary of information from scientific organizations on the unrestricted use alternative:*

A number of scientific organizations have provided information indicating that 10 μSv/yr (1 mrem/yr) presents a negligible level of risk to the public and is therefore protective of public health and safety. The National Academies report indicates that 10 μSv/yr (1 mrem/yr) is within the acceptable range of values used in U.S. health-based standards, is a small fraction of natural background, and is accepted by recognized national and international organizations. The NCRP and the ICRP both indicate that a 10 μSv/yr (1 mrem/yr) level poses a negligible risk. The Health Physics Society notes that 10 μSv/yr (1 mrem/yr) is well below doses received in routine activities without discernable health effect. EPA radioactive effluent standards in similar areas have safety goals that are comparable to 10 μSv/yr (1 mrem/yr). ANSI has concluded that a value of 10 μSv/yr (1 mrem/yr) is an appropriate criterion for release of solid materials and has published its findings in a standard entitled ''Surface and Volume

Radioactivity Standards for Clearance,'' N13.12–1999, August 1999; it is noted that the National Technology Transfer and Advancement Act of 1995 requires Federal agencies to consider this type of technical standard in rulemakings in pertinent areas.

(2) *Summary of information received in public comments:*

Public comments generally fell into categories of issues related to (a) protection of public health and safety and (b) regulatory burden:

(a) Issues related to public health and safety:

Certain commenters agreed with use of the unrestricted use alternative for the reasons noted in the scientific studies. However, other commenters were concerned about an unrestricted use alternative, noting that risks associated with these solid materials are avoidable and involuntary; long term and cumulative impacts cannot be accurately modeled; there is a potential for exposures to multiple products; any dose increases cancer risk; even a small risk when spread over the U.S. population is too high; there is no justification for adding more dose to what we receive from background; releases would not be accurately measured and tracked; licensees and the government cannot be trusted to assure that any releases would be carefully monitored; and a contractor who participated in NRC's technical support analyses had a conflict of interest.

(b) Issues related to regulatory burden:

This alternative engendered strong comment on both sides of this issue. The metals and concrete industries opposed unrestricted use because it would result in a large negative economic impact on steel/concrete industries because consumers would not buy products made with recycled solid material; the amount of steel available from licensed facilities is small, and therefore the economic benefit of recycling is small; and generators of the solid material should handle their own problem and not pass it along to other stakeholders. Other commenters were in favor of unrestricted use because the alternative of disposal of all solid material with no, or very small amounts of, radioactivity in a licensed LLW disposal site is costly to licensees without an accompanying health and safety benefit; and would cause a severe economic impact for small licensees, *e.g.*, medical facilities, universities.

(3) *Summary:* Scientific studies, including the National Academies report, indicate that unrestricted use at a level in the range of 10 μSv/yr (1 mrem/yr) presents negligible risk and is therefore protective of public health and safety, however there was also significant stakeholder comment related to health impact and economic burden issues which could make this alternative potentially difficult to implement.

C. Alternative 3—Conditional Use

Conditional use is an alternative in which solid material could be released but its further use would be restricted to only certain authorized uses.

(1) *Summary of information received in public comments:*

Public comments received generally fell into categories of issues related to (a) protection of public health and safety, (b) regulatory burden, and (c) concern over feasibility of conditional use.

(a) Issues related to public health and safety:

Some commenters noted that a benefit of this alternative is that it could limit radiation dose by permitting the solid material to be released for only certain authorized uses (*e.g.*, industrial products, metal in sewer lines or bridges, concrete in construction fill) that have limited potential for public exposure.

(b) Issues related to regulatory burden:

A benefit cited with the conditional use alternative is that solid materials that have no, or very small amounts of, radioactivity could be used under certain authorized conditions rather than using the more costly licensed LLW disposal alternative.

(c) Concerns about feasibility of conditional use:

Some commenters expressed concern about the feasibility or viability of conditional use, noting: (a) It may not be viable economically to set up a recycling process dedicated only to the limited quantities of solid material from licensed facilities; (b) a regulatory system of restrictions to limit where solid material is used would be hard to establish and enforce; and (c) it is not clear that restrictions would work to limit where the material goes, *i.e.*, solid material could wind up being released for unrestricted use. Commenters also noted that, even if a system of restrictions was set up, the authorized use would have some limited lifetime and the solid material might ultimately end up in an unrestricted use, and therefore that it makes more sense to focus on establishing criteria for unrestricted use. Some commenters indicated that the only viable conditional use would be to retain the solid material within the NRC licensing arena or the DOE complex.

(2) *Summary:* Restricting the further use or disposition of solid materials from licensed facilities to only certain authorized uses can have merit in public health considerations in that exposure scenarios are minimized. However, based on the comments received in the NRC public comment process, it is not evident that conditional use is a technically viable way to make sure the material ends up in its authorized use or that it is an economically feasible approach that will work.

D. Alternatives 4 and 5—Disposal of Solid Materials in Either EPA-Regulated Landfills or NRC/AS-Licensed LLW Disposal Sites

In this alternative, solid material would be prohibited from general commerce. The solid material would be required to be disposed of at an EPA-regulated landfill (Alternative 4) or under NRC's existing regulations in 10 CFR Part 61 in an NRC/AS-licensed LLW disposal site (Alternative 5) (see Section II.7 above).

EPA regulates municipal and industrial solid waste under the Resource Conservation and Recovery Act (RCRA). Under RCRA Subtitle C, the hazardous waste program establishes a system for controlling hazardous waste from the time it is generated until its disposal. Under RCRA Subtitle D, the solid waste program encourages states to develop comprehensive plans for managing non-hazardous industrial solid waste and municipal solid waste and also sets criteria for municipal solid waste landfills and other solid waste disposal facilities. RCRA does not address radioactive material under NRC jurisdiction.

(1) *Summary of information on this alternative from scientific organizations:*

The National Academies report compared disposing of solid material in landfills and in licensed LLW disposal sites, and found that disposal of solid materials in EPA regulated Subtitle C or Subtitle D landfills would be substantially less costly than disposal in sites licensed by the NRC or Agreement States under 10 CFR Part 61.

(2) *Summary of information received in public comments:*

Public comments generally fell into the categories of issues related to (a) protection of public health and safety, (b) regulatory burden, and (c) feasibility of landfill disposal.

(a) Issues related to public health and safety:

A rationale for this approach is that it would prevent solid material from

licensed facilities from entering general commerce thus limiting the potential for radiation dose to the general public. Opponents of this approach cite the National Academies study and the NCRP which both indicate that 10 μSv/yr (1 mrem/yr) levels are trivial for health reasons and, therefore, a requirement for a general prohibition would have minimal positive health impact.

(b) Issues related to regulatory burden:

A principal comment regarding Alternative 5 is that requiring all material, even that which has no, or very small amounts of, radioactivity but which has some economic value, to be sent to NRC/AS-licensed LLW disposal sites would be costly to licensees, in particular smaller entities like hospitals, without an accompanying health and safety benefit. However, a regulation limiting disposal of these materials to an EPA-regulated landfill would have much smaller costs than disposal at a licensed LLW disposal site and place much smaller economic burden on licensees for controlling the disposition of solid materials.

(c) Issues related to concerns over feasibility of landfill disposal:

Some commenters expressed concern about the viability of landfill disposal, noting that a regulatory system of restrictions to limit solid materials would have to consider NRC, EPA, and State responsibilities. Also, it is not clear how restrictions would work to limit where material goes, and it is not clear that landfill operators would accept solid material released from NRC-licensed facilities.

(3) *Summary*—An alternative in which all material from a licensed facility is prohibited from release and instead disposed of either at an EPA-regulated landfill or an NRC/AS-licensed LLW disposal site would keep additional radioactivity out of general commerce, although would be likely more costly than unrestricted or conditional use. If all solid material is required to be disposed of at NRC/AS-licensed LLW sites, the economic burden imposed might be large, especially on small licensees, and the health benefit obtained would likely be small. The economic burden of disposing of this solid material in an EPA-regulated landfill should not be as large. However, some of the same concerns noted in Section III.2.C, above, would also exist for the landfill alternative, in particular regarding whether there would be assurance that the material would not be diverted from, or taken from, the landfill, and also whether landfills would accept all this material. EPA, in cooperation with the NRC, is considering a rulemaking that could permit disposal of certain NRC regulated material in a RCRA permitted facility subject to, if necessary, an appropriate NRC approval process (*e.g.*, a site-specific or general license, or exemption). EPA is working with NRC on an EPA Advance Notice of Proposed Rulemaking to solicit stakeholder comment on disposing of such materials in a RCRA regulated facility.

IV. Current Status of Efforts and Request for Additional Information

As discussed in Section III.1, there has been extensive and wide-ranging discussion of alternatives for controlling the disposition of solid materials as part of NRC and other organizations' efforts. Substantial and substantive information has been developed and input received on potential impacts of the various alternatives on public health and regulatory burden. NRC has received over 800 comment letters and held several public information meetings on controlling the disposition of solid materials. In addition, the National Academies conducted a study on this subject during which they held several information gathering meetings open to the public, and several scientific organizations are conducting studies and/or developing standards in this area.

Based on the National Academies report and on other factors affecting decision-making, the NRC staff developed a set of options for a regulatory process for examining alternatives for controlling the disposition of solid materials and presented these regulatory options to the Commission in SECY–02–0133 on July 15, 2002. Based on this information, the Commission, on October 25, 2002, directed the NRC staff to proceed with an enhanced participatory rulemaking to develop specific requirements for controlling the disposition of solid materials at licensed facilities. Subsequently the staff prepared a plan for conducting this rulemaking which the Commission approved on January 27, 2003.

In directions to the NRC staff, the Commission noted that the rulemaking should give fair consideration to all alternatives in developing a proposed rule so that a broad range of alternatives is identified and can be weighed by the Commission. In particular, the Commission indicated that the NRC staff should seek stakeholder participation and involvement in considering alternative approaches. The Commission noted that, in approaching stakeholders on this issue, the staff should reiterate the Commission's continuing support for the release of solid materials when there are no significant health consequences. This is consistent with the NRC's agency mandate to ensure that the nation's use of radioactive materials is carried out in a manner that protects the public health and safety and the environment.

In its direction to the staff, the Commission noted the considerable information on controlling the disposition of solid materials previously collected (see Section III.1) and indicated that, rather than duplicating these efforts, the staff should build on this existing information (including the concerns and comments expressed in public comment) and utilize it as a starting point to focus on potential solutions. In particular, the Commission directed the staff to explore increased use of web-based methods for interacting with stakeholders for issues that might not warrant additional discussion at a workshop, and to focus additional workshops on areas where substantial new input is needed.

With regard to Alternatives 1, 2, and 5 (no action, unrestricted use, and disposal in NRC-regulated LLW disposal sites), the efforts described in Section III.1 have provided substantial information. However, NRC is interested in obtaining any additional information, beyond that expressed earlier, that should be considered for each of the types of materials noted in Section II.1. This includes areas where:

(a) There has been modification of the views that have been expressed in earlier public comments on any of the alternatives;

(b) additional scientific information is available with regard to any of the alternatives;

(c) additional economic information is available with regard to any of the alternatives;

(d) there are new or modified alternatives beyond those discussed above.

In certain other areas, in particular with regard to Alternative 3 (conditional use) and Alternative 4 (EPA regulated landfill disposal), earlier information collection efforts did not obtain sufficient information to clearly indicate the viability or economic feasibility of these alternatives. Although these alternatives were noted by the National Academies report as potential methods for controlling the disposition of solid materials, earlier public comments raised concerns about their viability. Thus, the Commission specifically directed the staff to explore and document the feasibility of these alternatives and, in particular, noted

that the staff should have discussions with stakeholders with regard to whether the alternatives: (1) Are effective; (2) are reasonably possible to implement; and (3) would increase public confidence in the process. To further consider these issues, input on the following questions is requested for each of the types of materials noted in Section II.1:

With regard to conditional use:

(1) The intent of the conditional use alternative is that solid material would be restricted to only certain authorized uses and kept separate from general consumer uses. Consideration needs to be given as to whether this alternative can: (a) Provide assurance that solid material goes to its authorized use and is not diverted to unrestricted use and (b) be established and implemented in a manner that is both practical and economical. Specific questions are:

(a) Can a scrap/manufacturing/ distribution process that is not licensed by NRC provide assurance that the material is limited to its authorized use?

(b) Would it be necessary for NRC to maintain regulatory control by licensing all or some portion of the process (*e.g.,* only the scrap process or the scrap and manufacturing process)? Could involvement by another Federal Agency in the scrap/manufacturing/ distribution process provide assurance that the material remains with its authorized use? What are the feasibility, cost, and increased assurance aspects of NRC or other Federal agency involvement?

(c) What are the feasibility, economic, and assurance aspects of a smelter facility being dedicated to such material, either full-time or as a portion of its process capability?

(d) What end use products could be manufactured under such a conditional use, *e.g.,* bridge girders, sewer pipes, industrial coils? Would there be sufficient need for these products so that a process to manufacture them would be viable given the magnitude of material from NRC/AS licensed facilities and/or from other facilities having similar material?

(e) What typical lifetimes might the conditional (authorized) uses have, and what would likely happen to the solid material after the lifetime was over? Could the material continue to be part of a conditional use, or would it become available for unrestricted use?

(2) What criterion of acceptability should be used before allowing release of solid material to a conditional use (*e.g.,* should dose-based or concentration-based criterion be used and what should it be?)

With regard to landfill disposal:

(1) The intent of the landfill disposal alternative is that the solid material be isolated from the public, and not be diverted to unrestricted use, either in transit or after disposal. Specific questions are:

(a) Would placing the material in a RCRA Subtitle C site accomplish the goal of isolating the material from the public? If so, what controls are in place in a RCRA Subtitle C site to provide such assurance?

(b) Would placing the material in a RCRA Subtitle D landfill accomplish the goal of isolating the material from the public? If so, what controls are in place in a RCRA Subtitle D site to provide such assurance?

(c) What criteria of acceptability should be used before allowing disposal of solid material at a landfill such that the public and landfill workers are protected? In particular, should a different regulatory scheme be used depending on the radioactivity level of the material potentially to be placed in the landfill facility, *i.e.* lesser requirements if the potential dose is lower?

(d) Is it necessary for NRC to maintain regulatory control to achieve the desired isolation of NRC regulated material from the public? If so, is there a need for NRC to license a RCRA landfill either under a specific or general license, or is an exemption with specific conditions adequate to cover material that has come from NRC-licensed facilities?

What cost considerations need to be taken into account and what possible additional assurance of isolation might be realized under these regulatory approaches?

(2) If EPA and/or NRC rulemaking is developed in this area, would RCRA Subtitle C or Subtitle D landfill operators accept material which had been surveyed and released from a NRC-licensed facility?

For either conditional use or landfill disposal

(1) As a backup, should a ''cap'' be placed limiting the dose that would occur if the restrictions for the conditional use became no longer effective, or if the material being disposed of at a landfill was diverted or removed from the landfill, and the material wound up in an unrestricted use? If so, what should the cap value be?

V. Request for Comment and Announcement of Workshop

To provide opportunity to discuss the issues noted in Section IV, we invite written and electronic comment. To supplement this request for comment, we also plan to hold a workshop on May 21–22, 2003, at NRC headquarters to discuss the alternatives. The workshop agenda will afford an opportunity to discuss the National Environmental Policy Act (NEPA) process (see Section VI of this FRN) and the alternatives being considered, with specific emphasis on building on NRC's earlier information collection efforts (see Section III.1). Because these earlier efforts did not obtain sufficient information to clearly indicate the viability of conditional use or landfill disposal, the workshop will focus on the feasibility of these alternatives as discussed in Section IV above, in particular with regard to the questions raised in Section IV. The first half of the first day of the workshop will focus on background, the NEPA process, and the alternatives being considered for controlling the disposition of solid materials. The second half of the first day and the majority of the second day of the workshop will focus on conditional use and landfill disposal. A detailed agenda will be made available in advance of the workshop. In doing so, we will be receptive to a range of options or scenarios for conditional use or landfill disposal to determine the feasibility of these options that (1) are effective, (2) are reasonably possible to implement, and (3) would increase public confidence in the process.

VI. Scoping Process for Environmental Impact Statement

An environmental scoping process was initiated in June 1999 as part of issuance of the Issues Paper. The rationale for combining the two efforts was that issues raised in a scoping process and in the Issues Paper were similar and therefore it was an efficient use of stakeholder's time and energies to combine the two. As noted earlier, in August 2000 the Commission decided to defer a rulemaking in this area pending a study by the National Academies of alternatives for controlling the disposition of solid materials. Following completion of that study in March 2002, the Commission decided, in October 2002, to conduct an enhanced participatory rulemaking which considers alternatives for controlling the disposition of solid materials. Hence, this FRN provides an opportunity to announce this rulemaking effort and to re-open the earlier scoping process.

In a rulemaking, the Commission must consider the effect of its actions on the environment in accordance with the National Environmental Policy Act (NEPA). Section 102(1) of NEPA requires that the policies, regulations, and public laws of the United States be interpreted and administered in accordance with the policies set forth in

NEPA. It is the intent of NEPA to have Federal agencies incorporate consideration of environmental issues into their decision-making processes.

NRC regulations implementing NEPA are contained in 10 CFR Part 51. To fulfill its responsibilities under NEPA, the NRC would prepare a generic environmental impact statement (EIS) by analyzing alternative courses of action and the impacts and costs associated with those alternatives. A generic EIS would analyze alternatives for establishing requirements for controlling the disposition of solid materials. All reasonable alternatives associated with the proposed action would be analyzed to determine their impacts and costs.

The Commission's regulations in 10 CFR 51.26 contain requirements for conducting a scoping process prior to preparation of an EIS, including preparation of a notice of intent in the **Federal Register** regarding the EIS and indication that the scoping process may include holding a scoping meeting. Requirements are contained in 10 CFR 51.27 regarding the content of the notice of intent, in particular that it should describe the proposed action and describe possible alternatives to the extent that information is available. In addition, the notice of intent is to describe the proposed scoping process, including the role of participants, whether written comments will be accepted, and whether a public scoping meeting will be held.

Participants in this scoping process on the environmental impacts of controlling the disposition of solid materials from licensed facilities may provide written or electronic comments and/or attend the workshop indicated under the **DATES** heading of this notice and provide oral comments on the proposed action and possible alternatives. Written (and electronic) comments on the proposed action and alternatives from the public, as well as from meeting participants, can be submitted as indicated under the **DATES** and **ADDRESSES** heading of this notice.

According to 10 CFR 51.29, the scoping process is to address the following topics:

(1) *Define the proposed action.* The NRC is considering whether to develop a regulation for controlling the disposition of solid materials that have no, or very small amounts of, radioactivity resulting from licensed operations.

(2) *Determine EIS scope and significant issues to be analyzed in depth.* The NRC is considering analyzing the impacts and costs associated with rule alternatives for controlling the disposition of solid materials at licensed facilities. Information will be developed on (a) types, and contamination levels, of solid materials present at licensed facilities potentially available for release; (b) pathways of exposure to, and environmental impacts of, solid materials released from licensed facilities; and (c) regulatory alternatives and methods of approach for analysis of the alternatives. Information is specifically requested regarding inventory of solid materials at licensed facilities, including quantities and radioactivity levels, and how control processes at licensed facilities function so that materials from different areas of a facility are kept separate to assure that those materials with no, or very small amounts of, radioactivity do not become mixed with those with higher levels. Information is also requested on scenarios associated with the alternatives, and in particular with regard to viable conditional use and landfill disposal alternatives.

(3) *Identify and eliminate from detailed study issues which are not significant or which are peripheral or which have been covered by prior environmental review.* The NRC has not yet eliminated any issues. Analysis of the scope of environmental impacts for this effort would be principally intended to provide input to decision-making for establishing acceptable regulatory alternatives for controlling the disposition of solid materials, and would not involve analysis of site-specific issues which may arise in the licensing process at specific facilities. The extent to which the environmental analysis may be applicable to a site-specific NEPA process would be described in a draft EIS and draft rulemaking.

(4) *Identify any environmental assessments or environmental impact statements which are being or which will be prepared that are related but are not part of the scope of the EIS under consideration.*

None are being prepared by the NRC. The DOE is preparing a programmatic EIS on disposition of scrap metals.

(5) *Identify other environmental review or consultation requirements related to the proposed action.* The NRC is obtaining contractor assistance in preparation of the generic EIS and cost information for use in the environmental analyses. The NRC has also placed contracts to obtain specific technical assistance regarding material inventories, exposure pathways, collective doses, and the capability of radiation survey instruments to practically and accurately detect radioactive contamination at levels near background.

(6) *Indicate the relationship between the timing of the preparation of environmental analysis and the Commission's tentative planning and decision making schedule.* A draft generic EIS is scheduled to be issued for public comment in September 2004.

(7) *Identify any cooperating agencies.* No cooperating agencies are involved at this time.

(8) *Describe the means by which an EIS would be prepared.* As part of its rulemaking effort, NRC will prepare a draft EIS in accordance with its regulations in 10 CFR Part 51. Specifically, in accordance with 10 CFR Part 51.71, a draft EIS will be prepared using the considerations of the scoping process and will include a preliminary analysis which considers and balances the environmental and other effects of the proposed action and the alternatives available for reducing or avoiding adverse environmental and other effects, as well as the environmental, economic, technical and other benefits of the proposed action.

In accordance with 10 CFR 51.29, at the conclusion of the scoping process, a concise summary of the determinations and conclusions reached, including the significant issues identified, will be prepared and a copy sent to each participant in the scoping process.

Dated at Rockville, Maryland, this 21st day of February 2003.

For the Nuclear Regulatory Commission.

Martin Virgilio,

Director, Office of Nuclear Material Safety and Safeguards.

[FR Doc. 03–4752 Filed 2–27–03; 8:45 am]

BILLING CODE 7590–01–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. 2002–NM–157–AD]

RIN 2120–AA64

Airworthiness Directives; Bombardier Model CL–600–1A11 (CL–600), CL–600–2A12 (CL–601), and CL–600–2B16 (CL–601–3A, CL–601–3R, and CL–604) Series Airplanes

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This document proposes the adoption of a new airworthiness directive (AD) that is applicable to

RULEMAKING ISSUE
NOTATION VOTE

March 31, 2005 SECY-05-0054

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: PROPOSED RULE: RADIOLOGICAL CRITERIA FOR CONTROLLING THE DISPOSITION OF SOLID MATERIALS (RIN 3150-AH18)

PURPOSE:

To request Commission approval for publication of a proposed rule in the *Federal Register* to amend 10 CFR Part 20, "Standards for Protection Against Radiation," to include radiological criteria for controlling the disposition of solid materials that have no, or very small amounts of, residual radioactivity resulting from licensed operations, and which originate in restricted or impacted areas of Nuclear Regulatory Commission (NRC)-licensed facilities.

SUMMARY:

In response to the Commission's October 25, 2002, Staff Requirements Memorandum (Attachment 1), the staff has conducted an enhanced participatory rulemaking on controlling the disposition of solid materials and is requesting Commission approval of publication of a proposed rule. This paper provides the Commission with the draft *Federal Register* notice (FRN) (Attachment 2) containing the "Statement of Considerations" for the rulemaking and the proposed rule text. This paper also provides the Commission with the draft Generic Environmental Impact Statement (DGEIS) (NUREG-1812) (Attachment 3) and the draft regulatory impact analysis (Attachment 4).

CONTACTS: Frank Cardile, NMSS/IMNS
(301) 415-6185

Kim Karcagi, NMSS/IMNS
(301) 415-6701

BACKGROUND:

NRC's existing regulations contain a framework of radiation standards to ensure protection of public health and safety from the routine use of materials at licensed facilities. These standards include a public dose limit in 10 CFR Part 20 and dose criteria for certain types of media released from licensed facilities, such as airborne and liquid effluents. However, Part 20 does not contain a specific dose criterion to be used to verify that solid materials being considered for release have no, or very small amounts of, residual radioactivity. Instead, NRC's current approach is to make decisions on disposition of solid materials by using a set of existing guidelines, primarily based on survey instrument capabilities. In a report reviewing NRC's current approach, the National Academies indicates that the current approach is "sufficiently protective of public health and safety that it does not need immediate revamping." However, because the current approach does not derive from a specific regulation, NRC's decisions in this area are inefficient in that they lack an overall risk basis, consistency, and regulatory finality. Therefore, the proposed rule is intended to improve NRC's regulatory process by incorporating risk-informed criteria into the Commission's regulations for disposition of solid material.

The staff has engaged in several information gathering-activities as part of its decision-making for this rulemaking and has actively sought stakeholder participation and input on alternate disposition approaches. Activities to solicit stakeholder input have included requesting public comment in the *Federal Register* in June 1999 and February 2003 on issues associated with rulemaking in this area. In response, the staff has received nearly 3500 letters and e-mails, from a range of different stakeholder groups, that present a diverse set of views. The staff held nine public meetings to solicit stakeholder views between September 1999 and February 2005. In addition, at the Commission's request, the staff supported a study by the National Academies to obtain an independent review of the issues and alternatives. In preparing its report, provided to the Commission in March 2002, the National Academies held three meetings with stakeholders between January and June 2001.

As part of its information gathering, the staff reviewed various related reports prepared by recognized national and international organizations such as the National Academies; the National Council on Radiation Protection and Measurements (NCRP); the American National Standards Institute (ANSI); and the International Atomic Energy Agency (IAEA). These organizations have issued findings about possible criteria for controlling the disposition of solid materials. In addition, the staff considered reports suggested by stakeholders. The staff also considered other relevant Federal and international standards in this area. Finally, as part of its information gathering, NRC completed several technical studies to evaluate alternatives for controlling the disposition of solid materials. The results of these studies have been incorporated into the DGEIS.

As part of this rulemaking effort, the staff is maintaining a website on NRC's activities regarding the disposition of solid materials at www.nrc.gov/materials.html. The website has information

about current activities, relevant documents, opportunities for public comment, and summaries of public comments received to date.

DISCUSSION:

As noted, the principal reason for this rulemaking is to improve the efficiency and effectiveness of the NRC regulatory process by establishing criteria for the disposition of solid materials in the regulations. In conducting this rulemaking, the staff has been guided by the goals in the NRC Strategic Plan of which the primary goal is ensuring the protection of public health and safety and the environment. In addition, as described in the Strategic Plan, the staff is conducting the rulemaking process in an open manner so that stakeholders are informed and involved in the process as appropriate.

The staff is proposing to amend NRC's regulations to establish requirements having the following elements:

(1) Limited allowed disposition paths: Solid material, meeting the dose criterion of #2, below, may be released from licensed control if sent to: (a) disposal in Environmental Protection Agency (EPA)/State-regulated landfills; (b) re-use in a pre-defined set of uses (specifically concrete in road bed construction and re-use of tools and equipment); or (c) other disposition paths, if supported by a case-specific analysis and approval of proposed procedures.

(2) A dose criterion set at 1 millirem per year (mrem/yr) [0.01 milliSievert per year (mSv/yr)]: This dose criterion is based on scientific analysis and regulatory considerations and is a generic constraint set well below levels established to ensure adequate protection of public health and safety.

(3) Tables of volumetric and surface nuclide concentration levels associated with the dose criterion of 1 mrem/yr [0.01 mSv/yr]: Solid material would be considered acceptable for release if its nuclide concentrations did not exceed the levels in the tables.

(4) A recordkeeping system: Maintenance of records provides reasonable assurance that disposition of the solid material has been conducted in accordance with the provisions of the proposed amendment.

The staff discussed with stakeholders and gathered information about a range of alternate approaches for disposition of solid material. These alternates included a rule allowing unrestricted release of solid material (i.e., the clearance approach); an approach in which all solid material goes to a licensed low-level waste (LLW) disposal facility (i.e., the prohibition approach); and a limited disposition approach.

The staff has decided to propose a limited disposition approach that it believes is a balanced consideration of technical issues and overall stakeholder concerns. The proposed approach would limit release of solid material, meeting a 1 mrem/yr [0.01 mSv/yr] dose criterion, from licensed control to the set of limited disposition paths, noted above. This approach is consistent with NCRP Report No. 141, which suggests an approach that would initially prohibit recycling into certain consumer products and which notes that it is possible to designate certain acceptable restricted industrial uses where direct contact of solid material with the general public can be minimized and avoided. Similarly, the National Academies' report also notes the

merits of an approach focusing on restricted uses and/or landfill disposal. This approach is also consistent with the diverse range of stakeholder comments that sought uniform standards for release, but which were either concerned about unrestricted releases or did not specifically support an unrestricted release approach.

Some stakeholders saw the limited disposition path approach as a means to provide additional protection of public health and safety, whereas others expressed concern about the feasibility and potential regulatory burden of limited disposition paths and about their ability to limit where material goes and protect public health and safety. As discussed in detail in Sections III.B.1.1 and III.B.1.2 of the attached FRN, the staff believes that the provisions in the proposed amendment provide reasonable assurance that doses will be maintained well below levels established to protect public health and safety and that unnecessary burden will be minimized. These provisions include: direct material to allowed destinations, including facilities under the regulatory structure of the Resource Conservation and Recovery Act (RCRA); establish a dose criterion that is a small fraction of the public dose limit in 10 CFR Part 20; place bounds on nuclide concentrations; and require maintenance of records. The staff does indicate in the FRN that it is interested in stakeholder input as to practices at various types of EPA/State-regulated RCRA landfills and specifically requests comment regarding this matter in the FRN.

Although the proposed rule would authorize disposal of solid material from NRC-licensed facilities to an EPA/State-regulated RCRA landfill facility or to a specific end user, it is the operator (or regulator) of each landfill facility and/or other recipient who will determine if a transfer to a specific facility will be allowed. Licensees will have to be aware of monitoring practices for incoming shipments to landfills or other destinations as part of their business practices, in addition to complying with the requirements of this proposed amendment for releasing solid material from further licensed control.

If a licensee chooses not to use one of the disposition paths allowed in the proposed amendment, it may request case-specific approval of another disposition path. Disposition paths considered as part of a case-specific request would include, in particular, metal recycle and soil disposition. Developing scenarios for use in the DGEIS for disposition of metals and soil is difficult, and neither stakeholders nor our technical analyses have provided a clear process as to how these materials could be generically directed for recycle or re-use into non-licensed industrial or construction related end uses. Thus, the proposed amendment indicates that any consideration of disposition of metal or soil should be proposed by a licensee as a case-specific request.

A 1 mrem/yr [0.01 mSv/yr] dose criterion is a small fraction (1/100) of NRC's public dose limit in 10 CFR Part 20 established to provide adequate protection of public health and safety. It is also in the range of Federal agency standards and allowable risk ranges for other similar media, like air and liquid effluent requirements in 10 CFR Part 50, Appendix I, and EPA drinking water standards in 40 CFR Part 141. A 1 mrem/yr [0.01 mSv/yr] dose criterion also comports with technical findings in reports prepared by various recognized scientific organizations. In particular, NCRP Report No. 141 notes that a dose below 1 mrem/yr [0.01 mSv/yr] can be defined as a "negligible individual dose," and that doses that fall into this range have an associated average annual excess risk below which "...efforts to reduce radiation exposure to the individual is unwarranted." NCRP Report No. 141 also cites several health effects studies and notes that this dose is in a risk range (10^{-7} to 10^{-6} per year) that is generally regarded as "trivial." A dose criterion of 1 mrem/yr [0.01 mSv/yr] represents a minute fraction (1/300) of

natural background and also is a small fraction of the variability in natural background across the U.S. that members of the public are exposed to without health impact. The staff is cognizant of reports on low doses of radiation cited by citizen groups that are different from the current scientific consensus views. However, the staff is confident in the information it does have to determine that a proposed standard of 1 mrem/yr [0.01 mSv/yr] is an appropriate dose criterion for this proposed rule. More detail on the 1 mrem/yr [0.01 mSv/yr] dose criterion is provided in the attached FRN, Section III.B.2, including a discussion of consistency with other NRC and EPA standards, relationship of the dose criterion to recommendations from national and international scientific bodies, comparability to background radiation, and effect of exposures from multiple sources.

The staff plans to supplement the proposed rule's dose criterion of 1 mrem/yr [0.01 mSv/yr] with tables of measurable nuclide concentration levels to facilitate confirmation that the dose criterion has been met. Several organizations have developed reports (including the NRC in NUREG-1640; IAEA in RS-G-1.7; and ANSI in N13.12-1999) that relate measurable nuclide concentrations to a dose of 1 mrem/yr [0.01 mSv/yr]. Each of these reports evaluates various exposure scenarios and pathways by which potential population groups might be exposed, based on release of a range of materials and nuclide concentrations. The appropriateness of the models in NUREG-1640 to evaluate the relationship between material released and a dose criterion of 1 mrem/yr [0.01 mSv/yr] was reviewed by the National Academies and peer-reviewed as part of the report's preparation. The National Academies report noted the technical soundness of NUREG-1640 and recommended that for any dose-based approach for disposition of solid materials, the NRC should use the conceptual framework of NUREG-1640 to assess dose implications. Table 2 of IAEA's RS-G-1.7 contains volumetric concentrations for nuclides of artificial origin, developed independently from NUREG-1640. The staff has reviewed Table 2 and found its concentrations reasonably consistent with NUREG-1640. An advantage of using the internationally accepted nuclide concentrations in RS-G-1.7 in this proposed NRC amendment is that it would promote consistency among nations in setting numeric standards for release of solid material from regulatory control.

Thus, the staff has decided to use Table 2 of RS-G-1.7 in this proposed amendment because it would make NRC's release concentrations consistent with international numeric standards. In addition, our review of RS-G-1.7 and NUREG-1640 indicates that the use of either document can provide reasonable assurance that the dose criterion in this proposed amendment is met. More detail on the bases for the nuclide concentrations is provided in the attached FRN, Section III.B.3.

The staff had to make decisions on two specific issues with regard to nuclide concentration tables. First, for nuclides not included in Table 2 of RS-G-1.7, the staff is using nuclide levels taken from NUREG-1640 normalized to the 1 mrem/yr [0.01 mSv/yr] dose criterion of this proposed amendment. Primarily, this includes licensees authorized to possess source material under 10 CFR Part 40 and special nuclear material under 10 CFR Parts 50, 70, and 72. Second, RS-G-1.7 does not yet contain limiting values for surface nuclide concentrations. Therefore, the staff has developed a table of acceptable surface concentration levels. In developing this table, the staff noted that solid materials released from further license control by the NRC under this proposed amendment would likely be transported in a variety of manners and that consistency between NRC requirements and Department of Transportation (DOT) regulations in 49 CFR Part 173 for transport of material is important. The staff decided to use surface concentrations based on the definition in 49 CFR 173.403 for surface concentrations

not requiring DOT regulation to provide consistency between these two Federal agencies regarding material needing no further regulation. Although the DOT values are not a direct derivation from a 1 mrem/yr [0.01 mSv/yr] dose level, they result in doses of less than 1 mrem/yr [0.01 mSv/yr] and are also reasonably consistent with existing values in Regulatory Guide 1.86. In considering how to proceed in this area, the staff also derived estimates of surface concentrations directly from the volume concentrations in RS-G-1.7 using information in the DGEIS for ratios of the mass of various solid materials to their surface areas. The DOT values are reasonably consistent with these derived surface concentrations for certain nuclides (such as Co-60 and Cs-137) and for typical mixes of nuclides, although for some nuclides the DOT values may introduce additional conservatisms resulting in more restrictive concentration levels. The staff is particularly interested in stakeholder views on the approach it has taken, and in the FRN specifically requests input from stakeholders on this item.

The volumetric and surface nuclide concentration tables are contained in a new Appendix E to 10 CFR Part 20. These tables provide an acceptable means to comply with the 1 mrem/yr [0.01 mSv/yr] dose criterion in an effective and efficient manner. Licensees may elect to calculate case-specific nuclide concentrations under the case-specific element of this proposed amendment.

The proposed amendment would require licensees to maintain records of material released (e.g., type and quantity of solid material, and nuclides present and their concentrations) and, as appropriate, its destination (e.g., the landfill or specific end use shipped to, etc.). The records required by this proposed amendment will provide for verification during routine inspections that the dose criterion has been met and provide reasonable assurance that the material was dispositioned in accordance with this proposed amendment. More detail on recordkeeping requirements is provided in the attached FRN, Section III.B.4.

Section III.C of the FRN discusses the scope of this proposed amendment and interfaces with other NRC requirements. One of the specific areas noted is that all materials in restricted or impacted areas would be subject to the provisions of the proposed amendment. However, it is also noted that making decisions on disposition of solid material based on its location in a "restricted area" may not be appropriate because the definition of restricted area in 10 CFR Part 20 may relate more to exposure to ambient external radiation fields than to residual radioactivity on solid material. Thus, it is noted that a more appropriate scope may be only material in "impacted areas" which is currently defined in 10 CFR Part 50 as "areas with some reasonable potential for residual radioactivity in excess of natural background." In the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NUREG-1575) this term, "impacted area" is used to signify the extent of surveys needed to release areas from licensed control. It would seem reasonable that this proposed amendment should have a similar requirement to allow for better focus by the NRC and licensees on disposition of solid materials from those areas where a reasonable potential for the presence of residual radioactivity exists. In the FRN, the staff specifically requests input from stakeholders on this item.

An interface with other NRC requirements is the relation to 10 CFR 20.2002. Currently, under the provisions of 10 CFR 20.2002, licensees can apply to the Commission for approval of proposed procedures, not otherwise authorized in the regulations, to dispose of licensed material. The proposed amendment would not change that provision. A licensee can continue to use the existing provisions of 10 CFR 20.2002 to request disposal of materials not within the scope of this proposed amendment and also to request consideration of alternate dose levels

for materials covered by this proposed amendment (for example, if a specific landfill is permitted by EPA or State regulator to receive material with a potential dose greater than that in this proposed amendment).

Discussion of the Rulemaking Process

The staff has participated in 12 meetings (from September 1999 to February 2005) with a range of stakeholder groups, and received over 3500 separate comment letters and e-mails (in response to June 1999 and February 2003 FRNs) representing viewpoints from a wide range of stakeholders. Information gathered in this effort has included: identification of economic concerns by the metals and cement industries; citizens groups concerns over the potential presence of radioactivity in solid materials, even in very small amounts, in consumer products and general commerce; reference to various studies regarding low doses of radioactivity; identification of practical issues of how solid materials are handled at the range of facilities that NRC licenses; issues of feasibility related to limiting solid materials to only a set of defined uses; and various viewpoints associated with disposal of solid materials in RCRA landfills. The staff believes that this proposed rule represents a reasonable position based on the information-gathering process it has conducted. The evolution of alternatives, from the range of alternatives initially discussed with stakeholders to the present content of the proposed rule (i.e., the limited disposition approach), clearly indicates that the NRC carefully considered stakeholder views, as well as various technical reports and related health standards and development of technical bases and the DGEIS analyses on disposition of solid materials, in formulating this proposed rule. The staff is issuing this proposed rule and DGEIS for public comment and also is considering discussing this issue further with stakeholders in two public meetings to solicit additional input on these documents.

Comments from Cooperating Agencies

The EPA, the Department of Energy (DOE), and the State of Massachusetts, identified as a State representative by the Conference of Radiation Control Program Directors and the Organization of Agreement States, have participated as cooperating agencies in the development of the DGEIS and submitted written comments on the DGEIS. The Naval Nuclear Propulsion Program (NNPP), a joint DOE/Navy program, also participated in the cooperating agency reviews at the request of DOE. In their comments on the DGEIS (Attachment 5), the agencies indicated that, in general, they found little difference in the environmental impacts between the current approach, the unrestricted release alternate, and limited disposition alternate; thus, they concluded the DGEIS analysis does not provide a compelling basis for selecting the limited disposition alternative. The NNPP indicated that it disagrees with the proposed limited disposition alternative, preferring instead the unrestricted release alternate. The cooperating agencies also recommend there should be an unrestricted release process for clearing material with no residual radioactivity from a restricted area. In addition, the agencies commented that there could be confusion regarding imports from other countries to the U.S. if those countries follow the IAEA safety guide which recommends unrestricted release for solid material meeting a 1 mrem/yr [0.01 mSv/yr] dose criterion, whereas the DGEIS recommends limited disposition. The cooperating agencies also made specific comments on the technical analyses in the DGEIS.

AGREEMENT STATE ISSUES:

A copy of the draft FRN for the proposed rule was posted on NRC's Technical Conference Forum for review by Agreement States. Input was received from the States of Massachusetts, Texas, and Washington (Attachment 5). In general, it was stated that there may not be a technical reason for this rule (with reference to the National Academies finding that the current approach is "sufficiently protective"), that there should be provisions for unrestricted use, and that the dose criterion is well below that needed to protect public health and safety and below constraints for other media such as liquid and gaseous effluents. Input was also received indicating the need for a provision for unrestricted release of material that was clean and/or had non-detectable activity. There also were questions regarding oversight of this material once it is released from the NRC license and how handling, inspections, or enforcement in the public domain would take place to ensure that the material stayed at the destinations allowed in the proposed amendment. There was also concern that the landfills may not take material released and that the case-specific approach may not be feasible for the metals and for soils. There also was some question about interface between this proposed amendment and the provisions of 10 CFR Part 20, Subpart E, on license termination of sites and provisions for on-site dispositions of solid materials. The staff believes that the these comments have been considered in preparation of the draft FRN.

Based on the Management Directive 5.9 process, the staff has assigned compatibility categories to the sections of the proposed rule. Some Part 20 sections remain the same, in particular the Category C designation of 10 CFR 20.2001 and the Category A designations in 10 CFR 20.1003. Proposed 10 CFR 20.2008 and 20.2009 and proposed Appendix E to 10 CFR Part 20 have been designated Category B because there could be transboundary impacts with respect to transporting or distributing material released in accordance with both proposed sections and the appendix. The recordkeeping requirements in 10 CFR 20.2108(a) are categorized as Category C to ensure that licensees in Agreement States keep a minimum set of records important to keeping track of where the material goes.

RECOMMENDATIONS:

That the Commission:

1. Approve, for publication in the *Federal Register,* the attached notice of proposed rulemaking (Attachment 2).

2. Note:

    a. A DGEIS has been prepared for this rulemaking (Attachment 3).

    b. A draft Regulatory Analysis has been prepared for this rulemaking (Attachment 4).

    c. An initial regulatory analysis of the impact of this proposed rule on small entities has been prepared as part of the draft Regulatory Analysis. Based on that analysis, the staff believes that this proposed rule would not have a significant impact on small entities. However, because it would be useful to have additional information on small entities as part of its analysis, the staff has specifically requested public comment on the potential impact of the proposed rule on small entities.

d. The appropriate Congressional committees will be informed.

e. A press release will be issued by the Office of Public Affairs when the proposed rulemaking is filed with the Office of the *Federal Register.*

f. The proposed rule would amend information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, et seq.). These requirements must be submitted to the Office of Management and Budget for review no later than the date the proposed rule is forwarded to the *Federal Register* for publication.

<u>RESOURCES</u>:

It is anticipated that 3.5 NRC FTE will be needed to complete this rulemaking action (2.5 FTE NMSS and 1.0 FTE all other). These resources are within the approved budget for FY 2005 and FY 2006.

<u>COORDINATION</u>:

The Office of the General Counsel has no legal objection to the proposed rulemaking. Resources needed to complete this rulemaking action are within existing budget allocation. The Office of the Chief Financial Officer has reviewed this Commission Paper for resource implications and has no objections. The Office of Information Services has reviewed this Commission Paper for recordkeeping implications and has no objections.

A copy of the draft FRN for the proposed rule was posted on NRC's Technical Conference Forum so the Agreement States could review it.

/RA/
Luis A. Reyes
Executive Director
for Operations

Attachments:
1. SRM Dated October 25, 2002
2. *Federal Register* Notice
3. Draft Generic Environmental Impact Statement
4. Draft Regulatory Analysis
5. Letters from Cooperating Agencies and Agreement States

d. The appropriate Congressional committees will be informed.

e. A press release will be issued by the Office of Public Affairs when the proposed rulemaking is filed with the Office of the *Federal Register*.

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A copy of the draft FRN for the final rule was posted on the NRC's Technical Conference Forum so the Agreement States could review it.

/RA/
Luis A. Reyes
Executive Director
for Operations

Attachments:
1. SRM Dated October 25, 2002
2. *Federal Register* Notice
3. Draft Generic Environmental Impact Statement
4. Draft Regulatory Analysis
5. Letters from Cooperating Agencies and Agreement States

ML041550790

OFFICE:	RGB/IMNS	RGB/IMNS	RGB/IMNS	OGC
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OFFICE:	D/IMNS	D/NMSS	DEDMRS	EDO
NAME:	CMiller*	JStrosnider	MVirgilio	LReyes /RA/
DATE:	3/17/ 2005	03/24/05	03/31/05	03/31/05

OFFICIAL RECORD COPY

March 31, 2005

U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: Opposition to Proceeding with Rulemaking on the Release of Currently Regulated Radioactive Waste and Materials to Unlicensed Destinations ("Controlling" the Disposition of Solid Materials)

Dear Commissioners Diaz, Jaczko, Lyons, McGaffigan and Merrifield:

Nineteen years ago, the Nuclear Regulatory Commission ignited a national firestorm of concern and outrage when it issued a Policy Statement on radioactive waste "Below Regulatory Concern" (BRC), essentially attempting to deregulate a major portion of the "low-level" radioactive waste stream. The BRC Policy would have permitted radioactive wastes to be disposed of in landfills not licensed or designed to handle radioactive wastes, and to be otherwise released, so they could end up in schools, farms, and parks throughout our cities, suburbs, and rural communities. The proposed policy would even have allowed "recycling" nuclear waste into consumer products. The Commission, charged with regulating such materials so as to isolate them from the human environment, had chosen instead - in order to save money for industry rather than protect the health of the public - to permit nuclear wastes to be placed into intimate human contact.

The outcry was intense. State legislatures around the country passed laws barring BRC practices within their borders. Eventually the Congress intervened, in a remarkable fashion, and by statute overturned the NRC's BRC 1986 Policy and its 1990 expanded BRC policy, and expressly reserved for the states the right to regulate any radioactive material that NRC might subsequently try to deregulate [Energy Policy Act of 1992].

Several years later, the Commission asked the National Academy of Sciences to perform a study about whether another attempt at deregulating certain radioactive wastes should be undertaken. Hoping for some political cover from the Academy, the NRC was shocked when NAS declined to endorse such an effort and provided very strong criticism of NRC's credibility in such matters. The Academy report concluded that if the NRC nonetheless remained interested in such a BRC endeavor, no such effort should be undertaken until and unless NRC had taken significant, successful measures to repair its credibility with stakeholder groups. The National Academy of Sciences committee - established at the request of the Commission - stated:

> *[T]hat in the past, the USNRC failed to convince any environmental and consumer advocacy groups that the clearance of slightly radioactive solid material can be conducted safely, and failed to convince certain industry groups that such clearance is desirable*

...Furthermore, a legacy of distrust of the USNRC has developed among many of the environmental stakeholder groups, resulting from their experience with the BRC policy, the enhanced participatory rulemaking on license termination ("decommissioning rule"), and the USNRC's 1999 issues paper, published in the Federal Register on June 30, 1999, on the clearance standards. Reestablishing trust will require concerted and sustained effort by the USNRC.

***

The USNRC must overcome serious levels of distrust, generated by its actions during the BRC policy and License Termination Rule efforts, before [any effort to revive a new BRC policy] is likely to succeed.

Despite these strong recommendations, however, no such efforts have truly been undertaken; indeed, every action has further eroded public confidence. Although NRC has had some public meetings and workshops, these have been few and far between, and NRC has used these meetings simply as a way to improve the image of the proceedings without seriously taking the input of citizen and industry groups into account.

Rather than give up on deregulating radioactive wastes, NRC has been quietly proceeding to put the pieces in place to try again. NRC has spent large amounts of staff and contractor time and international effort to do exactly what the public opposes - release radioactive waste into our communities.

At present, the NRC staff is set to submit to the Commission a recommendation that it approve a kind of "BRC II". The proposal is to instigate a rulemaking to once again try to deregulate significant portions of the "low-level" radioactive waste stream, permitting licensed nuclear material to go to unlicensed sites such as local municipal garbage dumps, hazardous waste sites, and recyclers for use in consumer goods and construction materials (giving new meaning to the phrase "hot roads"). This can only create, as did the ill-fated BRC efforts of the early 1990s, tremendous concern across the country and further damage the Commission's very tattered credibility.

We are therefore dismayed that the NRC is moving forward with BRC, the Sequel. We are furthermore concerned that the Commission is doing so in a non-transparent way that will further erode public trust. In particular, it is our understanding that the staff proposal will be presented to the Commission with no public meeting, no testimony from key stakeholders, and without the proposal becoming immediately public. The Commission rather will vote in private on this important and controversial proposal, after having only seen recommendations from the staff but not hearing directly from those who would be most affected.

There will of course be an opportunity for the public to submit written comments to the staff after the Commission approves the proposal for rulemaking and directs the proceeding to begin. But the Commissioners themselves really should hear directly from stakeholders NOW, prior to embarking on this dangerous course.

Furthermore, NRC appears to intend the rulemaking to have a pre-ordained outcome. NRC is already considering and approving such deregulations without public input and now seeks to do so generically. For example, the operators of the Connecticut Yankee reactor are requesting to dispose of significant quantities of radioactive decommissioning waste at an unlicensed landfill in Idaho. NRC staff appears on the verge of approving this request without any opportunity for a public hearing.

We therefore strongly urge you to:

1. Vote against initiating any rulemaking to remove from full regulatory control portions of the radioactive waste stream - i.e., do not move forward with a new, highly controversial BRC/deregulation endeavor.

2. Insist that before any such vote, the Commissioners hold a public meeting at which representatives of our stakeholder community can testify to the Commissioners as to why you should not proceed with the staff's proposal. It is highly inappropriate to vote on such an important issue after having only had input from the staff pushing the proposal and not from anyone opposing it.

3. Require that the staff recommendation be made public immediately when it is submitted to the Commissioners and before the Commission meeting requested in (2) above, so that stakeholders can effectively inform you of its problems in detail.

4. Direct staff to not approve the Connecticut Yankee request, or any similar requests to send decommissioning wastes to landfills not licensed to receive Atomic Energy Act radioactive wastes.

The job of the Nuclear Regulatory Commission is to *regulate* nuclear materials, not *deregulate* them. The lessons of the BRC controversy of a decade and a half ago should not be forgotten. The release of radioactively contaminated materials violates your mission of protecting public health. Proceeding with this ill-conceived favor to industry would destroy the last vestiges of opportunity for the Commission to resurrect public confidence. We urge you to not go down this dangerous path.

Sincerely,

Wenonah Hauter
Public Citizen
202 546 4996

Diane D’Arrigo
Nuclear Information and Resource Service
202 328 0002

Susan Gordon
Alliance for Nuclear Accountability

206-547-3175

Ed Hopkins
Sierra Club
202-675-7908

Robert K Musil Ph.D. MPH
Physicians for Social Responsibility
202 667 4260

Dan Hirsch
Committee to Bridge the Gap
831 332 3099

Erich Pica
Friends of the Earth
202 783 7400

Kevin S. Curtis
National Environmental Trust
202 887 8832

Julie Enszer, Margaret L. Keon
Nuclear Policy Research Institute
202-822-9800

Lisa Finaldi, Jim Riccio
Greenpeace

Alice Slater, Leslie Seth
Global Resource Action Center for the Environment (GRACE) Public Fund
New York, NY

Lawrence A. Plumlee, M.D.
Chemical Sensitivity Disorders Association

S.(Ziggy) Kleinau
Citizens For Renewable Energy/Great Lakes United

John Bailey
Institute for Local Self-Reliance

Peter Alexander
New England Coalition
Brattleboro, VT

Micah Walker Parkin
Alliance for Affordable Energy
New Orleans, LA

Anita L. Chronister
Concerned Citizens
Prescott, Arizona

Adele Kushner, Executive Director
Action for a Clean Environment
Alto, Georgia

Amy Williams
Concerned Citizens for Nuclear Safety
Santa Fe, NM

Austin Gelzer
Monmouth for Democracy
New Hampshire

Barbara Backman
PACE (People's Action for Clean Energy)
Canton, CT

Becky Bornhorst
Downwinders at Risk
Dallas, TX

Ms. Betsy Moon
Creators Syndicate
Austin, TX

Betty Schroeder
Arizona Safe Energy Coalition
Tucson, AZ

Lea Foushee
North American Water Office
Lake Elmo, MN

Bruce A Drew
Prairie Island Coalition
Minneapolis, MN

Carrie Dickerson
Citizens' Action for Safe Energy

Claremore, Oklahoma

Catherine Quigg
NEIS
Barrington, IL

Mr. and Mrs. Charles R. Hinton, Sr.
Concerned Citizens of Longview
Longview, Texas

Chris Trepal
Earth Day Coalition
Cleveland, OH

Connie Hogarth
Connie Hogarth Center for Social Action of Manhattanville College
Purchase, NY

Janet Greenwald
Citizens for Alternatives to Radioactive Dumping
Albuquerque, NM

Daniel Jameson, Emily Aversa, Marc Page
Gallup Street Solidarity
Gallup, NM

Daniela K. Horsman, R.N.
NursesNet LLC
Lorton, VA

Dave Kraft
Nuclear Energy Information Service
Evanston, IL

Jane Williams
California Communities Against Toxics
Rosamond, CA

Deb Katz
Citizens Awareness Network
Shelburne Falls, Ma

Dennis Larson
PASE (Peoples Action for Safe Energy)
Parthenon, Arkansas

Don J. Devine
Devine Design
Chester, NY

Diana McKeown
Clean Water Action Alliance of Minnesota
Minneapolis, MN

Ellen Thomas
Proposition 1 Committee
Washington, DC

John Blair
Valley Watch, Inc.
Evansville, IN

Eleanor Culberson
Committee for Consumer Rate Relief
Houston, Texas

Ellen Lebowitz
Green Delaware
Newark, DE

Alan Muller
Green Delaware
Port Penn, DE

Elinor Weiss
Social Action Committee of Temple Sinai
East Amherst, New York

Evelyn Justesen
Mothers for Peace
San Luis Obispo, CA

Floyd Sands
Families In Search of Truth
Fallon, NV

Frank C. Subjeck
airwaterearth, org
Lake Havasu City, Arizona

Ernest Fuller

Concerned Citizens for SNEC Safety (CCSS)
Saxton, PA

Gene Burke
Santa Monicans for Safe Drinking Water Coalition
Environmental Health Projects
Santa Monica, CA

Susan Clark
Americans for a Safe Future
Sherman Oaks, CA

Gladys Schmitz, SSND
Mankato Area Environmentalists
Mankato, MN

Lorriane Gold
S.E.A. Alliance, New Jersey
Blairstown, NJ

Greg Wingard
Waste Action Project
Seattle, WA

Gretel Munroe
Grassroots Actions for Peace
Concord, MA

Hart Feuer
Lafayette Environmental Awareness and Protection (LEAP)
Easton, Pennsylvania

Sr. Helen Lembeck
Medical Mission Sisters
La Mesa, CA

Holy Holily Holian
Social Security Administration for the Disabled Worker
Arcata, California

Jane Harris
Oregon Center for Environmental Health
Portland, OR

Jane Swanson
San Luis Obispo Mothers for Peace

Pismo Beach, Ca

Klaus Schumann, Mary Jane Adams
San Luis Obispo County GREEN Party
Paso Robles, Ca.

Jay Coghlan
Nuclear Watch of New Mexico
Santa Fe, NM

Jennifer O. Viereck
HOME: Healing Ourselves & Mother Earth
Tecopa, CA

Jeremy Maxand
Snake River Alliance
Boise, Idaho

Joanne Steele
Action for a Clean Environment
Nacoochee Presbyterian Peace and Justice Committee
Sautee-Nacoochee, GA

John B. Gilpin
No New Nukes
Champaign IL

Dr. Judith Johnsrud
Environmental Coalition on Nuclear Power
State College, PA

Hollis Zelinsky
Central Pennsylvania Citizens for Survival
State College, PA

Judy Alter
Alliance for Retired Americans,
Culver City, CA

Judy Treichel
Nevada Nuclear Waste Task Force
Las Vegas, NV

Karen H. Prather
C.A.R.I.E. Concern About Radiation In the Environment
Corry, PA

Kathryn Barnes
Don’t Waste Michigan

Ken Bossong
SUN DAY Campaign
Takoma Park, MD

Mary Lampert
Pilgrim Watch
Duxbury, MA

Rev. Larry Bernard, O.F.M.
Office of Justice, Peace and Integrity of Creation of the Franciscan Province of Our Lady of Guadalupe
Laguna/Albuquerque, New Mexico

Sister Mary Frances Gebhard
St. Bede Monastery
Eau Claire, WI

Laura Cayford
Jersey Shore Nuclear Watch
Asbury Park, NJ

LeGrande Renfroe
L & N Produce
Thomasville, GA

Leo and Carolyn Prinster
Pax Christi
Glenwood Springs, Colorado

Lionel Delevingne
Delevingne & Associates
Piermont NY

Lisa Guido
Ithaca Catholic Worker Community
Ithaca, NY

Lisa Johnson
Department of History
Carnegie Mellon University
Forest Hills, PA

Lyn Borisof,
Ethical Humanist Society of Greater Chicago
Skokie, IL

Marilyn and Steven Strong
Solar Design Associates, Inc
Harvard, Massachusetts

Mark A. Mitchell M.D., MPH
Connecticut Coalition for Environmental Justice
Hartford, CT

Martha Ferris
Vicksburg, MS

Mary Davis
Earth Island Institute's Yggdrasil Institute
Georgetown, KY

MaryJane Shimsky
Citizens for Safe Energy
Hastings-on-Hudson, NY

Agnes M. Reynolds RNC
Staff RN Women's Health
Hartford Hospital
Hartford, CT

Katherine Dietrich
Richmond Collective
Richmond, Virginia

Grace Potorti
Nevada Conservation League

Michel Lee, Esq.
Council on Intelligent Energy & Conservation Policy
White Plains, New York

Miriam MacGillis
Genesis Farm
Blairstown, NJ

Molly Johnson

Grandmothers for Peace
San Luis Obispo County Chapter
San Miguel, CA

Nancy Burton
Connecticut Coalition Against Millstone
Redding Ridge CT

Cary Vigneri
Nebraskans for Peace, Omaha chapter
Omaha, NE

Olivia Zivney
Gallipolis Developmental Center
Gallipolis, OH

Paula Gotsch
Grandmothers, Mothers and More for Energy Safety
Brick, NJ

Paxus Calta
PACE - Peoples Alliance for Clean Energy
Louisa VA

Pat Birnie
Women's International League for Peace and Freedom, Tucson Branch
Tucson, AZ

Patricia Krommer C.S.J.
Pax Christi, Los Angeles
Monterey Park, CA

Nebraska State Senator Don Preister
Lincoln, Nebraska

Peggy Maze Johnson
Citizen Alert
Las Vegas, NV

Peg Ryglisyn
Connecticut Opposed toWaste
Broad Brook, CT

Sandra Lindberg, Samuel Galewsky
No New Nukes
Bloomington, IL

Richard Hausman, Research Director
Clean Yield Asset Management
Greensboro, VT

Robert R. Holt
Truro Energy Committee
Truro, MA

Carolyn and Roy Treadway
No New Nukes
Normal, IL

Sandra Gavutis, Kathy Weinstock
C-10 Research and Education Foundation
Newburyport, MA

Sholey Argani MD
Assistant prof
George Washington University School of Medicine
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The Beacon Sloop Club
Beacon, NY

Wendy Oser
Nuclear Guardianship Project
Berkeley, CA

Carol A. Bruno
Brimfield Herb & Flower Farm
Brimfield, MA

Thomas V. Connor
SFO
Fraternity Minister
Secular Franciscan Order, Saint Peter Damian Fraternity
Saint Joseph Church
New Paltz, N.Y.

Anita Knight
St. Petersburg, Florida

June 1, 2005

MEMORANDUM TO: Luis A. Reyes
Executive Director for Operations

FROM: Annette L. Vietti-Cook, Secretary **/RA/**

SUBJECT: STAFF REQUIREMENTS - SECY-05-0054 - PROPOSED RULE: RADIOLOGICAL CRITERIA FOR CONTROLLING THE DISPOSITION OF SOLID MATERIALS (RIN 3150-AH18)

The Commission has disapproved publication of this proposed rule at this time. The Commission's decision is based on the fact that the Agency is currently faced with several high priority and complex tasks, that the current approach to review specific cases on an individual basis is fully protective of public health and safety, and that the immediate need for this rule has changed due to the shift in timing for reactor decommissioning. As such, the Commission is deferring this rulemaking for the time being.

cc: Chairman Diaz
Commissioner McGaffigan
Commissioner Merrifield
Commissioner Jaczko
Commissioner Lyons
DOC
OGC
CFO
OCA
OPA
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR

PUBLIC MEETING ANNOUNCEMENT

Title:	U.S. Nuclear Regulatory Commission Very Low-Level Radioactive Waste Scoping Study and Greater Than Class C Waste Public Meeting
Date(s) and Time(s):	February 22, 2018, 09:00 AM to 03:00 PM
Location:	NRC Two White Flint North, Auditorium 11545 Rockville Pike Rockville, MD
Category:	This is a Category 2 meeting. The public is invited to participate in this meeting by discussing regulatory issues with the Nuclear Regulatory Commission (NRC) at designated points identified on the agenda.
Purpose:	The NRC is holding a public meeting to discuss the Very Low-Level Radioactive Waste (VLLW) Scoping Study and concerns associated with disposal of Greater Than Class C waste. Reference: RIN 3150-AK00

Contact:	Cardelia Maupin 301-415-2312 Cardelia.Maupin@nrc.gov	Maurice Heath 301-415-3137 Maurice.Heath@nrc.gov

Participants: NRC
Office of Nuclear Material Safety and Safeguards

Teleconference:

Bridge Number	Pass Code
(800) 857-9840	4975456

Webinar:

URL	Meeting Number	Password
https://attendee.gotowebinar.com/register/8931017780586767363	800-857-9840	4975456

Comments: All NRC visitors may pre-register for this meeting via e-mail to Ms. Kellee Jamerson at Kellee.Jamerson@nrc.gov with your full name, organization, and telephone number no later than February 16, 2018. Please arrive early for security screening and badging. All visitors must present a valid, government-issued ID upon entry. Interested members of the public can participate in this meeting via Webinar and/or teleconference. This meeting will be transcribed and will have a facilitated bridgeline.

PUBLIC MEETING AGENDA

U.S. Nuclear Regulatory Commission Very Low-Level Radioactive Waste Scoping Study and Greater Than Class C Waste Public Meeting

February 22, 2018, 09:00 AM to 03:00 PM

NRC Two White Flint North, Auditorium
11545 Rockville Pike
Rockville, MD

Time	***Topic***	***Speaker***
8:30 am – 9:00 am	Registration and Badging	
9:00 am – 9:15 am	Facilitator Opening Comments	NRC
9:15 am – 9:30 am	NRC Welcome/Opening Remarks	NRC
9:30 am – 12:00 pm	Very Low-Level Radioactive Waste Scoping Study Discussion/Public Comments/Questions	NRC/Public
12:00 pm – 1:00 pm	*Break*	
1:00 pm – 3:00 pm	Greater Than Class C Waste Discussion/Public Comments/Questions	NRC/Public
3:00 pm	Closing Remarks/Adjournment	NRC

The time of the meeting is local to the jurisdiction where the meeting is being held.

The NRC provides reasonable accommodation to individuals with disabilities where appropriate. If reasonable accommodation is needed to participate in this meeting, or if a meeting notice, transcript, or other information from this meeting is needed in another format (e.g., Braille, large print), please notify the NRC meeting contact. Determinations on requests for reasonable accommodation will be made on a case-by-case basis.

ADAMS Accession Number: ML18040B304

OFFICIAL RECORD COPY

Link to meeting details: https://www.nrc.gov/pmns/mtg?do=details&Code=20180033

Commission's Policy Statement on "Enhancing Public Participation in NRC Meetings"
67 Federal Register 36920, May 28, 2002
The policy statement may be found on the NRC website
http://www.nrc.gov/reading-rm/doc-collections/commission/policy/67fr36920.html

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title:	Very Low-level Radioactive Waste Scoping Study and Greater than Class C Waste Public Meeting
Docket Number:	(n/a)
Location:	Rockville, Maryland
Date:	Thursday, February 22, 2018

Work Order No.: NRC-3535 Pages 1-173

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NUCLEAR REGULATORY COMMISSION

+ + + + +

VERY LOW-LEVEL RADIOACTIVE WASTE SCOPING STUDY AND GREATER THAN CLASS C WASTE PUBLIC MEETING

+ + + + +

THURSDAY

FEBRUARY 22, 2018

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Meeting convened at the Nuclear Regulatory Commission, Two White Flint North Auditorium, 11545 Rockville Pike, at 9:00 a.m., Daniel Mussatti, Facilitator, presiding.

NRC STAFF PRESENT:

DAN MUSSATTI, NRO, Facilitator

STEVE DEMBEK, NMSS

MAURICE HEATH, NMSS

KELLEE JAMERSON, NMSS

TIM McCARTIN, NMSS

CHRIS McKENNEY, NMSS

CARDELIA MAUPIN, NMSS

JOHN TAPPERT, NMSS

GREGORY SUBER, NMSS

HARRY FELSHER, NMSS

SARAH ACHTEN, NMSS

JANELLE JESSIE, NMSS

HAIYONG JUNG

HANS ARLT, NMSS

DAVID ESH, NMSS

IAN IRVIN, OGC

BOBY EID, NMSS

MICHELLE SAMPSON, NMSS

MARIA ARRIBAS-COLON, NMSS

PRIYA YADAV, NMSS*

ADAM SCHWARTZMAN, NMSS*

ANGEL MORENO*

BERNADETTE BACA*

CYNTHIA BARR, NMSS*

NRC STAFF PRESENT (CONTINUED):

DON LOWMAN*

GARY PURDY, NSIR*

GARY COMFORT, NMSS*

KATHY MODES*

MELANIE WONG, NMSS*

ALSO PRESENT:

AMANDA SPALDING*

AMBER IGOE*

AMEESHA MEHTA-SAMPATH*

ANDREW PARK*

ANDY ZACH*

BEN WISHERT*

BETSY FORINASH*

BETSY RIVARD*

BOB SKOWRONEK*

BOBBY SMITH*

BRAD BROUSSARD*

BRET LESLIE*

BRYAN BAKER*

CHARLES YARD*

CHRISTINE ANDRES*

DARRELL LILES*

DAVID MARTIN*

DAVID HASTINGS*

ALSO PRESENT (CONTINUED):

DAVID ASSELIN*

DAVID KANIA*

DAVID PICKETT*

DAVOOD ABOUDARDA*

DAWN CINQUINO*

DENNIS MEIER*

DEREK BRICE*

DONALD OESTERLE*

EARL FORDHAM*

ED LEDUC*

ELIZABETH ZIMMER-LLOYD*

ERIC SKOTAK*

GARY FORSEE*

HANS WEGER*

HEATHER THACKER*

HOWARD SHUMAN*

JAMES SHAFFNER*

JANET JODLOWSKI*

JAY JONES*

JEREMY HOOPER*

JESSI SNOOK*

JESSICA HERNANDEZ*

JIM RICKMAN*

JOHN MITCHELL*

ALSO PRESENT (CONTINUED):

JOSEPH SULLIVAN*

JUSTIN MARBLE*

JUSTIN JENSEN*

KATHLEEN HARKNESS*

KEITH SMITH*

KENNETH FUREY*

KEVIN SIEBERT*

KEVIN MILLER*

KYLE MOONEY*

L. ROBERT GREGER*

LARAINNE KOEHLER*

LARRY HARISIS*

LAWRENCE MILLER, III*

LEE LINE*

LESLIE MARCH*

LISA MATIS*

MARVIN LEWIS*

MELANIE SNYDER*

MICHAEL ALBANESE*

MICHAEL KEEGAN*

MICHAEL KLEBE*

MICHAEL AULT*

MILTON HUFF*

MOHANNED KAWASMI*

ALSO PRESENT (CONTINUED):

NICK EMME*

NICOLE TRAPHAN*

PAUL BESSETTE*

PETER LEOMBRUNI*

PHILIP EGIDI*

RICARDO MEDINA*

RICHARD McGRATH*

ROGER SEITZ*

ROY GRANT*

RUSTY LUNDBERG*

STEPHANIE WEIR*

STEVEN LOFTUS*

TAYLOR GRABNER*

TED BUCKNER*

TODD LOVINGER*

TOM PEAKE*

TOM SCHNEIDER*

TONY GONZALEZ*

VAISHALI TENDOLKAR*

ROB BLACK *

LARRY CAMPER, Talisman International*

KAY CUMBOW, Citizens for Alternatives to Chemical Contamination*

DIANE D'ARRIGO, Nuclear Information and Resource

Service

LISA EDWARDS, Electric Power Research Institute*

RICH JANATI, Pennsylvania Department of Environmental Protection*

THERESA KLICZEWSKI, US Department of Energy

MARVIN LEWIS*

TOM MAGETTE, Talisman International

MS. MICHETTI

CLINT MILLER, Pacific Gas and Electric

JANET SCHLUETER, Nuclear Energy Institute

DANIEL SHRUM, EnergySolutions

DOUG TONKAY, US Department of Energy

GLEN VICKERS, Exelon

JOE WEISMANN, US Ecology, Inc.*

ELIZABETH ZIMMER-LLOYD*

DAN SCHULTHEISZ

ALICE CARSON

JOSEPH RUSTICK

HILARY LANE

CHRIS SHAW

TIM SMITH

DAVID HAUGHT

*Present via teleconference

P R O C E E D I N G S

9:06 a.m.

MR. MUSSATTI: Good morning.

As you can possibly see on that screen up there, we have 38 attendees that are online with us in the webinar. We'll have a handful more that are on our telephone call line and we've got everybody here in the room, and those of us that are still coming that are probably stuck on the Metro.

My name is Dan Mussatti. I am with the NRC's Facilitator Corps.

I want to welcome you to this public meeting for two important topics, the very low-level radioactive waste and the draft technical analysis for the greater than Class C waste. Those have been prepared by the Office of the Nuclear Material Safety and Safeguards, NMSS.

And my role is to help ensure that this meeting is on time, that it's informative for the NRC to be able to understand what the issues are that come from the public, and to just sort of make sure that all of the cats are herded in one direction and traveling in unison.

With regards to getting around the building, as long as you have your ID badge, your guest

badge visible, you have full access to this auditorium, the foyer out in front of it, the next floor up, and the entire main floor from where you checked in this morning all the way down to the cafeteria. So, there seems to be a change in the policy here and we don't need to be providing adult supervision to get you to the cafeteria or to the coffee shop, and those sorts of things. You've got a little bit more freedom.

If you leave the building by the revolving door in the back, you're welcome to do that. But if you do that, you have to go out by the guard shack where the cars come in, all the way around to the front of the building, and enter again and go through security one more time. They don't have enough people here to be able to handle letting people back in through the back-end and doing the screening and everything for it. But you do have the ability to exit from there if you need to.

To get to the restrooms, that's very easy, out through these doors, straight across the foyer to the far side. The ladies room is on the left; the men's room is on the right.

If we are asked to evacuate this building, please follow the instructions of the folks that are

up here with NRC and with our security staff that's outside. We will exit through the revolving door right back on the next level up and we will gather over by the guard station over there where the cars come in. And when you get there, please don't wander away because we're going to want to take a head count to make sure that everybody got out safely. Which reminds me, we need to make sure that you get signed up on the sign-in sheets here because that's the only way we know that you are here and we didn't leave your head in the building when we evacuated.

So, take a moment at the break, whether you're NRC or a guest coming into the building, to sign that list for us. It's kind of a safety thing, and that's what we're all about around here.

Today's meeting is a Category 2 meeting, which means it's held with "a group of industry representatives, licensees, vendors, and nongovernmental organizations, and we use a facilitator to ensure that issues and concerns are presented, understood, and considered by the NRC." That's a direct quote.

We have provided an agenda for you and invite your comments and questions at the designated

points in the meeting. This is not a free discussion back and forth. We have specific periods of time when these comments are being collected.

For people in the room, we ask that you please turn off anything that buzzes, rings, speaks to you, or anything like that, all of those devices, so that we have as minimal a distraction as possible. This gentleman over here is trying to transcribe this meeting for us, and those sorts of things are a distraction, and, also, for people that are speaking in the room.

There are many of us that have jobs that require us to have our phones on all the time. Some of us are emergency response here with NRC. Some of us are just really important people in the real world. And if you have to take a phone call, I ask that you just head out to the foyer before you actually start the conversation, so you minimize the disruption in the room.

We have a court reporter. That's Charles. He's going to be transcribing this meeting. To ensure we get a clean transcript, we need to have only one speaker at a time, no interruptions, these sorts of things. Please do not be rude. If you need to have

a sidebar conversation in the room, resist as much as you can, but if you have to have a sidebar conversation on something that's technical that's related here that you may have a question later on or something else that's important, could you please take it to the outside the foyer there? And remember that we can still hear you, so use your inside voice when you're out there.

One last thing about the transcript. Sometimes what you say isn't what you think you're saying, and sometimes what we hear isn't what you wanted us to hear. It would be a good idea, if you make a comment on the microphones here that you follow that up by sending us an email that has your comment written down. That way, you can craft that language a little bit better to make sure that you have got it exactly the way that you want it, and we'll have less chance of miscommunication.

This meeting is being webcast, and we'll have the presentations posted on the website afterwards. If you're participating by the internet, we strongly urge you to not use the speaker and the microphone on your computer to communicate with us. We ask that, instead, what you do is you call into the bridgeline number that we have and use the telephone.

The bandwidth issues that we get when we're trying to use GoToMeeting or one of these other webinar communication techniques, that bandwidth problem can be a little bit tricky when we're trying to send images and at the same time we're trying to gather or send audio.

So, the phone number, if you are on your computer and need to switch over to the telephone, the phone number is 1-800-857-9840 and the passcode is 4975456. I'm going to repeat that again in case I caught somebody by surprise and they didn't have a pencil. 1-800-857-9840, and the passcode, 4975456. Okay. If you folks on the phone didn't get that, please raise your hand. All right.

Also, to ensure that we have a clean transcript, when you make your comments by telephone, not through the webinar, speak slowly and clearly, and if your last name is something that is a little bit hard to guess the spelling on, you might provide us with the spelling of your last name as well. For the record, my last name is spelled M-U-S-S-A-T-T-I.

We have an operator on the line that is going to help us with the telephone people that want to call in. Would you like to explain to us how to

do that now?

OPERATOR: Yes. If you would like to ask a question during today's presentation, you may press *1. Please unmute your phone and record your first and last name clearly when prompted. To withdraw your question at any time, please press *2. Once again, to ask a question during today's presentation, you may press *1.

MR. MUSSATTI: Thank you very much.

Okay. We want this meeting to be casual, open, and comfortable. We don't want to go to Robert's Rules of Order so that we can maintain order. And that means we have to have a couple little basic rules just to make sure that we get things right and we don't wind up with things getting out of hand too much.

When we get to the question-and-answer section, a lot of times somebody is going to ask a question, and when they get the answer, that's going to compel a follow-up question. That's not a bad thing. When the follow-up question is answered and it compels a second follow-up question, or a third follow-up question, it stops being a question-and-answer and starts turning into a conversation. We don't have time for that today. We've only got five hours, and for

the question-and-answer section of this thing, we've got nine questions that we specifically want to ask and have answers for, and we're going to have to roll through those as fast as we can and just get the high points of what everybody's concerns are.

So, what we would like to have you do is think about your question ahead of time, ask it quickly and concisely. You're welcome to have a follow-up if you really need that. But let's try to avoid that conversation thing where I have to play bad cop. And if you have further questions, you can always tackle one of these guys out in the hallway and ask them later on. You can communicate with them by email, anything like that, but we want to make sure that we get as many questions out as possible from as wide a group of people as possible.

For the NRC staff that are attending in this room, the people that are our guests have come here from a long ways away. They've changed their schedule. They've had to travel to get here. We just walk down from our offices and we can do that anytime we want to, so we really don't need to be asking questions necessarily because we can catch you in the cafeteria or we can go to your office, these sorts of

things.

If you have a question that you think is important, could you please hold off until you see there is a lull in the questioning and we're kind of reaching the end of everybody else asking a question before you start asking a question? That way, we've maximized the ability of the people that have come to visit us having an opportunity to participate in the meeting.

I need to point out that we need to be careful not to discuss any proprietary information here. And although we intend to have an open dialogue, please take note that we will not discuss any ongoing reviews, and neither industry nor the NRC will make any regulatory commitments during this conference.

To that end, I would also like to point out that all of these microphones used to be standing straight up in the air. That's because they're always hot. These are always hot as well, which means, if you're talking with somebody on a technical issue that could be confidential, industry-sensitive, these sorts of things, if you're standing by a microphone, everyone is going to hear it. And that's not as fun as when Joe Biden used to do that sort of stuff. Some of that could be kind of critical. So, please remember that

these are hot microphones at all times and stay away from them as far as possible if you're going to have a discussion, so that everybody else doesn't hear your grocery list, or whatever it is that you're talking about.

As you can see from the agenda, we've got a lot of stuff to cover today and a short time to do it. And I've taken up a lot of time already. So, I want to get started.

Today we have with us John Tappert, Director of the Division of Decommissioning, Uranium Recovery, and Waste Programs, and he's going to make a few opening comments and get this ball rolling.

John?

MR. TAPPERT: Good morning and welcome. I want to thank people for coming to this meeting and dialing in on the phone.

The purpose of this morning's meeting is to really get feedback from you. So, I'll be brief. Kellee is going to give a short presentation to tee-up the topic, but I just want to make a couple of quick points before she does that.

First of all, the NRC currently has a regulatory framework for low-level waste that

accommodates the disposal of waste streams with very low levels of radioactivity, which is fully protective of public health and safety.

So, kind of as a first principle, we have an effective system today and don't necessarily feel the need to change that. However, the NRC seeks to be a learning organization, and if there is a better way to build a mousetrap and if people have ideas about how we can strengthen and enhance and improve our efficiency and effectiveness in a regulatory framework, that's what we really want to hear. So, we really want to hear from the stakeholders where they see are opportunities for us to do better in the future.

We have a number of questions that we've asked. That's to kind of spur or seed the conversation, but it is not an indication that the staff has any specific proposals or agenda at this time. Really, we're seeking input from you to help us think about this issue to determine if any changes might be appropriate in the future. And if those changes are appropriate, then that will go through a very deliberate process with further stakeholder engagement and with the Commission as well.

So, we're looking to those informed

stakeholders, the kind of stakeholders who come to public meetings on low-level waste and read and respond to Federal Register notices. So, I'm very much looking forward to the conversation this morning.

And I guess the second point I'd make is that we're talking about disposal in our regulatory context, which means -- I'm paraphrasing -- but it's, essentially isolation from the human biosphere in a land disposal facility. And while we certainly want your ideas, and I often say there's no bad ideas, if the idea does not involve isolation from the human biosphere in a land disposal facility, it would be out of scope of today's discussion. So, just keep that in mind as we're going through this.

So, that's really all I wanted to say to kick this off. I look forward to the conversation and your active participation as we go through this.

And with that, I would like to turn it over to Kellee.

MS. JAMERSON: Good morning.

My name is Kellee Jamerson, and I'm a Project Manager in the Low-Level Waste Branch in the Division of Decommissioning, Uranium Recovery, and Waste Programs.

Next slide, please.

So, as you can see from this figure, the NRC's Low-Level Waste Program continues to be very active. Our focus for this presentation today is very low-level waste, and greater than Class C and transuranic waste will be discussed this afternoon.

To provide a little background, in 2007, due to developments in the National Program for Low-Level Radioactive Waste Disposal and changes in the regulatory environment, the NRC conducted a strategic assessment of the Low-Level Radioactive Waste Program. Of the 20 tasks identified in the assessment, three of those were related to low-activity waste which is now termed very low-level waste.

Those three tasks were to coordinate with other agencies on consistency in regulating low-activity waste disposal, develop guidance that summarizes disposition options for low-end materials and waste, and to promulgate a rule for disposal of low-activity waste.

Given the constantly evolving nature of low-level waste issues, a programmatic assessment was conducted in 2016. One task identified as a medium priority was to perform a Very Low-Level Waste Scoping

Study. This task combined the three tasks above from the 2007 Strategic Assessment.

The other task from the programmatic assessment which was deemed a high priority was to finalize the guidance for 10 CFR Section 20.2002, Method for Obtaining Approval of Proposed Disposal Procedures. Revisions to this guidance document are currently in process.

Currently, very low-level waste can be disposed under the provisions of 10 CFR 20.2002. With more decommissioning waste anticipated, the volume of very low-level waste is also expected to increase.

Next slide.

So, why perform a Very Low-Level Waste Scoping Study now? Although originally listed as a medium priority in the programmatic assessment, the Very Low-Level Waste Scoping Study has increased in priority. Changes in the timing of nuclear power plant decommissioning has elevated the importance of evaluating more risk-informed and performance-based approaches for the management of very low-level waste.

The staff also recognizes the potential opportunity to improve regulatory efficiency and effectiveness by considering other options for very

low-level waste disposal that might create less of a regulatory burden on licensees.

Lastly, there is an opportunity to explore closer alignment with the International Atomic Energy Agency standards and other international practices.

The purpose of the Very Low-Level Waste Scoping Study is to identify possible options to improve and strengthen the NRC's regulatory framework for the disposal of very low-level waste, including the potentially large volumes of very low-level waste associated with a radiological event, such as the use of a radiological dispersal device.

Secondly, and to reiterate the previous slide, the Very Low-Level Waste Scoping Study will evaluate more risk-informed and performance-based approaches for the management of very low-level waste.

The Very Low-Level Waste Scoping Study will consider disposal of waste, as defined by 10 CFR Part 61. As such, the Scoping Study will not address non-disposal-related disposition pathways, including unrestricted release, clearance, reuse, or recycle of materials.

In addition, the NRC intends to evaluate regulatory options that would define the conditions

under which very low-level waste, including mixed waste, could be disposed of in Resource Conservation and Recovery Act hazardous waste facilities.

In initiating the Very Low-Level Waste Scoping Study, the NRC staff has considered lessons learned and available information from a variety of sources, some of which are shown here. Staff will consider the efforts of other entities and government agencies, such as the Environmental Protection Agency's 2013 Advance Notice of Proposed Rulemaking and studies conducted by the National Academy of Sciences and the Electric Power Research Institute. Additionally, staff will consider learnings from other countries with respect to very low-level waste disposal as a benchmark and other factors to inform the NRC staff's recommendation to the Commission for addressing very low-level waste. In light of this, the staff has developed questions, which you will see momentarily, where we desire additional input from our stakeholders.

At the conclusion of the Very Low-Level Waste Scoping Study, results of the staff's assessment as well as staff recommendations will be presented to the Commission in a SECY paper. Potential results of the Very Low-Level Waste Scoping Study include:

promulgating a rule that would define the conditions under which very low-level waste could be disposed; developing guidance that summarizes disposition options for low-end materials and waste; the need for additional coordination with other federal agencies regarding very low-level waste disposal; the need for further analysis; or no action. I would add that there may be other possible outcomes and we welcome your feedback on other potential results.

The NRC staff published in The Federal Register on February 14th, 2018, a Notice of the Very Low-Level Waste Scoping Study and Request for Comment. During the Very Low-Level Waste Scoping Study, the NRC staff wants to hear from stakeholders to understand their concerns and to gain their input and perspectives on very low-level waste.

Within The Federal Register notice, the NRC staff requested comment on a number of questions, which we will go through at this time. We will go through each question on the following slides.

Now I will turn it over to Mr. Mussatti.

MR. MUSSATTI: Okay. Thank you.

There are nine questions that were posed in The Federal Register notice, and we would like to

go through them one at a time now and take no more than about 15 minutes apiece for them. I'm not going to time this, but if we can be sensitive to that, let's try to see how fast we can get through these.

Here's the first question: "The United States does not have a formal regulatory definition for very low-level waste. What should the NRC consider in developing its own regulatory definition? Is there another definition for very low-level waste that should be considered? Provide a basis for your response."

I'm open to comments from the floor.

Okay. Thank you. Please state your name first.

MS. D'ARRIGO: Diane D'Arrigo, Nuclear Information Resource Service.

No, you should not make this category.

MR. MUSSATTI: Okay. That was short.

Is there anybody else in the room?

(No response.)

Mr. Operator? I've forgotten your name already. I'm sorry.

OPERATOR: Not a problem. It's Brandon.

MR. MUSSATTI: Okay. Do we have anybody on the line?

OPERATOR: I'm currently showing no questions or comments at this time.

I would like to remind participants on the phone that you may press *1 to ask a question or leave a comment.

MR. MUSSATTI: Okay. We also have no questions on the webinar, but we do have somebody standing by a microphone.

Yes, sir?

MR. MAGETTE: Hi. My name is Tom Magette. I'm with Talisman International.

I would suggest that you should have a category for very low-level waste today, because of some of the things that Kellee mentioned, in particular, the disposal under 20.2002. Essentially, we have a de facto category, and it would be much more rigorous, I believe, to have a formal category. I think it would also be more risk-informed.

There are multiple ways that you could do it. One might be to set a percentage of the radioisotope limitations given in the tables in 61.55. Just, for example, 10 percent, not suggesting that that would be the right percentage, but that would be a way to formalize a definition.

Another way would be to use something analogous to what's going on in the proposed rulemaking right now for Part 61, whereby you would prepare a performance assessment and back-calculate waste acceptance criteria, which would, then, have the effect of a regulation for that site, to a different standard, a much lower-dose standard, obviously, than the 25 millirem; maybe 5 millirem. But, here again, not so much proposing a standard here, as just suggesting a way to get there.

But I think, also, for the reasons that Kellee mentioned, you need one because of the large volumes of waste that are going to come out of these decommissioning sites. It's been suggested that 20.2002 is an adequate way to manage that. I don't think that's the case. While that has been used to manage some of these large-volume disposals, there's also just an inherent disincentive in the notion that I have to file a case-by-case application. You have to treat each one of these as an individual licensing act, so to speak, if it's going to go to a site.

So, preparing a PA, these things have taken years in some cases to do. So, that's not really an efficient way to think about moving a million cubic

feet of lightly contaminated soil or rubblized concrete. So, it doesn't really provide a valid alternative, in my view, for disposing of these large quantities of waste.

I think there's a lot of reasons that you do want a standard. It would be defensible from a public health and safety perspective. It would be manageable from an industry perspective.

Thank you.

MR. MUSSATTI: Does anyone at the table wish to ask for clarification, comment, rebut?

(No response.)

Okay. Anybody else in the room?

There. Thank you.

MS. D'ARRIGO: Diane D'Arrigo, Nuclear Information Resource Service.

The definition that you've got for what you're going to do with very low-level waste, if you were to make such a category as to isolate it from the human environment or from the food chain of man, in order to isolate it, putting it into regular landfills and industrial landfills, most of which have or will leak, is not isolating it.

So, what our organization and what

organizations that have opposed below-regulatory concern over the decades have called for is the continued isolation of the radioactivity from nuclear power. Nuclear power generated this waste. Yes, it is a very large volume, but it's also including very long-lived radioactivity. There's not a safe level. I mean, I know that some people want to advocate hormesis. But, until that becomes the law of the land, we need to try to prevent exposures, rather than disperse the radioactivity.

Also, I would point out -- it might come up in a later question -- that women are 50 percent more likely to get cancer from the same dose as men, according to the BIER VII risk numbers. And so, protecting for a man's environment is not protecting women or youth, other parts of our fuel chain. I know that's 10 CFR 20, but that needs to be considered when we're talking about massive, routine generic release of radioactivity from the nuclear power complex.

MR. MUSSATTI: Thank you very much.

I believe we've got a question online? Why, yes, I would like you to read it.

MS. ACHTEN: "EPRI has published two public reports investigating very low-level waste as

a separate waste category, how the concept is already practiced in the U.S. and how it is applied in other countries. It also provides a generic technical approach on how it might be defined." This is from Lisa Edwards.

MR. MUSSATTI: Okay. Thank you. Thank you.

All right. Let me check with the telephones one more time, and if not, I think we're going to move on to the next question.

OPERATOR: Yes, we do have a question on the phone line from Marvin Lewis.

Your line is open.

MR. LEWIS: Thank you.

Look, I don't know if I'm coming in at the right time or I'm coming in a little late. A little problem with muting the phone. Anyway, I appreciate the chance to approach this subject.

Now we're asking about, yes, you were asking about how you define this stuff. And I agree. I sure had a problem reading your definitions. But, then, again, I happen to be a very good reader, according to the testing.

And I don't really like the idea that, when

you're defining very low-level waste, you're really taking the volume and the total out of the equation. We have waste all through the nuclear fuel cycle that's completely ignored or just eliminated from calculation. For instance, we have like 30,000 uranium mines in Australia, over 10,000 in Canada, probably just as many in the United States.

And when we look at radioactivity going into the biome, the air, the water, the foods, the soil, it just doesn't register. It doesn't register on anybody. It doesn't register on you. It doesn't register on me. Well, it does register on our organs.

And I want to point out that, since the 1940s, when the background was measured at 40 millirems per year, now the NRC, Department of Energy, EPA, alphabet soup, is calling out the background radiation at 360 millirems per year now.

MR. MUSSATTI: Sir? Sir?

MR. LEWIS: Yes?

MR. MUSSATTI: We're starting to wander a little bit off-topic here. We don't have a great deal of time. I don't know how long it took you to get on the phone line, but we've stressed that there's a lot to cover in a short amount of time. Can you

summarize --

MR. LEWIS: And that's what I'm afraid of. Your right to coverage is not my right to cover. My right to cover is what's going on out here. And you, sir, aren't interested in it.

MR. MUSSATTI: Thank you.

MR. LEWIS: Now if you want to stop this comment --

MR. MUSSATTI: Mr. Operator, could you turn that microphone off, please?

MR. LEWIS: Thank you.

MR. MUSSATTI: All right. I'm sorry about that.

We had one comment from up on the panel?

MR. HEATH: Yes. Thank you. This is Maurice Heath from NRC, for those on the phone.

Going back to the comment, I believe, from Lisa Edwards, and the question, we are aware of that EPRI publication. We have reviewed it. And the purpose of this meeting is also to get other publications that have been put out public or some organizations have done, because we're trying to gather comments. So, we appreciate that report, and we would like to have other reports or documents that have been

involved with very low-level waste. And we would take that into consideration when we're going through the Scoping Study.

MR. MUSSATTI: Okay. I believe that's pretty thorough.

Is this very brief?

MS. D'ARRIGO: Yes. Are the EPRI documents public?

MR. MUSSATTI: Okay. The EPRI documents should be public. Most of them are.

MS. D'ARRIGO: No, actually, a lot of them are not.

MR. MUSSATTI: Oh, yes, I did misspeak right there, but that one there I do believe is.

MS. D'ARRIGO: Okay. So, if those could be provided to the public, if that's part of your consideration? And we'll also provide documents about why we don't want this to happen.

MR. MUSSATTI: Okay. Thank you.

Let's move on to the next question.

"The EPRI has published two public reports investigating very low-level waste as a separate waste category, how this concept is already practiced in the U.S. and" -- okay, yes, the EPRI reports are public,

from Lisa.

Okay. Question No. 2: "The existing regulatory framework within 10 CFR 61.55 divides low-level radioactive waste into four categories, Classes A, B, C, and greater than Class C. Should the NRC revise the waste classification system to establish a new category for very low-level waste? What criteria should NRC consider in establishing the boundary between A and very low-level waste?"

Anybody in the room?

(No response.)

Anybody on the telephone that doesn't want to holler at me?

OPERATOR: Yes. Larry Camper, your line is open.

MR. CAMPER: Very good. Can you hear me?

MR. MUSSATTI: Yes, sir.

MR. CAMPER: Very good. Thank you.

I had a quick comment on the previous question. Somehow I couldn't get on.

But the fundamental answer to your first question is risk. The classification should be driven by risk.

In terms of other sources, you have the

EPA low-activity waste activities several years ago. You have the IAEA criteria. You have what's taken place in the State of Texas which addresses exemption for disposal of low-level waste at approximately the lowest 10 percent of Class A. And you have the agency experience with 20.2002. So, there are a number of things to draw upon.

With regards to the question of ''should you establish a category for various low-level waste'', my personal view is, yes, you should. I believe it would be more clear if you did that. It would eliminate the need for exemptions, which is the current process. And I think by establishing a regulatory criteria via rulemaking would subject it to the awareness of the public that is warranted. Comments could be gathered and the like.

In terms of establishing the boundary between Class A and VLLW, currently, of course, there is no lower threshold for Class A waste. If you're going to establish a category of VLLW, then there would need to be a clear line of demarcation. In the final analysis, that will be a policy matter. It will have to be selected. In the case of the disposal of the waste in Texas, for example, approximately 10 percent

of the low in a Class A waste was chosen as that benchmark. It's a good benchmark. It's not the only benchmark, but it's certainly well worth consideration. The work that's been done by EPRI in terms of its risk analysis for the very low end of Class A waste is a useful resource as well.

But, yes, there would need to be a clear line of demarcation between Class A waste and very low-level waste if you proceed with the rulemaking.

Thank you.

MR. MUSSATTI: Thank you, Mr. Camper.

Could we have No. 2 up on the screen again?

Is there anybody else who has a comment on Question No. 2?

MS. D'ARRIGO: It's Diane D'Arrigo.

I'd like to know what you think it would cost to enforce a new category. If you're going to bother to verify the distinction at a lower level, at this point -- okay, if you're going to bother to make a distinction at a lower level, how is that going to be enforced?

A concern that we had with the whole below-regulatory concern policies was that it was based on dose, and there's no way to verify dose. Any amount

of radioactivity could be calculated to be a dose. How are you going to prevent dilution from Class A down to this VLLRW class? It's, I think, going to cost more than it's going to provide value, at least from the public perspective. And we would like to be protected, not have people who don't think that low doses are harmful decide that the risk is so low that we can be exposed. We oppose that.

MR. HEATH: Yes, Diane, you make a good point. We do have a question, actually, coming up to deal with cost. That's something that we're trying to get more information or experience from folks, from our stakeholders, if they've seen that.

One distinction for very low-level waste is we are talking about disposal. And we want to get ideas to figure out, if we decide to or if the result is that it comes up that we need to make a separate category, we would do a cost analysis as part of that, if we go a rulemaking route. That's if we go that route.

But we're just trying, right now, to just gather the information to understand just from our stakeholders the issues, and we have a question later on to talk about cost.

MS. D'ARRIGO: Well, when the

below-regulatory concern policies were under consideration, we looked at verifying. And as the Department of Energy moves to clear radioactive materials from its site, it's extremely expensive and difficult to actually detect at those levels. It doesn't mean there's no harm, just because the detectors aren't able to detect. It takes a really long time to scan. I mean, when we looked at how the Department of Energy was supposedly clearing its materials, they had to scan items very, very slowly. So, I mean, procedurally, what's obviously going to happen is that a whole category of decommissioning waste is just going to be treated as rubble and garbage, and the assumptions are going to be made, based on whatever assumptions. And the reality is that there's not going to be verification.

And also, as I mentioned before, landfill disposal/incineration is not isolating the waste. Landfills, the majority of landfills do leak. Mixed-waste landfills have hazardous wastes. So, you've got synergistic effects. What kind of effects are going to happen if these materials are put into hazardous or regular leaking landfills? Incinerators disperse radioactivity.

I'll stop, since you look like you want to move on.

MR. HEATH: Diane -- oh, I'm sorry -- but one thing to point out, I would appreciate it if you would actually submit that and any reports that you have. Just submit those to the comments section that Dan will lay out later. If we could get those, we will consider every comment and every report.

MS. D'ARRIGO: And you've received that comment over and over and over for the last 32 years, but I will be glad to do it again. And we will do it again, and we will get more people to do it again.

MR. MUSSATTI: All right. Do we have another comment on the floor here?

MR. VICKERS: Yes, Glen Vickers, nuclear power generation.

So, the current Class A, B, and C limits are concentration-based limits and they're easy for licensees, regulators, and the public to measure and understand. As was previously noted, some of the 10 CFR 20.2002, applications can become complicated as they involve environmental analysis, et cetera. That may not be within the skill sets of the licensees. That may be difficult for the public to understand.

So, I think a concentration-based system would be easy for all stakeholders to validate the thresholds.

That's all.

MR. MUSSATTI: Thank you.

I'm going to go to the phones one more time.

OPERATOR: I'm currently showing no further comments on the phone line.

MR. MUSSATTI: Okay. Thank you very much.

And we have nothing on the webinar as well that I can see.

Does anybody else in the room wish to speak?

(No response.)

We're doing well on the time. We're just a few minutes ahead of that 15-minutes-apiece pace that I had suggested that we use. So, we don't need to worry.

We've got one more talker here.

MS. SCHLUETER: Janet Schlueter, Nuclear Energy Institute.

I have more of a process question when it comes to the current system, and so forth. And that is, what is NRC doing to reach out to the Agreement States, the Compact Commissions, the waste site operators? Because, as you know, this ultimately becomes an Agreement State, Compact site issue, and

compatibility-level issue, of course.

MR. DEMBEK: Hello. My name is Steve Dembek. I work in the Low-Level Waste Branch, and I'm a Part 61 Project Manager in the Low-Level Waste Branch.

And I did not work on the 2007 Strategic Assessment, but I did work on the later one for 2016, the Programmatic Assessment. In those assessments, we did ask for public comment, and we did receive comments from the Compacts and the Agreement States. And the same will be in this case with this Very Low-Level Waste Scoping Study. We are going to look for comments from those facilities.

And we understand that every time -- let's say very low-level waste is instituted and it saves some companies a lot of money. But every time some company is saving a lot of money, there's another company or another facility that is losing that money. So, we consider that.

If the Compact, for instance, says we're depending on this money coming in from some of this low-level waste and we'll have to change the way we're doing business if we're losing this money, certainly that is a legitimate comment we would have to consider. And we want to hear those kind of comments and we want

to consider those comments and make our judgment based on hearing from the public, hearing from the states, hearing from the Compacts, hearing from the industry, hearing from the industry groups, et cetera.

Does that answer your question?

MS. SCHLUETER: No.

MR. HEATH: Can I add onto what Steve said also? And this gets to both points. We do reach out to other federal agencies as well. We contact our Agreement State regulators. And also, coming up, we will be doing presentations at other public events or some meetings at waste management. We will, because we want to get out and communicate well with all different types of stakeholders across the country. So, we are making an effort to make sure that we involve all stakeholders and try to reach everybody, our co-regulators, the public, industry, everybody.

MS. MAUPIN: I would just add -- this is Cardelia Maupin. I'm with the Low-Level Waste Branch and a former member of Agreement State Programs.

Even in preparing for this meeting, we informed the Agreement States and others as part of the CRCPD OAS monthly telephone call. And we also sent out the all Agreement State letter that informed them

of The Federal Register notices about these meetings. So, I've got calls from the Agreement States already yesterday about these issues. So, we are thoroughly engaging them on these various issues.

MR. MUSSATTI: Thank you very much.

While all this conversation was going on, our fabulous web master over there has helped out somebody by the name of Lisa Edwards to try to figure out how to get on the phone line. And I'm going to ask if she has been successful in getting the attention of our operator.

OPERATOR: Yes.

And, Ms. Edwards, your line is open.

MS. EDWARDS: Good morning, everyone. This is Lisa Edwards with EPRI.

The way I would respond to this question is that I think we have a good place to start by looking both at home and looking abroad in terms of how the 20.2002 exemption process determines acceptability now for disposal in RCRA facilities.

Agreement States have also licensed various processes that allow some waste that would be similar to what is proposed here to go into alternate disposal facilities from the normal low-level waste

facilities.

And multiple countries abroad have developed this waste category, and they have definitions and approaches that they use. I think the NRC could investigate all of those as a basis for how to define this category in the United States.

Thank you.

MR. MUSSATTI: Okay. Thank you, Lisa.

Okay. I'm sensing the need to move on to Question No. 3. I really want to apologize for having to rush through these, but we want to make sure we get all nine. And we're right about on pace right now.

So, the Question No. 3 is: "The NRC's alternative disposal request guidance entitled "Review, Approval, and Documentation of Low-Activity Waste Disposal in Accordance with 10 CFR 20.2002 and 10 CFR 40.13(a)," which is undergoing a revision, allows for alternative disposal methods that are different from those already defined in the regulations and most often used for burial of waste in hazardous or solid waste landfills permitted under the Resource Conservation and Recovery Act, RCRA. Should the NRC expand the existing guidance to include very low-level waste disposal or consider the development of a new

guidance for very low-level waste disposal?"

And we'll start with the gentleman standing at the microphone.

MR. MAGETTE: Thank you. This is Tom Magette, Talisman International.

So, as to the first question, I would say no. As to the second question, I would say this isn't really a guidance matter. You have guidance that directs how to implement 20.2002 disposal actions on an individual exemption-by-exemption basis, as Larry Camper pointed out.

More guidance isn't necessary to do that. Guidance won't create a new category of waste. That would require regulation. So, I really don't see how guidance is applicable here, other than at some point you're going to have guidance in terms of, if you have a new regulatory standard, you have acceptable ways to meet that standard, which is a typical guidance function.

But, in this case, I don't see that this is a guidance matter. If you're talking about a site being able to accept a category of waste, then you need something that's more definitive and more robust than guidance, which would be a regulation. For example,

something like surety, which doesn't apply to 20.2002 waste exemptions, even if they go multiple times to the same site.

So, you would, I think, want to look at that question, what's the surety that's required for a VLLW site? Should you have that as a separate site from other categories of waste?

So, no, I don't think guidance is really the answer here. I don't know how that would help.

MR. MUSSATTI: Thank you.

MS. D'ARRIGO: It looks to me that this question is suggesting -- and maybe I'm misinterpreting -- that the 20.2002 and 10 CFR 40.13(a), which are case-by-case, that this is possibly going to be somehow transitioned into generic. In other words, at this point it requires the applicant to make analyses, and this looks like one other approach that the NRC is making to justify generically clearing radioactive waste.

And so, we would oppose that and, also, question the basis for the "a few millirems," that is used for 20.2002. My understanding is that it's based on the old Reg Guide 1.86, which was based on the level that the radiation detectors were capable, the levels

of detection that were technically possible in the 1960s and the early seventies, when that 1.86 guidance was developed at the Atomic Energy Commission for a completely different purpose, not for case-by-case, large clearances and not generic clearances. But that's how the NRC has been using it since the BRC policies were overturned in 1992.

MR. MUSSATTI: Okay. Another question from the floor here?

MR. VICKERS: Glen Vickers, nuclear power generation.

I think a process of concentration-based limits could replace 10 CFR 20. 2002. As was previously noted, many licensees don't have the internal skill sets to do complicated environmental analyses, et cetera. The burial site, you could give them a dose objective, and they could do that analysis. And then, once again, it would be easy for licensees, regulators, and the public to verify compliance with the concentration-based limits. So, I think there may be an opportunity to replace 20.2002 with something that's more easy to comply with.

MR. MUSSATTI: Okay. I sense some motion in the seats among people. Is anybody interested in

speaking?

(No response.)

No?

Let's go to the phone lines.

OPERATOR: One moment, please, for our first comment.

MR. MUSSATTI: Go ahead. There's nobody there?

OPERATOR: Joe Weismann, your line is open.

MR. WEISMANN: Thank you very much.

And thanks, NRC, for the opportunity to have this type of public meeting.

A lot of the conversations that are going on between these questions kind of weave in between each other. So, I think what I'm going to at least comment on is probably going to touch a little bit on all nine of the questions in some regard.

I fundamentally agree with what some of the previous commenters have said, that we do need an improved system. 20.2002 has worked for industry the past, but it is less than optimal. And as Tom Magette mentioned, it does disincentivize some licensees from using it because of the time requirements.

Whether or not the NRC chooses to pursue a rulemaking or not, I don't think that's the only answer here. There are opportunities in guidance, I believe, to vastly improve how 20.2002 is currently administered. For example, for a site like our Idaho facility, which has undergone 15 approvals under 20.2002, the NRC knows our site very well. We have performance assessments. There are opportunities for the NRC to, for lack of a better term, preapprove or advance approvals for certain facilities that meet the risk-informed and performance-based criteria that they regulate on. So, that's just one example.

A rulemaking, though, could be advantageous for industry, as long as it also is a performance-based standard. So that, in order for a site to qualify to be a VLLW site, it has to meet all kinds of requirements that the NRC would find. And that would include site-specific performance assessment and WAC.

And I've heard from the previous caller here about making it easier for industry. Once that approval is granted, then that information would be made available to the industry and they would know, just like they do now with Class A sites, what each

site can do. And I don't see that it has to be fundamentally different for a VLLRW site.

So, those are my comments. Thank you for the opportunity.

MR. MUSSATTI: Thank you.

Is there anybody else in the room?

(No response.)

Okay. We don't seem to have anybody on the webinar.

So, let's move on to No. 4.

Oh, a quick question? A quick comment here.

MS. D'ARRIGO: Yes, I want to point out that at your previous meeting that you had a couple of months ago on 20.2002 and 40.13(a) that there was strong encouragement of using those regulations to reuse and recycle radioactive waste. And now, you're talking about using this as a potential avenue into creating a new category which you're claiming is only going to be for disposal, and in the meantime that other regulation -- and I completely object to recycling and reusing radioactive waste under 20.2002 or any other way -- but you're looking at using 20.2002 and 40.13(a) as a slide into generic, as the previous speaker said,

that that should just be preapproved.

And yet, 20.2002 is potentially for releasing, recycling, and reusing radioactive materials. And you're trying to provide assurance to the public, which I think is a completely false assurance, that once it's cleared for this other type of alternative disposal, that under the very low-level category that it's not going to be used for recycling and reuse. And then, you're going to -- I can just tell you what your next step is -- you'll wait until you get that approved and, then, you're going to use your risk assessment to say, "Oh, well, it's okay for this; let's do it for that, because the risk is totally the same and it's totally acceptable." And I'm telling you that it's totally unacceptable in all of these scenarios.

The nuclear industry made this waste. It's part of the cost of doing business for the nuclear industry to isolate it.

MR. MUSSATTI: Okay. Comment?

MR. DEMBEK: Can I ask Diane a followup question?

Diane, on your answer to the first question we pose, and just what you said in this question, you

keep talking about the nuclear industry.

MS. D'ARRIGO: Uh-hum.

MR. DEMBEK: So, are you only concerned with radioactive waste from nuclear power plants or, like in the beginning of this discussion, we talked about a radiological dispersal device issue, maybe sources that we're trying to dispose of, or other things. I'm just trying to clarify what is your specific concern.

MS. D'ARRIGO: Preventing unnecessary exposure to the public, involuntary exposure to ionizing radiation. And primarily, we see the nuclear power fuel chain, nuclear power and weapons fuel chain is the source of this. It's true that there's radioactivity in medicine. Most of the medical isotopes for treatment and diagnosis are very short-lasting. But the iodine-129 from nuclear power has a 16-or-17-million-year half-life. That's a lot different when you're releasing that. It's an irreversible decision for the future.

So, we're concerned, especially with long-lasting. But, then, if you've got routine short releases -- I think sealed sources should be better regulated. I don't think there should be general

licenses for high-exposure sealed sources, but that's a separate discussion for a separate day.

We're talking now about what you've said at the beginning, the massive volumes of radioactive waste that are going to be coming from the decommissioning of the nuclear fuel chain. And we're just as concerned about the weapons facilities as the nuclear power facilities and all the shared fuel chain facilities along the way routinely releasing radioactivity.

The caller earlier mentioned the uranium mines and the radioactivity from that. I mean, that's not being factored in. The NRC, in calculating this 1 millirem a year, or whatever you're trying to say would be the allowable -- or a few millirems a year -- is not taking into consideration that more and more of this is happening all over the place, and we're going to have multiple exposures from multiple sources. And that's not calculated in.

It's clear that the NRC's goal is to relieve the liability of the nuclear power industry and the nuclear generators and convert that risk, put that risk on the public. You refuse to incorporate any cost for health effects. You deny health effects other than

certain cancers. And yet, these are costs that the public bears.

So, when you're talking about risks and the public hears you're doing risk-based, when we don't trust your assessment of risk, it's very difficult to support any kind of risk-based determinations.

I don't know if that answers what you were getting at.

MR. DEMBEK: Yes. Just a further clarification in that area. As I'm sure you're aware, all of our bodies have naturally occurring radioactive material in them, and that 1 millirem per year is on the order of magnitude that our bodies emit.

MS. D'ARRIGO: But it's in addition. It's in addition, and it's in addition many times.

MR. DEMBEK: Your concern is the additional? Your concern is with the additional amount?

MS. D'ARRIGO: I'm not asking you to clean out the potassium from the bananas or scrub the granite. I mean, I would prefer not to have granite countertops routinely giving off radon and gamma rays in every new home. But there's obviously a distinction, but just saying that there's a certain amount of naturally

occurring radioactive, which is also a certain kind of radioactivity, various certain kinds, does not justify manmade radioactivity.

Plutonium is not naturally occurring except for some little place in Africa where it possibly had a spontaneous formation, but, in general, we don't have a lot of these radionuclides natural in nature. And so, it's not fair, it's not acceptable to justify additional manmade exposures to remove liability from the nuclear waste generators.

MR. MUSSATTI: No, no. I'm going to try --

MS. D'ARRIGO: I'm just answering his question.

MR. MUSSATTI: I know, but we're off-topic.

MS. D'ARRIGO: Okay.

MR. MUSSATTI: And part of what I need to do is to pull us back on-topic.

MS. D'ARRIGO: Okay.

MR. MUSSATTI: So, I think I'd like to move on to the next question.

MS. D'ARRIGO: So, natural exposures don't justify unnatural additional exposures.

MR. MUSSATTI: We're going to move on to the next question now. No. 4, please. "If the NRC were to create a new class category for very low-level waste in 10 CFR Part 61, what potential compatibility issues related to the approval of very low-level waste disposal by NRC Agreement States need to be considered and addressed? How might defining very low-level waste affect NRC Agreement State regulatory programs in terms of additional responsibilities or resources?"

We kind of started talking about that the last time. I'm sure there's somebody in the audience that would like to stand up. There you go.

(Laughter.)

MR. MAGETTE: This is Tom Magette from Talisman International.

I think certainly, if you're going to modify Part 61, and if you're going to have a new line in the tables in 61.55, that it's only appropriate that it be Compatibility Category B because that's what 61.55 is today. And I think it would be wise to be consistent. I think, frankly, sometimes the NRC goes too far in slicing and dicing within an individual regulation to get some of it B, some of it A, some of it C, some of it D, some of it -- et cetera. So, I really don't think

there's any reason to put it anywhere than in Compatibility Category B if it's a new waste category defined in the regulations.

MR. MUSSATTI: Okay. Is there anybody on the phone?

OPERATOR: Larry Camper, your line is open.

MR. MUSSATTI: Go ahead.

MR. CAMPER: Yes. Good morning. Can you hear me?

MR. MUSSATTI: Yes, we can hear you.

MR. CAMPER: Yes, I think that I would agree totally with what Tom Magette just said. It should be Category B, as is the existing waste classifications contained in Part 61. I can't imagine why it would be anything else but that.

As far as what the impact would be on the Agreement States, I think that certain of the Agreement States, the State of Texas in particular, has taken leadership in addressing the disposal of VLLW, if you will, via the RCRA cell for the WCS in Texas. So, I think their view would be paramount for consideration as the NRC moves ahead in considering this matter.

Thank you.

MR. MUSSATTI: All right. Thank you, Mr. Camper.

I believe we have a comment on the floor here.

MS. D'ARRIGO: It's Diane D'Arrigo.

There are a number of states, in the range of 14 states, that passed laws that require continued regulatory control over radioactivity materials, even if the federal government decides to deregulate in some of those, if other states decide to deregulate. So, it would be important not to try to supercede existing state laws and regulations.

MR. MUSSATTI: Thank you very much.

Any comments from the panel?

(No response.)

Back in the room?

(No response.)

Nothing on the webinar?

(No response.)

If we don't have anybody on the phone, I'm going to take advantage of the shortness of this comment response and try and gain some time for us.

Okay. Let's move on to No. 5. Please feel free, if you have an "aha moment" and think of something

from No. 4 in the future here, you can bring it up because we've gained quite a bit of time here.

"Following the Low-Level Radioactive Waste Policy Amendments Act of 1985, states formed regional Compacts for the disposal of low-level radioactive waste. If the NRC were to create a new waste category for very low-level waste, does it fall within regional Compact authority to control very low-level waste management and disposal? How might defining very low-level waste affect regional Compacts in terms of additional responsibilities or responses?"

It's kind of a deja vu there at the end, but a difference.

Yes, sir?

MR. SHRUM: Hi. Dan Shrum with EnergySolutions.

I chose to speak on this particular topic because, actually, Tom and I have a bit of a disagreement, and for us to disagree on something, I think you're going to be walking into somewhat of a gray area on this specific issue.

So, if you go back to Question 2, should there be a new category, A, B, C, greater than C -- oh, I'm sorry, you don't actually have to go back. If you

have a very low-level category and it falls under Part 61 -- I don't speak on behalf of the Compacts, but I do deal with all of them -- they may want to or feel obligated to regulate very low-level waste. I think that would fall within their purview or they may consider that that falls within their purview.

So, it's just something to consider as you go about making this rule. If you decide to pull very low-level waste out and place it in some other regulation, which would also be difficult, that might remove the Compacts from their belief or their desire to regulate it. Again, I don't speak for the Compacts, but I do know that they are very concerned or they do discuss very low-level waste and how it will impact and what authority they have over waste coming into their states. That's my comment.

MR. MUSSATTI: Okay. Thank you. Good position.

Comment from the panel?

(No response.)

There doesn't seem to be anybody online that's asking a question.

On the telephones?

OPERATOR: There's no comments on the

phone line.

I would like to remind participants, if you would like to leave a comment, then please press *1.

MR. MUSSATTI: Okay. Back to the room.

(No response.)

All right. We may be having a little longer lunch than we were anticipating if we keep going at this pace.

OPERATOR: Sir, it looks like we have a comment on the phone.

MR. MUSSATTI: Good. Good.

OPERATOR: Okay.

Marvin Lewis, your line is open.

MR. LEWIS: Thank you.

Yes, I admit I was hollering before, and I think deservedly so, because the NRC doesn't seem to listen to anything it doesn't want to hear, nor does the industry. The industry, I have to admit back in the day, 1979, the industry did listen to me, and Three Mile Island No. 1 is operating with hardened vents, which I put into a contention. And it was accepted, making my intervention moot. But I got what I wanted like that.

Now here we are with another situation, another situation where the NRC is doing its best to make it a cheap power source and a cheap source of nuclear materials for the nuclear arsenal. I find that just about every question here is aimed at reducing costs to the industry and reducing costs to the military, the nuclear arsenal.

MR. MUSSATTI: Okay. Are we bringing this around to the topic at hand?

MR. LEWIS: I would like to see a little more honesty out of the NRC.

Thank you.

MR. MUSSATTI: Thank you very much.

Okay. Where are we? Up to No. 6 by now? Okay. Question No. 6, "The Environmental Protection Agency imposed waste analysis requirements for facilities that generate, treat, store, and dispose of hazardous wastes that are different in 40 CFR Parts 264 through 270. How would NRC incorporate and apply waste analyses requirements for very low-level waste at RCRA Subtitle C and D facilities? Should the NRC impose concentration limits and/or treatment standards for very low-level waste disposal?"

Our concentration level expert may have

something to say on this in a moment, but do we have any comments from the floor?

Yes?

MR. MAGETTE: This is Tom Magette.

So, I guess I would start with asking the NRC a question on this one. Because there's already significant volumes of waste going to Subtitle C and D facilities under 20.2002, my question is, have you consulted with EPA on those exemption applications so far?

MR. HEATH: Well, Tom, this is Maurice again.

I want to ask you something in return to your question. Are you saying, are you referring to a 20.2002 that would go to a RCRA facility? Is that what you're saying?

MR. MAGETTE: Yes.

MR. HEATH: When NRC does 20.2002s, we are involved if it's in a non-Agreement State such as Idaho, as someone has mentioned previously. And we work with the state as well as the utility submitting the application to us. So, that's how the process works.

So, are you referring to is there a separate communication with EPA regarding that?

MR. MAGETTE: Yes. I mean, this kind of raises the question that, hey, maybe we'll go ask EPA what they think we should do with waste going into these kind of sites. And wastes like this is already going into those kind of sites. So, I'm kind of wondering, is the question just now coming up or is it something that you do as part of all these individual exemption applications? Is this new or not new?

MR. HEATH: No, this is not new.

MR. MAGETTE: Okay.

MR. HEATH: And we are; we've reached out to EPA at the beginning of the Very Low-Level Waste Scoping Study. And we are working with other agencies during this effort. But, previously, with that, we make sure when we get in these requests that we follow the rules that have been set per the RCRA permits. So, we make sure that what is trying to be disposed in that facility meets the waste acceptance criteria that has been developed through those RCRA permits and what the EPA has for that RCRA Subtitle C facility.

MR. MAGETTE: Okay. So, it seems to me that there are a couple of differing points here. One is, obviously, I would expect the EPA to comment on its own behalf, if you were to promulgate a rule in

this regard, and speak to whether or not this is something that could be categorized in order to go into those sites, or if there would continue to be some necessary consultation.

But it seems to me, if you create a VLLW waste category, then the answer would be, no, you don't need that. I do think you need concentration limits or risk-based. You know, if you're going to do, as I commented earlier, a back-calculated waste acceptance criteria from a PA, I think that would be fine. But I think you need some sort of specificity around the limits.

As for treatment, I don't think that you need treatment standards for something that is a lower risk than the waste that today doesn't have a treatment standard. So, unless you're talking about a waste stream that, in order to comply with some regulation for some reason, requires treatment -- I mean, mixed waste comes to mind, for example -- I don't think VLLW as a category merits a treatment standard. So, concentration, yes, or risk-based, but some level of concentration, whether it's in the reg or whether it's derived, yes; treatment, no.

MR. MUSSATTI: Okay. Thank you very much.

We have one commenter on the line.

MS. MAUPIN: I don't know if Maurice -- this is Cardelia Maupin -- if Maurice wanted to mention that we do have, you know, sometimes have conference calls or discussions with EPA. And also, most of the Agreement State programs are either in their Department of Health or in their environmental quality department of the state. And some states are, as you know, EPA-designated states where they have entered into an agreement with the EPA that they will carry out the EPA requirements within their state.

Okay. Thank you.

MR. MUSSATTI: Okay. Yes?

MS. D'ARRIGO: It's Diane D'Arrigo.

Would treatment allow for dilution? In the whole low-level waste scheme over the decades, originally, it was not permitted for waste to be down-blended or made from Class C to go to Class A. However, then, those regulations changed or the guidance changed.

So, with this, you're talking about potential treatment. Would one of the treatments be allowing higher contaminated waste to be diluted to meet -- or would you just do a calculation, an overall

averaging over a much larger amount, and then, allow all of that stuff in the same vein that it's supposedly going to go into the EnergySolutions site in Utah and go above Class A levels by averaging? Could this, then, happen with this very low-level category?

The other concern is, and I would ask -- it's part of the next question as well -- what is the NRC doing with regard to risk of synergistic hazardous and radioactive combined stressors on health effects in determining allowable release levels or -- I don't know if you're calling them "recategorization levels".

MR. MUSSATTI: Thank you.

We had a question?

MR. HEATH: Well, let me address the comment, Dan?

MR. MUSSATTI: Yes, sure.

MR. HEATH: Diane, just what you were saying about, you were referring to mixing, and we're not talking dilution when we're talking treatment. We're trying to get comments on treatment. The question is -- and maybe I should clarify this for everybody -- the question is design, just to get feedback on things that we should look at if we're

talking with these type of wastes.

And we recognize currently how disposals are. We earlier talked about 20.2002 and these RCRA Subtitle C hazardous waste facilities. So, we're just trying to get comments on things that we should consider when we're looking at, you know, if we develop a very low-level waste category or not. We're just looking for feedback. We're not trying to make any decisions or imply that some decision has been made through this slide. So, I just wanted to make sure I clarify that with you.

So, we're looking here --

MS. D'ARRIGO: So, maybe I'm --

MR. HEATH: -- for feedback.

MS. D'ARRIGO: Oh, I'm sorry.

So, maybe I'm moving into Question 7 about unintended consequences, but it looks like there are a lot of ways that the promise that it's not going to get into reuse or recycling, or that statement that's in The Federal Register that it's not going to be used, that very low-level waste will not be reused or recycled, how is that going to be enforced when sometimes solid waste facilities do subsequently separate out and allow for reuse and recycling of

materials that are there? I know several specific facilities that do that.

It's unrealistic to expect that the kinds of protections are going to be provided that you are claiming. Once this stuff is no longer considered radioactive and it doesn't have radioactive controls, it's no longer radioactively controlled, and you can't trust some other hazardous or solid waste regulations to protect us from the radioactive component.

MR. MUSSATTI: We have one more question on the floor, and I think we had a comment that was on the webinar.

MR. VICKERS: Glen Vickers, nuclear power generation.

So, we already have a required list of radionuclides we have to routinely analyze for. I think that works as a good, fundamental set for any category.

I also recognize that a disposal facility in a specific state may have to have another nuclide such as radium for water treatment residuals, et cetera, or their limits may be lower than Class A, B, or C. But I think we already have a list of analyses that are required by Part 61 that would aid in consistency

and getting a new rule off of the ground.

MR. MUSSATTI: Okay. Thank you.

I wish you folks that were on the phone and on the webinar could have seen the staff here, the scrambling to try to turn this comment from tech-speak into something we understand.

Would you like to read that comment?

MS. ACHTEN: It's for Question 5.

MR. MUSSATTI: It's for Question 5?

MS. ACHTEN: Yes.

MR. MUSSATTI: I think we've still got time to do that, and that will clear it up. I think we're pretty well done with 6 here in a minute. Go ahead and read this comment.

This comment is related to Question No. 5. That's what all that discussion was about.

MS. ACHTEN: The question on the webinar is, "The Low-Level Radioactive Waste Policy Amendment Act of 1985, Section 3(a)(1)(A), establishes Compact authority over low-level waste as low-level waste was defined of January 26, 1983. You would need to change the Act to alter the authority of the Compact Commissions."

MR. MUSSATTI: Okay. Good

considerations.

Back to 6. Do we have any other comments? Anybody on the phone?

OPERATOR: Yes. We have a comment from Joe Weismann.

Your line is open.

MR. WEISMANN: Thank you very much.

As far as Question No. 6, the relationship between NRC and EPA is very well understood and has been working, I would say, very well since the institution of the Memorandum of Understanding on mixed waste. So, I don't see any issues with the NRC extending that type of interpretation and regulation, if they were to create a very low-level waste category in Part 61.

Us as RCRA operators, our primary objective, if we want to take low-activity waste, is it has to exit out of NRC regulatory space first. Then, the material is, then, accepted into RCRA regulatory space.

And in our State, in Idaho, we have a robust regulatory scheme for radioactive materials as part of our RCRA permit. So, contrary to what some of the commenters have said, once the NRC releases regulation

of this material, it's not like it fails to be regulated after that. It's just regulated under a different scheme. And depending on the state and the type of regulation they choose to enact, they can also be very rigorous.

So, for going forward on this, I don't see No. 6 as being a particularly difficult issue to overcome, considering the NRC and EPA's history and how the wastes are currently regulated now.

Thank you.

MR. MUSSATTI: Okay. Thank you.

One more comment?

MS. D'ARRIGO: I just wanted to know if Joe Weismann is with US Ecology. I don't know who he is, and he's been commenting. I would be interested to know his affiliation, the person that just spoke.

MR. MUSSATTI: Okay. Our friend, the operator, could you find out what the affiliation is of the gentleman that we just talked to?

OPERATOR: Yes. And actually, his line is still open.

MR. WEISMANN: Yes, Joe Weismann. I am with US Ecology.

MR. MUSSATTI: Okay. Thank you very much.

That also helps our court transcriber.

Remember, when you introduce yourself, to give your affiliation. That's very helpful for us.

At this time -- this has been a lot. We've like been drinking from the fire hose here this morning, a lot of information and a lot of discussion -- I would like to take about a 10- or 15-minute break and come back, give everybody a chance to decompress a little bit.

According to up here, it's now 10:29. Let's be back by 10:45 and we'll finish out the morning.

(Whereupon, the foregoing matter went off the record at 10:29 a.m. and went back on the record at 11:45 a.m.)

MR. MUSSATTI: Okay. This is how the second half of this morning's session is going to go. We've got Questions 7, 8, and 9. That's only three of them. And we've got quite a little bit of time to take care of them.

So, once we've gone through all these last three questions, we've got time to go back and revisit, kind of at will, any one of the nine questions that you've got a comment that you hadn't made before and that you would like to make now or to expand on the

scope just a little bit beyond the narrow scope that we have on the questions.

We're not going to go to lunch early and come back early and start early because we've made a promise to the people that are on the webinar and on the telephones that we would start at one o'clock in the afternoon for their topics. And if it's something that's important to them and we've started early, they could miss out on something that they feel important, you know, very strongly about. So, we're going to start back at one o'clock, even if we do wind up finishing early here. And that just winds up being a bonus to you folks.

You don't necessarily have to sample the cuisine of the NRC. You would have a little bit more time and flexibility to wander off-campus, remembering that you've got to come in through the front doors like normal, but you'll have your badge with you. So, that might help.

With that, let's get on to Question No. 7. "Are there any unintended consequences associated with developing a very low-level waste category?"

And, yes, sir?

MR. VICKERS: Glen Vickers, nuclear power

generation.

I think we already have a lot of experience at RCRA facilities that you could refer to when handling low levels of radioactive materials.

MR. MUSSATTI: Okay. I'm going to go to the phone to give people in the room a chance to take a few more notes as to what they want to say. Do we have anybody interested?

OPERATOR: As a reminder, please press *1.

One moment.

MR. MUSSATTI: We changed operators.

OPERATOR: One moment for our first question.

MR. MUSSATTI: Somebody's on the line?

OPERATOR: Our first question comes from Janati.

Your line is open.

MR. JANATI: Okay. Thank you very much.

Rich Janati, Pennsylvania Department of Environmental Protection.

One of the unintended consequences could be the potential impact on the existing low-level waste disposal facilities as it relates to the amount of waste that they have been receiving. If we have a separate

category of very low-level waste, then what would be the impact on the existing disposal facilities? This should be a consideration.

MR. MUSSATTI: Okay. Is that all?

We have somebody on the panel?

MR. HEATH: This is Maurice, NRC.

Rich, just a clarifying question to you.

MR. JANATI: Yes.

MR. HEATH: When you are referring to disposal facilities, are you specifically just talking about low-level waste, Part 61?

MR. JANATI: That's right, low-level waste disposal facilities --

MR. HEATH: Okay.

MR. JANATI: -- because of the amount of volume that they will be receiving could potentially, you know, increase substantially. So, from an economic point of view, it will be a potential impact on the existing facilities. And I'm particularly talking about Part 61 facilities.

MR. MUSSATTI: Okay. That cleared it up for you, Maurice?

MR. HEATH: Yes. Thank you.

MR. MUSSATTI: Okay. All right. Thank

you very much for that comment.

Larry, I see that you've made a comment online. So, you tried to get on for Item No. 6. After we get done with Item No. 9 here on the list, I think I'll jump right back to you. So, consider yourself almost on deck.

Is there anybody in the room that would like to comment on this unintended consequences question?

Okay. There we go.

MS. D'ARRIGO: So, I guess I wanted to clarify, are the comments that we're making here verbally part of the official comments or this is just a discussion?

MR. MUSSATTI: Yes, these are official comments and these are going to be part of the transcribed record. They're going to go into ADAMS.

MS. D'ARRIGO: Okay. So, I don't know whether the consequences are intended or not, but I do think that the materials, the waste, could get out into commercial products and into recycling. Even though you're writing in your Federal Register notice that you don't want them to, the possibility is that, once they're released from radioactive controls, that

they could become reused and recycled, especially in light of the fact that NRC is encouraging, under 20.2002 and 40.13(a), to reuse and recycle radioactive waste.

MR. MUSSATTI: Thank you for that comment.

MR. HEATH: Diane, I just want to address that. Thanks for that comment. But I just wanted to make it clear that just today we're talking about very low-level waste and we're talking about disposal. We're not discussing anything, we're not talking about any kind of release criteria or anything to that nature. We're specifically just talking about disposal at a regulated facility.

MS. D'ARRIGO: And this question is, what are the unintended consequences of that? So, that's where it goes beyond what you want to keep the limits. I'm saying that you can't guarantee that and an unintended consequence is that it gets out beyond your scope here today.

MR. HEATH: Oh, okay. Understood. Thank you.

MS. D'ARRIGO: But I think there's also the unintended consequence that people will be exposed. Landfills leak. Solid waste landfills leak. In 20 or 30 years -- they do have liners; liners leak.

There's not an economic way to monitor. I mean, the drinking water in this country is not routinely monitored for radioactivity. So, the leachate from landfills is not going to be routinely monitored for radioactivity. But, if more and more radioactive materials go into solid waste facilities, which already do leak, then radioactivity is eventually going to be leaking out. We're dispersing the radioactivity from the nuclear power and weapons complex.

MR. MUSSATTI: Thank you.

We have another comment here on the floor?

MR. SHRUM: Dan Shrum with EnergySolutions.

Through that comment it made me think of something, and you responded. But it should be very clear that, if a release standard is developed for very low-level, so that it can go to a facility that can receive it, that only applies for disposal. That's what you're saying, correct? This release will not apply to other items that may not go for disposal?

MR. DEMBEK: Yes, that's correct. What we're talking about for the Very Low-Level Waste Scoping Study is to discuss and consider how we could change, possibly change, the regulatory limits, possibly change

the guidance to talk about material that is on the low end of the radiation, say, Class A, low end of Class A, and can go into another disposal facility, such as municipal waste facility or a RCRA facility. We're not talking about changing the 20.2002 process, which could talk about disposal of even lower levels of radioactive material and possibly recycling or release. So, that is the procedure on a case-by-case basis that could talk about releasing this material, recycling this material. We're not talking about doing that in the Very Low-Level Waste Scoping Study.

MR. MUSSATTI: Okay. That clarifies that.

More?

MS. D'ARRIGO: Yes. I would like to have a scenario of, say, a large amount of radioactive metal that goes to some disposal facility. Once it is cleared or determined to be so very low-level that it doesn't need radioactive labeling or protection, how is that going to be kept out of the recycling stream? Are you only going to let it go to facilities that guarantee that none of their solid waste gets recycled?

MR. HEATH: Diane, what we're talking about is simply disposal.

MS. D'ARRIGO: I know.

MR. HEATH: So, to address your scenario, with the Very Low-Level Waste Scoping Study, if the material is contaminated, we are talking about in a package and disposal to keep it separate, as we said earlier, out of the biosphere. So, we are talking about in a package, disposed at a regulated facility. That's what we're addressing. We're not talking about anything about any clearance or cleared material. We're talking about metal in a package being disposed at a regulated facility. That's the intention. That's what we're --

MS. D'ARRIGO: At a regulated facility? A regulated facility?

MR. HEATH: Yes, that is correct.

MS. D'ARRIGO: What kind of regulated facility? It sounds to me like you're saying you're going to send it to a solid waste, a RCRA C or D facility. So, RCRA C or D facilities are not regulated for radioactivity.

MR. HEATH: Now we are talking about a regulated facility and --

MS. D'ARRIGO: Radioactive regulated? What kind of regulated?

MR. HEATH: And RCRA Subtitle facilities are hazardous waste, but do take constituents that are low concentrations of radioactivity. They are regulated. And so, we're making that -- I'm sorry.

MR. DEMBEK: Yes. This is Steve Dembek.

Just to follow on to what Maurice is saying, we're talking about a regulated disposal facility. So, it's going to be isolated from the public, and it's going to have that barrier from the public. It's going to be disposed of with other potentially hazardous material in those facilities and isolated from the public in that manner.

And getting back to your point about the contaminated metal, basically, all steel after the atomic bomb, atmospheric atomic bomb explosions is contaminated. So, I'm not sure where you're trying to draw the line there as far as what could be, what has to be buried at one of these facilities or what doesn't. If you can clarify that for me again, that would be helpful because --

MS. D'ARRIGO: It's my understanding that steel has lower background radioactivity than other materials. But the point I'm trying to -- the question is, what are unintended consequences? I am saying that

I believe you have every intent in this discussion to only send it to a specific landfill, incinerator, solid or hazardous waste facility, licensed under RCRA C or D by the EPA. That sounds to me like you're limit on your discussion. I'm saying that I know of situations where those facilities allow some of their materials to not necessarily just be disposed.

MR. MUSSATTI: Okay. I think what we want to do is we want to hear from somebody else.

MS. D'ARRIGO: I'm trying to understand how you're going to prevent the --

MR. MUSSATTI: I understand. I understand, but what we need to do is probably get another voice in here that can explain somewhat.

Yes?

MR. McKENNEY: This is Chris McKenney. I'm the Chief of the Performance Assessment Branch.

And, Diane, exactly that type of scenario needs to be evaluated and addressed on how that would not occur if we were to go forward in a rulemaking. What are the constraints? What are the other things to avoid those type of scenarios? Those would have to be evaluated because that wouldn't be our intent, is to allow a situation that would allow for the stuff

to be sent to a landfill with the intention for disposal, but, then, it be redirected into another situation. But those would have to be things.

So, thank you for bringing up that scenario and those comments.

MS. D'ARRIGO: So, you are staff that's dealing with this potential rulemaking?

MR. McKENNEY: Yes, I am. I am. I am.

MS. D'ARRIGO: Okay.

MR. McKENNEY: We don't have a rulemaking at this time.

MS. D'ARRIGO: I said "potential".

MR. McKENNEY: Right. This discussion --

MS. D'ARRIGO: We hope doesn't happen.

MR. MUSSATTI: Okay. I hope that answered some of your concerns, that they are actually looking into these things for you, or for us, all of us.

Are there any other comments from the floor?

(No response.)

Anything on the webinar?

(No response.)

Our operator, do we have anybody that's online or on the phone lines?

(No response.)

I have lost my operator?

OPERATOR: Oh, I'm sorry, I was on mute.

Jay Cumbow (sic), your line is open.

MS. CUMBOW: My name is Kay Cumbow.

And, yes, I agree with Diane. The scanners -- you're also talking about municipal landfills. At least that's what it says in The Federal Register notice. And many municipal landfills do not possess scanners, and if they do, they're not used as well as they could be. They also are gamma radiation scanners. So, they don't scan for alpha and beta. And so, things like plutonium and americium, neptunium, and many, many others don't show up if you're scanning for them.

And they're going to outlast any liner of landfill, and landfills leak. In Michigan many, many landfills have leaked into groundwater or into nearby communities. So, if you've got stuff that's going to outlast a liner, then it's going to get into the food chain and, yes, it's going to be a problem downline.

We're surrounded here in Michigan by water, by the Great Lakes. I think you can go anywhere in Michigan and be eight miles away from water. So, it's

a very serious, it's a very serious concern.

MR. MUSSATTI: Okay. All right. Thank you for your comment.

Could you please tell us if you're affiliated with an organization?

MS. CUMBOW: Oh, sure. I did when I first signed on here. It's Citizens for Alternatives to Chemical Contamination.

MR. MUSSATTI: Okay. Thank you very much.

Did I cut you off in the middle of your comment or were you coming to an end when I broke in?

MS. CUMBOW: Well, I just think that, once it's released into a regular landfill, that there's not going to be any controls. If something looks like it's something in good shape, and it's not labeled as radioactive, people are going to use stuff. They do all the time.

MR. MUSSATTI: Okay. Thank you. I appreciate that comment.

We have another commenter in the room.

MR. MAGETTE: Hi. This is Tom Magette.

So, I think Diane and the last commenter actually raise a really valid point, and it probably goes to my assumption. Yes, I think it's something

like that. So, my assumption is we're talking about a licensed site. We are talking about a waste stream that's profiled and manifested. In other words, it's regulated like a Part 61 waste stream is regulated today. It's just a different hazard level and a different category.

Now that's probably not necessarily a reasonable assumption for me to make. So, that probably goes back to -- I don't know -- Question 2 or 3 as to what is it that you should do; how should you regulate this waste?

So, I think the way to properly control it, and to demonstrate to the public that you are properly controlling it, should have those protections built in. So, if you're going to talk about a lower activity level, it's not been, to my understanding -- and Dan asked for clarification a while ago, and Steve gave it to him -- it's not about clearance. It's not about a release standard. It's not about a scanner at the gate of a disposal site. It's not about gamma emitters only, or at least it shouldn't be, I think.

It's reasonable to say that there are lower-hazard waste streams that are going into Class

A disposal facilities that don't need to. The level of protection provided by those facilities isn't necessary. That's not saying, therefore, just throw it in the trash. That's not my expectation.

So, understand that unintended consequence of how you define these things could be that, all of a sudden, there's another escape hatch, so to speak. But, if you're profiling a waste stream and you're manifesting it, and you're sending it to a site that has been analyzed, shown to be acceptable, and is, thereby, licensed, then those are the kind of protections that need to be built into this system, so that those consequences, in fact, don't occur.

Thank you.

MR. MUSSATTI: Okay. We did have a comment from Lisa on the webinar that's saying that she's having a hard time hearing people. If you would turn the microphone up towards your mouth a little bit closer when you speak, I think that would be very helpful.

And they're having trouble hearing the operator, if you've got a volume control.

We have one more comment from the floor on this issue.

MS. D'ARRIGO: How much plutonium are you envisioning is going to be allowed in the very low-level waste category?

MR. HEATH: Right now, this is the beginning of this Scoping Study. We're just trying to get comments from everybody. We haven't made any type of decision or determination on anything, any values or anything to that nature. We're just in the beginning phase. So, we're just trying to get comments from everybody.

MR. TAPPERT: John Tappert, NRC staff.

So, just to reinforce what Maurice just said, this is very much early days. I mean, there's not a proposal that we're advocating for any changes at all. And we just really want to get the perspectives of the stakeholders. And so, I think this has been very beneficial to hear people's comments about the values of concentration basis, concerns about dilution and the availability of some of these RCRA cells or others, how well they can isolate. So, that's kind of the feedback and comments we're looking. I think that's very helpful.

But I just want to say again that we're not advocating a certain position. So, we don't have

concentrations that we're proposing. We don't have controls, how we would implement those controls to ensure the full disposal.

So, it's early days to think about, are there alternatives to isolating this waste for disposal, not recycling, not for reentering into the commerce chain? And so, I think all these thoughts and perspectives are helpful.

Thank you.

MR. MUSSATTI: Okay. You're just going to provide additional information or is this going to be --

MS. D'ARRIGO: It's another question.

MR. MUSSATTI: Okay.

MS. D'ARRIGO: So, what I meant by the previous question specifically with plutonium, my point is that I'd like to know if there is some consideration of limiting which materials could be subject to the very low-level category. Class A has plutonium. It has iodine, long-lasting. It has got everything. It's got all of the isotopes in it.

So, if you're talking about just taking a slice out of the bottom of the Class A category, it sounds to me like you're taking a slice out of the whole

alphabet soup of radionuclides. Is there any consideration to only allowing very short-lasting radioactivity that couldn't leak before it's exceeded its 10 half-life decay period?

It seems like the way the 10 CFR 61 runs is that we've got all of the isotopes in most of the categories. I mean, I realize B and C have some distinctions. But I'm wanting to know what thoughts are being given to that very low-level. Would it include materials that should by no means be released?

MR. DEMBEK: Yes, this is Steve Dembek again.

To respond to that, yes, we want to hear comments like that. We want to hear comments that some things in the waste classification tables may not be appropriate to put into these very low-level waste facilities or some other materials that aren't on the waste classification tables are appropriate for putting in there or not putting in there. We also want to hear any comments on if the waste classification tables need to be expanded to include additional radioactive material. And any kind of comment like that are the comments we're looking for. We're very early in the Scoping Study at this point and we do want to hear

comments like that. And we want to thoroughly consider comments like that.

Because there were a couple of comments saying we could use the current waste classification tables, but do they need to be expanded? If the set of materials that are proposed to go into these facilities is a lot more than what was proposed back in the 1980-1982 timeframe when Part 61 was created, then maybe we need to consider that, consider changing that. So, we want to hear all those comments and consider all those comments.

MR. MUSSATTI: This is a good segue for me. This is exactly why we want you to follow up anything that you say in here with written comments that are emailed in or sent back to us through whatever vehicle we have available, because this is all important information. We don't want to lose any of it. And we want you to be able to expand upon what it is that you've said.

But I want to move on to Question No. 7.

Wait. We've got something here? We had a question on the webinar. And as soon as you find the "on" button --

MS. ACHTEN: This is from Elizabeth

Zimmerman on the webinar. "What contingency plans will be in place in the event of an unintended consequence?"

MR. MUSSATTI: Well, that's a real broad question. Do you care to talk about the scoping process one more time?

MR. HEATH: Well, sorry, I didn't catch the first name of that person who gave the question, but --

MR. MUSSATTI: Elizabeth.

MR. HEATH: Elizabeth, thank you for that question.

We're in the early phase. So, we have not begun any type of evaluation. We're just trying to receive comments on ideas and things that we should look at during this Scoping Study.

MR. MUSSATTI: Okay. We're going to move on to Question No. 7 now.

MS. D'ARRIGO: Can I just -- you said a minute ago that we could email our comments in.

MR. MUSSATTI: Yes.

MS. D'ARRIGO: And I would like to have an email address for comments. There is not one in The Federal Register, and we would like to have an email address.

MS. JAMERSON: That information will be provided after we discuss the questions.

MS. D'ARRIGO: You're saying that there's possibly going to be an email address provided?

MS. JAMERSON: It's on the back of the agenda as well, the methods for providing comments.

MS. D'ARRIGO: Right. Which doesn't include an email option. It's regulations.gov, and it's paper snail mail.

MS. JAMERSON: There's email addresses for contact information.

MS. D'ARRIGO: But not for official comments. I'm asking for --

MS. JAMERSON: Not for email submission for --

MS. D'ARRIGO: -- an email for comments, and the facilitator here said we could email our comments in. And I'm reaffirming that we would love to be able to email our comments in, and we would like an email address.

MR. MUSSATTI: We'll get you one.

Question No. 7, "Are there any unintended" -- didn't we just do that? Eight. I'm sorry.

MS. MAUPIN: Excuse me. We just noticed that Larry Camper had a comment on No. 6, before we go to 7.

MR. MUSSATTI: We've already talked about that.

MS. MAUPIN: Oh, okay.

MR. MUSSATTI: When we get one, we're going to circle back and pick Larry up. I was hoping he was online to hear that. We've acknowledged that --

MS. MAUPIN: Okay.

MR. MUSSATTI: -- he tried before desperately to raise his hand, but nobody saw him.

MS. MAUPIN: Okay. Great. I just wanted to make sure.

MR. MUSSATTI: Okay. Larry, hang on.

No. 8, "What analytical methods/tools should be used to assess the risk of disposing very low-level waste at licensed low-level waste disposal facilities or RCRA Subtitle C and D facilities; i.e., generic or site-specific?"

And, please.

MR. SHRUM: Dan Shrum with EnergySolutions.

The only thing I would like -- I've got

kind of a cold, so maybe that has something to do with it. For this specific question, I would like you, as you go through your rulemaking, to limit the analysis to only packages as received, as opposed to as averaged over the entire facility. So, treat it the same way the Part 61 packages are received today, A, B, or C. And so, by package, not by averaging over the entire facility.

MR. MUSSATTI: Okay. That's a good point.

Anybody else?

(No response.)

Is there anybody on the phone?

OPERATOR: Yes.

Marvin Lewis, your line is open.

MR. LEWIS: Thank you. Another bite of the apple.

Look, this unintended -- are we still on 7 or have we gone to 8? I don't even know.

MR. MUSSATTI: We are No. 8 now, sir.

MR. LEWIS: Ah, all right. Well, then, I'm out of order. I should be waiting at the end then. Would you like me to do that?

MR. MUSSATTI: I'd invite you to talk now, since we've got you on the phone.

MR. LEWIS: Oh, okay. Look, what analytical methods? Now this is the problem, and it's not the method. It's not putting it down on paper. It's not putting it into the computer. The problem is that, at some point, the boss can come around and tell a technician like Harold Hartman to put down a certain number or to bubble up the hydrogen, or whatever. And you don't get a representative number representative of the actual system or problem, or whatever. You just get something that's put down by somebody because the boss told them to do it.

And I don't see anything in any of the things that I've been attending. I don't see anything out there in the field. The guidance goes around and picks up samples. I have been the bench chemist for many years who's done this analysis and who's watched as his input to the computer is changed by other people who I don't know.

MR. MUSSATTI: Okay. Thank you very much.

MR. LEWIS: And I just wanted to point that out. It's very, very nice to have good analytical methods, but that doesn't tell me that is really representative.

Thank you.

MR. MUSSATTI: Okay. Thank you very much. What you've been discussing right here is what's called an allegation. If this actually were to happen, that would be something that you could report to the NRC. The NRC would take that under consideration and they would investigate to see if there was anything there that was wrongdoing. And it sure sounded from your scenario that that's what it was. So, we do have a process in place for that, and I hope you're sensitive to that.

MR. LEWIS: What makes you think I haven't done all that?

MR. MUSSATTI: No, I remember you talking that you had done all that, but there is a process in place.

Thank you for --

MR. LEWIS: That process in place is worthless. Thank you.

MR. MUSSATTI: Okay. We have a question in the audience?

MR. VICKERS: Glen Vickers, nuclear power.

I think there are already some mature methodologies out there for complying with 10 CFR 20.2002 and existing RCRA facilities. Now the RESRAD

is a common industry code. Now perhaps there is an opportunity to maybe come up with a Reg Guide or a NUREG to make it a more standard process perhaps. I don't know if there's an opportunity to do that. But, that way, you would come up with a standard analysis methodology, whether it be a state or federal facility.

MR. MAGETTE: Hi. This is Tom Magette. I was going to make a similar comment.

I think you have tools. You're using tools today. You have NUREGs. You have a new one that you're working on to go with Part 61 that outlines appropriate analytical methods.

I don't think there's a need for a change. I think the tools should be similar to what you're using today. Kind of like my previous comment in terms of the standards for the system, in order for the system to be robust, it has to have these components to it. And so, I think from a tools perspective you have them. You don't need new ones or different ones, nor do you want to be prescriptive, "Use this model," right? That's guidance. That's guidance space, is to make sure that the tools meet a certain expectation, but that's not a regulatory standard.

MR. MUSSATTI: Okay. Thank you.

Nothing on the webinar?

Anybody online, on the phone line?

OPERATOR: Yes.

Larry Camper, your line is open.

MR. CAMPER: Thank you very much.

We're discussing No. 8 now, yes?

MR. MUSSATTI: Yes, sir.

MR. CAMPER: Okay. I tried to raise some comments on 7 also, but seemed to be unsuccessful in getting in.

So, let's focus upon No. 8 for a moment. I agree with what Tom Magette just said.

Oh, I'm with Talisman International, Larry Camper.

I agree with Mr. Magette's comment that the existing methods and tools are acceptable. If I look at the question, when it goes on to say "disposal at RCRA C or D facilities, should it be generic or site-specific?", my answer to that is it should be both.

If, for example, the NRC were to create a VLLW category, presumably, that category would, then, follow the same kind of analyses that have been in place to establish the existing classes of waste in 61.55. Rather, some component Class A waste could become,

in theory, VLLW. And therefore, some concentration values would be set forth in the regulation that would allow disposal of these materials just as is the case today for Class A waste.

With regards to site-specific, the ongoing rulemaking that's being prepared by the staff and the Commission contains an "or" provision. Waste may be disposed of using the classification tables in Part 61 or through the use of a site-specific performance assessment. That will not change. It should not change.

And it's important to note that RCRA facilities regulated by the states through EPA delegated authority also have a requirement that the operator contained, utilized a waste acceptance criteria, a WAC. So, yes, reactive material going into a RCRA facility must satisfy the waste acceptance criteria. That is site-specific. That should not change.

Thank you.

MR. MUSSATTI: Okay. Thank you, Larry.

Are there any other comments on Question No. 8?

(No response.)

Well, let's move on to 9 because, then, we're going to move onto a little bit more organic of a discussion here. Question 9, "How should economic factors be considered in the Very Low-Level Waste Scoping Study?" And I'm sure that we're going to have some comments on that from somebody in the audience.

Yes, sir?

MR. VICKERS: Glen Vickers, nuclear power.

I think we had mentioned before particularly the 20.2002 process is lengthy and quite costly for licensees to perform. And so, a clear compliance table would eliminate that unnecessary cost.

Thank you.

MR. MUSSATTI: Okay. Thank you.

Anybody else in the room?

(No response.)

On the webinar?

(No response.)

No?

Anybody on the phones?

OPERATOR: Yes.

Ms. Michetti, your line is open.

MS. MICHETTI: Well, I was on the phone from Question 7. So, I don't know how that got delayed.

But I do have concerns that low-level, very low-level waste includes things that I have always considered to be inappropriate, such as long-lived isotopes. And I do think that long-lives isotopes need to be taken out of very low-level waste. That includes uranium, plutonium, some of the iodines, things that harm people and are going to totally destroy our earth and food supply and our ability to live, our food and water, if it gets out.

MR. MUSSATTI: Okay. Thank you very much for that.

All right. I'm going to add a 10th question here. What I want to do is, in asking nine very specific questions and trying to hold the answers to nine very specific, tunnel-vision type of answers, so that we can go through all of them, what we've lost is the organic nature of this discussion.

The overall question, if you were to try to condense all nine of these down to one thing, would be, what should the NRC do to put together a very low-level waste management program that will work? And these are all the different aspects, the economic of it, the unintended consequences. What are things that we can do? What should be excluded? All of this.

But let's just open up the floor to the question, what should we do, and have that as a conversation, instead of having these very narrow questions where we're afraid to say, "I'm sorry, you're out of scope, but on the next question you could answer that."

First of all, we should probably go back to Larry, if Larry's available, because he had a comment on No. 6, and I promised him we would start there.

Mr. Camper, are you available?

MR. CAMPER: Can you hear me?

MR. MUSSATTI: I can hear you.

MR. CAMPER: Okay. Very good. Thank you.

I tried to get in several times and have not been able to. So, please bear with me. I have a couple of comments to make.

Regarding Question No. 6, I think it's important to put on the table the fact that the regulations in 40 CFR 264 through 270 are rather extensive in nature. And those regulations would continue to be brought to bear upon any VLLW category that would be authorized for disposal in a RCRA facility.

I think the NRC should coordinate

extensively, however, with EPA because the EPA, several years ago, actually conducted its own regulatory initiative to create a category called low-activity waste. They withdrew those actions for a number of reasons, not the least of which was the changing of Administrators at the EPA to coincide with our various elections. But the staff has from time to time spoken to the NRC about resurrecting that idea. So, I think that a good coordination with EPA would be in order.

With regards to the question imposing concentration limits, I think the answer is yes. Clearly, concentration limits should be clearly articulated if there is to be a category of VLLW. But, with regard to treatment standards, I would agree with some of the earlier comments that the treatment standards are in place, well-established, and are currently brought to bear for Class A waste. So, I don't see the need for a new treatment standard there.

On Question 7, if I may, since I have the floor, about the unintended consequences, one caller earlier raised the question on a point about unintended consequences to the industry. There would be significant, potentially significant, unintended consequences economically to the industry for the waste

operators that currently operate commercial low-level waste disposal facilities.

If you look at the EPRI data and other analyses, you come to realize that a very large percentage of Class A waste that is currently disposed of in a Class A disposal facility could, in fact, be disposed in a RCRA-type facility, a very large percentage. The numbers vary, but I've read numbers and seen numbers of analyses that range from 50 to 70 percent. So, the potential for an economic impact is rather significant.

The economic factors, how should they be considered? Obviously, NRC is concerned about safety, based on risk- and performance based approaches. However, that economic impact would need to be articulated in any regulatory basis document in the classical manner. And so, that's how that unintended consequence would be articulated, explained to the public.

I'm sorry, now what was the general question you asked?

MR. MUSSATTI: My general question?

MR. CAMPER: Yes.

MR. MUSSATTI: Just basically

incorporating all of the different levels here, what should we be doing? What advice would you give us as to how to put together this very low-level waste program?

MR. CAMPER: Well, from my perspective, if I may while I have the floor, for the longest time we have, as an industry, disposed of, arguably, what is called VLLW in this discussion via the 20.2002 process, via the process that's now in place in the State of Texas. It's being disposed of safely.

But that process is case-by-case and it involves an exemption. It strikes me as being a better approach that, if there were to be a category of VLLW that could be set forth in regulations and subjected to the regulatory process, that individuals could comment upon, express their concerns, and so forth, that's a better course of action than continuing to dispose of this lower-risk Class A waste through an exemption process. Therefore, I personally advocate the use of a rule rather than the existing process, although it is certainly safe.

I think that if we are not, if the NRC is not going to create a category, then the earlier question about should guidance be enhanced, I should

saythe answer to that, in my mind, is clearly yes. And I think guidance, for example, as to how the industry meets the requirements of 20.2002(a) through (d) should be more carefully articulated, and especially (d) with regards to how the dose assessment is to be conducted.

So, if rulemaking is not the ultimate outcome, I don't think a no-action alternative is very good, and certainly guidance would need to be enhanced.

Thank you.

MR. MUSSATTI: Thank you very much.

We've got a comment to be sent back to a lady named Lisa who tried to get in earlier and was not able to. And we told her that we would get to her next on the phone lines, once Larry Camper is complete. And I think you're about as complete as you're going to get for a minute.

So, Operator, can we go to Lisa?

OPERATOR: Yes.

And, Lisa Edwards, your line is open.

MS. EDWARDS: Hi. This is Lisa Edwards. Thank you for that.

I guess I'll kind of answer the last, more general question as best I can. The NRC has expressed interest in moving more toward a risk-informed and

performance-based regulation, and a necessary part of that conversation is proper characterization of the hazard.

EPRI's role is to provide a sound technical and independent analysis and research that addresses these types of questions. And in an effort to technically inform this discussion surrounding very low-level waste, we undertook a couple of different research projects on very low-level waste. That research indicates that both operating and decommissioning plants do, in fact, generate volumes of radioactive waste, such as building rumble and lightly contaminated soils, which are characterized by much lower levels of activity than are typically associated with the more common low-level waste streams, such as resin or filters or even more highly contaminated dry active waste which is composed of cloth and metals and plastics.

So, when we looked at the waste itself and saw that, in fact, there is this rather large volume of waste that has these very low levels of activity, we said, how else do other people handle this? So, in recognition of the lower hazard that is presented by this category of waste, that recognition we found

was recognized both domestically and abroad. The IAEA calls it out as a separate waste category. Many countries around the world have recognized this waste category and a most recent report we looked at did. We looked at six different countries. The U.S. was one of those six and was the only country that did not have very low-level waste or was piloting very low-level waste.

So, the category itself is recognized around the world, and it is, in fact, recognized here at home, just not called the same name. The 20.2002 exemption process and other Agreement State license processes, more or less, apply this same concept.

So, when you look at a disposal system, it's complex. It has to consider both the hazard and the disposal requirement. And generally, what we see done in any disposal situation is to consider and characterize the hazard, then develop and impose requirements that are suitable to that hazard.

So, what we did is we said, well, how have other people looked and approached this hazard, and do the RCRA disposal facilities in terms of very low-level waste, how do they compare to the disposal requirements that other countries have imposed on the

waste streams that they call very low-level waste? That analysis provides very useful insight in terms of how other people grappling with the same question have defined those requirements, and we used that information along with traditional approaches that are currently used in low-level waste facilities to develop a generic technical basis for how one might go about defining very low-level waste categories.

And it hinges on what is the hazard you're trying to prevent. If you look at most countries, they consider a dose limit. So, they look at the mixture of radioisotopes that are present in the waste stream and they provide limits for the resulting dose that could be anticipated via various intrusion scenarios.

And we applied that same concept in our technical approach. We didn't expect this approach to be the all-defining definition of very low-level waste. It, instead, was undertaken so as to offer an example or a template of the considerations that we thought were important to go into defining this waste stream, and was really meant to be a starting basis for others to improve upon.

So, I'm very glad that we're having this conversation, and we hope that the technical work that

we have done at the Electric Power Research Institute helps inform this discussion.

Thank you.

MR. MUSSATTI: Thank you. That was very informative.

Do we have anybody on the floor who is looking to speak first?

MS. EDWARDS: That was all.

MR. MUSSATTI: My microphone is off? Sorry about that.

Is there anybody on the floor that would like to speak?

MR. MAGETTE: Hi. This is Tom Magette. I'd like to address Question 10.

And I think the answer to that is that there should be a rulemaking. I think you should define VLLW by rule. That will help address some of these other concerns. But I think it's important that you regulate the waste stream and that you regulate the site.

And if you put it in a Part 61, and those other components are inherently a part of that section of the regulations -- you have the siting section. You have these other issues addressed as to the extent you have to deal with packaging or the extent you have

to deal with the site stability. It's simply a lower risk, so it would be a lower standard, but it would be regulated, not done by exemption, and it would be formal.

I think it's a mistake to permit large volumes, millions of cubic feet kinds of volumes, to go to a given site under 20.2002, even if the site is appropriate, because it's simply not been analyzed in a way that would adequately justify that. So, I think you'll end up using some of the sites, but you should have a regulatory basis for that. So, I would encourage a rule.

I appreciate what we're doing today, and I certainly echo what Lisa just said. It is very much a useful conversation, and I appreciate the idea for us to help formulate what a rule might look like.

My fear, my unintended consequence fear is that, you know, I could spend the next 10 years of my life standing at microphones talking about very low-level waste, which I don't really want to do.

Part 61 has been a very good process. I like the idea of the preliminary proposed rulemaking language, but I don't want to see this taken to an extreme. I don't want to see a technical basis next

and, then, an Advance Notice of Public Rulemaking, and, then, a proposed preliminary rule language and, then, a proposed -- you know, really, I think we know an awful lot here. We can learn a lot from the EPRI work. You can learn a lot from what you've done for Part 61. And if you agree, if you write a report here that says that your inclination is to write a proposed rule, then I would encourage you to write a proposed rule next. Otherwise, I think we'll be tortured to death by the process, not to be overly dramatic.

Thank you.

MR. MUSSATTI: Okay. We had one comment that was on the webinar that we need to get to here.

MS. ACHTEN: The webinar comment is from Earl Fordham on Questions No. 7 and 9. "The State of Washington is concerned about continued economic viability of the existing sites if very low-level waste is diverted to other sites."

MR. MUSSATTI: Okay. If you're still on the line there, Earl, thank you for that comment. We've got people taking notes furiously at the head table here.

Back in the room, is there anybody else that would like to make a comment? Okay. Thank you.

MR. DEMBEK: I have a followup question for Earl. Hopefully, he's still online.

If we can get more specifics about the economic viability issue, for instance, will the disposal site be forced to go out of business or will the disposal site be forced to raise the price for the regular Class A material and the Class B and C material, such that the utilities might not gain that much because they're paying more for this material or they're paying less for the other material? So, if it's possible, if we can get more specific details on what the economic concerns are, that would be helpful to us as we make our decisions.

MR. MUSSATTI: Good point. That kind of input would be very helpful.

Yes, please.

MS. D'ARRIGO: I think there should be some kind of provision for the public to have the ability to do independent monitoring to verify the implementation of whatever results. At this point, we're in a complete, in a position of complete, having to have complete faith in the Nuclear Regulatory Commission and, then, in the state regulators and, then, in the industries to fulfill the commitments. And in

order to enhance public confidence, it would be helpful to have some kind of independent verification. And that is an economic concern because I have in the past tried to verify, to identify the levels that were being cleared by the Department of Energy, for example, and a multi-channel analyzer that can identify the specific radionuclides, not just the counts per minute or the millirems per hour, or whatever, is in the range of $15,000, or at least it was several years ago. So, in order to be able to verify and enforce, I think there needs to be -- it's time that provisions be made for the public to have the ability to do independent monitoring and verification.

MR. MUSSATTI: Okay. Sir?

MR. SHRUM: Dan Shrum with EnergySolutions.

In 2007 I was given the opportunity to address the ACRS on this specific issue and presented some of the differences. Because, actually, we operate a low-level cell. We operate a mixed-waste cell which combines the RCRA rules with the NRC rules for low-level waste.

And one of the things as you go through this process, I agree with Tom, I think rulemaking is

essential. This cannot be done with a guidance document. It should be B, compatibility Category B.

But one of the things that concerns me is, when you start to cross between what the NRC does and what EPA does -- and we've got some EPA representatives here, and I don't mean to speak for you -- but the EPA is very prescriptive: you will put in a liner. You will put in another liner. You will have three feet of clay that's compacted to 10 to the minus 6. You know, just making this stuff up, but that's what it says. It's very, very prescriptive.

As you take what you do wherever you're going to do it, be it in Part 61 or possibly Part 20, of how you're going to take this material and either remove it from license space or exempt it through a specific process, and then, make sure that you coordinate with these folks that like to have things very, very, very prescriptive, they are not so much into the modeling. They like all of the waste codes and things like that. So, as you go through this process, again, rulemaking will be essential. I would prefer that you do it your way.

There's some performance objectives that need to be met. We would prefer that as opposed to

specific requirements. But just make sure that coordination happens there. So, when you say, yes, it can go to their facility, they say, yes, this can come to one of our facilities because it can also meet our prescriptive rules.

Okay.

MR. MUSSATTI: Okay. Yes, please.

MS. D'ARRIGO: I think another important provision would be that the liability for this material, this waste, remain with the generator, regardless of where it is disposed.

MR. MUSSATTI: Okay. Is there anybody on the phone that has a question?

OPERATOR: Yes.

Elizabeth Zimmer-Lloyd, your line is open.

MS. ZIMMER-LLOYD: Yes, I would like to go back to Question No. 7, which leads up to the economic factors, considering. Again, I agree with the others about the law. I agree that something should be put in place or written as a law that would require, as she said, the generators of this material. I mean, traditionally, it seems to have been passed on in negative cost to the local municipality and surrounding area where it may be put in place.

And in the unintended consequence of a leak, who's going to be responsible? And as far as it being called management, I mean, once it's put in place, who's managing it? Who's monitoring it? That concerns me.

I live eight blocks from St. Clair River and a mile and a half from Lake Huron. And I'm surrounded by water here in Michigan. It just is a concern of mine that, once it's put in place, it's just going to sit there. It's not being monitored. Again, these liners within 30 years aren't going to be too protective from this potentially leaking into the water that I drink and I give my grandchildren.

MR. MUSSATTI: Okay. Thank you very much.

Operator, we've got a comment from a guy named Joe who says *1 on the phone isn't working, Joe Weismann.

OPERATOR: Oh, yes, he's in queue. I have his line now open.

MR. MUSSATTI: Perfect. Joe?

MR. WEISMANN: I'm sorry, this is Joe Weismann. Did you want me to go now?

MR. MUSSATTI: Yes, please.

MR. WEISMANN: Oh, thank you very much.

My apologies, I had to step away from the call for a while. So, if I'm reiterating what others have said, my apologies.

But, given the summary opportunity for this call and for the public information session, I would just like to kind of summarize some of our thoughts about the NRC's activities and some of what our recommendations would be, I would say.

So, we're not opposed to a rulemaking as such for the NRC versus continuing with guidance, but would urge the NRC to continue in the vein of what they're doing for Part 61 and the movement toward site-specific performance assessments, and treating these sites for the performance that they do show.

Publishing concentrations as part of a rule would be treating all sites as a one-size-fits-all position. That is one thing that Part 61 tables back from the eighties have shown. Although they're protective, they don't necessarily represent what the industry can perform for generators and for licensees.

So, we've learned a lot over the last 34 years. We're continuing to learn about our sites, and that we would like the opportunity to continue to do that through site-specific calculations and risk

assessments. I think it would benefit industry, in general. It would benefit licensees. And it would ensure that the waste is going to the most appropriate places.

How the NRC chooses to do that, we don't really have an opinion. It's just we think that the NRC is on a good regulatory path as far as learning the processes that have gone on with the Part 61 rulemaking and what we've learned collectively as part of 20.2002 over the last 15-20 years. So, there's a lot of collective knowledge to be examined and to learn from, but I think we're starting from a very good place and there are opportunities for the NRC to make real good movement here and at the same time be able to serve the industry and generators in the way that they need to be served.

So, thank you very much for your time.

MR. MUSSATTI: Thank you very much for that comment.

Anybody else in the room?

(No response.)

On the phones?

OPERATOR: Yes.

Clint Miller, your line is open.

MR. MILLER: Good morning. Clint Miller from Pacific Gas and Electric Company.

My comments range on previous questions about effects on the low-level waste Compacts and, also, the tracking of this material. First of all, if you're looking to manage something, you need to be able to measure it. And really, we're talking actively now with three programs, if you will, driven by the states. The State of Tennessee has their Bulk Survey for Release Program, which should really be called the Bulk Survey for Alternative Disposal Program. The State of Idaho, in concert with NRC, has a program at the US Ecology site. It's been mentioned. And there's the RCRA facility that WCS Texas operates in Andrews County, which is a RCRA cell for the State.

There is already for low-level radioactive waste, and commercial, a national database that tracks the low-level waste disposal that's manifested. That's done by the DOE, the Manifest Information Management System, or MIMS. That system does not track -- only collects data from the licensed low-level waste disposal sites. It is not collecting any data from Tennessee on Bulk Survey for Release disposal, US Ecology Idaho, or the RCRA cell in Texas.

So, it may be prudent in the Scoping Study for NRC to assess and evaluate and get in touch with DOE to say, you know, what additional funding would DOE need to include the collection of data from the alternate disposal sites and put that into MIMS? So, that's comment one.

As far as impact to the Low-Level Waste Compacts, the power plant in California, the Southwest Compact, we've since 1980 had to submit export permits to the Southwest Compact. The Tennessee program has been running since the 1980s. Historically, the Southwest Compact has never been interested in any quantity of material that could meet that alternative disposal in Tennessee.

The Compact does collect fees based on our export permits, which have a projected disposal volume. And so, as the advent of other alternative disposal options came up, US Ecology up in Idaho at a RCRA cell and the disposal of RCRA in Texas, as someone pointed out, that really is sort of a diversion of material that otherwise would have gone to a Class A disposal site. And so, the Southwest Compact was interested in knowing about those quantities, I believe to some extent to know that they were still getting their

revenue stream as far as the Compact.

So, anything that we would send that gets diverted from what had been a Class A site to a RCRA site, we will report those quantities to the Compact to show them that we've paid sufficient funds for an export permit to cover that material independent of where it was disposed of.

But, again, there's sort of a line of demarcation. The disposal material in the Tennessee process has never been of interest to the Southwest Compact. The higher-tier material, if you will, a little more radioactive, at Idaho or Texas is at least of interest to them at this point in time.

MR. MUSSATTI: Okay. Is that about it?

MR. MILLER: Yes. That's my input on that you should reach out to the Compacts to see what their interest is.

MR. MUSSATTI: Okay. I appreciate that.

We've got about 10 minutes left, and we've got about three or five minutes of housekeeping to go before we can let you go.

But we did have a Rich Janati who is on the webinar and has been trying to get on the phone line. And I'm wondering if --

MR. JANATI: Yes. Can you heard me?

MR. MUSSATTI: I can hear you now.

MR. JANATI: Okay. Very good.

I have just a couple of general comments that I would like to make at this point.

First of all, I think that is for the NRC. The first thing you need to do is to provide a justification of why there is a need for a new classification of waste. I mean, this is a very good meeting, but I really didn't see a lot of comments from NRC staff on why we're even taking on this new initiative, a justification such as, obviously, the volume, expected volume from the decommissioning of nuclear power plants and RDD events, high disposal cost, Part 61 facilities, and impact on smaller licensees or generators, things in that nature. That would have to be explained very early on in the process.

My second comment has to do with benchmarking with other countries who have already implemented a very low-level waste classification program, lessons learned.

The other comment, a third comment has to do with economic viability of the existing disposal system. And I raised this before. In order to do that,

obviously, you really need to have some idea as to how much this waste, of low-level waste, is going to be classified as very low-level waste. And in order to do that, obviously, you're probably going to have to know what the concentration limits are going to be for very low-level waste. So, some ideas as to a projection as to what is going to be considered very low-level waste. Otherwise, you're going to have a difficult time with the economic impact on existing facilities.

A couple of other comments. My concern is, from some of the comments that I heard from individuals who attended the meeting on the phone, obviously, it seems to me that there's a lack of familiarity with the RCRA Type C landfill requirements, as well as RCRA Type B. I mean, most people who are in the radioactive waste business, they don't know much about RCRA Type C and RCRA Type B requirements. So, NRC, you really need to do some, require some educational work here as well to describe what those requirements are.

And finally, as far as the impact, again, the economic impact, I would recommend that you talk to the existing disposal facilities. And then, obviously at some point in the future, some direct

interactions with the Compact Commissions would be highly recommended.

Thank you very much.

MR. MUSSATTI: Thank you. You have successfully used up all of my wiggle room.

I'm going to turn the meeting over to Kellee now, who's got a few more slides for us to go through. And then, I'll give you a couple of quick reminders for things. And then, we'll break for lunch.

And I guess next slide.

MS. JAMERSON: So, just a few final things. As you know, the Scoping Study was noticed in The Federal Register. Our comment period is 90 days and will end on May 15th, 2018.

We are having a public meeting, this one scheduled for today, and we have another scheduled for March 23rd, which will be in Phoenix, Arizona. This meeting will be announced on our public meeting notice system. So, stay tuned for those details about how you can participate.

Next slide.

Lastly, on how to provide comments, we do have the designated federal rulemaking website, and the docket ID for the Scoping Study is NRC-2018-0026.

Comments are accepted there as well as via mail, also referencing the docket number. The address is provided on this slide as well as in The Federal Register notice. And if you picked up an agenda at the sign-in table, information is also located on the back of that.

To ensure that your comment is considered, we ask that you formally submit all of your comments through the methods that are provided in the FRN. However, since we were not able to produce a resource email inbox, we will accept your comments via email per the contact information listed on the paper as well as on the next slide. And we'll be sure that it's added to the docket.

Again, the comment period will end on May 15th. This is where you can find additional information about the Very Low-Level Waste Scoping Study. There is a page dedicated for the very low-level waste on the NRC's public website. You can contact myself, Kellee Jamerson, or Mr. Maurice Heath. The phone numbers are there.

Thank you. I'll turn it back over to Dan.

MR. MUSSATTI: Okay. Thank you.

We had promised to give you addresses for you to be able to send in comments. There are three

of them up on the board. Well, two of them here and one on the previous slide. There's two actual email addresses, one for Maurice and one for Kellee. And the regulations.gov is an official site that collects all of our comments for us. And if you go to the NRC-2018-0026, you will go right to where you get a hot link right there and you can put your comment in. So, I think we have taken that off of the parking lot and we can consider that done.

We've had a pretty informative morning.

MS. D'ARRIGO: So, can I just clarify? You're saying that for the very low-level waste comments, they can go to rulemaking.comments@nrc.gov if the subject line has "NRC-2018-0026"?

MR. MUSSATTI: Yes.

MS. D'ARRIGO: Thank you.

MR. MUSSATTI: Yes.

MS. JAMERSON: No. That email inbox is specifically for the greater than Class C and transuranic waste. It does not accept comments for the Very Low-Level Waste Scoping Study.

MS. D'ARRIGO: What email can be used for that?

MS. JAMERSON: For the Very Low-Level

Waste Scoping Study, use either myself or Maurice for the contacts, the email addresses for very low-level waste.

MS. D'ARRIGO: In order to submit official comments? You will, then, provide them to the docket?

MS. JAMERSON: We will be sure that it's placed on the docket.

MS. D'ARRIGO: Okay.

MR. MUSSATTI: Yes, I'm sorry about that. I was making an assumption, and you're not supposed to do that.

Okay. When you leave here to go to lunch, remember to have your visitor badge visible the whole time that you're in the building. This floor, the next floor up inside the auditorium area, and the main floor of the One Building, the building that you came in this morning, you can move around on that freely without having to be escorted. You cannot get anywhere further than that guard station that's for the Two Building over there by the cafeteria. To get passed that, you would be going into where our gymnasium is and those sorts of things or you would be heading to the elevator bays, and both of those are kind of forbidden. So, you have the main floor. You've got the Starbucks and

our cafeteria and the little gift shop that's across the hall that are available to you.

We're going to start exactly at one o'clock, I hope, because we promised the folks that have that as an important topic that they're going to get their full two hours this afternoon to be able to listen to it.

If you leave the building, remember that you have to come in through security. But, if you do leave the building, you can leave through the back door and go out through the guard shacks by where the cars are. But factor in the additional time that you're going to need to get back here for the meeting.

You can leave everything of yours in this room here if you've got a laptop or a briefcase, or something like that, and you don't want to drag it around lunch. I stay here for the whole lunch period. So, there won't be any time that this room will be unattended. So, your stuff is safe in here with me.

And have a great lunch. I'll see you in about an hour.

(Whereupon, the foregoing matter went off the record for lunch at 12:00 p.m. and went back on the record at 1:00 p.m.)

MR. MUSSATTI: All right, welcome back.

Did everyone have a good lunch? Oh, it's one of them kind of crowds. Okay.

Just a few reminders before we start, please silence your phones, ringers, anything like that so that we do not bother each other.

And, please remember your manners while talking, one person speaking at a time so that our bedraggled person that is transcribing this can actually get an accurate transcription of what we are saying.

Again, what you say -- what you think you're saying here may not be exactly what you said or what we heard, so we encourage you to follow it up by sending us a written version of what it is that you tried to say.

All right, on the phones, I want to -- in case there's anybody new, we have this thing on a web line with the webinar. And, the webinar usually has audio and -- attached to it so you can speak through the computer.

We don't use that because it uses up so much bandwidth and garbles everything. We encourage you instead to use the telephone and dial into our number there and make any of your comments by dealing with

our operator, who, right now, her name is Carrie. And, later on, we'll be back with Brandon after he's done with a lunch break.

Grab a pencil, if you are needing the telephone number to get into our call in line, 1-800-857-9840. And, the pass code that you will be asked for is 4979456.

That way, you'll be watching on your computer, but you'll be communicating with us through the telephone which will be a much clearer signal for us to be able to get.

And, if you want to get onto the phone lines, I'm going to ask Carrie to explain how to do that and then I'm going to add a few words at the end.

Carrie, could you explain how to get in the queue to make comments?

OPERATOR: Yes, as a reminder to join the queue, please press star one on your touch tone phone and record your name when prompted.

Again, press star one, please check to be sure that your line is unmuted and record your name at the prompt.

MR. MUSSATTI: Okay. The key there is press star one on your touch tone phone. We've had

problems in the past, from what I understand, with some people not necessarily at this conference who have been desperately beating out star one on their computer on the numeric keypad when they're trying to get their telephone to understand that they are trying to get into the queue. So, we want to make sure that that is clear.

We want to get started right away and as soon as I can find where Greg Suber is -- there he is, I'd like to turn the meeting over to Greg.

He's the Deputy Director of the Division for Decommissioning Uranium Recovery and Waste Programs, 18 years of service.

MR. SUBER: All right, thank you.

First of all, I'd like to welcome you all to the afternoon session. I appreciate you guys coming out.

Apologize that I couldn't order up the same kind of weather we had yesterday for today. It's a little cooler, but hopefully, you guys enjoyed your walk outside nonetheless.

First of all, I'd like to emphasize, once again, that we appreciate your coming out and just state that public engagement is really important to the NRC.

And, this is the way we prove to our stakeholders that we are open and that we are transparent.

So, we welcome your comments here. We welcome a lively, respectful discussion. And, we also just want to remind you that to formally submit your comments, you do have to go through the mechanisms that are included on the back of your agenda.

So, I would like, at this time, to welcome to the microphone Ms. Cardelia Maupin.

MS. MAUPIN: Thank you, Greg, and good afternoon.

Basically, we will start with the second slide which is the purpose of the meeting. And, basically, we, at the NRC have good -- principles of good regulation that requires us to do our business in an open manner that provides public -- is publically and candidly transacted.

So, that's why we are here today… is to ensure stakeholder participation and involvement as we identify the various technical issues that we will be looking at in the development of a regulatory basis for the disposal of greater than Class C and transuranic waste.

This supports NRC's openness strategies

and also the cumulative effects of regulation initiatives.

For those of you who might not be as familiar with cumulative effects of regulation, or as commonly referred to as CER, back in March of 2011, the Commission directed the staff to make the rulemaking process -- to make enhancements in the rulemaking process that would include increased interaction with external stakeholders throughout the rulemaking process.

And, the development of a regulatory basis is a part of that rulemaking process. And, that is part of our openness strategies and why we are here today.

Next slide, please?

As you look at this particular slide, it basically outlines what happened with the Low-level Waste Policy Act of 1980, which basically defined radioactive waste not as -- not classified, this is a unique way to define a substance as not, okay, not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel or byproduct material as defined in Section 11(e)(2) of the Atomic Energy Act of 1954, as amended. And, that was done

in 1980.

And then, in 1982, as a result of the interests of stakeholders and a lot of things that were going on in waste disposal at that time, the NRC developed regulations in 1982, that what we see as Part 61.

And, Part 61 basically also provides the definition of waste. As defined in Part 61, low-level waste -- waste means low-level waste containing source, special nuclear or byproduct material that are acceptable for disposal in a land disposal facility.

And, this definition goes on to indicate that low-level waste, it means, again, not classified as high-level waste, transuranic waste, spent nuclear fuel or byproduct material.

In addition, when we -- when the NRC developed Part 61, its low-level waste regulations, it came up with a waste classification system which is basically reflected in this diagram where we have waste that is divided into the classes of A, B or C.

And, it also provides for waste that is greater than C which we are going to talk about more today, and that's greater than Class C.

Greater than Class C waste is

concentrations of radionuclides that, in itself, by its own definition, is greater than that in Class C. Okay, greater than Class C.

Next slide, please?

So, you might ask yourself, okay, why are we here? Why now? Why is the NRC looking at greater than Class C at this time and at the possibility of even revising its Part 61 requirements to look at potential inclusion of this waste within the Part 61 regulatory framework?

Well, this is all outlined in SECY-16-0094, the title of which is ``Historical and Current Issues Related to the Disposal of Greater Than Class C Low-Level Radioactive Waste.''

Basically, in that document, the staff discusses that the Waste Control Specialist of Texas filed a petition or rulemaking with the State of Texas requesting that they amend the Texas Administrative Code to remove the prohibitions to the disposal of greater than Class C and ``greater than Class C-like materials.

And, as a result of that petition for rulemaking, the State of Texas came to the NRC to look at whether or not they could do this with all the various

technical, legal issues surrounding it.

And so, for the purpose of this paper that the staff developed, greater than Class C was basically looked at as those materials that was covered by the Atomic Energy Act licensed activity, whereas, this, new term ''greater than Class C-like'' waste is that developed by the U.S. Department of Energy and is generated or owned by them.

So, this paper that the staff came up with basically focused on that within our sphere and, that being, greater than Class C.

So, as a result, of course, when you send the paper up to the Commission, the Commission gives you a response back. And, that response back is what we have as the Staff Requirements Memo, or SRM.

And, it basically directed the staff to prepare a regulatory basis for the disposal of greater than Class C through means other than geologic disposal, including what we see presently in Part 61 called near-surface disposal.

In addition, at present, there is no definition of transuranic waste in Part 61. So, the Commission also directed to staff to look at adding a definition of this term to the Part 61 definitions

in Section 61.2.

After which, they had initially told us to complete this regulatory basis within six months of the, which was at that time, the Part 61 rulemaking activity.

However, subsequent to that, through SRM-SECY-16-0106, the Commission gave us new direction and indicated that we should complete this regulatory basis within six months after publication of the Part 61 supplemental proposed rule.

As you know, this is a very complex topic, legally, technically and policy wise. So, six months is not a very long time to discuss all of the important issues that are going to need to be considered in developing a regulatory basis.

Once again, that brings us to why we are here today. We, at the NRC, believe it is vitally important to communicate with our stakeholders early and often, early and often.

That way, we can get and understand all the various issues associated with this particular development of this particular regulatory basis.

Next slide, please?

So, in looking at the next steps, once the

Part 61 supplemental proposed rule is done, we are to, within six months, complete the regulatory basis. As I said, that's a very short time to do all we need to do. So, that's why we're talking to you today.

And, if the analysis in the regulatory basis concludes that some or all of greater than Class C is potentially suitable for near-surface disposal as described in 10 CFR Part 61 and the Commission agrees, then the staff would proceed with that box there, which would be to develop a potential Part 61 rulemaking for greater than Class C and transuranic waste disposal.

Are there any questions for me before I turn it over to my colleague, Mr. Tim McCartin?

MS. D'ARRIGO: I just wondered if the six month clock started ticking yet, complete 61 supplemental proposed rule? So, that's -- that hasn't happened, right?

MS. MAUPIN: That's correct. That's why I referred to early and often because that -- the supplemental proposed rule has not been published as of yet. So, that's why we are out speaking to you, our stakeholders, early on this issue. It has not been completed.

MS. D'ARRIGO: And that's going to be on

the whole gamut of things that Part 61 is, not just this greater than C piece?

MS. MAUPIN: It would not include this Part -- it would not include the greater than Class C piece. It would just include the piece that was being -- preceded us.

Thank you, if no more questions, I'm going to turn it over to Tim.

OPERATOR: On the phone line, we have Rob Black.

MS. MAUPIN: Okay.

OPERATOR: Your line is open.

MR. MUSSATTI: Go ahead.

MR. BLACK: Sorry, I missed the question. We don't have input right now.

MS. MAUPIN: All right, I'm turning it over --

MR. MUSSATTI: Okay.

OPERATOR: Okay, next, we have Larry Camper. Your line is open.

MR. MUSSATTI: Go ahead, Larry.

MR. CAMPER: Okay, can you hear me?

MR. MUSSATTI: Yes.

MR. CAMPER: Very good, thank you.

Thank you, Cardelia.

Before I make my comment or question, I want to thank the staff for the hard work you're doing on this very important national issue that's been going on now for 30-plus years.

The question that I have before we get into the specific question is, I want to try to understand just where we are in the process.

I'm a little bit perplexed at some of the questions. Let me explain what I mean.

Cardelia, you referenced SECY-15-0094. And, I would bring to our attention the attachment or enclosure to that paper which was an extensive analysis of the GTCC waste inventory in the United States today bringing to bear the materials set forth in the Department of Energy’s EIS.

And so, it's a very extensive document. But, it strikes me that some of the questions that we're going to be discussing doesn't seem to take the benefit of that analysis.

I mean, for example, the first question asks what are the important radionuclides, et cetera? But, yet, that very document, this Executive Summary cited Section 2 and presented a summary of the DOE EIS

and went on to say that this document is currently the most comprehensive and detailed source of GTCC waste types and inventories, disposal methods including conceptual facility designs, on and on and on.

And then, that same summary cited certain questions that weren't addressed within that staff analysis.

And so, I'm curious in a general nature as to how much that rather in depth good work by the staff is being brought to bear now as you bring forth the issue in this set of questions?

Thank you.

MS. MAUPIN: I will take it -- my first cut at it and then I will turn it over.

I think some of it is based on what the SRM said and the direction that we got from the Commission in that SRM in looking at the paper.

But to -- I will now turn to my colleagues who will talk more about the technical aspects.

MR. MCCARTIN: Good afternoon, I'm Tim McCartin and, Larry, let me go through my presentation and then, at the end, if that still doesn't answer your question, you can bring it up again.

But, I hope to address in that -- in my

presentation.

And, we're at this initial meeting and the staff, in preparing for the meeting, we conducted some simple technical analysis drawing upon information from before as well as possibly packaging it a little differently than was done before.

But, we certainly are aware of a lot of work that's been done, especially recently, DOE published their EIS for GTCC waste. And, we have relied on that.

However, for today, what we were looking to see is, before we go any further in developing a regulatory basis, we want to understand the potential hazards with disposal of GTCC waste.

And so, this presentation today is trying to give you some information of how we've looked at it and we're interested in hearing from people, because before you proceed to suggest any changes to the regulations, one would want to make sure you have a good understanding of the hazards.

And, that's what we've done today. This analysis we provided in the Federal Register Notice. It was a hope that possibly this analysis that we did would assist people in understanding why we asked the

questions we did.

So, next slide?

First, you want to understand the characteristics of the type of waste that you're proposing to be disposed of. And, generally, GTCC waste is characterized in three rather large bins, if you will, waste streams.

One would be from primarily from commercial reactors, that's activated metals. They are components from a nuclear power plant.

Sealed sources primarily from medical and university hospital uses.

And then, the other category which is a variety of different sources that are greater than Class C. And, I'll go into detail in the next few slides of those -- of these three areas that we looked at. They are the same three areas that are in DOE's EIS.

So, activated metals -- next slide?

As I said, these are mainly reactor components is the most significant source. There's two aspects to the radiation for activated metals.

So, there's certain atoms that can get activated by the fact that they've been in a nuclear reactor. Nickel in a metal, nickel-63 is an

activation -- activated radionuclide. And, that's where the name typically comes from.

But, we would not want to neglect the fact that there is some surface contamination of these metal components in a nuclear reactor. And, they include other radionuclides such as transuranics.

And, I will point out here that I labeled greater than Class C for activated metal, sealed sources and other wastes.

We do not have in this analysis a separate category for transuranic waste.

Now, there are transuranic radionuclides in some of these waste streams. They may not be at the level of concentrations that would classify them as transuranic waste, but we believe it allows one to understand the concern with disposing of transuranic wastes.

And so, that's why there isn't a separate category that you'll see in my presentation for transuranic waste.

There's also -- and, in this activated metal source term, there is long-lived radionuclides as well as short-term. The short-term tend to generate more heat. And so, that's another aspect of this

greater than Class C waste that typically is not considered in low-level waste disposal, heat generation.

Next slide?

Sealed sources, as I said, are typically due to medical applications and they can be short-lived, cesium-137 is a fairly large amount of curies that are present in the source terms that DOE included in its EIS.

There's also others that include transuranic radionuclides, including plutonium isotopes.

Plutonium-239, in particular, is a fissile material and, with that, depending on the quantity, the configuration, it raises potential concerns with respect to the potential for criticality.

Because it's a fissile material, it also, depending on the amounts, there's certain security requirements that NRC has for these types of materials.

Additionally, sealed sources can generate a fair amount of heat.

Next slide?

The other category is, you know, I hate to say, well, it's a variety of different sources.

DOE noted a couple potential sources for the future.

One, if there was a decision to exhume the West Valley site, there could be some other -- it would be classified as this other waste, some of that.

Also, molybdenum-99 production, a radioisotope used in medical field procedures. There is waste from that, that would be also included as other waste.

Certainly, the molybdenum-99 production has a transuranic radionuclide that's fissile plutonium-239 in it.

So, you can see there's a variety of different aspects to each one of these.

Next slide?

And so, when we look at this spectrum of potential waste that would be disposed, there's the thermal output.

Some of these waste sources, depending on the amount that's disposed of, could generate a fair amount of heat.

Also, the same radiation that generates the heat can also cause radiolysis and hydrogen gas generation. Is that an issue? Right now, it's something to at least look at.

The fissile material, as I mentioned, and certainly, you always want to be aware of -- you might have short-lived radionuclides but what do they decay into?

And, if they decay into a long-lived nuclide, what's the overall impact of that sequence?

And so, with that as a backdrop, I will go to the results, but don't go to the slide -- that slide yet.

These were simple analyses we did to help us better understand the problem. We are not endorsing any particular design, or site, it's a way to help us better understand the problem.

And so, with that, let me go to the results side. Yes.

And, although there's a lot of stuff up there, let me point to a few things that I think are the message -- the takeaway message that I'd like to convey today, on the far left-hand side, -- are a number of different potential hazards.

You can see the thermal aspect, the gas generation, a dose to the off-site, the intruder. And so, you can see there's a number of things you need to consider when you're disposing of this type of

material.

You can see the three categories. There's also under each category, there's two different time frames, 500 years and 5,000 years. Part of that, in our analysis, we were trying to look at, you know, what happens over the long time?

As you can see in terms of the thermal part, clearly, most of the thermal effect is gone after the 500 years. It's there early on, as one would expect. But, it dies off over time.

You can also see in that middle set of columns for sealed sources, there's a lot of transuranic radionuclides there.

And so, you can see that's one of the reasons -- well, we didn't need to have a separate transuranic column, you can see, it does show up. So, disposal of transuranic radionuclides is going to need to consider a number of these hazards.

You can see the bottom two rows, the first one is intruder dose with respect to shallow disposal. The bottom most is intruder dose with respect to deeper than shallow. And, you can see, it made an impact.

And so, what this slide is trying to convey, and clearly, the assumptions we made about, well, how

much of it did you have there? In general, for each one of these sources, we included approximately 400 cubic meters of waste. And so, we kept them about all the same just to -- so, it was a fair benchmark between the two.

But, you can see, there's a number of things to consider and that's up to the particular site design, the site. It could vary considerably, but, I think what this shows to us as we go forward, there's a number of hazards that need to be considered.

One thing I would not want anyone to take away from this slide is, oh, we've identified the important radionuclides. These showed up in our analysis, it's very dependent on our assumptions.

But, it shows the importance of doing an analysis to identify what's important for your particular site, the volumes that you're going to dispose of, the design you have. And, that's all this should be used as.

We have not made any safety decisions on this, but it's in the view of the technical staff doing this, it's important to have a good understanding of what you're disposing of and what impacts you need to consider.

As I said, the thermal aspect, if you didn't account for it, would your engineered -- would your waste form -- would your waste package degrade faster because you didn't consider the heat aspect?

And so, that's the takeaway from this is that we believe we've tried to identify the potential hazards. Now, we'd like to hear from the public. You might have different views on this and that's why we're here.

But that -- and, that's why we provided this analysis. You can see, as Greg said, this is a complex issue. And, there's a number of facets to this problem.

And, with that, I will go to the questions.

MR. MUSSATTI: Okay, we have three questions that were posed in the Federal Register Notice and we're going to spend about 15 minutes of each of them we did before.

And, at the end of that, we'll get a sense of where we are. And, if we can --

MR. MCCARTIN: Excuse me, Dan, we would prefer you just read the three questions and let the discussion flow from there. And, we're not as --

MR. MUSSATTI: But expand with the

others --

MR. MCCARTIN: -- I know with the nine, it was a little more, but we think we can just hear from the public after.

MR. MUSSATTI: I stand corrected.

Well, the three questions are, for anybody that can't see them, what are the important radionuclides that need to be considered for the disposal of the GTCC and transuranic wastes?

How might GTCC and transuranic wastes affect the safety and security of a disposal facility during operations? In other words, pre-closure period?

And, how might GTCC and transuranic wastes affect disposal facility design for post-closure safety including protection of an inadvertent intruder?

And, we've got somebody at the microphone already. Go ahead.

MR. MAGETTE: Surprise. I'm Tom Magette with Talisman International.

I really appreciate the difficulty of what you're trying to deal with here as Cardelia pointed out. This is a waste stream that's been always defined by what it's not.

And so, what I'm hoping is that ultimately through this process, you'll get to a place where we actually define the waste stream.

There's a little bit about this that seems still like trying to define it a little bit less than what it's not, but, there’s still kind of a ‘‘what it's not’’ element to this.

Like, to the first question, I mean, you ask for us to identify radionuclides. I mean, kind of a first order of reading of a GTCC nuclide is they are in the tables in 61.55, except in greater concentration than what's in the tables because you're defining it by Class C, except exceeding the concentration limits that currently apply to Class C.

So, there's kind of a bounding there and, I think part of this would be helped by losing the GTCC terminology and losing the transuranic waste terminology. Okay?

Because, I mean, you have a transuranic waste definition in legislation which may be complicating your lives a little bit. And, it's pretty simple, I think, given that it's driven by atomic numbers greater than 92, but that's not really what you're talking about here.

You're really talking about defining a waste stream that you need to understand in order to protect the public from the hazard.

And, this may be one of those cases where we should look harder at what's done internationally. Right? So, it's not -- it shouldn't be just GTCC. So, you don't have to have the table in your hand to know what you're talking about.

And, it shouldn't just be atomic number 92 or higher, it should be an intermediate waste stream so that there's nothing left out once you finish this exercise other than, and it won't be left out either, would be defense high-level waste and at least spent nuclear fuel.

And, below that will be low-level radioactive waste, not including GTCC, but A, B, C and hopefully Class V as well.

But, you'll capture everything in some sort of category. And, I think, you know, the terminology is getting in the way of doing that. So, that's one broad thought.

Another is that you have done some work and you've generated this table which is nice. DOE has prepared an EIS that took a long time.

And so, I think we have a good opening position. And so, I appreciate the opportunity for us to provide more specific comment here, but what I would really like to see is that that gets us to some sort of proposed technical basis more quickly.

So, that we can kind of put the cards on the table. Because, I mean, I think we've had enough years talking about what might it be to get straight to something that looks like a technical basis that leads to a proposed rule.

Because, we've got a lot of work, you've done a lot of work, DOE's done a lot of work to potentially define this problem.

So, I would say, we need to define this as an intermediate waste. We need to stop talking about nuclides as compared to the tables in 61.55 and we need to publish specifically for proposed technical comment, kind of a combination between what you've done and what DOE has done.

MR. MUSSATTI: Thank you.

Is there anybody else in the room for comment?

MR. VICKERS: Glen Vickers.

Just a few observations. As was noted,

the DOE has done a lot of work and already made some initial recommendations for either surface disposal, shallow bore holes, et cetera. So, a lot of good work is done.

Here's just a couple observations from where I see from nuclear power's perspective.

First of all, we know our waste streams very well in nuclear power, they'd be activated metals from activated analysis or the TRUs.

Surface contaminates, we might have on activated metals, would likely be far less than 10 nanocuries per gram on a heavy piece of activated metal.

Now, if you had a low density waste like a light-weight glass fiber filter paper, maybe you get enough to exceed 10 nanocuries per gram transuranics. But, those surface contaminants would not likely be significant compared to the amount of curies.

Pretty much all your plants in the U.S. already store dry fuel, you know, in the interim fuel storage containers and concrete vaults on pads. So, we have good feedback on watts in containers, thermal generation.

And also, we have -- also have been licensed for storing activated metals in similar containers,

we call them non-fuel waste storage containers.

And so, there's good data for watts, et cetera.

We may find that we have very few waste forms that really would need any subsurface cooling, I would think.

As far as driving nuclides that I kind of see in nuclear power, I think they were already identified in the DOE paper, nickel-63, transuranics greater than five-year half-life and those kinds of things.

But, I would think things like reactor vessels, activated metals, those could easily be done in concrete cells or vaults above ground and not need, you know, something subsurface like WIPP or something.

And, I would even imagine that a good amount of the source term in WIPP is that low density waste that, while it's greater than 10 nanocuries per gram or something, it may not really necessarily need that deep geological repository and could be stored more efficiently elsewhere.

Thank you.

MR. MUSSATTI: Okay, have we got anybody on the phone?

OPERATOR: Yes, Larry Camper, your line is open.

MR. CAMPER: Thank you very much.

Tim, thank you for your presentation and your comments. These were eloquent as ever.

However, I remain concerned about where we are. If I go back to the enclosure two to SECY-15-0094, if I look back at a paper presented by Terrence Bromfield and others at the WM Symposium conference, if I look at the EIS prepared by the Department of Energy, I think we have a good understanding of what constitutes GTCC waste.

And, I think we also have a good understanding of what constitutes TRU waste.

What I'm concerned about is GTCC is an issue that we've been wrestling with since 1985 in policy space.

And, when it comes to TRU waste in excess of 100 nanocuries per gram commercial, we don't have a disposal pathway laid out.

It's for intensive purposes more than waste.

And then, you stop and think the GTCC and TRU waste are commingled and according to the Department

of Energy, as much as 87 percent of the inventory is commingled.

What I'm concerned about is urgency. Where are we? And, I want to make sure we maximize all the work that's been done thus far and not repeat some of the same questions that I would argue the staff has already addressed and the Department of Energy has already addressed.

And then, rather, I would suggest that we might take a look at the Executive Summary of Enclosure 2 and look at those issues that the staff identified as not being addressed in that paper as to what is outstanding.

I mean, I could sit here and read it to you, but you can look at it for yourself. Just go to the Executive Summary of Enclosure 2, it's right there.

To me, those are the questions that we should be focused upon now. While, I understand the value of asking these kinds of questions and making the general public aware, that's good, but that's not moving us down the goal field to solve a problem that desperately needs to be solved, in my opinion.

So, I think that we can maximize our efficiency in the process by better focusing upon some

of these outstanding questions that haven't already been addressed.

But, I appreciate the explanation and your comments were really thorough and I thank you for that.

That's all.

MR. MCCARTIN: Right. And, I appreciate that, Larry. We certainly are going to make use of all the previous work. And we do not believe we're reinventing past analyses. We may be packaging it a little differently, but it's all part of what we're -- and, as Cardelia said, this is a six month time frame we're going to move fairly quickly.

But, the first step was, we want to make sure that we have a good understanding of the types of waste streams and radionuclides we're talking about before we go to the Commission with any recommendation, no matter what it be.

And, this is that first step, but we certainly will -- are aware of the previous work. We will make use of it and, you know, I believe it's as much we are packaging it in a certain way and that may change with time as we learn more.

But, it's -- yes, and Greg wants to say something.

MR. SUBER: Yes, this is Gregory Suber.

Yes, and Larry, I'd also thank you for that chronology. But, I'd like to pull your attention to the fact that, even though those papers were vetted and released publically, that there was never a formal opportunity for anyone in the public to respond to the NRC with -- or concur that we have captured the universe of things that are out there or either to introduce anything that we could possibly have missed.

And so, the real goal behind this effort is to say, hey, this is the universe of things that we have seen and are considering. We're doing a scoping study to make sure that we have captured everything.

And, this forum is the first opportunity to make sure that we got that right. And, is that correct, Tim?

(NO AUDIBLE RESPONSE)

MR. SUBER: Okay.

MR. MUSSATTI: Let the record show that Tim was nodding yes.

MR. MCCARTIN: Oh, yes.

MS. D'ARRIGO: Okay, so I'm a little confused. If this is scoping like Greg just said for greater than C, just out of curiosity then, why can

we comment to the regulations -- to the rulemaking.gov. I was just told, they can't comment on rulemaking.gov on the very low-level waste because it's not a rulemaking.

MS. MAUPIN: This one is in rulemaking, because when the Commission directed us to look at developing a regulatory basis, it was inserted into our ``rulemaking tracking system.''

So, it was added on the docket as that, budgeted as that under rulemaking.

Whereas, the other issue has not had that level of attention by the Commission as of yet.

So, we have all those vehicles that we -- four vehicles with the ways you can comment are consistent with how a rulemaking process is handled.

So, you can email us, fax us, write us, you can even hand-deliver it, if you want. So --

MS. D'ARRIGO: Okay.

MS. MAUPIN: Okay?

MS. D'ARRIGO: And then, one more clarification then.

So, I understand that the NRC is funded usually by user fees. So, who's paying for these rulemakings and for the exploration of very low-level

waste?

MS. MAUPIN: In responding to that, what we have is, we have certain resources that are given to us by Congress that are -- that is outside of the fee process.

And, this activity is not on the fee system or the fee process.

MR. MUSSATTI: Do we have other questions or comments from the room?

Yes, sir?

MR. TONKAY: Doug Tonkay, U.S. Department of Energy.

I just wanted to make a comment about I believe you said you were going to be updating the transuranic waste definition or you were including -- looking at including that in Part 61.

And, picking up on what a couple of the others have said, I wanted you to be aware of, there is a legal definition in the WIPP Land Withdrawal Act for transuranic waste.

And, it may be, as I recall, a bit different than NRC's definition because -- and we use that in DOE because it also includes a half-life of greater than 20 years.

And so, I would hope that we could come together on that definition.

And, the second thing was, I think on slide 12, I would --

MS. MAUPIN: If I could just jump in to that. In our SECY-15-0094 in Enclosure 3, we have an extensive discussion on the definition and this conflict of definition.

So, that was one of the reasons why the Commission directed us to, hey, we need to come to some kind of agreement on this definition and have one in Part 61. So, it was included in that paper.

MR. TONKAY: And then, the second question or comment was on the slide 12 that you had where you had, I believe, the impacts in 5,000 years, it showed plutonium-238. Is that a typo? Should it have been plutonium-239?

MR. MUSSATTI: It is 239 up there.

MR. TONKAY: Okay, it looked like 8.

So, thank you.

MR. MUSSATTI: It's 239.

MR. MCKENNEY: All right, the print's too small, it's too much of an eye test. This is Chris McKenney.

(OFF MICROPHONE COMMENTS)

MR. MCKENNEY: Really? Maybe it's too small for us.

(OFF MICROPHONE COMMENTS)

MR. MUSSATTI: Oh, yes, that's in the --

(OFF MICROPHONE COMMENTS)

MR. MUSSATTI: We need you on the microphone if you're making a comment.

MR. MCCARTIN: I will double check that, I believe you're right that that -- in that column.

MR. TONKAY: As I recall, the half-life of plutonium-238 it's under a 100 years, so that would represent over 50 half-lives if that -- and it would have to be a very high concentration to be --

MR. MCCARTIN: Right. It should have been 239 in that last column, yes.

MR. MUSSATTI: Okay, have we got anybody on the phone lines that would like to speak?

OPERATOR: I'm currently showing no comments on the phone line at this time.

MR. MUSSATTI: Okay. And, nothing on the webinar. Anything else in the room?

MR. VICKERS: Glen Vickers, just one more comment.

You know, out of -- outside of arbitrarily driving things, coming up with perhaps a watt density that would require, you know, subsurface cooling, watts per cubic foot or something like that.

That would be another thing that licensees could use to assess their materials or help you better decide whether it would need subsurface cooling or could be above ground in that.

That's all.

MR. MCKENNEY: And, that is, again, we have the material from a number of analyses over the years.

But now, every analysis is fit for purpose. It is what are you actually analyzing and what is the answer?

And so, you know, we're trying to ask to make sure that there isn't data out there, there hasn't been too conservative of assumptions of what might be on a type of waste stream or anything like that.

Then it's what's out there because it may have been fine to have that conservative assumption in a paper several years ago on what radionuclides are present.

But, when you keep -- when you're refining that or even if we could look into the future if that

was site specific analyses by the waste sites, they would, you know, want to know a more realistic value than a conservative value for what is the -- what are these radionuclides on these specific types of equipment?

To the degree we can, to the degree we're not asking for people to go out and reanalyze these things and do worker dose for this particular enterprise.

But, if people have sources of data on that to say, yes, this was used in this analysis, that's a bit conservative but it, you know, it might fit for that -- the question they were analyzing at the time.

And, but, for this one, you should take into account it's a bit conservative. And, that may, you know, influence the overall decisions because, if you're too conservative in some places in these analyses, that can just compound and then you're making the decision -- a risk decision on something that really isn't part of the analysis -- shouldn't be part of the analysis.

MR. MCCARTIN: Yes, and if I could clarify, and it's possible I mean, it's always dangerous to put a table like Table 12 up.

It wasn't an intent to say, oh, these are issues that we're worried about necessarily. But, they are issues that need to be considered. And, it may be a very, very simple consideration to say, gee, I don't have a thermal problem.

But, because, once again, for all of these, if you're disposing of 10 cubic meters versus a 1,000 cubic meters, it's a different world. And, that's part of the assumptions of this analysis.

But, whoever is looking to dispose of something, needs to consider these things. Some may be a very simple analysis to show it's not an issue, others may take a lot more effort.

And, it really depends on the quantities that should not be overlooked here. And, that's part of the --

So, I don't want to, does someone have to do a detailed analysis for all these? I was not trying to imply that, that's for sure.

MR. MUSSATTI: Do you have a comment?

MS. D'ARRIGO: I have a question, it's Diane D'Arrigo, Nuclear Information and Resource Service.

Could somebody describe to me how the

federal government and I guess the State of Texas right now, I don't know whether it would include Utah as well or any of the other South Carolina, Washington, what's before us?

We have the ongoing DOE EIS that's kind of stringing out on greater than C. Now, we've got a proposal, I guess, WCS wants to have Texas give them permission to dispose of this waste. And so, NRC needs to make a decision to advise the State of Texas on whether or not they have the authority to permit WCS to do this.

And then, you need to do possibly some kind of rulemaking in order to -- I'm just trying to figure out what's going on.

MS. MAUPIN: I'll speak from the Agreement State and policy issue briefly. And, I will lean on Ian to correct me if I say something that's not quite right.

So, you have the low-level waste --

MS. D'ARRIGO: Who's Ian?

MS. MAUPIN: Oh, I'm sorry, our --

MS. D'ARRIGO: Are you WCS?

MS. MAUPIN: No, he's our attorney.

MS. D'ARRIGO: Oh, thank you.

MS. MAUPIN: Okay. First off, I'm going to try to make this as brief as possible.

First, you had the Low-level Waste Policy Amendments Act that basically set out the responsibilities of the States and the federal government, in this case, for greater than Class C which was designated to DOE, as I understand it.

So, you have a federal law that says that greater than Class C basically is supposed to be a federal responsibility and that facility, and there is some confusion on it, is supposed to be regulated by the NRC.

Now, okay, prior to the Low-level Waste Policy Amendments Act we had some States that inherited some low-level waste disposal facilities from the federal government like South Carolina, which was licensed under Part 20 with a lot of problems with that.

So, we came up with Part 61 and then, as I said, that was around '82.

And then, after that, we came up with what we call a way where States could decide if they only wanted to regulate low-level waste to comply with the requirements in the Low-level Waste Policy Amendments Act.

So, we came up with what we call a limited agreement just for low-level waste disposal. And, that was right after the Low-level Waste -- in between the time of the Low-level Waste Policy Amendments Acts.

So, at that time, we thought a lot of States were going to consider it. We came up with criteria and everything, what an Agreement State program should look like if they wanted that responsibility.

Okay, bring that around to present day, we have a licensee who says -- who has said to an Agreement State, we want you to take off your books, your laws, that greater than Class C is prohibited. That's a real -- that's a sticky wicket.

Because, now, we've got to look at, okay, NRC, we don't have a clear program to say, hey, you can do this, that we not established in Part 61 a greater than Class C program. And, according to the law under Section 274-74, if an Agreement State is going to have a program, it's supposed to be adequate and it's supposed to be compatible with the federal government.

So, that's why this is a very complex issue because there are a lot of legal issues involved and there are a lot of policy issues involved and there are a lot of technical issues involved.

And, layer on top of that, there's this little provision in the Atomic Energy Act that said, okay, certain hazards are such a level that they should be reserved to the federal government.

And so, traditionally, that -- one of those hazards has been identified as greater than Class C. So now, we're looking at whether or not there are some or all, based on the new technology that's being applied, because, if you look at what the Waste Control Specialist facility, it's not your normal like within the 30 meter, you know, of the biosphere near-surface disposal facility.

What was, you know, envisioned when Part 61, and at the time, Part 61 was being developed. So, it's just a whole lot of technical, policy and legal issues involved.

MS. D'ARRIGO: So, WCS has some State licenses to dispose of federal waste and commercial compact waste. So, and, as I understand what you said, what came out of the earlier history is that the State licensed 10 CFR 61 facilities could decide on a case by case basis to accept some greater than C on a case by case basis?

Because, I know Barnwell has done that.

MS. MAUPIN: I guess the short answer is, he's saying yes but you go back and look at the compatibility designation, is the compatibility D. And, that's something that would not necessarily be compatible.

MS. D'ARRIGO: So, what can -- I mean, what do you want to hear from public on this? Whether we want you to proceed to allow greater than C to go to 10 CFR 61 facilities with sort of a similar question to the depleted uranium, you know, pretending it's Class A and letting that go into the sites if the generators do their performance assessment and decide everything's going to be an acceptable dose in a 1,000 or 10,000 years.

So now, you're looking at doing a similar thing with greater than C.

MR. MCKENNEY: Currently, the Part 61, if you go back and look at the -- back in the late '80s there was a rulemaking related to high-level waste that was looking at the definition of high-level waste.

And, was considering putting GTCC under that definition. At the end of that rulemaking, it was decided that instead of actually putting it there, there was to be put a statement into Part 61 that it

would be preferable for geologic disposal, but could be done on a case by case basis under 61.

What we're trying to do now is, especially with the State of Texas is question to us, is what exactly is needed in that case by case basis? What do we -- do we need to change Part 61 to actually establish specific criteria for GTCC disposal? And, are there, you know, and are there any other ancillary issues related to that?

And, one of the biggest ancillary issues is, can that be handed to the Agreement State or not for large volumes of GTCC -- relative of the volume of GTCC?

MS. D'ARRIGO: So, how does that dovetail with what DOE's doing?

MR. MCKENNEY: Right behind you, they will talk for DOE.

MS. KLICZEWSKI: Hi, this is Theresa Kliczewski, U.S. Department of Energy, Office of Environmental Management.

So, your question or your comment earlier about the continuation of the EIS, I just wanted to be clear, the final EIS for greater than Class C disposal was published in 2016. So, that's done.

What we have done recently is, in accordance with EPAC to 2005, we have issued a report to Congress on greater than Class C disposal.

The Department of Energy, as part of our next step, will have to -- the legislation states to await congressional action before making a final determination.

So, the Department of Energy will be issuing eventually at a TBD time frame a record of decision, to be determined record of decision on greater than Class C disposal.

So, I just wanted to clarify that because of your comment earlier saying the continuation of the EIS, that part is done. We did issue it, yes.

(OFF MICROPHONE COMMENTS)

MS. KLICZEWSKI: Correct, the record of decision is TBD, but that is with the Department of Energy.

MR. MUSSATTI: Okay, I'm going to pull this conversation back to the topic of the day. We've wandered off into the weeds and I let it go for a little while hoping that it would come back on its own, but it seems that those weeds are getting deeper the further we go. And, we're into Commission space now, not into

something that we can handle ourselves right here.

So, do we have any other comments related to the three questions, to the exploration at hand? In the room?

(NO RESPONSE)

MR. MUSSATTI: On the telephone line?

OPERATOR: We have on the phone Larry Camper. Your line is open.

MR. MUSSATTI: Larry, good to hear from you.

MR. CAMPER: Thank you, thank you very much for the opportunity to comment. I appreciate, again, all the hard work you're doing.

These are tough questions. Greg, I want to go back a comment you made, if I might.

Regarding the fact that the Enclosure 2 to SECY-15-0094 was never a subject to public comment. Perhaps it should be because the amount of analysis that was done in that enclosure by the staff coupled with the work that Terrence Bromfield and others did to make a presentation at the WM Symposia represent a tremendous amount of time and effort.

If the concern is that all that work was never subject to public review or comment, I would

suggest that it might be.

Because I think many of the questions that are being asked here are, in fact, captured and embodied in that staff work. And, it may be that the most beneficial thing to do therefore is to offer an opportunity for comment and perhaps convene a workshop of industry experts and public participation and awareness to address the outstanding issues that the staff cited in the Executive Summary of that enclosure that were not addressed within that particular body of work.

So, that's something I would offer as worthy of pondering.

Thank you.

MR. MUSSATTI: Thank you.

Is there anybody else on the phone?

OPERATOR: I am currently showing no further comments on the phone line.

MR. MUSSATTI: Okay, thank you.

I don't see anything on the webinar that -- where anyone's asking to comment.

Is there another comment from the room that is on topic?

MR. VICKERS: Glen Vickers.

One thing related to security. So, for 10 CFR 37, NRC wrote Enforcement Guidance Memorandum 14-001. I think that's for large items, greater than so many kilograms absent certain waste types or robust structures.

It provided an alternate set of controls as to what's been Part 37. That would be something to look at when you look at your security measures.

MR. MUSSATTI: Anybody else?

(NO RESPONSE)

MR. MUSSATTI: Do we need leadership and guidance? Should we close it up?

MR. SUBER: Sure.

MR. MUSSATTI: Okay.

MR. SUBER: Once again, this is Gregory Suber, the Acting Deputy Director of the Division of Decommissioning Uranium Recovery and Waste programs.

If you can go to the last slide with the information on it?

All right, so, first of all, thank you all for your active participation in the discussion.

And, I would like to remind you again that we appreciate your comments. We do have them transcribed as we have transcribed this meeting. But,

to have your comments formally submitted for consideration, we do ask you to submit them to the information you see here, either at regulations.gov. For this particular meeting, you can submit it to -- by email to rulemaking.comments@nrc.gov.

And, I believe we modified the handout. Did we not? We modified the handout that is available for you which will have the email addresses for submitting comments for very low-level waste scoping study along with the Docket Number that we would like to have in the title line so that we can identify easily those comments -- those emails as comments on that particular topic.

And, with that, I thank you for coming and have a good afternoon.

(Whereupon, the above-entitled matter went off the record at 2:06 p.m.)

Nuclear Information and Resource Service
www.nirs.org; dianed@nirs.org

Comments on NRC-2018-0026-0001

Federal Register / Vol. 83, No. 31 / Wednesday, 2/14/2018

VLLW: Very Large Loophole (Low-Level) radioactive Waste

May 15, 2018

This is our input to NRC on a "scoping study" intended to justify calling huge amounts of nuclear waste ***"very low level waste"*** or **VLLW** which would then be exempt from radioactive controls. We call it **"Very Large Loophole Waste."** We oppose squandering resources to justify exempting man-made nuclear waste from radioactive controls. The industry and the public agree that massive amounts of nuclear power waste will result from decommissioning nuclear power reactors and other nuclear fuel chain facilities. Nuclear power generates large amounts of waste and the goal should be to isolate it from the public and environment to the best of our human ability in this day and age for the long time it remains radioactive. It needs to be handed down to future generations in forms and systems that isolate it from the biosphere. Exempting, dispersing, releasing it now is an irreversible decision that sentences them to random but deliberate exposures. We continue to oppose the immoral and selfish efforts to send known radioactive waste to regular garbage dumps, to industrial or hazardous waste sites, possibly into incinerators and recycling facilities to make everyday household and personal-use items (although the scoping study will consider landfills only). Huge amounts of dangerous but hard-to-detect nuclear wastes would *no longer be regulated as radioactive.* The *"alternative methods of disposal,"* not at licensed radioactive waste sites, will add to the unavoidable radioactivity and risk in the world without truly calculating the risks and costs. We ask NRC to NOT LIE. The waste is known to be radioactive so pretending it is not is untruthful.

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NO SAFE DOSE—NO REAL LIMITS

DON'T EXEMPT WASTE TO RELIEVE INDUSTRY FROM LIABILITY

The nuclear industry wants NRC to allow *additional* radioactive doses to workers and the public. They calculate that 5 millirems a year *additional* dose to those exposed would enable 2/3 of decommissioning waste from closed nuclear power reactors to go to unregulated destinations, saving $6 Billion dollars. A tenth of the radioactive waste from nuclear power operations could also be treated as VLLW or not radioactive and dispersed to cheaper destinations. Hazardous dumps charge a tenth as much as radioactive licensed sites and solid waste sites even less. Imagine the savings if they can sell it into recycling.

What is the cost? Five millirems/year for a 70 year lifetime would cause 1 cancer in every 2500 of us exposed. Multiply by as many waste streams as the industry wants to clear—the rule would legalize unlimited public exposures, releases and negative health impacts, without counting them in the cost/benefit analysis.

Unenforceable, unverifiable dose limits (5 millirems, 1 millirem, 10 millirems—it doesn't really matter) are a blank check to send nuclear waste out it as if not radioactive. The industry would make its own determinations, with no enforcement or verification. Fox guarding the chicken house…

Using the US Environmental Protection Agency's "Blue Book" radiation risk information, *1 in every 2500 people exposed will get cancer* from the additional 5 millirems/year lifetime dose that the Electric Power Research Institute uses in its calculations. If NRC changes the definitions of waste in this way, there could be this additional dose from every deregulated waste stream and there is no limit on the number of waste streams from the hundred plus nuclear reactors and the dozens of other nuclear power fuel chain facilities operating to enable nuclear power. Of course there is no way to verify or enforce any dose level. We, who are called "DOSE RECEPTORS," will never know what doses we get and are expected to trust computer codes developed and used by nuclear advocates to estimate our "acceptable" doses and "protect" us. If and when a VLLW category is established, it will be legal for us to be exposed above the already-unacceptable nuclear power release levels. No nuclear waste generator will be liable. Landfill operators and downstream residents, metal and other recyclers, others down the line will be exposed and if there is any liability it will fall on them, not the nuclear industry (which profits from generating the nuclear waste).

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The public completely defeated *many* previous efforts to declare nuclear waste Below Regulatory Control, exempt, excluded, de minimus, etc. ; this is a new name for the same dangerous, deadly plan: VLLW- Very Large Loophole nuclear Waste.

VLLW nuclear power waste would be treated as if it's not radioactive; it would be disposed of or reused without radioactive regulation or control, trusting that other solid and hazardous waste regulations will protect us even though those dumps are not designed for nuclear waste and the health effects are even worse when exposures are from both radioactive and hazardous waste. Solid and hazardous waste sites all leak eventually and the long-lasting radioactive materials will leak out with the leachate or be released in the gasses.

The proposed VLLW classification is intended to open the door to routine, generic release of unlimited amounts of waste with NO public notification or opportunity to intervene or even comment.

ENTIRE REACTORS BECOME WASTE AT DECOMMISSIONING TIME—
NRC MUST REQUIRE ISOLATING THAT WASTE

The industry is promoting this now because enormous nuclear power reactors are closing. EPRI projects 84 billion cubic feet of "class A" radioactive waste and would like to release 66% of it. Entire reactors, the whole building and most of the components and parts became radioactive. They are considered nuclear waste under federal regulations (10 CFR 61.55). NRC should work on ways to isolate all of this waste rather changing the regulations to avert disposal costs at licensed disposal sites. We oppose this blatant move to relieve the nuclear power industry of liability for nuclear power waste.

Our simple message to the NRC is NO VLLW!
Keep all nuclear waste under radioactive regulatory control!

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NIRS Responses to Questions Posed by NRC:

1. The United States does not have a formal regulatory definition of VLLW. What should the NRC consider in developing its own regulatory definition for VLLW? Is there another definition of VLLW that should be considered? Provide a basis for your response.

THE NRC should NOT waste its and taxpayers' resources creating a new category within the "low-level" waste category.

This is clearly an effort to reduce and remove radioactive regulatory controls which are already inadequate to protect the public and environment from man-made radioactive materials and wastes.

US NRC should be discouraging international nuclear promotion and guidance organizations (such as IAEA, ICRP, OECD, EURATOM, etc.), some in which NRC plays very influential roles, from proceeding with developing a VLLW category.

VLLW would disperse rather than isolate man-made radioactivity when isolating it should be the goal.

2. The existing regulatory framework within 10 CFR 61.55 divides low-level radioactive waste into four categories: Class A, Class B, Class C, and Greater Than Class C. Should the NRC revise the waste classification system to establish a new category for VLLW?

NO

What criteria should NRC consider in establishing the boundary between Class A and VLLW categories?

Since NRC should not be establishing a new VLLW category, there is no need to squander resources on it. Rather NRC should use its available resources to provide greater regulatory control and to track the increasing amounts of decommissioning waste.

3. The NRC's alternative disposal request guidance entitled, "Review, Approval, and Documentation of Low-Activity Waste Disposals in Accordance with 10 CFR 20.2002 and 10 CFR 40.13(a)," which is undergoing a revision, allows for alternative disposal methods that are different from those already defined in the regulations and is most often used for burial of waste in hazardous or solid waste landfills permitted under the Resource Conservation and Recovery Act (RCRA). Should the NRC expand the existing guidance to include VLLW disposal or consider the development of a new guidance for VLLW disposal?

NO, NO

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Why or why not?

It is bad enough that NRC allows radioactive waste to be exempted from radioactive control on a case by case basis via 10 CFR 20.2002. Making this a generic approval, as the proposed VLLW category would do, will only make that worse and remove any opportunity for public knowledge and input by the very public that would be harmed by the re-categorization.

4. If the NRC were to create a new waste category for VLLW in 10 CFR part 61, what potential compatibility issues related to the approval of VLLW disposal by NRC Agreement States need to be considered and addressed? How might defining VLLW affect NRC Agreement State regulatory programs in terms of additional responsibilities or resources?

Members of the public and residents of agreement states appreciate the potential for states (whether agreement states or not) to be more protective than the federal government. NRC has various compatibility levels for its regulations. The NRC should NOT make any regulations that weaken public protection. NRC should respect state authority, and expressly permit states to retain full requirements for regulatory control that is more protective than NRC. If there is a concern about inconsistencies between states, make the standards that are most protective of the public apply to all states. If the industry convinces one or more states to reduce its radioactive controls, that should NOT be permitted in other states. Example: Tennessee's BSFR and BWAP radioactive release systems deliberately allow nuclear waste into solid waste landfills, some of which are already leaking. It is not clear how much nuclear waste is being deliberately released into commercial recycling from state-licensed facilities, but it is an abuse of public trust to release any man-made radioactive waste into commercial recycling and re-use streams of any kind including but not limited to metal, concrete, cement, soil, asphalt, plastics, wood, aluminum, oil, equipment, parts and other property, materials, buildings, building supplies, etc.

5. Following the Low-Level Radioactive Waste Policy Amendments Act of 1985, states formed regional compacts for the disposal of low-level radioactive waste. If the NRC were to create a new waste category for VLLW, does it fall within regional compact authority to control VLLW management and disposal? How might defining VLLW affect regional compacts in terms of additional responsibilities or resources?

Since the proposed "very low" or VLLW radioactive waste is currently part of the regulated "low-level radioactive waste stream (LLRW), states and compacts have authority over it. Even if NRC tries to redefine some LLRW as VLLW to exempt or remove radioactive controls, the states and compacts retain authority over that material. The NRC cannot and must not try to define away state authority. If NRC insists on creating the unneeded category, which is clearly to release the waste from control, state authority over it will remain. Constitutionally, changing the regulations or definitions should not affect the existing states' rights. It would be a highly objectionable power grab if NRC tried to do this.

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6. Environmental Protection Agency-imposed waste analysis requirements for facilities that generate, treat, store, and dispose of hazardous wastes are defined in 40 CFR parts 264 through 270. How would NRC incorporate and apply waste analysis requirements for VLLW at RCRA Subtitle C and D facilities? Should the NRC impose concentration limits and/or treatment standards for VLLW disposal?

Nuclear industry efforts kept radioactive waste from being subject to RCRA when the law was being adopted. Now the industry wants to sweep massive amounts of its waste into those sites, while denying the danger of the radioactivity. The public has repeatedly opposed and stopped every known effort to allow radioactive waste into solid and hazardous waste facilities and prevented hazardous waste from going into radioactive waste facilities.
There is no technical justification for putting radioactive materials into solid and hazardous waste facilities…it is obvious this is only being proposed because such facilities exist and are less expensive than radioactive licensed facilities.

NIRS raised the issue of what to do with "low-level" radioactive waste during the licensing proceedings for nuclear power reactors and the NRC claimed then that capacity would exist when needed for radioactive regulated "low-level" waste disposal. Now, because decommissioning volumes are large, the NRC wants to allow radioactive waste to go to destinations that will not isolate it for as long as it remains radioactive. This is a clear case of externalizing the costs of nuclear power with the general public paying the cost while NRC fails to even attempt to estimate the costs to health from the dispersal and exposures. Because it is difficult and expensive to track radioactivity, NRC is taking advantage and authorizing the dispersal. NRC is clearly exempting the nuclear power industry from liability and shifting the costs to other industries, the public and the environment. It is immoral, unethical, selfish, greedy and deliberate, premeditated murder.

7. Are there any unintended consequences associated with developing a VLLW waste category?

Whether intentional or not, developing a VLLW category will disperse radioactive materials/wastes that should be isolated. A basic international principle of ionizing radiation protection is to prevent and minimize exposures. Spreading the waste to locations not even intended to manage or track radioactivity is irresponsible and a clear effort to externalize the costs of nuclear waste production. The consequences will be multiple, additive, cumulative and synergistic. Impacts to the health of our communities and environment include concealed, uncounted damage to future generations with birth defects and genetic mutations.

If the intent is to allow the nuclear industry to dump on the rest of us to save money, VLLW will achieve the goal. That is an intended consequence even if NRC and the industry deny it.

The precautionary principle directs that the waste should be kept under radioactive regulatory controls for at least 10-20 half lives.

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8. What analytical methods/tools should be used to assess the risk of disposing of VLLW at licensed LLW disposal facilities or RCRA Subtitle C and D facilities? (*i.e.,* generic or site-specific)

We oppose any pseudo-scientific analysis, assessment or rationalization for dispersing man-made radioactivity from radioactive regulatory control.

9. How should economic factors be considered in the VLLW Scoping Study?

Until the NRC admits that there are health effects from low continuous doses of radiation, the Commission is incapable of assessing the true economic consequences (including health effects) of the widespread releases and exposures that creating a VLLW category would cause. Health effects are inevitable but not tracked. The costs to society and individuals are completely ignored and denied by NRC and the industry. It is unacceptable that absolutely no effort is made to estimate the costs in disease and suffering caused by the deliberate dispersal of man-made nuclear power waste.

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VLLW RADIOACTIVE WASTE= VERY LARGE LOOPHOLE WASTE

Diane D'Arrigo

Radioactive Waste Director

Nuclear Information & Resource Service

Presentation NRC RIC Regulatory Information Conference

March 13, 2018

Contact:

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NIRS

Nuclear Information and Resource Service

For a Nuclear-Free, Carbon-Free World

NO to VLLW

Don't Bother!

Keep all nuclear waste from the nuclear power and weapons fuel chain under **radioactive** controls.

Public opposes removing radioactive controls from radioactive waste

VLLW

Clearly for industry benefit

Weakening 10 CFR 61 protections for a large portion of the radioactive waste streams.

IAEA, HPS, EPRI and other supporters of the concept, which NRC is using to justify the new category, represent industry perspectives exclusively—no meaningful public input.

NRC Scoping announcement indicates large volumes of nuclear decommissioning waste would go to solid and hazardous waste facilities.

Radiation Risk

The most common justification for adding more radioactivity to the radioactive environment is that there is some preexisting natural and manmade radioactivity in the environment. Doubling an unavoidable risk by deliberately permitting release of manmade radioactivity is not publically or morally acceptable.

The National Academy of Sciences (BEIR VII) reports that there is risk of cancer from the preexisting radioactivity. Adding to background may not be directly attributable to increased cancer but it certainly does increase the risk to the exposed population.

The science shows that all ionizing radioactive exposures can cause harm--cancer and non-cancer health effects. NRC and nuclear waste generators SHOULD have a goal of PREVENTING radioactive releases and exposures, not legalizing and encouraging them.

Dose Limits are Unenforceable

- Dose limits such as 1 millirem/year are not verifiable or enforceable. They are not meaningful units of measure or protection. Further there is no effort to limit the number or practices or waste streams that can give that dose.
- Concentration limits are *theoretically* potentially enforceable but not practically so. The ability to verify release levels is expensive, time consuming and highly exclusive to industry and possibly some well-funded regulatory agencies.
- Creating a generic, across the board category of radioactive waste such as VLLW that does not need radioactive control is a clear, unacceptable shift of liability from the nuclear waste generators to the public.

Dilution or Averaging

- Radioactive wastes could be physically or mathematically averaged to enable hotter, more concentrated wastes to be considered VLLW.

- What is there to prevent higher concentration wastes from being diluted or packaged to VLLW levels, enabling more waste to avoid nuclear controls?

- What provision is there for calculating and observing the totality of the radioactivity released from radioactive control?

Long-lasting waste

If a VLLW category is created as a percentage of the 10 CFR 61.55 concentration tables, every kind of radionuclide is eligible to go to unregulated destinations including

Plutonium 239 half life 24,000 years

Strontium 90 half life 28 years

Cesium 137 half life 30 years

Tritium (H-3) half life 12 years

Uranium-238 half life ~4.5 billion years + decay chain

Uranium-235 half life ~ 700 million years + decay chain

Landfills Leak

- Synergistic health effects from radioactive and hazardous and radioactive and other stressors

- “Although liners and leachate collection systems minimize leakage, liners can fail and leachate collection systems may not collect all the leachate that escapes from a landfill. ... The USEPA has concluded that all landfills eventually will leak into the environment…” (U.S. Environmental Protection Agency, 1988).

10 CFR 20.2002 and 10 CFR 40.13a

Case by Case exemptions from radioactive regulatory controls

Codification of exemption from radioactive regulatory controls

NRC clearly ENCOURAGING REUSE AND RECYCLE

Appears to be the step toward VLLW—Industry requesting "relief" from burdensome 20.2002 analyses

Nuclear Information and Resource Service

For a Nuclear-Free, Carbon-Free World

From: Diane D'Arrigo dianed@nirs.org
Subject: from marlayna doell FW: question on specific language change in guidance for 10 CFR 20.2001+ extension
Date: July 9, 2020 at 2:01 PM
To: taylor.altenbern@gmail.com, danielhirsch558@gmail.com

DD

From: Doell, Marlayna [marlayna.doell@nrc.gov]
Sent: Thursday, July 09, 2020 4:50 PM
To: Diane D'Arrigo; Holahan, Trish; Dembek, Stephen
Cc: Koenick, Stephen
Subject: RE: question on specific language change in guidance for 10 CFR 20.2001+ extension

Hi Diane!

In addition to adding your questions below to our running list of potential implementation items, some quick responses are below:

1. No language has yet been crafted to update NUREG-1736. Should we decide to move forward with the proposed interpretive rule, determining the specifics of this guidance/language will be part of the next phase of the process.

2. The VLLW does remain licensed, although the disposal facility would have an exemption from needing its own license to possess the waste material. The original licensee for the material would continue to be responsible for the safe disposal of the VLLW, under the requirements of Part 20.

3. I will keep an eye out for any comment extension requests, and they will be evaluated based on our normal process.

Hope that helps and that you are having a good week so far.

Cheers,
Marlayna
301.415.3178
605.348.2334 (home)

From: Diane D'Arrigo <dianed@nirs.org>
Sent: Wednesday, July 8, 2020 12:15 PM
To: Doell, Marlayna <marlayna.doell@nrc.gov>; Holahan, Trish <Patricia.Holahan@nrc.gov>; Dembek, Stephen <Stephen.Dembek@nrc.gov>
Subject: [External_Sender] question on specific language change in guidance for 10 CFR 20.2001+ extension

Dear Marlayna, Trish and Steve

Thank you for providing the updated 20.2002 request list and status which was previously requested. Three more questions are arising--

1) I am trying to find the proposed change that would appear in the guidance to effect the proposed reinterpretation of 20.2001

I understand from the Federal Register and the public meetings that there will be no change in the

regulatory [10 CFR] language, but rather a change in NUREG-1736, the guidance for the regulation 20.2001.

Your 4-29-2020 online fact sheet states:

"The proposed change would result in a revision to current guidance documents related to VLLW disposal."

Could you please provide the exact language change you are proposing in the guidance? Apologies if it is right there and i am missing it.

2) Following on to this--if the waste or material stays licensed but goes to an unlicensed (for nuclear) authorized specific exempt landfill, who is the license holder? Or what happens to the license?

3) On another aspect of this--

I have been hearing from people who don't follow NRC closely who are concerned about the solid and hazardous facilities they do track being able to take radioactive waste. Some are just hearing about the proposed change and want to know how to get more time...So this is a heads up to expect another extension request and a question about the time line for this process. Are there a compelling deadlines staff must meet that would prevent NRC from more time to comment?

Thanks so much,

Diane D'Arrigo
Nuclear Information and Resource Service
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202 841 8588