DOE G 435.1-1

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IMPLEMENTATION GUIDE
for use with DOE M 435.1-1

U.S. DEPARTMENT OF ENERGY

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IMPLEMENTATION GUIDE FOR USE WITH DOE M 435.1-1, *RADIOACTIVE WASTE MANAGEMENT MANUAL*

INTRODUCTION

This guide was developed to aid in implementing the requirements of DOE M 435.1-1, *Radioactive Waste Management Manual*. The guide has the same format as the Manual and is divided into four chapters.

Chapter I, *General Requirements and Responsibilities*
Chapter II, *High-Level Waste Requirements*
Chapter III, *Transuranic Waste Requirements*
Chapter IV, *Low-Level Waste Requirements*

The material presented in this guide provides suggestions and acceptable ways of implementing DOE M 435.1-1 and should not be viewed as additional or mandatory requirements. The objective of the guide is to ensure that responsible individuals understand what is necessary and acceptable for implementing the requirements of DOE M 435.1-1. For each requirement in DOE M 435.1-1, the guide provides:

- The objective of the requirement;
- Discussion of the technical, management, and administrative aspects covered by the requirement;
- Principles, practices, and methods for implementing the requirement, including examples;
- Performance measures for evaluating implementation of the requirement; and
- Supplemental references which may be consulted for more detailed information related to the requirement.

The guide aids in understanding what is necessary to attain compliance, facilitates effective and efficient implementation of the requirements, and offers acceptable ways to implement the requirement. As noted, the guide provides suggestions and acceptable ways of implementing the requirements, and is not mandatory. Provisions in the guide should not be construed as requirements. The approaches presented in the guidance are not the only acceptable ways of complying with any given requirement. Alternate methods that satisfy the requirements of DOE O 435.1 and DOE M 435.1-1 also are acceptable. A rationale and basis for the approaches identified in the guide has been provided and no further basis is required to implement the approaches outlined in the guide. Any implementation method selected must ensure an adequate level of safety commensurate with the hazards associated with the work. The implementation method selected must be consistent with the radioactive waste management basis.

Situation-specific attributes and application of the graded approach should always be considered in applying the information contained in this guide. Activities with greater potential consequences or hazards may require more rigor or effort to implement the requirements of DOE M 435.1-1, *Radioactive Waste Management Manual*.

Wherever possible, existing processes, programs, and documentation should be considered as possible routes to complying with the requirements of DOE M 435.1-1. Existing processes and programs generally provide mechanisms for demonstrating compliance and providing auditable records which will also meet the requirements of DOE M 435.1-1. Therefore, it should not be necessary to repeat or recreate programs into which the DOE M 435.1-1 requirements can be integrated.

Chapter I, *General Requirements and Responsibilities*, provides guidance on DOE management responsibilities and requirements that are applicable to the management of all DOE radioactive waste types. Chapter II, *High-Level Waste Requirements*; Chapter III, *Transuranic Waste Requirements*; and Chapter IV, *Low-Level Waste Requirements*, provide guidance on waste-type specific requirements to be used in conjunction with the guidance on General Requirements and Responsibilities.

Other requirements and DOE directives are referenced in DOE M 435.1-1, *Radioactive Waste Management Manual*, because their applicability to radioactive waste management facilities, operations, and activities was identified through a hazards analysis as necessary for protection of workers, the public, or the environment. It is understood and expected that requirements of this Manual may be satisfied by compliance with other requirements.

Paragraph (4) of the Introduction to the *Radioactive Waste Management Manual*, DOE M 435.1-1, states that any of the requirements in the Manual may be waived or modified through application of a DOE-approved requirements tailoring process, such as the "Necessary and Sufficient Closure Process" in DOE P 450.3 and DOE M 450.3-1 and DOE P 450.4, *Safety Management System Policy*, the applicable or relevant and appropriate requirements identification process for actions taken pursuant to the Department's CERCLA authorities, or by an exemption processed in accordance with the requirements of DOE M 251.1-1A, *Directives System Manual*. The series of manuals and implementation guides under DOE P 450.4 contain requirements and guidance for implementing the evaluation processes mentioned above that would allow a waiver or modification to any of the individual DOE M 435.1-1 requirements. Chapter VII of DOE M 251.1-1A provides the requirements, including roles and responsibilities, for exempting a DOE site or facility from any of the DOE M 435.1-1 requirements.

When the exemption process of DOE M 251.1-1A is used, the policies of the integrated Safety Management System must still be followed, and the overall effect of modifications and exemptions to individual requirements should be evaluated and a determination made that they are

not detrimental to the objectives of DOE O 435.1 and DOE M 435.1-1 for the protection of the public, workers, and the environment.

Paragraph (4) of the Introduction to the *Radioactive Waste Management Manual*, DOE M 435.1-1, also states that all DOE entities shall be in compliance with this directive within one year of issuance. Compliance is defined as implementing the requirements or an approved implementation or corrective action plan. If compliance cannot be achieved within one year, the Field Element Manager must request approval from the cognizant Program Secretarial Officer to extend the compliance date to no later than October 1, 2001. The purpose of this requirement is to encourage DOE sites and programs to implement the requirements of the Order and Manual as soon as possible, to ensure that a plan is developed for implementing requirements that will take longer than one year to implement, and to ensure that the cognizant Program Secretarial Officer is aware of those requirements for which compliance cannot be achieved in one year. Field Elements need to evaluate the state of readiness of facilities, operations, and activities under their authority for compliance with the revised radioactive waste management requirements, and invoke a systematic process for achieving full implementation as soon as possible.

Implementation or corrective action plans establish a commitment and strategy for how sites will implement the requirements by October 1, 2001, and should include objectives and milestones, including dates, for implementing the requirements on a site or facility basis.

> *Example 1: A site implementation plan addresses the requirement for Radioactive Waste Management Basis (RWMB) in one of two ways. For facilities with an existing Authorization Basis, the strategy for implementing the RWMB requirement is to review the Authorization Basis to determine whether it sufficiently covers the requirements needed for a RWMB, then issue a blanket RWMB for those facilities. For facilities which do not have an Authorization Basis, implementation of the RWMB will follow implementation of Waste Acceptance Requirements (for facilities receiving waste) and Waste Generator Requirements (for facilities generating waste).*
>
> *Example 2: A site develops an implementation plan for section III.L.(1)(b) "Vents or other mechanisms...." The site has 1,000 drums of transuranic waste in storage. Two hundred drums have been prepared to the Waste Acceptance Criteria for the Waste Isolation Pilot Plant (WIPP WAC) including having filter vents installed. Of the remaining 800 drums which are not vented, 500 drums are stored in air support storage buildings awaiting certification, and 300 drums are retrievably stored in earthen-covered berms. The site prepares an implementation plan for this requirement which summarizes how the remaining 800 drums will meet the requirement based on existing plans for management of this waste. The plan states that the 500 drums in the air support storage buildings are scheduled to be prepared to WIPP WAC during the following two years. Filter vents will be installed during the certification process. The site has plans to begin*

retrieving the bermed waste in five years. Filter vents will be installed on the drums as they are removed from the berms. The implementation plan shows the schedule and notes that although the requirement will be implemented outside of the three year implementation period, the requirement allow for vents to be installed on existing waste in storage as soon as practical (i.e., the next time the waste is actively managed).

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Chapter I

General Responsibilities and Requirements

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I. 1.A. **<u>Delegation of Authority</u>**.

> **Managers charged with responsibilities within this Manual may delegate authority for these tasks to another manager. All delegations of authority shall be documented.**

Objective:

The objective of this requirement is to provide DOE managers with the needed flexibility in managing programs while retaining DOE responsibility and ensuring traceability of authority.

Discussion:

Delegation of authority is authorizing another DOE manager to perform the task for the manager who has been assigned the responsibility in a DOE Directive. The responsibility for ensuring that the task is performed remains with the DOE manager charged with the responsibility in the DOE Directive. Requiring that delegation be to another DOE manager retains the elements of DOE responsibility, accountability, and attention. DOE attention provides a mechanism for assigning resources necessary for successful execution of the task. Requiring documentation ensures the traceability of authority.

The delegation of authority can be made to any DOE manager at any level by the DOE manager charged with the responsibility in DOE M 435.1-1. Any managers who fall in the management chain between the manager who has been assigned the responsibility in DOE M 435.1-1 and the manager who is charged the responsibility for the task have no responsibility for the task themselves but should be notified of the delegation by a copy of the memorandum of record. The delegation of authority can be revoked at any time and delegated to a different DOE manager by the DOE manager charged with the responsibility in DOE M 435.1-1. The manager delegated the authority for a task may further delegate this authority to another manager but must notify the DOE manager charged with the responsibility of this re-delegation, with a copy to other managers, as appropriate for their information. The performance of tasks by other DOE staff or contractors can be assigned by the DOE manager with the authority to perform a task without affecting the delegation of authority. The manager charged with the responsibility in DOE M 435.1-1 needs to ensure the delegation of authority is successful. This can be achieved by periodically discussing the task with the manager to whom the authority was delegated, or requiring a written report from that manager describing how the task is being implemented.

The delegation of authority can be indefinite or for a specific time period, but the selected time period should be clearly identified in the documentation of the delegation of authority. The documentation of the delegation of authority can be accomplished by a memorandum of record which should be maintained as an auditable record. The documentation of the delegation of

authority should clearly describe the authority being delegated; identify any terminating condition(s) or a termination date of the delegation, as appropriate; identify the DOE manager to whom authority is being delegated; contain a mechanism for acknowledgment of receipt; and be managed as an auditable record as long as the delegation is in effect. A delegation of authority that contains these elements should be considered complete and meets the Manual requirement.

> *Example: The Field Element Manager is assigned responsibility in DOE M 435.1-1 for ensuring development of, review, approval, and implementation of closure plans for low-level waste disposal facilities. The Field Element Manager delegates authority for these responsibilities to the DOE Radioactive Waste Manager at the site in a memorandum. The Radioactive Waste Manager does not report directly to the Field Element Manager but is two levels removed in the management chain. The memorandum states that the Radioactive Waste Manager is responsible for ensuring development of, review, approval, and implementation of closure plans for all of the site's low-level waste disposal facilities. The memorandum establishes the effective date as the date that the Radioactive Waste Manager acknowledges receipt of the memorandum and states that this delegation is in effect until revoked by the Field Element Manager. The manager who falls in the management chain between the manager charged with the responsibility and the one who is delegated the authority is copied in the memorandum. The memorandum is identified as a quality assurance record that must be maintained in accordance with the Quality Assurance Program's record keeping requirements.*

Delegations of authority should be reviewed whenever a change in DOE management takes place (e.g., there is a reorganization or a manager leaves). These reviews should evaluate the status of the delegation of authority to establish its continued validity over time or under the changed circumstances.

Compliance with this requirement is demonstrated if all DOE managers who have been delegated authority for DOE M 435.1-1 have documentation that describes the authority being delegated, identifies the time period for the delegation, and contains an acknowledgment of the receipt of the delegation of authority. This documentation must be maintained as an auditable record.

Supplemental References:

1. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

I. 1.B. Use of Guidance.

Additional information supporting the requirements in this Manual is contained in the Implementation Guide for use with DOE M 435.1-1, *Radioactive Waste Management Manual*. This Guide, DOE G 435.1-1, *Implementation Guide for DOE M 435.1-1,* shall be reviewed when implementing the requirements of this Manual. The Guide provides additional information and acceptable methods for meeting the requirements. Other methods may be used but must ensure an adequate level of safety commensurate with the hazards associated with the work and be consistent with the radioactive waste management basis.

Objective:

The objective of this requirement is to ensure that individuals responsible for DOE radioactive waste management operations, facilities, and activities understand what is necessary and acceptable for implementing the requirements of DOE O 435.1, *Radioactive Waste Management*, and DOE M 435.1-1, *Radioactive Waste Management Manual*. By understanding the objective of these requirements, individuals responsible for managing radioactive waste should be able to take the appropriate action even in situations not previously discussed in the requirements.

Discussion:

The *Implementation Guide for DOE M 435.1-1*, DOE G 435.1-1, serves as a tool to assist personnel in gaining a comprehensive understanding of how to implement DOE O 435.1 and DOE M 435.1-1 requirements. Guidance for each requirement discusses the technical, management, and administrative aspects of the requirement and identifies acceptable principles, practices, and methods for implementing the requirement. Performance measures for evaluating acceptable implementation of each requirement are also presented. The guidance also includes examples to help illustrate concepts being discussed. These examples are based on hypothetical situations and should not be used as the basis for adapting specific technical standards. Users need to evaluate real situations to identify the hazards which need to be managed and establish the appropriate technical standards. The guide, in many cases, also provides a list of supplemental references that may benefit the individuals responsible for implementing DOE O 435.1 and DOE M 435.1-1. The referenced documents may, in some instances, be regularly updated. Users are responsible for ensuring that the most current versions of these documents are available to affected workers and are referenced as appropriate.

Although the requirements in DOE M 435.1-1 were prepared to be as clear and concise as possible, they may be interpreted differently among users. The guidance provides contextual information and explanation to aid users in understanding the purpose and intent of the requirements. Reviewing the guidance can facilitate use of more consistent approaches to

implementing the requirements throughout the complex and prevent over or under-interpretation of the requirements. The information is intended to facilitate understanding of intent, scope of application, graded application, degree of effort, and, if possible, measurable standards.

The guide also serves as the mechanism for further elaboration and emphasis on concepts which are important to consider in the implementation of requirements, and describes acceptable ways of implementing the requirements. The guidance describes situation-specific considerations and application of the graded approach and necessary and sufficient processes, which can be considered in applying the requirements. In addition, many requirements of DOE M 435.1-1 can be met with existing processes, programs, and documentation.

Although DOE M 435.1-1 stipulates that the guidance must be reviewed, this does not mean that all personnel are responsible for reviewing all guidance. The intent of the requirement is that personnel responsible for performing particular work processes are accountable for correctly understanding and interpreting the DOE M 435.1-1 requirements that apply to the work they perform. For example, those personnel who are responsible for translating specific DOE M 435.1-1 requirements into controlling documents and operating procedures at the sites should understand how to effectively and efficiently implement them.

> *Example: Site Z has constructed a new facility for storing transuranic waste. Facility personnel responsible for preparing the waste acceptance criteria read DOE O 435.1 and DOE M 435.1-1 to identify relevant requirements. Based on their review, they determine that they need to review the General Requirements and Responsibilities guidance for Radioactive Waste Management Basis, Radioactive Waste Acceptance Requirements, Radioactive Waste Generator Requirements, Training and Qualification, Storage, and Waste Declassification. They also read guidance corresponding the Transuranic Waste Requirement for Definition of Transuranic Waste, Management of Specific Wastes, Radioactive Waste Management Basis, Contingency Actions, Waste Acceptance, Waste Certification, Waste Transfer, Packaging and Transportation, and Storage. The review reminds the storage facility personnel of other sources of information which need to be considered in developing the waste acceptance criteria, including the safety analysis, the Waste Acceptance Criteria for the Waste Isolation Pilot Plant, and the DOE directives addressing safeguards and securities, records management, and the Safety Management System. Equipped with all of these resources, waste acceptance criteria that provide for safe receipt and storage of transuranic waste are developed.*

The guide aids in understanding what is necessary to attain compliance, facilitates effective and efficient implementation of the requirements, and offers acceptable ways to implement the requirement. Guidance documents, including technical standards, can assist in implementing requirements. This guide is intending to provide useful information and methodologies on how a

requirement might be implemented. The guidance includes background information regarding the intent of the requirement and its technical underpinnings.

Unlike the requirements specifically set forth in a rule or Order, the provisions in guidance documents are not mandatory. Failure to follow a guidance document does not in itself indicate noncompliance with a specific requirement – a finding of noncompliance must be based on a failure to satisfy the requirement. The guidance provided in implementation guides and standards referenced therein are considered acceptable methods to satisfy requirements. The approaches presented in the guidance are not the only acceptable ways of complying with any given requirement. Alternative methods that satisfy the requirements of DOE O 435.1 and DOE M 435.1-1, are also acceptable. Any implementation method selected must ensure that an adequate level of safety commensurate with the identified hazards associated with work is achieved and be consistent with the radioactive waste management basis. Generally it is expected that site documents (e.g., program plans, procedures, waste acceptance criteria) will provide documentation showing that a requirement is being met consistent with the guidance. However, personnel can employ alternative methods that may be more appropriate for specific situations.

To the extent that a unique or different approach other than that addressed in the guidance does not otherwise have a documented rationale or basis, it will be necessary to create one. Documentation should identify the alternative method and should include a technically defensible reason for using the alternative approach. The Integrated Safety Management standards identification processes already have safeguards to address the adequacy of standards and these should be the processes used for making and documenting any such decisions.

Compliance with this requirement is demonstrated by key individuals being familiar with the intent of DOE M 435.1-1 requirements based on their review of the guidance, and sites meeting DOE M 435.1-1 requirements by establishing processes described in the guidance. Sites meeting DOE M 435.1-1 requirements in a way different than described in the guidance will be able to demonstrate that an adequate level of safety commensurate with the hazards associated with the work is being maintained, that the method is consistent with the radioactive waste management basis, and if necessary, documentation of the rationale for the alternative approach.

Supplemental References:

1. DOE, 1998. *Directives System* and *Directives System Manual*, DOE O 251.1A and DOE M 251.1-1A, U.S. Department of Energy, January 30, 1998.

2. DOE, 1995. *Performance Indicators and Analysis of Operations Information*, DOE O 210.1, U.S. Department of Energy, Washington, D.C., September 27, 1995.

3. DOE, 1995. *Environment, Safety, and Health Policy for the Department of Energy Complex*, DOE P 450.1, U.S. Department of Energy, Washington, D.C., June 15, 1995.

4. DOE, 1996. *Identifying, Implementing and Complying with ES&H Requirements*, DOE P 450.2A, U.S. Department of Energy, Washington, D.C., May 15, 1996.

I. 1.C. Radioactive Waste Management.

All radioactive waste subject to DOE O 435.1, *Radioactive Waste Management*, and the requirements of this Manual shall be managed as high-level waste, transuranic waste, low-level waste, or mixed low-level waste.

Objective:

The objective of this requirement is to ensure that all DOE radioactive waste is managed as one of the established waste types, and to eliminate the creation of other waste categories or the management of radioactive waste outside of the requirements established in DOE M 435.1-1. It is also the objective of this requirement to ensure that the radioactive waste is managed safely and effectively within the established programs for high-level waste, transuranic waste, low-level waste, or mixed low-level waste.

Discussion:

The DOE system for management of radioactive waste has evolved over the last several years into four complex-wide program areas. The first three correspond to the radioactive waste types identified in DOE O 435.1: high-level waste, transuranic waste, and low-level waste. The fourth program, for management of mixed low-level waste, evolved separately from the low-level waste management program due to the hazardous portion of the waste also being subject to the *Resource Conservation and Recovery Act* (RCRA). Mixed low-level waste, being a subset of low-level waste, must be managed in accordance with the low-level waste requirements of DOE M 435.1-1 and the applicable requirements of RCRA.

The evolution of the management of high-level waste and transuranic waste, based on the driving statutes for their management, has not resulted in separate programs for mixed high-level or mixed transuranic waste. Rather, the programs for those waste types address the combined programmatic planning aspects of storage, treatment, and disposal of mixed and non-mixed waste varieties of those waste types.

Management of wastes containing radioactivity that do not meet the definitions of the radioactive waste types in DOE O 435.1 and DOE M 435.1-1 (i.e., 11e.[2] byproduct material, residual radioactive material as defined in the *Uranium Mill Tailings Radiation Control Act* [UMTRCA], or naturally occurring radioactive material [NORM]) should continue to be managed under the provisions of the UMTRCA, 40 CFR Part 192, or DOE 5400.5, *Radiation Protection of the Public and the Environment*, as applicable. However, DOE M 435.1-1 allows for small quantities of these wastes to be managed in accordance with Chapter IV, Low-Level Waste Requirements (see the Guidance on DOE M 435.1-1, Section IV.B). Waste in quantities too large for acceptance at DOE low-level waste disposal sites shall be managed according to the requirements

of 40 CFR Part 192, and disposed of at specially designated DOE sites or tailing disposal sites established under the *Uranium Mill Tailings Radiation Control Act of 1978*.

During the development of the requirements in DOE M 435.1-1, a safety and hazards analysis was performed to identify operational activities which presented potential hazards that needed to be mitigated. The analysis was conducted on the waste types that have been established through federal legislation and regulation, i.e., high-level, transuranic, low-level, and mixed low-level waste. In order to ensure that the public, workers, and the environment are protected in the course of radioactive waste management, any waste managed by the Department, pursuant to DOE M 435.1-1, must be identified as one of these waste types and managed within the appropriate program. For many years some sites have identified as special case waste that would otherwise meet the definition of high-level, transuranic, or low-level waste. This term was initially used for any waste that did not have a disposition path and evolved to encompass waste which needed special attention. This requirement is intended to preclude the categorization of a radioactive waste as a special-case waste or something other than high-level, transuranic, low-level, or mixed low-level waste, and avoid potential problems associated with the waste not being recognized by and managed within one of the existing waste type programs discussed above. Table I-1.C provides examples of different waste streams and how they could be categorized by waste type and by waste management program.

Table I-1.C. Examples of Waste Type and Program Identification

Previous Designation or Description of Waste	***DOE O 435.1 Designation***	***Management Program***
DOE Equivalent to GTCC	Low-Level Waste	LLW or MLLW
Surplus Sealed Sources with No Potential Reuse	Low-Level Waste or Transuranic Waste	LLW or TRU
Special Performance Assessment Required (SPAR)	Low-Level Waste or Transuranic Waste	LLW, MLLW, or TRU
Waste Samples from Control Runs of DWPF	High-Level Waste or	HLW
	Waste Incidental to Reprocessing if determined to be so	LLW, MLLW, or TRU

Example: A site with a low-level waste disposal facility has waste that has been accumulating in storage over the last 20 years. The waste is contaminated with less than 100 nCi/g (3700 Bq/g) of transuranic radionuclides so it does not meet the definition of

transuranic waste. Even though the transuranic radionuclide concentration is less than 100 nCi/g (3700 Bq/g), the low-level waste disposal facility performance assessment does not project that the waste can be disposed with a reasonable expectation of meeting the disposal performance measures. Rather than categorize the waste as a special case, performance assessment-limited waste, the site correctly categorizes the waste as a low-level waste and includes it as such in the site radioactive waste management program. Since it is included as a low-level waste and there is not an identified path to disposal, plans will be developed for resolving conditions which prevent its disposal, and its existence will be reported to Headquarters for consideration in complex-wide planning.

This requirement mandating the management of all radioactive wastes as one of the waste types is not intended to force a presumption about the hazards of managing a waste, nor to automatically define the management steps to be followed based on the categorization of a radioactive waste. Instead, it is intended to promote safe management and timely disposal by ensuring that all wastes subject to DOE O 435.1, including legacy waste and various wastes traditionally called special case wastes, are managed within one of the four existing waste programs. The hazards associated with the waste should still be the most important factor in determining the appropriate management steps for the waste. Therefore, it would be appropriate, for example, to manage all remote-handled waste in one location, even if some of it has been categorized as transuranic waste and some as low-level waste, as long as the waste containers are distinctly marked and segregated, if necessary to deter cross-contamination.

Example 1: The Defense Waste Processing Facility has a piece of failed equipment that is contaminated as a result of high-level waste operations. Site personnel characterize the failed equipment to determine the radioactive species and inventories. By applying the "waste incidental to reprocessing" process described in DOE M 435.1-1, Chapter II, High-Level Waste Requirements, site personnel determine that the failed equipment is low-level waste because it meets the evaluation criteria of Section II.B and can be disposed of in the onsite low-level waste disposal facility.

Example 2: A site has a waste known to be contaminated with transuranic radionuclides that has been accumulating in storage over the last 20 years. Because a method for disposing of the waste has not been determined, the waste has been called a special case waste. Site management determines that the waste meets the definition of transuranic waste. This categorization does not mean that the waste will necessarily be disposed of at WIPP. However, it establishes the program in which the waste will be managed and also the Manual requirements for managing the waste. Site management must ensure that the waste is appropriately managed as a transuranic waste, considering the hazards of managing it, and managed to achieve disposal in an appropriate waste disposal facility.

If a legacy waste is not characterized and the waste type is not known, then the organization responsible for the waste should:

- decide the program under which the waste should be managed;
- identify whether there is a path forward for disposition of the waste;
- delineate any issues associated with further management steps, including whether it requires further characterization;
- provide plans for accomplishing the steps needed to achieve disposal; and
- include this information in the documentation of the Site-Wide Radioactive Waste Management Program.

Example: A piece of equipment remaining from certain processes no longer conducted at the site is in storage at Building 400. The equipment has been declared waste, but is not fully characterized. It has lead shielding which is known to be contaminated, and based on the processes it was used for, is called mixed low-level waste. It is included in the FY 1999 Site-Wide Radioactive Waste Management Program documentation as mixed low-level waste without a path forward for disposal, and management steps are described to fully characterize the equipment to confirm the waste type designation and to begin an options analysis for treatment and disposal. (Note: Documentation in this case is the information in the update to the Site's FFCA Treatment Plan.)

Figure 1 provides a logic diagram to assist in determining the proper waste type and the appropriate program for managing wastes. Guidance for each waste type chapter should also be consulted for more detailed information about characterization of specific wastes or waste streams. As noted above, any waste managed by the Department, pursuant to DOE M 435.1-1, must be identified as high-level, transuranic, low-level, or mixed low-level waste, and managed within the appropriate program. For many years some sites have identified as special case waste that would otherwise meet the definition of high-level, transuranic, or low-level waste. This term was initially used for any waste that did not have a disposition path and evolved to encompass waste which needed special attention. Special case waste designations should not be used, nor should separate systems and/or management programs be established outside the existing radioactive waste programs.

The Assistant Secretary for Environmental Management is responsible for developing and maintaining complex-wide programs for managing the three radioactive waste types (DOE M 435.1-1, Section I.2.B.(1)). Guidance on that requirement discusses the important elements to be included in a waste type management program. The guidance also explains how

this responsibility can be met through the existing four waste type specific programs. Specific guidance for the mixed low-level waste management program, which supplements the guidance on General Requirements, is provided in the guidance for a complex-wide low-level waste program, DOE M 435.1-1, Section IV.C.

Compliance with this requirement is met by demonstrating that all radioactive wastes are correctly categorized as high-level waste, transuranic waste, low-level waste, or mixed low-level waste, and that all waste and waste streams are managed under one of the four existing waste type specific management programs. For waste that is not adequately characterized, the Site-Wide Radioactive Waste Management Program documentation should detail the plans for management of this waste under one of the four programs and should include a step for confirming the waste type categorization.

Supplemental References:

1. *Resource Conservation and Recovery Act of 1976,* as amended, October 21, 1986.

2. NRC, 1969. "Proposed Rule Making, 10 CFR Part 50 Licensing of Production and Utilization Facilities," *Federal Register*, Vol. 34, No. 8712, U.S. Nuclear Regulatory Commission, Washington, D.C., June 3, 1969.

3. *Nuclear Waste Policy Act of 1982,* as amended, January 7, 1983.

4. *Low-Level Radioactive Waste Policy Amendments Act of 1985,* as amended, January 15, 1986.

5. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992,* as amended, October 30, 1992.

6. EPA. *Identification and Listing of Hazardous Waste*, 40 CFR Part 261, U.S. Environmental Protection Agency, Washington, D.C.

7. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

8. *Uranium Mill Tailings Radiation Control Act*, as amended, 42 U.S.C. 7901 et seq., 1978.

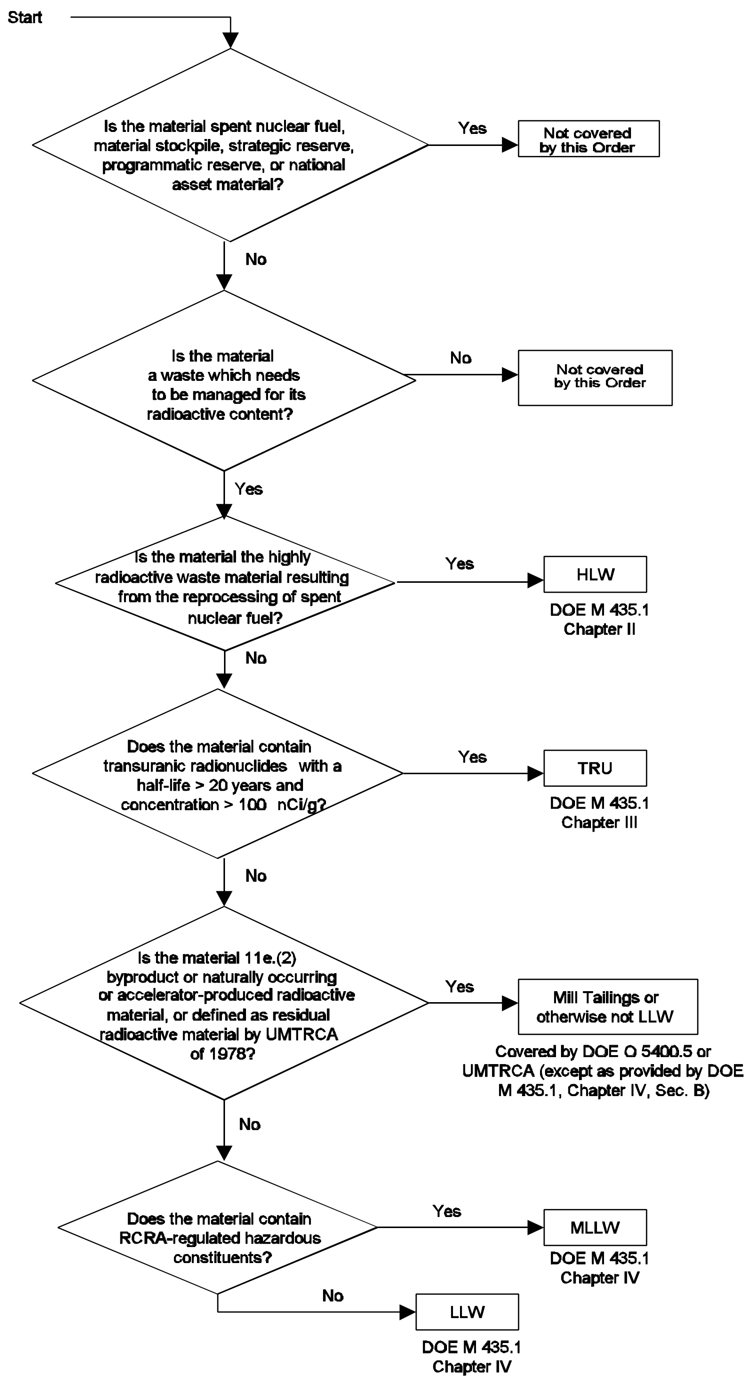

Figure 1 Logic Diagram for Waste-Type/Program

I. 1.D. Analysis of Environmental Impacts.

> **Existing and proposed radioactive waste management facilities, operations, and activities shall meet the requirements of 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures*; and DOE O 451.1A, *National Environmental Policy Act Compliance Program*. All reasonable alternatives shall be considered, as appropriate. Nothing in this Order is meant to restrict consideration of alternatives to proposed actions.**

Objective:

The objective of this requirement is to ensure the protection of the public, workers, and the environment in the management of radioactive waste, and in particular, compliance with the requirements of the *National Environmental Policy Act*.

Discussion:

The safety and hazards analysis indicated that comprehensive evaluation and documentation of alternatives to radioactive waste management operations and activities was one way of ensuring that risks associated with the management of radioactive waste were understood, and avoided if possible. Additionally, compliance with the requirements of the *National Environmental Policy Act* (NEPA) is required for all Departmental actions. The requirements analysis concluded that the current set of requirements invoked by 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures*, and DOE O 451.1A, *National Environmental Policy Act Compliance Program*, adequately addressed the controls which were needed to effect such a program.

Under 10 CFR Part 1021, the Department adopts in full the regulations for implementing the *National Environmental Policy Act* published by the Council on Environmental Quality (CEQ) at 40 CFR Parts 1500 through 1508. 10 CFR Part 1021 lays out the procedures DOE decision making must follow and the general requirements for implementing the CEQ requirements for Department of Energy projects. In accordance with these requirements, the Department must review all actions to determine the significance of potential environmental impacts and, as appropriate, prepare environmental assessments and environmental impact statements; prepare, analyze, and consider alternatives; and provide for public participation in the Department's decision making processes.

DOE's Office of Environment, Safety, and Health (EH) has published extensive guidance on implementation of CEQ regulations and performing required NEPA analysis for DOE projects in a two volume set entitled, *National Environmental Policy Act Compliance Guide*. This guidance contains all the relevant sections of laws, and all Executive Orders, DOE policies, and policies from other governmental agencies that need to be considered in complying with NEPA

requirements for DOE projects, including those involving radioactive waste management facilities, operations, and activities. No additional guidance on complying with NEPA requirements or to evaluate radioactive waste management facilities, operations, and activities is needed.

Supplemental References:

1. DOE. *National Environmental Policy Act Implementing Procedures*, 10 CFR Part 1021, U.S. Department of Energy, Washington, D.C.

2. CEQ. *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*, 40 CFR Parts 1500-1508, Council on Environmental Quality, Executive Office of the President, Washington, D.C.

3. DOE, 1998. *National Environmental Policy Act Compliance Guide*, Volumes I and II, U.S. Department of Energy, Washington, D.C., August 1998.

I. 1.E. Requirements of Other Regulations and DOE Directives.

> **The following requirements and DOE directives are required for all DOE radioactive waste management facilities, operations, and activities as applicable. Any of the requirements for the following Departmental directives may be waived or modified through application of a DOE-approved requirements tailoring process, such as the "Necessary and Sufficient Closure Process" in DOE P 450.3 and DOE M 450.3-1 and DOE P 450.4, *Safety Management System Policy*, or by an exemption processed in accordance with the requirements of that directive or DOE M 251.1-1A, *Directives System Manual*.**

Objective:

The objective of this requirement is to ensure the protection of the public, workers, and the environment in the management of radioactive waste through the implementation of controls required in other regulations and DOE Directives.

Discussion:

The safety and hazards analysis conducted during development of DOE O 435.1 and DOE M 435.1-1 was a comprehensive analysis which evaluated all functions of radioactive waste management from generation to post-closure of disposal facilities, and which considered potential impacts on the public, workers, and the environment. The analysis identified numerous weaknesses and conditions requiring controls that are addressed in other existing DOE directives or Federal regulations. During the requirements analysis, these directives and regulations were evaluated to determine if they adequately address the weaknesses and conditions identified in the safety and hazards analysis. It was determined that many of the directives and regulations include all of the controls necessary. Rather than repeating or paraphrasing existing requirements within DOE O 435.1 and DOE M 435.1-1, the current requirement invokes the controls of those directives and regulations in order to provide full regulation of the activities undertaken in the management of radioactive waste.

In the case of a few of the directives and regulations evaluated, certain controls were considered too generic to adequately address the specific needs in management of radioactive waste, but most of the controls were found to be adequate. Also, in the case of a few of the directives and regulations, emphasis on certain important requirements in them was considered necessary to ensure adequate protection of the public, workers, and the environment. In both of these cases, the current requirement invokes the controls of the existing directive or regulation, and additional requirements are added in DOE M 435.1-1. The need for additional controls is included in the guidance discussions addressing each of the existing directives or regulations which has been invoked.

The safety and hazard analysis conducted in support of the DOE O 435.1 and DOE M 435.1-1 requirements was conducted using generalized assumptions and generic facilities. It is recognized that this may have resulted in the directives list in this Section containing one or more directives that do not apply to certain facilities. This list is not meant to force a facility to comply with those directives, rather, the facility should continue to comply with only the applicable directives.

> *Example: Facility A is not a nuclear facility or activity. Therefore, the requirements of DOE O 420.1 and other nuclear safety orders are not being followed at Facility A. No additional requirements are invoked to replace these requirements, nor is there any implication that a provision of DOE M 435.1-1 is being violated.*

It is expected that the responsibilities which are assigned in these directives and regulations will be adhered to, as well as the requirements for processing exemptions and other administrative requirements. It is also expected that any implementation guidance which already exists for the other directives or regulations will be followed. The guidance discussions that follow include specific implementation guidance for radioactive waste management facilities which augments whatever implementation guidance already exists.

Waivers, Modifications, and Exemptions. Because the comprehensive safety and hazards analysis is the basis for inclusion of the controls of the other existing DOE directives and regulations in DOE M 435.1-1, the controls should be met to ensure the public, workers, and the environment are protected. However, since the safety and hazards analysis was conducted using generic scenarios for radioactive waste management, it is recognized that facility-specific requirements may be different. There are structured processes through which the requirements of DOE directives invoked in this section of DOE M 435.1-1 may be determined to be unnecessary or satisfied through application of some other requirement. See DOE P 450.3 and DOE M 450.3-1 on Necessary and Sufficient Closure Process. Also, an exemption may be requested and granted for DOE requirements which can be demonstrated to be unnecessary for protection of the public, workers, or the environment. Consistent with the guidance implementing the *Safety Management System Policy*, DOE P 450.4, this requirement does not allow exemptions from regulations or other requirements which are mandated by law. Regulatory relief from these regulations and requirements must be obtained by the contractor. See DOE M 450.3-1 and 48 CFR 970.5204-7(8).

The process that is used to justify a requirement as unnecessary or adequately addressed (e.g., "Necessary and Sufficient Closure Process" in DOE P 450.3 and DOE M 450.3-1 and DOE P 450.4, *Safety Management System Policy*) should be documented in accordance with the requirements and guidance of that process. If an exemption is used to demonstrate a requirement does not need to be met, the exemption should be documented in accordance with the process and requirements in the directive from which an exemption is being requested. If the subject directive does not have requirements for exemptions, then the requirements for exemptions in DOE M

251.1-1A, *Directives System Manual*, should be followed. Additionally, the documentation should be managed as an auditable record as long as the requirement is considered unnecessary or an exemption is in effect. Documentation that identifies a requirement as being unnecessary or adequately addressed, through the use of an accepted process and which meets the requirements of that process, should be considered complete and in compliance with the DOE M 435.1-1 requirement.

Each of the regulations and DOE directives invoked by the current requirement is identified below, and a discussion follows that includes information on why the regulation or directive is specifically identified in DOE M 435.1-1. Also, where needed, information on implementing the regulation or directive at DOE radioactive waste management facilities, operations, and activities is included, as well as references to other guidance sections that discuss the implementation of requirements in these regulations or directives.

I. 1.E.(1) Analysis of Operations Information. Data that measure the environment, safety, and health performance of radioactive waste management facilities, operations, and activities shall be identified, collected, and analyzed as required by DOE O 210.1, *Performance Indicators and Analysis of Operations Information*.

Discussion:

The functional and requirements analyses conducted in development of DOE O 435.1 and DOE M 435.1-1 concluded that an effective system for identification, monitoring, and analysis of important data and measurements of environment, safety, and health performance was an effective measure for identifying potential issues before they begin to propagate throughout the system or begin to present themselves at other facilities in the complex. The Complex-Wide and Site-Wide Radioactive Waste Management Programs required by DOE M 435.1-1 should include such a feedback mechanism as part of the evaluation process.

The requirements analysis indicated that the programs in compliance with DOE O 210.1, *Performance Indicators and Analysis of Operations Information*, were sufficient for effecting this type of program for radioactive waste management. The program should track and analyze appropriate measures of radioactive waste management performance in order to identify potential problems requiring technical or management attention before the safety of workers, the public, or the environment, is threatened. More guidance on an effective feedback mechanism for radioactive waste management programs can be found in guidance on DOE M 435.1-1, Sections I.2.B.(1) and I.2.F.(1). The Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 98-1, *Department of Energy Plan to Address and Resolve Safety Issues Identified by Internal Independent Oversight*, March 10, 1999, contains additional guidance for feedback and tracking systems.

I. 1.E.(2) **Classified Waste. 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*.**

Discussion:

During the safety and hazards analysis, no significant risks were identified concerning the management of DOE classified waste. However, the requirements analysis did conclude that any classified radioactive waste should continue to be managed appropriately, and if this meant that its classified status must be maintained, then the current requirements invoked by the Department for protecting and controlling classified materials were sufficient.

On the other hand, the requirements analysis also concluded that, if possible, the management of waste as classified should be continued only if necessary. Therefore, DOE M 435.1-1 contains a requirement to declassify or render suitable for unclassified radioactive waste management to the extent practical (DOE M 435.1-1, Section I.2.F.(17)) so it can be managed efficiently with other like wastes, which would help ensure consistency of controls and probably be less expensive. Guidance is provided on DOE M 435.1-1, Section I.2.F.(17) for making as much radioactive waste as practical suitable for unclassified management, thereby minimizing the amount that must continue to be managed as classified waste.

I. 1.E.(3) **Conduct of Operations. Radioactive waste management facilities, operations, and activities shall be conducted in a manner based on consideration of the associated hazards. Waste management facilities, operations, and activities shall meet the requirements of DOE 5480.19, *Conduct of Operations Requirement for DOE Facilities*.**

Discussion:

The safety and hazard analysis indicated that many weaknesses and conditions which could lead to potential radiation exposures and environmental contamination could be prevented through effective analysis of functions being conducted in management of waste and establishment of procedures to control the activities that would lead to the desired results. These types of required controls are already implemented by compliance with DOE 5480.19, *Conduct of Operations Requirement for DOE Facilities*, and this requirement serves to emphasize the continued importance of effective conduct of operations as a protective measure, especially in light of some of the complex activities that are needed in radioactive waste management. No additional guidance is provided here for implementing these requirements for radioactive waste management facilities, operations, or activities.

I. 1.E.(4) Criticality Safety. Radioactive waste management facilities, operations, and activities shall be covered by a criticality safety program in accordance with DOE O 420.1, *Facility Safety*.

Discussion:

The safety and hazard analysis identified that situations which could lead to criticality were a particularly high-risk aspect of radioactive waste management because the consequences of a rare event of this type could be catastrophic. The Department already requires a criticality safety program in compliance with DOE O 420.1, *Facility Safety*. This DOE M 435.1-1 requirement serves to emphasize that a criticality program in accordance with DOE O 420.1 must be in place for radioactive waste management facilities, operations, and activities for which criticality is an important consideration. No additional guidance is provided here for implementing these requirements for radioactive waste management facilities, operations, or activities.

I. 1.E.(5) Emergency Management Program. Radioactive waste management facilities, operations, and activities shall maintain an emergency management program in accordance with DOE O 151.1, *Comprehensive Emergency Management System.*

Discussion:

The safety and hazards analysis identified that an emergency management program which institutes precautions against potential situations which could lead to worker and public radiation exposures, and which can effectively respond to emergencies is a mitigating measure that should be in place for all radioactive waste management facilities, operations, and activities. The requirements analysis indicated that the programs required to be in compliance with DOE O 151.1, *Comprehensive Emergency Management System*, would be sufficient.

The safety and hazard analysis also revealed a few weaknesses and conditions concerning radioactive waste management that required special emphasis due to the consequences of accidents involving liquid radioactive waste. Therefore, additional requirements for contingency actions for radioactive waste management facilities, operations, and activities are found in each of the waste type chapters, and implementation guidance on the requirements (DOE M 435.1-1, Sections II.H, III.E, and IV.E) should be consulted for discussions on meeting those requirements by incorporating actions into the existing emergency response programs of DOE O 151.1.

I. 1.E.(6) Environmental and Occurrence Reporting. Radioactive waste management facilities, operations, and activities shall meet the reporting requirements of DOE O 231.1, *Environment, Safety and*

***Health Reporting*, and DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*.**

Discussion:

The functional and requirements analyses conducted in development of DOE O 435.1 and DOE M 435.1-1 concluded that a system for monitoring and reporting important environmental data and occurrences of certain actions or off normal events was an effective measure for mitigating radioactive waste management problems. Reporting is especially important for identifying potential issues before they propagate through the system or for identifying problems and issues before they present themselves at other facilities in the complex. The requirements analysis indicated that the programs already in place in compliance with DOE O 231.1, *Environment, Safety, and Health Reporting*, and DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*, were sufficient for effecting this type of program for radioactive waste management.

The Complex-Wide and Site-Wide Radioactive Waste Management Programs should incorporate these feedback mechanism as part of the evaluation process. More guidance on effective feedback mechanisms for radioactive waste management programs can be found in guidance on DOE M 435.1-1, Sections I.2.B.(1) and I.2.F.(1).

I. 1.E.(7) Environmental Monitoring. Radioactive waste management facilities, operations, and activities shall meet the environmental monitoring requirements of DOE 5400.1, *General Environmental Protection Program*, and DOE 5400.5, *Radiation Protection of the Public and Environment*.

Discussion:

The safety and hazard analysis identified that monitoring for releases of radiation and radioactive material to the environment was an especially important mitigating factor for potential weaknesses and conditions in radioactive waste management. The requirements analysis concluded that the environmental monitoring programs and plans, as required by DOE 5400.1, *General Environmental Protection Program;* and DOE 5400.5, *Radiation Protection of the Public and Environment*, implemented monitoring that would address the kinds of concerns evaluated in the analysis.

However, monitoring of disposed radioactive waste, because it must remain effective for a long time period following cessation of operations, presents a unique challenge. Additional monitoring of low-level waste disposal facilities is addressed in DOE M 435.1-1, Section IV.R. Implementation guidance for those requirements should be consulted for information on

incorporating additional low-level waste disposal facility performance monitoring into the environmental monitoring program and plans already required to be in compliance with the subject DOE Orders on environmental monitoring.

I. 1.E.(8) Hazard Analysis Documentation and Authorization Basis. Radioactive waste management facilities, operations, and activities shall implement DOE Standards, DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23, Nuclear Safety Analysis Reports,* and/or DOE-EM-STD-5502-94, *DOE Limited Standard: Hazard Baseline Documentation,* and shall, as applicable, prepare and maintain hazard analysis documentation and an authorization basis as required by DOE O 425.1A, *Startup and Restart of Nuclear Facilities*, DOE 5480.21, *Unreviewed Safety Questions*, DOE 5480.22, *Technical Safety Requirements*, and DOE 5480.23, *Nuclear Safety Analysis Reports*.

Discussion:

The safety and hazard analysis that was conducted in development of DOE O 435.1 and DOE M 435.1-1 considered a generic or composite facility, operation, or activity in determining the risks associated with management of radioactive waste. During the analysis, it was recognized that for an actual facility, operation, or activity, the real risks posed could be different than those used in development of the set of requirements in the Manual. This requirement was included to ensure that, where appropriate, hazard analysis and documentation was prepared for actual facilities in accordance with the established DOE directives covered, so that if any more severe risks did exist with any radioactive waste management facilities, operations, or activities, then appropriate controls would be developed to mitigate them. Guidance that discusses the authorization basis that may be developed in implementing DOE O 425.1A, *Startup and Restart of Nuclear Facilities*, DOE 5480.21, *Unreviewed Safety Questions*, DOE 5480.22, *Technical Safety Requirements*, and DOE 5480.23, *Nuclear Safety Analysis Reports*, appears in discussions of the radioactive waste management basis requirement, DOE M 435.1-1, Section I.2.F.(2).

Supporting the implementation of the DOE Orders are two DOE Standards: DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, and DOE-EM-STD-5502-94, *DOE Limited Standard: Hazard Baseline Documentation*. The first Standard establishes guidance for the preparation and review of hazard categorization and accident analyses techniques as required in DOE 5480.23 and therefore, applies only to nuclear facilities, i.e., Hazard Category facilities/operations 1, 2, and 3. The second is a DOE-EM Limited Standard that establishes uniform Office of Environmental Management guidance on hazard baseline documents that identify and control radiological and

non-radiological hazards for all Office of Environmental Management facilities including nuclear, radiological, non-nuclear, and industrial.

Supplemental References:

1. DOE, 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports,* DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C., December 1992.

2. DOE, 1994. *DOE Limited Standard: Hazard Baseline Documentation*, DOE-EM-STD-5502-94, U.S. Department of Energy, Washington, D.C., August 1994.

I. 1.E.(9) Life-Cycle Asset Management. Planning, acquisition, operation, maintenance, and disposition of radioactive waste management facilities shall be in accordance with DOE O 430.1A, *Life-Cycle Asset Management*, and DOE 4330.4B, *Maintenance Management Program*, including a configuration management process to ensure the integrity of physical assets and systems. Corporate physical asset databases shall be maintained as complete, current inventories of physical assets and systems to allow reliable analysis of existing and potential hazards to the public and workers.

Discussion:

The hazards analysis and requirements analysis conducted in development of DOE O 435.1 and DOE M 435.1-1 indicated that effective planning throughout the entire life of a facility or process, coupled with a maintenance program to maintain facilities and systems in proper working order, and configuration management to orderly track changes and decisions made in the life of a facility or operation, were effective ways to avoid problems in management of radioactive waste. DOE O 430.1A, *Life-Cycle Asset Management*, provides for the kind of planning and configuration management envisioned by the development process, and is cited in this requirement for emphasis. Likewise, the maintenance process required by DOE 4330.4B, *Maintenance Management Program*, would achieve adequate maintenance for radioactive waste management facilities, operations, and activities, and is also cited for emphasis. The guidance for the following requirements should be consulted for incorporation of aspects of implementation of the process and programs required by these Orders into radioactive waste management facilities, operations, and activities: DOE M 435.1-1, Section II.P.(2); Section III. M.(2); and Section IV.M.(2).

However, both the safety and hazards and the requirements analyses indicated that some of the specific weaknesses and conditions which could be experienced with management of radioactive

waste are not covered by the planning required by DOE O 430.1A, *Life-Cycle Asset Management*. Specific weaknesses identified that were not adequately addressed by DOE O 430.1A requirements dealt with planning and facility closure when waste streams requiring additional management or which had no path to disposal were involved. An emphasis on life-cycle planning for cradle-to-grave management of waste streams from facilities, operations, and activities was thought to cover these weaknesses and conditions that need controlling in the management of radioactive waste. Therefore, the concept of life-cycle planning for waste streams is introduced in DOE O 435.1 and DOE M 435.1-1. The incorporation of life-cycle planning for radioactive waste is discussed in guidance for the Complex-Wide and Site-Wide Radioactive Waste Management Programs (DOE M 435.1-1, Sections I.2.B.(1) and I.2.F.(1)), and the Radioactive Waste Generator Requirements (DOE M 435.1-1, Section I.2.F.(7)).

I. 1.E.(10) Mixed Waste. Radioactive waste that contains both source, special nuclear, or by-product material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component is also subject to the *Resource Conservation and Recovery Act* (RCRA), as amended.

Discussion:

The potential additional risks posed by mixed radioactive waste due to the hazardous constituents involved, and the complexities of managing mixed radioactive waste, have been recognized for years. This requirement acknowledges the regulation of the hazardous constituents of mixed radioactive wastes in accordance with the *Resource Conservation and Recovery Act* (RCRA), as amended or in accordance with state hazardous waste regulations promulgated under RCRA authority. Each of the waste type chapters in DOE M 435.1-1 contains additional requirements for mixed radioactive wastes. Guidance for those additional requirements (DOE M 435.1-1, Sections II.C, III.B, and IV.B.(1)) should be consulted to find discussions on management of radioactive mixed waste under DOE O 435.1. Also, implementation guidance on the Department's management of mixed low-level waste is in the guidance on the Complex-Wide Low-Level Waste Management Program requirement, DOE M 435.1-1, Section IV.C.

I. 1.E.(11) Packaging and Transportation. Radioactive waste shall be packaged and transported in accordance with DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management*.

Discussion:

The Department of Transportation maintains regulations covering the transportation of radioactive materials, and DOE will continue to meet these requirements for all applicable transportation situations. This requirement emphasizes the need to continue to meet DOE O

460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management*, for all transportation of radioactive waste. However, the safety and hazard analysis revealed weaknesses and conditions concerning packaging of radioactive waste and waste containers that are not sufficiently covered in the existing transportation regulations because of the long time frames radioactive waste needs to be managed compared with the short time radioactive waste is in transport. Therefore, additional requirements for packaging and transportation of radioactive waste are found in each of the waste type chapters, and guidance for the requirements (DOE M 435.1-1, Sections II.O, III.L, and IV.L) should be consulted for discussions on meeting those requirements.

I. 1.E.(12) Quality Assurance Program. Radioactive waste management facilities, operations, and activities shall develop and maintain a quality assurance program that meets the requirements of 10 CFR 830.120, *Quality Assurance Requirements*, and DOE O 414.1, *Quality Assurance*, as applicable.

Discussion:

The safety and hazards analysis indicated that a strong quality assurance program is appropriate because of the risks posed by the management of DOE's radioactive waste. The analysis of requirements concluded that most of the requirements already imposed for quality assurance programs in 10 CFR 830.120, *Quality Assurance Requirements and Responsibilities*, and DOE O 414.1, *Quality Assurance*, would establish a sufficient program to maintain the quality of products and processes needed for radioactive waste management. Some specific additional quality assurance program requirements are invoked for high-level waste management in DOE M 435.1-1, Section II.G, and the guidance for those requirements should be consulted to determine how they can be implemented within the quality assurance programs already in place as a result of compliance with 10 CFR 830.120 and DOE O 414.1.

I. 1.E.(13) Radiation Protection. Radioactive waste management facilities, operations, and activities shall meet the requirements of 10 CFR Part 835, *Occupational Radiation Protection*, and DOE 5400.5, *Radiation Protection of the Public and the Environment*.

Discussion:

The protection of humans and the environment from the dangers of radiation due to radioactive waste management facilities, operations, and activities is a fundamental requirement of the revised DOE O 435.1, *Radioactive Waste Management*, and is invoked in DOE O 435.1, Section 4, *Requirements*. This DOE M 435.1-1 requirement emphasizes the need to ensure that the requirements of 10 CFR Part 835, *Occupational Radiation Protection*, and DOE 5400.5,

Radiation Protection of the Public and the Environment, are met for radioactive waste management facilities, operations, and activities.

An important element of these DOE directives is the As Low As Reasonably Achievable (ALARA) process. The Manual contains a specific requirement for the Field Element Manager to ensure that the ALARA principles are incorporated for radioactive waste management facilities, operations, and activities. The guidance on that Manual requirement (DOE M 435.1-1, Section I.2.F.(12)) should be consulted for additional information in implementing the ALARA principles for activities covered by this Manual.

I. 1.E.(14) Records Management. Radioactive waste management facilities, operations, and activities shall develop and maintain a record-keeping system, as required by DOE O 200.1, *Information Management Program*, and DOE O 414.1, *Quality Assurance*. Records shall be established and maintained for radioactive waste generated, treated, stored, transported, or disposed. To the extent possible, records prepared in response to other requirements may be used to satisfy the documentation requirements of this Manual. Additional records may be required to satisfy the regulations applicable to the hazardous waste components of mixed waste.

Discussion:

The safety and hazards analysis demonstrated that management of information important to understanding the risks posed by radioactive waste and the needs for establishing controls was an important control in and of itself. This mitigating factor showed up in many places in the analysis, and the requirements analysis indicated that DOE O 200.1, *Information Management Program*, and DOE O 414.1, *Quality Assurance*, provided for the necessary programmatic considerations in establishing effective records and information management.

However, some of the specific controls which were thought necessary for managing the technical adequacy and accuracy needed for radioactive waste records, especially considering the magnitude of consequences that could be involved and the long time frames associated with disposal of waste, are not specific enough in these two orders. Thus, there are specific references in many places in all three waste type chapters to establishing a particular kind of record, what the record may be used for, and some indication of the time the record must be kept. These additional considerations are then discussed in the guidance that explains that requirement in detail. It is intended that the programmatic recordkeeping requirements of the particular site will incorporate the necessary changes and accommodations to implement the intent of the DOE M 435.1-1 recordkeeping requirement.

<u>Records for Waste Generated, Treated, Stored, Transported, and Disposed</u>. The requirement states that records shall be established for radioactive waste generated, treated, stored, transported, or disposed. The intention of this part of the requirement is to emphasize that records should be kept throughout the entire life-cycle of the waste, including after it is disposed. To that end, there are specific requirements for recordkeeping in waste certification, waste transfer, high-level waste disposal, low-level waste storage, and radioactive waste management basis sections of DOE M 435.1-1. Site- or facility-specific recordkeeping requirements for any radioactive waste management functions that are deemed necessary in addition to the requirements called out in DOE M 435.1-1 should be established in order to maintain the information important to protection of the public, workers, and the environment.

<u>Use of Other Documentation Requirements</u>. It is possible that documentation required by other DOE directives, regulations, or site- or facility-specific requirements may contain all the necessary information needed and be maintained adequately for radioactive waste management recordkeeping. To the extent practical, any other recordkeeping requirements that are already being complied with should be used, or modified if appropriate, to meet the recordkeeping requirements of DOE M 435.1-1. It is not intended that duplicate or additional recordkeeping be established to meet DOE M 435.1-1 requirements where sufficient recordkeeping already exists.

<u>Mixed Waste Documentation Requirements</u>. Additional recordkeeping and records management requirements may be needed for radioactive mixed waste to comply with Federal and/or State hazardous waste requirements. This part of the requirement stands as a reminder that the hazardous waste records requirements must still be complied with regardless of the records management requirements for the radioactive contaminants being addressed in DOE M 435.1-1. Unless it is agreed to by the appropriate regulators for the hazardous component of mixed waste, the recordkeeping requirements of DOE M 435.1-1 do not necessarily achieve compliance with the separate requirements for the hazardous component of the waste.

I. 1.E.(15) Release of Waste Containing Residual Radioactive Material. The process for determining and documenting that waste is suitable to be released and managed without regard to its radioactive content shall be in accordance with the criteria and requirements in DOE 5400.5, *Radiation Protection of the Public and the Environment*.

Discussion:

The requirements analysis indicated that controls for the management of radioactive waste in DOE M 435.1-1 may not be necessary for wastes that may have low concentrations of residual radioactive material. Consistent with DOE 5400.5, *Radiation Protection of the Public and the Environment,* this requirement allows the determination of waste streams that may be managed without regard to their radioactivity. The current requirements in DOE 5400.5, *Radiation*

Protection of the Public and the Environment, along with implementation guidance established by the Office of Environment, Safety, and Health, for making and documenting these determinations should be consulted for appropriately managing waste streams without regard to their radioactive content.

I. 1.E.(16) Safeguards and Security. Appropriate features shall be incorporated into the design and operation of radioactive waste management facilities, operations, and activities to prevent unauthorized access and operations, and for purposes of nuclear material control and accountability, where applicable; and shall be consistent with DOE O 470.1, *Safeguards and Security Program*.

Discussion:

The requirements analysis concluded that the current requirements delineated in DOE O 470.1, *Safeguards and Security Program*, adequately provide for the safeguarding of classified information and material as well as security for radioactive waste management facilities, operations, and activities. Therefore, DOE O 470.1 is cited in DOE M 435.1-1 for emphasis. No additional implementation guidance is considered necessary to address any special needs of the required programs due to the management of radioactive waste.

I.1.E.(17) Safety Management System. Radioactive waste management facilities, operations, and activities shall incorporate the principles of safety management as described in DOE P 450.4, *Safety Management System Policy*, and DOE P 450.5, *Line Environment, Safety and Health Oversight*, and meet the requirements of the safety management systems sections of 48 CFR Chapter 9, *Department of Energy Acquisition Regulations* and DOE M 411.1-1, *Manual of Safety Management Functions, Responsibilities, and Authorities.*

Discussion:

DOE P 450.4, *Safety Management System Policy*, establishes the Department's policy that a formal, organized process shall be used for planning, performing, assessing, and improving the safe conduct of work. DOE P 450.5, *Line Environment, Safety and Health Oversight*, establishes the Department's policies that line management conduct environment, safety and health line oversight in a cost-effective, coordinated, integrated, and efficient manner that is seamless to contractors and that value is placed on the Department's line managers and contractors working together to identify and ensure resolution of environment, safety and health concerns. In keeping with this Departmental policy, the principles of integrated safety management were embodied in the technical analyses and processes used to determine the essential requirements of the DOE

Order and Manual on radioactive waste management. The core functions for implementing these principles are (1) define the scope of work; (2) analyze the hazards; (3) develop and implement hazard controls; (4) perform work within the controls; and (5) provide feedback and continuous improvement.

Requirements for these policies are set forth in Chapter 9 of Title 48, the *Department of Energy Acquisition Regulations*, and in DOE M 411.1-1, *Manual of Safety Management Functions, Responsibilities, and Authorities.* These requirement sets are invoked in DOE M 435.1-1 not only because of the flowdown of the Departmental policies, but also because the implementation of the policies in the Order and Manual were done through evaluating generic situations on a complex-wide basis. The actual implementation of the policies for radioactive waste management facilities, operations, and activities is required on an actual site- and facility-specific basis. Guidance for implementation of a compliant integrated safety management system is found in DOE G 450.4-1A, *Safety Management System Guide*. No additional guidance is needed for implementing a system for radioactive waste management facilities, operations, and activities.

I. 1.E.(18) Site-Evaluation and Facility Design. New radioactive waste management facilities, operations, and activities shall be sited and designed in accordance with DOE O 420.1, *Facility Safety*, and DOE O 430.1A, *Life-Cycle Asset Management*.

Discussion:

The safety and hazards analysis demonstrated that the selection and evaluation of a suitable site plus an appropriate facility design that considered the characteristics of the site chosen were effective mitigation measures to prevent potential problems with the management of radioactive waste, especially when the long-time frames required for effective management of disposed waste are considered. The provisions of DOE O 420.1, *Facility Safety*, and DOE O 430.1A, *Life-Cycle Asset Management*, were evaluated and found to be adequate in providing the necessary controls in radioactive waste management. In addition to these Orders, refer to the DOE Handbook, DOE-HDBK-1132-99, *Design Considerations*. This Handbook includes information and considerations for the design of systems typical to nuclear facilities, design considerations specific to various types of special facilities, and information useful to various design disciplines. The Handbook specifically includes design considerations for confinement systems and radiation protection and effluent monitoring systems as well as good practices and design principles that should be considered in specific design disciplines.

The DOE M 435.1-1 waste-type chapters contain specific requirements to supplement DOE O 420.1 and DOE O 430.1A for radioactive waste management facilities. DOE M 435.1-1 (Sections II.P, III.M, and IV.M) contains detailed additional requirements for both site evaluation and facility design.

The intent of the specific facility design requirements in each waste type chapter is to have them applied to all radioactive waste management facilities, both existing and new. However, it is recognized that in some cases it may not be practical, or possible, to apply these requirements to existing facilities or operations. In such cases a graded application of the requirement, or an exemption to the requirement, may be warranted. Use of a graded application or exemption to the requirements may be due to limited programmatic usage, a short service life, or other reasons that make long-term, capital intensive upgrades unreasonable. The guidance for the DOE M 435.1-1 waste type specific facility design requirements contain discussions for conducting adequate facility designs for radioactive waste management facilities, operations, and activities and additional discussions on the application of a graded approach to achieving compliance with the requirements.

I. 1.E.(19) Training and Qualification. A training and qualification program shall be implemented for radioactive waste management program personnel, and shall meet the requirements of DOE O 360.1, *Training*, and DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*.

Discussion:

The safety and hazards analysis indicated that an effective mitigating measure for a large number of weaknesses and conditions that could arise in management of radioactive waste was an effective program for qualification and training of personnel. The requirements analysis indicated that DOE's current programs implementing DOE O 360.1, *Training*, and DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities* were adequate in establishing effective radioactive waste management personnel qualification and training programs.

It is expected that some changes, additions, or improvements to the existing radioactive waste management personnel qualification and training programs would be needed to train personnel on the new and revised requirements of DOE O 435.1 and DOE M 435.1-1. The Field Element Manager is assigned a specific responsibility in DOE M 435.1-1, Section I.2.F.(11) to ensure that this training and re-qualification is reflective of each individuals specific job responsibilities and the changes and improvements made to the radioactive waste management Order. Guidance on DOE M 435.1-1, Section I.2.F.(11) should be consulted for more discussion about the implementation of a radioactive waste management qualification and training program.

I. 1.E.(20) Waste Minimization and Pollution Prevention. Waste minimization and pollution prevention shall be implemented for radioactive waste management facilities, operations, and activities to meet the requirements of Executive Order 12856, *Federal Compliance with*

Right-to-Know Laws and Pollution Prevention Requirements**, and Executive Order 13101*****, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*****, and DOE 5400.1, *****General Environmental Protection Program*****.**

Discussion:

The safety and hazards analysis indicated that an effective mitigating measure in management of radioactive waste was to avoid potential weaknesses and conditions through minimization of waste. The requirements analysis indicated that DOE's current programs implementing Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements and Responsibilities*, and Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition,* and DOE 5400.1, *General Environmental Protection Program*, were adequate in establishing effective waste minimization programs. In addressing this subject, the NRC endorsed EPA's *Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program* (*59 FR 31114*). This guidance should be reviewed for applicability to site waste minimization issues, and establishing a waste minimization program. For emphasis, the Field Element Manager is assigned a specific responsibility in DOE M 435.1-1, Section I.2.F.(3) to ensure that a waste minimization program is fully implemented.

I. 1.E.(21) Worker Protection. Radioactive waste management facilities, operations, and activities shall meet the requirements of DOE O 440.1A, *****Worker Protection Management for DOE Federal and Contractor Employees***.**

Discussion:

The safety and hazards analysis indicated that many risks were posed by the management of radioactive waste that were related to non-radioactive characteristics of the waste, and/or by activities that would need to be carried out on the waste regardless of its radioactive content. A few examples of these activities are: conducting activities in tight spaces, handling of heavy, unstable packages, and operation of forklifts. The requirements analysis concluded that the requirements of DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* adequately covered these risks and should be cited in DOE M 435.1-1 for completeness. DOE O 440.1A invokes external Occupational Safety and Health Administration requirements (e.g., 29 CFR Part 1910, *Occupational Safety and Health Standards)* for both DOE Federal and contractor personnel, along with several industrial and consensus standards for safe workplaces, such as the American Society of Mechanical Engineers' *Boiler and Pressure Vessel Safety Code,* and the National Fire Protection Association's *Electrical Safety Requirements for*

Employee Workplaces. No additional implementation guidance is needed for implementing DOE O 440.1A for radioactive waste management facilities, operations, or activities.

Supplemental References:

1. DOE. *Nuclear Safety Management, Quality Assurance Requirements*, 10 CFR 830.120, U.S. Department of Energy, Washington, D.C.

2. DOE, 1995. *Facility Safety*, DOE O 420.1, U.S. Department of Energy, Washington, D.C., October 13, 1995.

I. 2.A. Program Secretarial Officers.

Program Secretarial Officers with radioactive waste management facilities, operations, or activities are responsible within their respective programs for ensuring that the Field Element Managers meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to ensure DOE Headquarters management attention and oversight of Field Offices' management of radioactive waste.

Discussion:

This requirement applies to any Program Secretarial Officer (PSO) that has responsibility for facilities, operations, or activities involving the management of radioactive waste. PSOs should be cognizant of Field radioactive waste management activities under their purview and provide appropriate oversight of Field Element Manager's implementation of DOE O 435.1 and DOE M 435.1-1.

A key to successful compliance with any DOE Directive is oversight. This is particularly true of directives which, like DOE O 435.1 and DOE M 435.1-1, have performance-oriented requirements that call for review and approval of site- or facility-specific implementation of procedures and other controls to ensure the requirements are being met. Oversight is defined (DOE M 435.1-1, Attachment 2) as:

> The responsibility and authority assigned to line management to assess the adequacy of DOE and contractor performance. Independent Oversight refers to the responsibility and authority assigned to the Assistant Secretary for Environment, Safety, and Health to independently assess the adequacy of DOE and contractor performance.

The DOE complex has initiated the integrated Safety Management System under Secretarial policies DOE P 450.4, *Safety Management System Policy*, DOE P 450.5, *Line Environment, Safety, and Health Oversight*, and DOE P 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy*. These policies are invoked by DOE M 435.1-1, I.1.E.(17) for the purposes of emphasis and clarity. DOE P 450.4 provides the overall goals and objectives of the DOE integrated Safety Management System. Core function No. 5, "Provide Feedback and Continuous Improvement," calls for a system of evaluations and reporting in order to continuously improve in achieving the goals and requirements for safety and protection of the environment. DOE P 450.5 explains that line management has the responsibility for oversight of

DOE facilities, operations, and activities, including those involving management of radioactive waste.

It is expected that the revised requirements of DOE O 435.1 and DOE M 435.1-1 will be incorporated into contractor self-assessments established under the integrated Safety Management System, and incorporated into the Field Office oversight of the contractor programs, as appropriate. Similarly, under the Safety Management System policies, PSOs have the responsibility to monitor the Field Office oversight and participate in Field Office oversight functions, as appropriate. Likewise, under the Safety Management Systems policies, the Assistant Secretary for Environment, Safety, and Health (EH-1) has the responsibility to assess the adequacy of Field Office and contractor performance, and it is expected that the revised DOE O 435.1 and DOE M 435.1-1 requirements will be assimilated into the Assistant Secretary for Environment, Safety, and Health's programs for independent oversight at his/her discretion.

> *Example: The Assistant Secretary for Defense Programs (DP-1) has been delegated the responsibility for waste management at the Kansas City Plant. He has delegated the authority for this responsibility to DP-24, the Office of Site Operations. DP-24 directs personnel in his organization to conduct an annual evaluation at the Kansas City Plant during which they assess the site's implementation of DOE O 435.1 and DOE M 435.1-1. DP-24 is advised of any non-compliance issues and in turn advises DP-1 of these issues.*

Compliance with this requirement is demonstrated by appropriate incorporation of DOE O 435.1 and DOE M 435.1-1 requirements within the functions, responsibilities, authorities, and requirements explained in the set of Safety Management System directives. This results in thorough and effective oversight of radioactive waste management facilities, operations, and activities, and assurance that the public, workers, and the environment are protected from the hazards associated with management of radioactive waste.

Supplemental References:

1. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy,* DOE P 411.1, U.S. Department of Energy, Washington, D.C., January 28, 1997.

2. DOE, 1996. *Safety Management System Policy,* DOE P 450.4, U.S. Department of Energy, Washington, D.C., October 15, 1996.

3. DOE, 1997. *Line Environment, Safety and Health Oversight,* DOE P 450.5, U.S. Department of Energy, Washington, D.C., June 26, 1997.

4. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities,* DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

5. DOE, 1992. *Environmental Audit Program Guidance*, DOE/EH-0232, U.S. Department of Energy, Washington, D.C., January 1992.

6. DOE. *Performance Objective and Criteria for Conducting DOE Environmental Audits*, DOE/EH-0229, U.S. Department of Energy, Washington, D.C.

I. 2.B. Assistant Secretary for Environmental Management.

The Assistant Secretary for Environmental Management is responsible for:

(1) Complex-Wide Radioactive Waste Management Programs. Establishing and maintaining integrated Complex-Wide Radioactive Waste Management Programs for high-level, transuranic, low-level, and mixed low-level waste. These programs shall use a systematic approach to planning, execution, and evaluation to ensure that waste generation, storage, treatment, and disposal needs are met and coordinated across the DOE complex.

Objective:

The objective of this requirement is to ensure development of complex-wide programs that result in the safe and efficient management of all DOE high-level, transuranic, low-level, and mixed low-level waste. The programs are to ensure coordination among DOE sites and among Headquarters program offices. Such programs provide Headquarters and Field personnel a common basis for carrying out the radioactive waste management programs' missions.

Discussion:

The Department is responsible for managing radioactive waste in a manner that is protective of the public, workers, and the environment. To accomplish this in the most efficient manner, and to make the best use of resources, programs for managing the various waste types need to be coordinated among Headquarters Program Offices and among the DOE sites. Radioactive waste subject to the *Radioactive Waste Management Order* (DOE O 435.1) and the Manual (DOE M 435.1-1) is to be managed within one of four waste-type programs in accordance with the Radioactive Waste Management requirement of the Manual (DOE M 435.1-1, Section I.1.C). The complex-wide programs must respond to current needs affecting the safe, effective, and efficient management of waste. The complex-wide programs should provide a vision of the final disposition of each waste type for the complex, yet need to be responsive to the issues that arise at individual DOE sites.

The Assistant Secretary for Environmental Management is assigned responsibility for maintaining programs for managing each waste type to ensure that there is a focal point for managing the wastes and ensuring integration across the complex. Integration across the complex involves coordinating treatment, storage, and disposal to allow the needs of one site to be met by capabilities at another site, if practical. To that end, activities at individual DOE sites should support the complex-wide program by providing data needed for complex-wide planning (e.g., waste inventories and projections, facility capacities) and by budgeting for and executing site activities that lead to accomplishing complex-wide program goals. Conversely, the complex-wide

program should also be supportive of the site programs by establishing realistic goals and resolving complex-wide issues (e.g., disposal configurations, equity issues, certain issues affecting waste with no path to disposal), and should be developed with cognizance of individual site constraints (e.g., agreements with State or local governments, compliance orders).

In addition to ensuring integration across the complex, assigning the Assistant Secretary for Environmental Management responsibility for program development and maintenance also provides a focal point for coordination across all Headquarters Program Offices. Thus, regardless of whether other Headquarters program offices (e.g., Defense Programs, Science) have responsibility for various waste management activities, the Assistant Secretary for Environmental Management is responsible for ensuring that activities are coordinated within the waste type programs.

The requirement calls for a program for each waste type. This is consistent with the way DOE manages the radioactive waste types and allows the focus of the program to be on the characteristics and/or legal and regulatory requirements specific to the waste type. For example, the regulatory constraints on disposal vary among the waste types. DOE plans to dispose of high-level waste in a geologic repository so the end point objective of the high-level waste program is to convert the waste into a form that meets the waste acceptance criteria for the repository. Federal legislation provides for the disposal of defense transuranic waste in a geologic repository, separate from the spent nuclear fuel/high-level waste repository. Waste characteristics and the need to coordinate transportation to the repository provides the common basis for having a transuranic waste management program. The Department's policy and regulatory authority for onsite disposal of low-level waste establishes the underlying basis for addressing this waste within a program; and in part, because of the overlay of external requirements, mixed low-level waste is addressed within a separate program.

Although individual programs for the waste types are established at the complex-wide level, separate programs for each waste type are not required at the DOE sites. Rather, the site programs are to be developed in a manner that the Field Element Manager deems appropriate, as long as the site programs support the individual complex-wide programs (see guidance for Site-Wide Waste Management Program).

A systematic approach for managing each waste type should provide all of the organizations involved in the program with a common framework within which they can discharge their responsibilities. The program framework should identify the overall mission of the program, the key program participants, participants roles, and expected accomplishments. The top-level functions of the program are *planning* or formulation, *execution*, and *evaluation*. The *planning function* identifies the organizations or sites responsible for implementing the strategies and activities directed at accomplishing the program mission. Under the *execution function* of the program, each organization performs the work for which it is responsible. For example, site

personnel would perform the activities associated with storing, treating, and disposing of waste and Headquarters personnel would perform the necessary coordination, data collection and analysis, and further complex-wide planning. The *evaluation function* provides the means of improving the program by learning from the experience gained through execution of the program. Each of these functions is discussed in more detail below.

Planning. A systematic approach to planning involves identifying and defining those aspects of the program necessary for the sites to execute their individual responsibilities. The planning should be consistent with DOE policies, other programs, and controlling or higher level documents that specify DOE policy or direction.

> *Example: The waste type programs need to be consistent with the overall plan for clean up of DOE sites developed under the auspices of the Assistant Secretary for Environmental Management. The Assistant Secretary's plan is a higher level document establishing policy and direction for environmental restoration and waste management activities in the Department.*

The complex-wide program for each waste type should be defined in terms of *scope*, *mission*, *goals* and *objectives*, *priorities*, and *interfaces*. As used here, the term scope means the boundaries of the program, such as the waste and the waste management facilities and activities that are included in the program. The *mission*, and *goals* and *objectives* provide program participants a common view of what the program is intended to accomplish in the short and long term. The *priorities* address the order of importance of the goals, objectives and activities to be accomplished. A priority may be based on the need to complete a fairly minor activity in order to support a subsequent activity. The *interfaces* describe where and how the program interactions occur, both within the program and with other organizations and facilities outside of the program. A key interface for each waste type program is the interaction with the other waste type programs since there are occasions when waste exits one program and enters another programs (e.g., see guidance on Waste Incidental to Reprocessing).

In order to ensure that waste management needs will be met (e.g., sufficient waste storage capacity), it is necessary to have data on inventories of waste and estimates of future waste receipts to compare with current and projected facility capacities. These data provide the basis for determining the strategy for meeting current and future waste management needs. A strategy for meeting waste management needs may include constructing new facilities (permanent or mobile), using commercial facilities or capabilities, coordinating among DOE sites, or combinations of these and other actions. The Assistant Secretary also needs to ensure that *National Environmental Policy Act* (NEPA) analyses are performed to support policy-making and configuration decisions.

Lastly, the planning function includes developing and submitting a budget request to implement the planned program activities. Depending on organizational responsibilities assigned at Headquarters, the Assistant Secretary for Environmental Management may not be responsible for funding all waste management activities. However, in exercising the responsibility assigned by this requirement, the Assistant Secretary should be cognizant of the funding for waste management being requested by other Program Offices to ensure that waste management activities are integrated. In performing budget planning, it is necessary to plan for events far enough into the future to allow sufficient lead time for the Federal funding process. Generally, this requires identifying major expenditures two or three years in advance.

Implementation of the program planning activities may be provided for by existing actions undertaken by or on behalf of the Assistant Secretary for Environmental Management. To the extent the planning function is already met by ongoing activities (e.g., the annual budget submittal, existing waste type program plans), no additional effort is required to fulfill this responsibility.

Execution. Execution of the waste management programs involves those activities taken to implement planning. At the complex-wide level, execution will involve performing the studies and analyses that form the basis for resolving issues and conducting future planning. At the site level, execution includes the generation, storage, treatment, and disposal of waste. In addition, program execution includes data collection and documentation associated with waste management activities, as well as construction and procurement activities necessary to provide future waste management capabilities.

Evaluation. An important part of a systematic approach to the waste management programs is evaluating the work accomplished during the execution phase. Progress should be measured against programmatic goals established during the planning phase. In addition, success should be measured against parameters established to evaluate protection of the public, workers, and the environment. The evaluation should include the following elements:

Performance Measures. Metrics should be used in evaluating performance against program, and environmental, health, and safety goals should be selected and agreed to by Headquarters and the field;

Performance Data. Performance data should be collected from across the complex to enable evaluation of performance relative to the measures selected above;

Performance Evaluation and Reporting. Collected data should be reduced into a form that allows it to be analyzed against the metrics and to allow it to be interpreted and evaluated for performance and trends; and

Feedback. Information should be provided for use in the planning process and for use by the sites in improving performance. Feedback should be in the form of recommendations for potential changes to program policies, goals, priorities, strategies, or interfaces. Additionally, feedback may include recommendations on methods to improve protection of the environment, and human health and safety, either through top-level management actions (e.g., administration of contractor award fees) or working level management actions (e.g, changes to site operating practices and/or procedures).

The process of *planning*, *execution*, and *evaluation* is iterative. The lessons learned from the activities undertaken during one fiscal year, or changes in the assumptions on which the program strategy was based, will require revising the program planning. This in turn will affect the execution of the program, and therefore the performance measures that will be included in the evaluation step.

Compliance with this requirement is demonstrated if complex-wide waste type programs exist for high-level, transuranic, low-level, and mixed low-level waste. These programs should result in safe and efficient management of all DOE radioactive waste and ensure coordination among DOE sites and programs.

Supplemental References:

1. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE P 411.1, U.S. Department of Energy, Washington, D.C., January 28, 1997.

2. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

3. DOE, 1996. *DOE Low-Level Waste System Description Document*, U.S. Department of Energy, Office of Environmental Management, September 1996.

I. 2.B.(2) Changes to Regulations and DOE Directives. Ensuring changes to regulations and DOE directives are reviewed and, when necessary, incorporated into revisions of this Manual to ensure the basis for safe radioactive waste management facilities, operations, and activities is maintained.

Objective:

The objective of this requirement is to ensure that changes to pertinent regulations and other DOE directives are evaluated and incorporated into revisions to radioactive waste management directives to keep current with new information and practices.

Discussion:

The Assistant Secretary for Environmental Management is responsible for ensuring changes to regulations and DOE directives are reviewed and evaluated for their impact on safe radioactive waste management. The results of the review should be used to assess the need to revise DOE O 435.1, *Radioactive Waste Management* and the associated Manual and Contractor Requirements Documents. When warranted, these documents are to be revised to ensure protection of workers, the public, and the environment.

New information leads to changes in regulations and other DOE directives, and practices used in the management of radioactive waste. This information and the changes should be evaluated and, when appropriate, incorporated into revisions of DOE O 435.1, *Radioactive Waste Management*, or DOE M 435.1-1, *Radioactive Waste Management Manual*, so that DOE radioactive waste management requirements and practices are consistent with requirements and practices within DOE and in commercial radioactive waste management. If the review of a change in a regulation or directive leads to the potential need for a revision, the determination of the need and rationale for a revision should be documented. The documentation should be maintained as an auditable record as long as the directive is in effect.

> *Example: The DOE directive on environmental and occurrence reporting is revised and a new version issued. The Order and associated documents are reviewed and primarily administrative requirements (e.g., the way DOE does business) are changed. A review of the technical basis document does not reveal any reliance on the administrative requirements of the revised order for protection of workers, the public, or the environment. Therefore, the results of the review lead to the conclusion that there is no need to revise DOE O 435.1, Radioactive Waste Management. This conclusion is documented and maintained as a quality assurance record. Additionally, however, a change to a technical requirement which was relied upon to address a weakness or condition associated with radioactive waste management is assessed to determine impact on the protection of workers, the public, and the environment. A significant impact is identified that warrants a revision to the requirements of DOE M 435.1-1. The method of effecting the revision (change page, memorandum, order revision, etc.) should be documented and managed as a quality assurance record.*

Compliance with this requirement is demonstrated by the existence of a systematic process of reviewing new and proposed directives and regulations for their impact on the basis for safe management of DOE radioactive waste. Documented conclusions from the reviews provide evidence that the process is being implemented.

Supplemental References: None.

I. 2.C. Assistant Secretary for Environment, Safety, and Health.

The Assistant Secretary for Environment, Safety and Health is responsible for providing an independent overview of DOE radioactive waste management and decommissioning programs to determine compliance with DOE environment, safety, and health requirements and applicable Environmental Protection Agency (EPA) and state regulations, including:

(1) Advising the Secretary of the status of Departmental compliance with the requirements of DOE O 435.1, this Manual, and applicable provisions of other DOE Orders.

(2) Conducting independent appraisals and audits of DOE waste management programs.

(3) Reviewing site Waste Management Plans with regard to compliance with DOE environment, safety, and health requirements.

Objective:

The objective of this requirement is to ensure that the existing role of the Office of Environment, Safety and Health for providing independent oversight is maintained and understood.

Discussion:

The role of the Assistant Secretary for Environment, Safety and Health is to conduct independent oversight of DOE activities, including radioactive waste management. The purpose of this oversight is to determine compliance of DOE Headquarters and Field Element programs with DOE Environment, Safety and Health regulations and applicable EPA and state regulations.

During the development of DOE M 435.1-1, it was recognized that explicit inclusion of this statement within the General Requirements and Responsibilities Chapter would serve to clarify this role.

The inclusion of this requirement/responsibility is not expected to change any current reporting, oversight, or compliance arrangements within the Department, rather it further clarifies existing roles and responsibilities.

Supplemental References:

1. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

2. DOE, 1988. *General Environmental Protection Program*, DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

3. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

I. 2.D. Deputy Assistant Secretary for Waste Management.

The Deputy Assistant Secretary for Waste Management is responsible for:

(1) Complex-Wide Radioactive Waste Management Program Plans. Developing, implementing, and maintaining integrated Complex-Wide Radioactive Waste Management Program Plans for high-level, transuranic, low-level, and mixed low-level waste. Each plan shall, at the DOE complex-wide level, describe the functional elements, organizations, responsibilities, and activities that comprise the system needed to store, treat, and dispose of radioactive waste in a manner that is protective of the public, workers, and the environment. In addition, the plans shall:

(a) Present a waste management strategy that integrates waste projections and life-cycle waste management planning into complex-wide facility configuration decisions; and

(b) Describe the approach to research and technology development being pursued to improve safety and/or efficiency in managing radioactive waste.

Objective:

The objective of this requirement is to ensure that complex-wide plans provide an overarching strategy for making and implementing waste management decisions. The overarching strategy provides site personnel a framework within which they can formulate and execute plans for managing wastes at the individual sites.

Discussion:

The *Radioactive Waste Management Manual*, DOE M 435.1-1, Section I.2.B.(1), assigns the Assistant Secretary for Environmental Management responsibility for establishing and maintaining complex-wide management programs for each waste type. This responsibility is fulfilled through the planning, execution, and evaluation of these programs. The current requirement assigns the responsibility for a complex-wide program plan for each waste type to the Deputy Assistant Secretary for Waste Management. These plans are to provide a clear picture of the waste type program and its direction, and serve as a mechanism for documenting most of the planning functions of the programs. Although assigned to the Deputy Assistant Secretary, the development of these plans is a cooperative and iterative effort with the site representatives and other affected programs. Whereas the Field Element Managers are to develop and implement site

programs that support the complex-wide plan, the complex-wide plan should be developed based on the inventory, facility status, constraints, and needs of the individual sites.

Definition of Waste Management Program. The following topics are to be addressed in the waste type program plans to define the program in a manner that conveys the extent and intent of the program.

Mission. The program plans should provide a succinct statement of the overall purpose of the program. The mission statement should reflect the expectation to safely manage each waste type throughout all stages of waste management and should reflect disposal of waste as part of the mission.

Example: The Low-Level Waste Management Program mission statement states - The mission of the Department of Energy Low-Level Waste Management Program is to develop, implement, and coordinate a nationally integrated program for low-level waste treatment, storage, and disposal that uses a combination of Federal and private facilities to meet the needs of waste generators while fully protecting workers, the public, and the environment. Safety of operations and timely disposal of waste are high priorities for the Department.

Goals, Objectives, and Milestones. A key element of the complex-wide waste type program plans is the identification of program goals, objectives, and major milestones. Goals to be defined in the program plans may be general and apply to the complex as a whole, or they may be site-specific goals, based on input from the field, that are major events for the program (e.g., opening the Waste Isolation Pilot Plant). One of the complex-wide goals that should be defined in the plans is the expected end-state for the waste type. That is, the end of the life-cycle for the particular waste type should be one of the long-term goals of the program. The complex-wide goals should be specific, long-term measures of the waste type program's progress, and the goals should be challenging, yet achievable. To support the periodic assessment of the program's progress, the goals should be measurable.

Objectives should be established as interim measures of progress towards meeting the program goals. The objectives may be established as complex-level objectives, or may reflect key events at individual sites that are significant to measuring progress in the program.

Milestones are more specific events, e.g., decision points, completion of specific studies or analyses, or operation of specific facilities, which have a date of completion associated with them. Milestones are to be established in support of the goals and/or objectives. As with the goals and objectives, milestones may be established for activities being addressed

at the complex-wide level, or may represent major activities that are to be completed at a specific site consistent with site programs (see DOE M 435.1-1, Section I.2.F.(1)). The following examples shows program goals, supported by objectives, and specific milestones.

Example 1:

Goal: Convert Environmental Management high-level waste to a form that can be accepted by the Office of Civilian Radioactive Waste Management.

Objective: Vitrify all of the high-level liquid waste at the Savannah River Site.

Milestone: Produce 250 canisters of vitrified Savannah River Site high-level waste in conformance with Environmental Management Waste Acceptance Product Specification during FY 1999.

Example 2:

Goal: Provide for disposal of all transuranic waste.

Objective: Dispose of defense transuranic waste at the Waste Isolation Pilot Plant.

Milestone: Begin disposal operations at the Waste Isolation Pilot Plant by September 1998.

Milestone: Remove all packaged transuranic waste from the Rocky Flats Environmental Technology Site by December 2XXX.

Priorities. The complex-wide program should establish priorities which are then reflected in the goals and objectives of the program. The priorities for the program may be influenced by a number of different factors, including legal commitments or agreements, predecessor-successor relationships of related program activities, timing of the availability of a technology or facility, and funding considerations.

Example 1: A prioritization of activities in the high-level waste management program has resulted in a decision to construct and start operation of vitrification facilities at the Savannah River Site and the West Valley Demonstration Project, followed by facilities at Hanford and the Idaho National Engineering and Environmental Laboratory. These priorities are based on availability of funding and the stage of technology development and readiness at these sites.

Example 2: An example of prioritization for the Transuranic Waste Management Program would be deciding to open the transportation corridors through New Mexico, Colorado, Wyoming, Utah, and Idaho prior to opening corridors through eastern states. This priority is based on the sites that are expected to ship waste to the Waste Isolation Pilot Plant first.

<u>Boundaries and Interfaces</u>. The program plans should clearly define the boundaries or scope of the program and describe the internal and external interfaces which must be managed. The complex-wide plans should define what is within the program boundary, including a general description of the wastes to be managed. Part of defining the boundaries or scope in the waste type program plans includes identifying the internal interfaces. The internal interfaces include the interactions among organizations or activities that have different funding sources, but are part of the DOE waste management (e.g., high-level, transuranic, low-level, or mixed low-level waste) programs. Internal interfaces are defined through the identification of organizations and responsibilities discussed in a following subsection.

Interfaces external to a waste type program should also be defined in the program plan. The interfaces exist between waste type programs, with generators, and with external entities. First, interfaces between waste type programs need to account for transfers of waste between the programs. Transfer may be necessary to accommodate waste that changes from one waste type to another (e.g., as a result of assay or a waste incidental to reprocessing determination), or from generating a waste as a result of managing another waste type (e.g., high-level waste treatment generates a secondary low-level waste stream). An important outcome of identifying interfaces with other waste type programs is ensuring that all waste (subject to DOE O 435.1) under the Department of Energy's purview is being managed within one of the waste type programs.

Example: Pretreatment of high-level waste at the Savannah River Site results in a high-volume stream of salt solution. Through application of the waste incidental to reprocessing process, a determination is made that the salt solution should be managed as low-level waste. The high-level and low-level waste programs establish an interface that ensures that the waste is safely managed according to the appropriate set of requirements.

Second, each of the programs needs to identify interfaces with the generators of each waste type. The program plan should document the sources of waste that the program will manage. Whereas some waste is generated by activities within the program, waste is also generated by the Environmental Restoration Program, Defense Programs, Science Programs, and Nuclear Energy Programs.

Third, the program plan should document interfaces with organizations external to the Department of Energy. This could include external regulatory agencies (Federal or State) as well as commercial facilities.

Constraints. The program plans should discuss significant constraints on the planning and execution of each waste type program. As used here, the term constraints has a broad meaning including program assumptions, Departmental policies which direct or restrict certain waste management actions, external regulations, etc. Key assumptions that may impact planning at the complex-wide level include major policies, current and out-year program funding, expected programmatic or activity decisions, and expected contract awards.

Example: A key assumption affecting the management of low-level waste is that the six currently operating low-level waste disposal facilities will continue to operate for the next two years. Therefore, there would be no significant changes to existing generator-disposal facility relationships.

Organization and Responsibilities. The organizational and functional responsibilities of the participants in the complex-wide waste type programs, and their interrelationships, should be described in the program plans. This description should include the identification of the organizations within both the Headquarters and Field organizations, and a discussion of their respective roles in formulating, executing, and evaluating the waste type programs. The plan should include organization and interface charts that define the roles, responsibilities, and authorities for each of the major program participants, as well as required lines of communication.

Example: For the Low-Level Waste Management Program, the Program Plan identifies the entity responsible for supporting the Deputy Assistant Secretaries for Waste Management and Environmental Restoration in the review and evaluation of disposal facility performance assessments and composite analyses.

Integrated Program Strategy. The program plan provides a description and basis for the strategy being pursued to fulfill the program mission and meet the program goals. The strategy addresses the life-cycle management of waste from generation and generation reduction through the plans and approaches for effecting disposal of waste. The strategy also needs to recognize that part of the life-cycle management of the waste may include continued safe storage of legacy waste pending the ability to dispose of it. The strategy needs to be consistent with the assumptions described earlier and should be developed considering the following elements:

- Technical and programmatic issues;
- Waste projections;
- Life-cycle waste management planning;

- Waste minimization and pollution prevention;
- Research and development; and
- Implementation of DOE O 435.1.

Technical and Programmatic Issues. Major issues that impact the safe management of waste, including regulatory issues; expected changes in Federal, State or local statutes; and major technical issues should be discussed in the plan. Among the issues included in the plan should be problems identified by the sites that would best be addressed at a complex-wide level (e.g., resolving certain issues that result in waste with no path to disposal). Examples of these types of problems are issues that need to be negotiated at the Federal level (with Headquarters of another Federal agency or Congress) or issues that occur at multiple sites that would benefit by a common resolution. In addition to identifying the issues, the plan should describe proposed solutions or steps towards resolving them (e.g., obtaining data, completing studies).

Example 1: A major issue that should be addressed at the complex-wide level for transuranic waste management is the disposition of non-defense transuranic waste. There is currently no path to disposal for non-defense transuranic waste. The plan should address the development of information and other steps necessary to support resolution of the issue.

Example 2: In the high-level waste management program, a key technical and regulatory issue is the high-level waste tank closure process. The plan identifies technical issues that need to be resolved, such as appropriate methods to solidify and stabilize residues that remain in the tank, and regulatory issues such as the waste categorization of the tanks. The activities and schedule for resolving these issues is identified in the plan.

Waste Projections. The waste projections element of the programs plans should identify the minimum data requirements that must be included in waste projections, a consistent projections methodology, data quality objectives, and evaluation of data uncertainties, maintenance of data quality, and a periodic review and assessment of waste projections data quality. The collection of waste projections data should be focused on promoting the safe and efficient life-cycle management of waste. Therefore, data collection is an element in ensuring that sufficient storage, treatment, and disposal capacity will be available to handle current and future wastes.

Example: Projections of low-level waste volumes are necessary to ensure that sufficient disposal capacity will be available, either within DOE and/or at commercially-operated facilities. Therefore, the types of information that would be needed include the volumes of waste that would be generated in different time periods, and the inventories and/or

concentrations of key radionuclides. Through a cooperative effort among personnel from the complex-wide program, the generating sites, and DOE disposal sites, a determination is made as to what actions are necessary to ensure adequate waste disposal capacity.

Life-cycle Waste Management Planning. At the complex-wide level, personnel working on the program plan should consider the management needs for all of the waste included in the program when mapping out a strategy. In so doing, personnel developing the strategy should consider the volumes and characteristics of waste in storage and those projected to be generated. The availability of waste management facilities to safely and expeditiously manage the types and amounts of waste should be considered in developing the program strategy. For much of the waste, management through its entire life cycle will be possible using existing or planned facilities. The strategy for these types of waste should then focus on actions to improve efficiency and safety in effecting disposal. If appropriate, the strategy should consider the use of non-DOE facilities for meeting waste management needs.

Example 1: In the Transuranic Waste Management Program, a strategy is developed that calls for the use of mobile equipment for certifying waste at small generator sites. Use of the equipment results in program cost savings by avoiding the construction of facilities for waste certification at multiple sites. Program efficiency is also achieved by being able to coordinate the schedule for the mobile equipment with the schedule for shipping waste to WIPP.

Example 2: Use of non-DOE facilities to help meet waste management needs occurs in the management of mixed low-level waste for disposal where DOE capabilities do not currently exist. A commercial facility that has the necessary radioactive materials license and RCRA permit provides disposal of mixed low-level waste which cannot currently be transferred to a DOE site for disposal. The use of the commercial facility is determined to be in the best interest of DOE and an exemption has been approved. The DOE strategy to allow disposal of small volumes of mixed low-level waste at a commercial facility promotes compliance with agreements and external regulations at the individual DOE sites, and reduces the costs and risks associated with storage.

The strategy should also account for managing the wastes that do not have an apparent path to disposal. The complex-wide plan should provide sufficient information that site personnel can use to determine whether activities being taken at the complex-wide level address the issues that prevent disposal or whether the site should take individual actions to resolve the issues.

Example: For transuranic waste that currently cannot be disposed at WIPP, a strategy might be to address the issues preventing disposal of the waste. In this case, personnel with non-defense wastes that could otherwise meet the WIPP waste acceptance criteria would rely on the efforts being taken by Headquarters to resolve the issue.

Waste Minimization and Pollution Prevention. The complex-wide plan should acknowledge the role that waste minimization and pollution prevention play in the management of radioactive waste. The plan should reference any applicable pollution prevention program plans which address commitments concerning the particular waste type.

Example: The program plan for low-level waste or mixed low-level waste references the Pollution Prevention Program Plan that documents a Secretarial commitment to reduce the generation rates for the waste types by 50 percent by the end of 1999 (compared to the 1993 generation rates). This commitment is then translated into a program goal for the low-level waste and mixed low-level waste programs.

Research and Development (R&D) Activities. The complex-wide plan should address the research and development being done to address multi-site issues related to disposal and other waste management issues. This provides a basis for the sites to determine what issues need to be addressed at the site level.

Example: In the Transuranic Waste Management Program, research is being performed to re-evaluate the potential for generation of explosive gases in transuranic waste containers. If the research concludes that gases are not generated in closed transuranic waste containers, the need for sampling and/or venting prior to placement into the TRUPACT II could be eliminated for transportation. This research being undertaken by a central organization may benefit all shippers of transuranic waste.

Implementation of DOE O 435.1. The program plan should consider the time and cost of implementing the *Radioactive Waste Management Order*, DOE O 435.1 and the supporting Manual, DOE M 435.1-1 when establishing program goals and objectives. In the near term, the complex-wide strategy must include attaining compliance with the Order as one of its goals. Individual objectives may address significant facilities at individual sites.

Example: Completion of a performance assessment and composite analysis for low-level waste disposal facilities, and issuance of a Disposal Authorization Statements, are appropriate key objectives for inclusion in the Low-Level Waste Management Program Plan. These are required to comply with DOE M 435.1-1 and are significant to the overall low-level waste management program.

The program plan also provides a mechanism for documenting means by which the program progress and compliance can be evaluated. The plan should indicate the types of evaluations that are going to take place and at what level in the organizational structure they will occur. The evaluation and oversight responsibilities should include a clear delineation between the roles of Headquarters, Field, and contractor organizations. Periodic evaluations of program activities will provide the basis for determining progress toward achieving the program goals and provide the feedback necessary to improve performance of the waste-type programs.

Examples of evaluation and oversight activities include:

- *Contractor self-assessments;*
- *Field oversight assessments;*
- *Progress Tracking System reporting; and*
- *Quarterly Management Reviews.*

Compliance with this requirement is demonstrated if a program plan is developed for each of the waste types specified in DOE M 435.1-1. The program plans should convey the overall purpose (end-point) of the program, the responsibilities for accomplishing different program activities, and a strategy that reflects the uncertainties and constraints that affect management of the specific waste type.

Supplemental References:

1. CAO, 1997. *The National TRU Waste Management Plan*, Revision 1, DOE/NTP-96-1204, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1997.

2. DOE, 1997. *DOE Low-Level Waste Program Management Plan,* Revision 0, DOE/LLW/PMP-001, U.S. Department of Energy, Washington, D.C., March 1997.

I. 2.D. Deputy Assistant Secretary for Waste Management.

The Deputy Assistant Secretary for Waste Management is responsible for:

(2) Waste Management Data System. Establishing and maintaining a system to compile waste generation projection data and other information concerning radioactive waste management facilities, operations, and activities across the complex.

Objective:

The objective of this requirement is to ensure information and data concerning the management of radioactive waste is collected and compiled at the DOE complex level. Compilation of waste management information promotes safe management of radioactive waste by supporting the integration and optimization activities, and life-cycle waste management planning across the DOE complex.

Discussion:

To effectively manage radioactive waste, the Department is dependent on information and data which describe its waste, both previously generated and projected, as well as the facilities and systems used to manage the waste. In the development of DOE O 435.1 and DOE M 435.1-1, collecting and managing this information was determined to be an important function for the safe and effective management of radioactive waste. The information and data are generated and developed as a result of site-specific compliance with various requirements including DOE M 435.1-1.

The "waste management data system" is a general description used to describe systems and processes needed to collect, compile, and report information in a uniform and consistent manner. The specific mechanisms for collecting the data and information will vary based on changes in management approach and implementation methodology. However, the information and data that are to be managed originate from many diverse sources so consistent reporting is important. The data must be collected and reported in a manner that makes them useful to the complex-wide waste-type programs and plans required by DOE M 435.1-1, Sections I.2.B and I.2.D. For instance, information on waste with no path to disposal needs to be included in the data system to allow evaluations which could lead to common solutions that would benefit multiple sites. Also, data need to be collected to support the evaluation phase of waste management by depicting progress made in the program.

The development and documentation of data requirements are to be completed for all information to be collected from the field. Use of data requirements ensures consistency and provides a basis

for accurate reporting. Data requirements describe the information requested, why it's requested, and how to report it. Information and data will generally be collected for each DOE site in the complex. Typically, the following information and data for high-level waste, transuranic waste, low-level waste, and mixed low-level waste are to be included in the waste management data system:

- Quantities of past, current, and projected waste, by waste type and year;
- Waste characteristics;
- Waste management life-cycle plans, including final disposition and no path to disposal information;
- Facility and operational information including capacities; and
- Barriers to disposition and technology needs.

Example: Information on DOE field waste management activities is provided to DOE-HQ through the "Accelerating Cleanup: Paths to Closure" reporting process using various systems and tools. The information is used to generate a DOE report that includes disposition maps used to help depict the waste management life cycle and any barriers that may exist for final waste stream disposition.

Compliance with this requirement is demonstrated by the existence of systems and processes for the collection and management of complex-wide information about DOE radioactive waste. The data systems should be updated on a routine basis, and support capacity and facility planning, resource and budget planning, integration and efficiency efforts, and lessons learned.

Supplemental References:

1. DOE, 1998. *Accelerating Cleanup: Paths to Closure*, DOE/EM-0362, U.S. Department of Energy, Washington, D.C., June 1998.

2. DOE, 1996. *Low-Level Waste Projection Program Guide*, U.S. Department of Energy, Office of Environmental Management, Washington, D.C., December 18, 1996.

I. 2.E. <u>Deputy Assistant Secretaries for Waste Management and Environmental Restoration</u>.

The Deputy Assistant Secretary for Waste Management and the Deputy Assistant Secretary for Environmental Restoration are responsible for:

(1) Disposal. Reviewing and approving, along with EH-1, transuranic waste disposal facility performance assessments and other disposal documents as required in waste specific chapters for which DOE is responsible for making compliance determinations. Reviewing and approving performance assessments and composite analyses, or appropriate CERCLA documentation, for low-level waste disposal facilities, and issuing disposal authorization statements.

(a) The Deputy Assistant Secretaries shall establish a review panel consisting of DOE personnel to review low-level waste disposal facility performance assessments and composite analyses, review appropriate CERCLA documentation, recommend low-level waste disposal facility compliance determinations to the Deputy Assistant Secretaries, and develop disposal authorization statements.

(b) The Deputy Assistant Secretaries shall issue disposal authorization statements containing conditions that low-level waste disposal facilities must meet in order to operate with an approved radioactive waste management basis.

Objective:

The objective of this requirement is to ensure that the evaluations conducted in the performance assessment for a transuranic waste disposal facility, and in the performance assessment (or appropriate CERCLA documentation) and composite analysis (or appropriate CERCLA documentation) for a low-level waste disposal facility, are found by DOE to be technically adequate, logical, complete, and defensible for establishing the controls on disposal of waste for protection of the public and the environment into the future. The evaluations and controls should result in a reasonable expectation that the standards of 40 CFR Part 191 will be met at the transuranic waste disposal facility or in a reasonable expectation that the performance objectives of Chapter IV of DOE M 435.1-1 will be met at the low-level waste disposal facility.

Discussion:

During the development of the requirements of DOE O 435.1 and DOE M 435.1-1, the safety and hazard analyses indicated that disposal is a critical activity requiring controls. Disposal is the final waste management function performed, yet the potential hazards from disposed radioactive waste will continue far into the future. Thus, there are specific requirements for the protection of the public, workers, and environment that are critical to maintaining safe and effective disposal of radioactive waste. Analyses conducted in a performance assessment for a transuranic and a low-level waste disposal facility (or appropriate CERCLA documentation for a low-level waste disposal facility), and the composite analysis (or appropriate CERCLA documentation) for a low-level waste disposal facility, are critical in determining the nature and extent of the controls that need to be put in place at the facility being evaluated. The review and approval of these evaluations is extremely important for management of transuranic and low-level waste to ensure it is being conducted safely and effectively. Therefore, the review and approval of these evaluations are assigned as the responsibility of senior management within the Office of Environmental Management.

The requirement states that it is the responsibility of the Deputy Assistant Secretaries for Waste Management and Environmental Restoration, within their respective programs, to review and approve certain radiological assessments for transuranic and low-level waste disposal facilities and to issue the disposal authorization statement based on the reviews. The discussions that follow provide guidance on the requirement for review and approval of the documents and issuance of the disposal authorization statement. The discussion begins with an explanation for excluding certain waste disposal from the DOE M 435.1-1, Section I.2.E.

Disposal of Transuranic Waste at WIPP and High-Level Waste. Requirement 4.d of DOE O 435.1 identifies WIPP and facilities and operations licensed by the Nuclear Regulatory Commission (NRC) or an Agreement State as having special requirements that supplement, or in many cases, replace requirements in DOE O 435.1 and DOE M 435.1-1. Requirement 4.d of the Order effectively ties the protection of the public, workers, and the environment--the major objective of DOE O 435.1--to key external legal drivers and regulations that achieve these goals at certain facilities managing DOE radioactive waste. Key among the facilities currently under external regulation for public, worker, and environmental protection are WIPP (certified by EPA), the proposed high-level waste repository (regulated by the NRC), and commercial waste treatment and disposal facilities utilized by DOE (regulated by the NRC or Agreement States) for treatment and disposal of low-level and mixed low-level waste. A DOE facility for the disposal of commercial (NRC licensed) Greater-than-class C (GTCC) low-level waste will also be regulated by the NRC, as specified in 10 CFR Part 61, Section 61.55 (a)(2)(IV) (see additional discussion on commercial (NRC licensed) GTCC in the guidance on the Complex-Wide Low-Level Waste Management Program (DOE G 435.1-1, Section IV.C)).

One effect of this requirement is that the design, construction, operation, closure, analysis of, licensing, permitting, and regulation of disposal of DOE transuranic waste at WIPP, and high-level waste at a proposed geologic repository, are evaluated and controlled by regulations and requirements outside of the DOE directives system. Based on the safety and hazard and requirements analyses conducted in the development of DOE O 435.1, and the review and approval of permitting and licensing documentation by other government organizations, it was concluded that there is no need to repeat any specific requirements from these external regulations within DOE M 435.1-1, or to define new requirements for disposal.

> *Example: The NRC requirements for siting, design, facility performance, package design, quality assurance, and training and certification of operators for a high-level waste disposal repository are found in 10 CFR Part 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories. No additional disposal requirements were determined to be necessary for inclusion in Chapter II of DOE M 435.1-1.*

The only requirements for disposal found in DOE M 435.1-1, Chapter II, *High-Level Waste Requirements*, and DOE M 435.1-1, Chapter III, *Transuranic Waste Requirements*, for disposal at WIPP, reference the regulatory drivers that have created the external requirements for disposal of these wastes. Guidance for Chapters II and III contains additional discussions concerning these drivers, and the disposal of high-level waste and transuranic waste.

Disposal of Transuranic Waste (not at WIPP). In cases where the Department disposes of transuranic waste in a facility other than WIPP (e.g., Greater Confinement Disposal at the Nevada Test Site), the Department is responsible for determining compliance with 40 CFR Part 191 and issuing a disposal authorization statement. Therefore, the requirement includes the responsibility for reviewing and approving performance assessments for a transuranic waste disposal facility for which DOE must make a compliance determination (i.e., other than WIPP). The Deputy Assistant Secretary for Waste Management and the Deputy Assistant Secretary for Environmental Restoration, along with EH-1, are responsible for reviewing and approving performance assessments for transuranic disposal facilities other than WIPP. A process similar to that described below for reviewing and approving low-level waste disposal facility performance assessments will be required. In developing the review criteria, DOE staff should evaluate the following:

- General provisions including purpose, scope, definitions, conditions of approval, and alternative provisions;

- Compliance certification including completeness and accuracy of submissions and reference materials;

- General requirements addressing inspections, quality assurance, models and computer codes, waste characterization, future state assumptions, expert judgment, and peer review;

- Containment requirements considering application of release limits, scope of performance assessments, consideration of drilling events in performance assessments, and results of performance assessments;

- Assurance requirements including active and passive institutional controls, monitoring, engineered barriers, and consideration of natural resources; and

- Individual and groundwater protection requirements considering the protected individual, exposure pathways, underground sources of drinking water, and the scope and results of the performance assessment.

Example: The Field Element Manager of a site with a small amount of transuranic waste that cannot be accepted for disposal at the Waste Isolation Pilot Plant confers with Headquarters and decides to construct a small transuranic waste disposal facility. The Manager directs the preparation of a performance assessment that provides a reasonable expectation of meeting the performance measures in 40 CFR Part 191 for the onsite facility. Since the facility is not WIPP, following approval at the site, the performance assessment is submitted to Headquarters for approval. The Deputy Assistant Secretary for Waste Management assigns the task of establishing criteria and conducting a review to a staff member. The staff member assembles a review team of technically qualified DOE and contractor staff. The team develops criteria for the review based on the Department's criteria for review of low-level waste disposal facility performance assessments. Upon completing its review, the team provides a recommendation to the Deputy Assistant Secretary who makes a final determination and documents it in a memorandum to the Field Element Manager.

Since 40 CFR Part 191 defines performance assessment, the contents of a performance assessment, and requirements for compliance, the transuranic waste chapter only contains reference to the 40 CFR Part 191 standards. Guidance on the transuranic waste disposal requirements in Section III.P of this document should be consulted for additional discussion.

<u>Disposal of Low-Level Waste</u>. Although some of DOE's low-level waste is disposed at commercial facilities, much of it is still disposed at DOE-owned and operated low-level waste disposal facilities. The Department meets its responsibilities under the *Atomic Energy Act of 1954*, as amended, by providing the requirements for protection of the public, workers, and the environment for its low-level waste disposal facilities in DOE O 435.1 and DOE M 435.1-1. Meeting the low-level waste disposal requirements remains a responsibility of DOE managers at

Headquarters and in the Field. DOE M 435.1-1, Chapter IV, *Low-Level Waste Requirements*, includes the detailed low-level waste disposal requirements. At the Headquarters level, the Deputy Assistant Secretaries for Waste Management and Environmental Restoration are responsible for reviewing and approving the performance assessments and composite analyses (or reviewing appropriate CERCLA documentation) for low-level waste disposal facilities and for issuing disposal authorization statements. For purposes of DOE O 435.1 and DOE M 435.1-1, the term "appropriate CERCLA documentation" means the written materials prepared to demonstrate compliance with the substantive requirements of DOE M 435.1-1 for low-level waste disposal facilities managed under CERCLA. Specifically included in such written materials are crosswalks between CERCLA requirements and DOE M 435.1-1 requirements which are used as the basis for issuance of a disposal authorization by the Deputy Assistant Secretary for Environmental Restoration.

<u>Low-Level Waste Performance Assessment and Composite Analysis Reviews</u>. Performance assessments are conducted to demonstrate that there is a reasonable expectation that low-level waste disposed of at a DOE facility will not result in exceeding low-level waste disposal facility performance objectives contained in DOE M 435.1-1, Chapter IV, *Low-Level Waste Requirements*, and related performance measures associated with protection of the public from disposed low-level waste. Composite analyses are conducted as a planning tool to analyze the interaction of other radioactive source terms at a site along with the low-level waste disposal facility to minimize the likelihood that current low-level waste disposal activities will result in the need for future corrective or remedial actions, and to protect the public and environment, consistent with Departmental limits on total allowable public doses of radiation from all sources.

Performance assessments and composite analyses are reviewed to determine that they are complete, comprehensive, reflective of site- and facility-specific conditions, are supported by appropriate rationale, and therefore, are defensible. These reviews are performed to provide the information to the Deputy Assistant Secretary for Waste Management or the Deputy Assistant Secretary for Environmental Restoration to conclude there is a reasonable expectation that the disposal performance objectives of Chapter IV will be met and will continue to be met.

<u>Review Panel</u>. The Deputy Assistant Secretaries for Waste Management and Environmental Restoration must formally establish a panel or group to review performance assessments and composite analyses. At the time of issuance of DOE O 435.1 and DOE M 435.1-1, the Low-Level Waste Disposal Facility Federal Review Group was established by the Deputy Assistant Secretaries for Waste Management and Environmental Restoration to manage the reviews of low-level waste disposal facilities prepared in accordance with DOE 5820.2A and DNFSB 94-2 commitments and make recommendations regarding performance assessment and composite analysis approvals and issuance of disposal authorization statements. The Low-Level Waste Disposal Facility Federal Review Group has been guided by the *Department of Energy LLW Disposal Facility Federal Review Group Performance Assessment and Composite Analysis*

Review Guidance Manual, Revision 0. Following issuance of DOE O 435.1, Revision 0 of the Low-Level Waste Disposal Facility Federal Review Group Manual will be revised to reflect any new guidance for reviews and approvals of performance assessments and composite analyses in accordance with DOE O 435.1 and DOE M 435.1-1 and will be issued as a DOE G 435.1-1 guide. The Low-Level Waste Disposal Facility Federal Review Group reports its findings on performance assessment and composite analysis reviews directly to the Deputy Assistant Secretaries.

> *Example: The Brown Site Low-Level Waste Disposal Facility Composite Analysis is submitted to Headquarters by the Field Element Manager for review. The Deputy Assistant Secretaries for Waste Management and Environmental Restoration convene the Low-Level Waste Disposal Facility Federal Review Group, who in turn selects a Team Leader to form the Brown Site Review Team to evaluate the Brown Site composite analysis against the Review Guide. The Low-Level Waste Disposal Facility Federal Review Group prepares a report based on the Brown Site Team review and submits their findings to the Deputy Assistant Secretary, Office of Waste Management. Based on the Low-Level Waste Disposal Facility Federal Review Group's findings, the Deputy Assistant Secretary makes a decision on approval of the composite analysis.*

Performance Assessments and Composite Analysis Approvals & Issuance of Disposal Authorization Statement. A review of a performance assessment and/or composite analysis performed by the Low-Level Waste Disposal Facility Federal Review Group or a similar review panel produces a report in the form of a compliance evaluation that is transmitted to the appropriate Deputy Assistant Secretary. The report recommends whether the disposal facility operations are to be approved, approved with conditions, or disapproved. The *Review Guide* contains detailed guidance on the compliance evaluation and approval recommendation.

The Deputy Assistant Secretary is responsible for issuing a disposal authorization statement in accordance with DOE M 435.1-1, Section IV.P.(5). The disposal authorization statement provides Headquarters approval of the performance assessment and/or composite analysis, and includes conditions deemed necessary for long-term protection of the public and the environment from the low-level waste disposal facility. In this fashion, the disposal authorization statement should be viewed as analogous to a license for a low-level waste disposal facility that would be issued by the U.S. Nuclear Regulatory Commission or an Agreement State. The disposal authorization statement will be issued to the Field Element Manager responsible for the disposal facility. The Field Element Manager must consider any conditions in the disposal authorization statement that are to be incorporated into the radioactive waste management basis (see DOE M 435.1-1, Section IV.D.(4)) for the facility. Additional detailed guidance on disposal authorization statements can be found in the guidance on DOE M 435.1-1, Chapter IV, *Low-Level Waste Requirements.*

Example: The Deputy Assistant Secretary for Waste Management and the Deputy Assistant Secretary for Environmental Restoration jointly issue the Disposal Authorization Statement Concerning Operation of the Brown Site Low-Level Waste Disposal Facility to the Field Element Manager. The Statement refers to the compliance evaluation prepared by the Brown Site Composite Analysis Review Team, which contains six conditions that must be implemented at the facility in order for operations to continue safely in accordance with the performance objectives. The compliance evaluation was reviewed by the Low-Level Waste Disposal Facility Federal Review Group, which transmitted its recommendation for approval with conditions, those conditions and a draft disposal authorization statement to the Deputy Assistant Secretaries.

CERCLA Documentation. As discussed in guidance for DOE M 435.1-1, Section I.2.F.(5), Environmental Restoration, Decommissioning and Other Cleanup Waste, environmental restoration remedies involving the development and management of radioactive waste disposal facilities under the CERCLA process are to meet the substantive requirements of DOE O 435.1. The original guidance on this topic was articulated in: 1) Policy for Demonstrating Compliance with DOE 5820.2A for Onsite Management and Disposal of Environmental Restoration Low-Level Waste under the *Comprehensive Environmental Response, Compensation, and Liability Act*, May 31, 1996 (DOE, 1996); and 2) Guidance for Complying With DOE 5820.2A, *Radioactive Waste Management*, for Onsite Management and Disposal of Low-Level Waste (LLW) from Environmental Restoration Activities (Alm, 1997). The major concepts of these policies are:

- The CERCLA requirements and DOE M 435.1-1 requirements include significant overlap in their substantive requirements given both are designed to ensure safe management and disposal of waste;

- The CERCLA process is to be used to comply with the requirements of DOE M 435.1-1 for environmental restoration actions;

- The substantive requirements of DOE M 435.1-1 should be directly incorporated into the CERCLA process to the extent practical and consistent with site-specific technical and regulatory issues; and

- The Department must demonstrate compliance with the substantive requirements of DOE M 435.1-1 to fulfill its responsibilities under the *Atomic Energy Act of 1954*, as amended.

When a proposed environmental restoration response at DOE sites on the National Priorities List (NPL) involves the development and management of a radioactive waste management facility, the CERCLA process will be used to assess the performance of the disposal facility. Subject to final

regulatory approval, the CERCLA process is expected to incorporate the substantive requirements of DOE M 435.1-1 as described in this section. For sites not on the NPL, DOE may initiate a response action in accordance with CERCLA under the authority assigned by Executive Order 12580, *Superfund Implementation.* In this case, if the remedy under consideration involves the development and management of a radioactive waste disposal facility, then the requirements of DOE M 435.1-1 are to be incorporated into the CERCLA documentation as described in this section, as appropriate, subject to final regulatory approval. There may be situations at non-NPL sites where DOE chooses to implement a remedy using its authority under the *Atomic Energy Act of 1954*, as amended, in which case the procedural requirements of DOE M 435.1-1 would also apply.

When consideration is being given to a cleanup response that requires development and management of a radioactive waste disposal facility under CERCLA, in most cases an analysis satisfying the requirement for a performance assessment will be prepared as part of the project-specific CERCLA document. The analysis is often contained in the Feasibility Study and is prepared in accordance with the National Contingency Plan (40 CFR Part 300). In some cases, an analysis will be performed which includes an evaluation of all interactive sources near the proposed disposal facility, as suggested in *EPA's Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A, Interim Final*. This analysis would essentially be equivalent to a composite analysis. If the CERCLA analysis does not include evaluation of all interactive sources at the proposed radioactive waste disposal facility, then a separate composite analysis is to be prepared. This separate analysis may be incorporated into the CERCLA process, including review by the regulatory agencies and stakeholders, or it may be handled as a document that is reviewed by the Low-Level Waste Disposal Facility Federal Review Group (LFRG) established under the authority of DOE M 435.1-1.

To fulfill DOE's responsibilities under the *Atomic Energy Act of 1954*, as amended, the Department must demonstrate compliance with the substantive requirements of DOE M 435.1-1 for low-level waste disposal facilities managed under CERCLA. A crosswalk between the CERCLA and the DOE M 435.1-1 requirements needs to be prepared and reviewed as described below when the cleanup action involves development and management of a radioactive waste disposal facility. It is not necessary to prepare a crosswalk to demonstrate compliance with DOE M 435.1-1 requirements for environmental restoration activities that do not involve development and management of a radioactive waste disposal facility.

The appropriate CERCLA documentation is to be submitted by the Field Element Manager to the Deputy Assistant Secretary for Environmental Restoration. For purposes of DOE O 435.1 and DOE M 435.1-1, the term "appropriate CERCLA documentation" means the written materials prepared to demonstrate compliance with the substantive requirements of DOE M 435.1-1 for low-level waste disposal facilities managed under CERCLA. Specifically included in such written materials are crosswalks between CERCLA requirements and DOE M 435.1-1 requirements

which are used as the basis for issuance of a disposal authorization by the Deputy Assistant Secretary for Environmental Restoration. Based on the appropriate CERCLA documentation, the Field Element Manager certifies that compliance with the substantive requirements of DOE M 435.1-1 has been achieved through application of the CERCLA process. Any other analyses that have not been incorporated into the CERCLA process require a separate review. The Deputy Assistant Secretary may assign the LFRG the task of reviewing the information submitted by the Field Element Manager. In this instance, the documents would be reviewed against the criteria set forth in the guidance entitled *Department of Energy LLW Disposal Facility Federal Review Group Performance Assessment and Composite Analysis Review Guidance Manual* (the *Review Guide*). Based on the content of the crosswalk, the LFRG will determine whether it needs to review the detailed analysis. The Low-Level Waste Disposal Facility Federal Review Group will report its conclusions from this review to the Deputy Assistant Secretary for Environmental Restoration. The Deputy Assistant Secretary for Environmental Restoration will use this information as the basis for deciding whether to issue a disposal authorization based on DOE's responsibilities under the *Atomic Energy Act of 1954*, as amended.

The disposal authorization statement does not impact the decision documented in the CERCLA Record of Decision on whether to build a facility because this decision is made through the CERCLA process. The disposal authorization statement specifies the limits and conditions on design, construction, operation, and closure of the radioactive waste disposal facility. The disposal authorization statement could be included as part of the Record of Decision. If this is the case, then the guidance on disposal authorization (Chapter IV) should be followed during the development of the ROD on CERCLA radioactive waste disposal facilities, to the extent practical. However, it should be understood that compliance with requirements of a law (e.g., CERCLA) does not release DOE of compliance with another law (e.g., *Atomic Energy Act of 1954*, as amended). DOE must determine that whatever actions are taken, *Atomic Energy Act* requirements are met.

> *Example: The remedial action on Operable Unit 34 at Site Q considers construction and operation of a facility for onsite low-level waste disposal. The CERCLA RI/FS contains analyses equivalent to the performance assessment and composite analysis required in DOE M 435.1-1. The site prepares a crosswalk between the CERCLA NCP and DOE M 435.1-1 requirements that demonstrates that the RI/FS documents contain the substantive requirements of DOE M 435.1-1. The Low-Level Waste Disposal Facility Federal Review Group evaluates the crosswalk and, if necessary, selected supporting documentation against the guidance and criteria in the Review Guide, and presents their conclusions to the Deputy Assistant Secretary for Environmental Restoration. Based on the evaluation and conclusions, the Deputy Assistant Secretary for Environmental Restoration decides whether to issue a Disposal Authorization.*

Demonstrating Compliance. Compliance with this requirement is demonstrated by:

- Establishment of qualified panels to conduct reviews of performance assessments, composite analyses, and, as requested, appropriate CERCLA documentation for environmental restoration activities involving the development and management of a radioactive waste disposal facility;

- Performance of the reviews by the panels and use of the results that leads to a decision on operations and long-term protectiveness of a low-level waste disposal facility, or compliance with 40 CFR Part 191 for a transuranic waste disposal facility; and

- Documentation of such decisions for low-level waste disposal facilities in a disposal authorization statement issued by the appropriate Deputy Assistant Secretary (for Waste Management or for Environmental Restoration) to the cognizant Field Element Manager. The disposal authorization statement contains conditions that the disposal facility must meet in order to operate under an approved radioactive waste management basis. For environmental restoration activities, if the CERCLA Record of Decision is to serve as the disposal authorization statement, it must include the same information as stated above, or the disposal authorization statement can be issued separately.

Supplemental References:

1. DOE, 1999. *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (in preparation), DOE G 435.1-1, U.S. Department of Energy, Washington, D.C., 1999.

2. DOE, 1999. *Review Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (in preparation), DOE G 435.1-2, U.S. Department of Energy, Washington, D.C., 1999.

3. DOE, 1999. *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses.* (in preparation), DOE G 435.1-3, U.S. Department of Energy, Washington, D.C., 1999.

4. EPA, 1985. "Final Rule; Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

5. EPA, 1989. *Risk Assessment Guidance for Superfund, Vol. 1, Human Health Evaluation Manual (Part A),* Interim Final, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C., December 1989.

6. EPA, 1993. "Final Rule; Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register,* Vol. 58, No. 242, U.S. Environmental Protection Agency, Washington, D.C., December 20, 1993.

7. DOE 1996. *Interim Format and Content Guide, and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments,* U.S. Department of Energy, Washington, D.C., October 1996.

8. DOE 1996. *Interim Review Process and Criteria for Department of Energy Low-Level Waste Disposal Facilities Composite Analyses,* U.S. Department of Energy, Washington, D.C., November 1, 1996.

9. DOE, 1996. *Interim Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy Low-Level Waste Disposal Facilities*, U.S. Department of Energy, Washington, D.C., October 1996.

10. DOE, 1998. *Department of Energy LLW Disposal Facility Federal Review Group, Performance Assessment and Composite Analysis Review Guidance Manual,* Revision 0, U.S. Department of Energy, Washington, D.C., September 1998.

I.2.E.(2) Site Closure Plans. Reviewing and approving closure plans and other closure documentation for deactivated high-level waste facilities/sites and issuing authorization for closure activities to proceed.

Objective:

The objective of this requirement is to ensure that closure activities for deactivated high-level waste facilities/sites do not proceed prior to the review/approval of the site closure plans .

Discussion:

The scope of the requirement, and this guidance, applies only to deactivated high-level waste closure plans, and other closure documents, e.g., CERCLA documentation, developed in accordance with the requirements of DOE M 435.1-1, Chapter II.U., Closure. The requirement

does not apply to the Decommissioning path documentation required by Section II.U. The documentation and review/approval requirements for this path are defined in DOE O 430.1A and DOE 5400.5 and are not repeated in this guidance.

This requirement is to be implemented by the Offices of the Deputy Assistant Secretary for Waste Management and the Deputy Assistant Secretary for Environmental Restoration, and their staff. However, since the requirement requires prior review and approval by the submitting Field Element Manager, guidance for Section I.2.F.(8), Closure Plans, should be consulted in implementing this requirement.

During the development of the requirements for DOE O 435.1 and DOE M 435.1-1, one high-level waste site was in the process of initiating closure activities for storage tanks. Additionally, DOE was in the process of responding to DNFSB Recommendation 94-2 related to the performance of low-level waste disposal facilities. These two activities required consistency in implementation, and influenced the final requirements. Closure is the final waste management function performed, yet the potential hazards from residual radioactive material within the facility or at the site must be assessed to determine their suitability for unrestricted use of the facility/site; or, if not suitable for unrestricted access, to determine the activities necessary to be incorporated into the site closure plan to protect members of the public, workers, and the environment. The development, review and approval, and implementation of high-level waste facility/site closure plans and other closure documentation are crucial functions in assuring that closure will be, and is being, conducted safely and effectively, and that the closed facilities/sites will remain safe.

Objectives of the DOE Headquarters Review and Approval. Closure of deactivated high-level waste facilities can be executed under three paths, as explained in the requirement and guidance for closure in DOE M 435.1-1, Section II.U. Closure conducted by the first path, Decommissioning, performed under the provisions of DOE O 430.1A and DOE 5400.5, is not discussed in this guidance. Refer to these Orders, and guidance, for details on documentation requirements and review/approval requirements. For the remaining two closure paths, CERCLA (Section II.U.(2)) and Closure Plans (Section II.U.(3)), the Deputy Assistant Secretary for Waste Management or the Deputy Assistant Secretary for Environmental Restoration, as appropriate, must review and approve the appropriate closure documentation and issue an authorization to proceed with closure activities. This authorization is required prior to the commencement of remedial actions or activities that cannot be reversed without expending significant resources. Such activities include, for example, remedial actions such as decontamination activities or the placing of immobilization materials in a deactivated high-level waste tank. Excluded are such activities as design and field survey work which are needed to support the development of a closure plan or other documentation.

As discussed in the guidance to Section II.U, closure plans are expected to be two-tier documents, i.e., their development and review/approval are expected to be conducted in two

phases. This multi-phase process is considered necessary because much of the data needed may not be available initially, but becomes available as engineering data and/or other documents/permits are developed. Headquarters review and approval is primarily focused on the first tier plans, from which subsequent plans are developed.

The first tier plan, which is to be approved by the Deputy Assistant Secretaries for Waste Management and/or Environmental Restoration (Section I.2.E.(2)), is intended to define and bound the parameters of a closure action(s). This level of closure plan should include, at a minimum the following:

- closure methodology;
- schedules and assumptions
- site or individual closure standards/performance objectives;
- allocation of closure standard/performance objective budgets to individual facilities/sites;
- assessment (preliminary) of the projected performance of each unit to be closed relative to the allocated performance objectives;
- assessment (preliminary) of the projected composite performance of all units to be closed at the site;
- alternatives (if any);
- waste characterization data;
- closure controls plans; and
- stakeholder concerns.

While the availability of some of the above information may be limited and therefore preliminary, it is necessary to ensure that a credible, bounding review can be conducted by DOE Headquarters. The Deputy Assistant Secretaries for Waste Management and/or Environmental Restoration are responsible for issuing an authorization to proceed with closure activities to the responsible Field Element Manager. This authorization to proceed with closure activities represents DOE Headquarters approval of the first tier site closure plan, or other closure documentation, as adequately representing and assessing the closure action planned. In addition, the authorization to proceed with closure activities contains any conditions on which the approval of the plan or documentation is based.

As discussed in the guidance to Section II.U., once approved it is expected that closure plans will be updated periodically, as determined by the Field Element Manager, to reflect revised analysis and the status of individual facility closure actions that are part of a site closure. However, once DOE Office of Environmental Management review/approval is gained on the first tier documentation and an authorization to proceed is issued, additional DOE Office of Environmental Management approvals are not required provided the bounding conditions defined in the DOE

Office of Environmental Management-approved first their plan(s) are not exceeded. (See the guidance for Section II.U for an example.)

The assessments of the projected performance of each unit to be closed and the assessment of the projected composite performance of all units to be closed are critical to deactivated high-level waste facility closure activities. Therefore, the DOE Headquarters technical review includes the determination of the adequacy of these analyses to establish the expected performance of the closed facility/site, the potential hazards, and the activities necessary to protect members of the public, workers and the environment. The review and approval of the assessment/analysis is extremely important to ensure that the assumptions regarding source term, leach rates, transport mechanisms, analytical transport models, hydrologic and other critical aspects of the site, effectiveness of any barriers to migration of radionuclides on which performance is based, and other key assumptions are supported by the available data. Furthermore, uncertainties associated with the key assumptions and are data addressed through identification of compensatory measures, through combinations of conservatism in the estimates, defense-in-depth, or other appropriate measures. The review specifically examines and documents the conclusions of the review with respect to the adequacy of each of these key assumptions.

The reviews of the assessment of performance or composite analysis documentation provide the basis for approving/disapproving the evaluations contained within them. The Deputy Assistant Secretary with authority over the facility/site is responsible for issuing an authorization to proceed with closure activities to the responsible Field Element Manager. The authorization to proceed with closure activities represents DOE Headquarters approval of the site closure plan, and other closure documents as adequately representing and assessing the closure action planned. This includes the acceptance of the assessment of performance and composite analysis, the identification of long-term hazards, and establishment of the necessary closure activities to ensure the protection of the public and the environment. In addition, the authorization to proceed with closure activities contains the conditions on which the approval of the plan or documentation is based.

> *Example: The authorization to proceed with closure activities for deactivated high-level waste Tank XYZ at Site A specifically lists the key assumptions on which the performance is based (e.g., source term for the specific tank and for other contributors, leach rates, transport mechanisms, transport models, hydrologic and other critical aspects of the site, assigned effectiveness of barriers to retard the migration of radionuclides, the uncertainties in the available data and the measures incorporated in the plan to account for uncertainties), and the controls (e.g.,the boundary for institutional controls to restrict access, and the time period for the restriction) necessary for the long term protection of the public, workers, and the environment both during and after closure.*

Process for Review and Approval of Site Closure Plans and Other Closure Documents. The Deputy Assistant Secretaries for Waste Management and Environmental Restoration should establish a cohesive and systematic process to evaluate the technical adequacy of the submitted closure plans and other closure documents including the assessments of performance or composite analysis, and to formulate recommendations to the Deputy Assistant Secretaries regarding approval/disapproval of the plan, and the potential issuance of authorization for the closure activities to proceed. This process should include the following elements:

1. Acceptance Review--Determine that the closure plan is acceptable detailed technical evaluation by determining that all the essential elements of the plan as outlined in the requirement in DOE M 435.1-1, Section II.U, and the associated guidance, are contained in the plan.

2. Review Team--A review team is established whose members include subject matter experts from Headquarters or the field who do not, by virtue of their current or past alignments, have a conflict of interest that would prevent an objective and effective review.

3. Review Team Responsibilities--The responsibilities of the team members are established as well as the administrative procedures, to include quality assurance, by which the review will be conducted and documented.

4. Site Visits--The process for conducting site visits is established, whenever it is determined by the team members to be prudent for such visits in order to acquaint the team members with the actual circumstances of the facility/site and thus prepare them to conduct the evaluation of the documentation.

5. Technical Reviews--A overall strategy for evaluating the assessment of performance and composite analysis and other closure technical documentation is established, and includes the specific criteria on which the team is to render its findings. A detailed plan to conduct the review is prepared and assignments made to team members based on their expertise and experience.

6. Reporting--An outline of the report is established which contains the findings of the review team with respect to each criterion, a recommendation on the adequacy of the closure plan and a recommendation relative to issuance of an authorization to proceed with closure activities. The report contains any other essential elements that the Deputy Assistant Secretaries may require on which to base their decision.

The *Low-Level Waste Disposal Facility Federal Review Group Manual* provides a systematic process that can be tailored to provide a documented process for review of site closure plans, and

other closure documents, for deactivated high-level waste facilities/sites and the issuance of an authorization to proceed with closure activities. The process should be interactive, involving the subject matter experts and the field site personnel to obtain clarifications and additional data as required to support the review and approval activities.

Analysis conducted during the performance assessment and composite analysis needs to be integrated into closure planning. Conversely, any information that becomes available during the closure operations, or any changes made to closure of the facility, that impact the analysis in the assessment of performance and composite analysis needs to be incorporated into these evaluations in a reasonable period of time to determine the extent of their impact. When major impacts are identified or when major changes are required to the closure plan that affect the conditions or the controls as contained in the authorization to proceed with closure activities, it is the Field Element Manager's responsibility to conduct a review and re-approve the revised analysis. In addition, it is the Field Element Manager's responsibility to inform the appropriate Deputy Assistant Secretary of the changes. Upon receipt of such notification, the Deputy Assistant Secretary reviews the changes and determines what action, if any, is required. At a minimum, the revised closure plan or analysis is distributed to organizations that have an interest in it.

Compliance with this requirement is demonstrated by:

- The authorization to proceed with closure activities at the facilities/sites contains the conditions for authorization, and the controls necessary to protect the public, workers, and the environment during and after closure;

- Physical closure activities for high-level waste deactivated facilities/sites do not proceed prior to the review and approval of closure plans by the appropriate Deputy Assistant Secretary (based on a formal documented review process) and the issuance of an authorization(s) to proceed with closure activities at the facilities/sites;

- Closure operations are actively monitored by the Field Element Manager to ascertain compliance with the conditions and controls as contained in the authorization, and to ensure that whenever any information that becomes available during the closure operations, or any changes made to closure of the facility that impact the analysis in the assessment of performance and composite analysis are incorporated into these evaluations to determine the extent of their impact; and

- The appropriate Deputy Assistant Secretary requires site closure plans and other closure documents to be re-submitted for review and approval when analysis indicates the bounding conditions within the first tier plans or documents may be exceeded.

Supplemental References:

1. DOE, 1998. *Low Level Waste Disposal Facility Federal Review Group Manual*, Revision 0, U.S. Department of Energy, Washington, D.C., September 1998.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(1) Site-Wide Radioactive Waste Management Programs. Developing, documenting, implementing, and maintaining a Site-Wide Radioactive Waste Management Program. The Program shall use a systematic approach for planning, executing, and evaluating the site-wide management of radioactive waste in a manner that supports the Complex-Wide Radioactive Waste Management Programs and ensures that the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

Objective:

The objective of this requirement is to ensure that radioactive waste is managed in a safe, effective, and efficient manner; radioactive waste management activities are integrated, coordinated, and support site-wide and complex-wide goals and objectives; and progress towards goals and objectives are measured and evaluated, and feedback is provided for continued improvement of the management of radioactive waste. Additionally, the requirement is to ensure there are mechanisms in place for providing input to and receiving direction from the complex-wide programs.

Discussion:

Sites with radioactive waste shall develop and document a Site-Wide Radioactive Waste Management Program. To the extent practical, the site-wide program and documentation requirement may be met by existing site programs and documents. Multiple programs or documents can be used or existing programs or documents can be supplemented to meet this requirement. While the use of existing programs or documents to meet this requirement is encouraged, what constitutes the site-wide program and its associated documentation is to be clearly defined and maintained so that ambiguity is avoided. Implementing and maintaining the Site-Wide Radioactive Waste Management Program should be addressed in site-specific procedures. These procedures should require periodic review of the Site-Wide Radioactive Waste Management Program, and review whenever there is a change to complex-wide programs or plans, site-specific radioactive waste management activities, or DOE policy or directives regarding the management of radioactive waste. These reviews should evaluate the status of the Site-Wide Radioactive Waste Management Program and its associated documentation and the program’s continued validity over time or under the changed circumstances.

The site-wide program addresses all of the site’s radioactive waste, including any off-site radioactive wastes managed by the site. Additionally, all radioactive waste is to be categorized

and managed as high-level, transuranic, low-level, or mixed low-level waste to facilitate consistent, efficient, and effective management of radioactive waste among sites. Guidance on the categorization and management of radioactive waste can be found in Section I.1.C.

The site-wide program provides for the systematic planning, execution, and evaluation of site radioactive waste management activities in a manner that supports the Complex-Wide Radioactive Waste Management Programs. The site-wide program incorporates the direction of the complex-wide programs into site-level planning, execution, and evaluation activities as appropriate. The site-wide program reflects complex-wide direction and also includes site-specific activities necessary to accomplish site missions and result in the safe, effective, and efficient management of radioactive waste in a proactive manner. The site-wide program includes mechanisms for providing input into the complex-wide programs (such as radioactive waste inventories and projections and the identification of technical and programmatic issues and other constraints). The complex-wide and site-wide programs are to be integrated and provide input in both directions. The Complex-Wide Radioactive Waste Management Programs and program plans guidance can be found in Sections I.2.B and I.2.D.

The site-wide program provides personnel with an understanding of the site's radioactive waste management needs and the strategy for meeting those needs; identifies the organizational responsibilities and the facilities and methods that will be used by the site to meet those needs; and establishes evaluation and feedback programs to facilitate continuous improvement of the site-wide program. The program should implement the requirements of DOE M 435.1-1 and other directives and regulations such as those listed in DOE M 435.1-1, Section VI.1.D (e.g., radiation protection requirements of DOE 5400.5 and 10 CFR Part 835, quality assurance requirements of DOE O 414.1 and 10 CFR 830.120) for waste management activities.

The Field Element Manager is assigned the responsibility for the Site-Wide Radioactive Waste Management Program. This establishes a clear management responsibility for radioactive waste management activities at a site. It is the Field Element Manager's responsibility to decide how to meet this requirement. A site may have separate programs for each waste type at the site or one program that addresses all waste types at the site, however, it is not important that each site have one single program.

> *Example: At a site that manages mostly transuranic waste, but also small amounts of low-level and mixed low-level waste, the Field Element Manager has one program that addresses all three waste types. At another site where large amounts of high-level and low-level waste are managed by different organizations, the Field Element Manager has two separate programs. In this situation, the interface between the programs (with respect to the generation of low-level waste, including waste incidental to reprocessing, under the high-level waste program and its transfer to the low-level waste program) should be addressed.*

Additionally, each site may have a Site-Wide Radioactive Waste Management Program or several sites may be covered under one program.

> *Example: A Field Element Manager is responsible for the management of DOE radioactive waste at a DOE site and three off-site locations. Based on the types of waste being managed and the organizations involved, the Field Element Manager develops and supports two programs. One program covers the radioactive waste at the primary DOE site and a separate program covers the radioactive waste at the three off-site locations. The rationale for this approach is included in the documentation for each program.*

In addition to its role defining the radioactive waste program at a site, the documented Site-Wide Radioactive Waste Management Program may also serve as the site's end-state description for radioactive waste at that site, or as a primary reference document for such a plan. A well-documented Site-Wide Radioactive Waste Management Program could significantly facilitate development of radioactive waste end-state documents at individual sites.

<u>Systematic Approach</u>. Applying a systematic approach for planning, executing, and evaluating the site-wide management of radioactive waste facilitates the integration and coordination of radioactive waste management activities across both the site and the DOE complex. In addition, it provides a framework within which the site can identify and communicate a logical approach for effecting waste management activities (planning), manage waste in a manner that is protective of worker, the public, and the environment (executing), and provide measures of progress towards completing site and complex-wide goals, as well as generating feedback to support continuous improvement of the radioactive waste management program (evaluating).

The following sections describe components that are part of a systematic approach to waste management. Whereas there are various methods of implementing a systematic approach, each will generally include some common elements. The most basic element is defining the mission or what the program intends to accomplish. Another common element is the identification of the functions or what needs to be done to accomplish the mission. At the top level, these functions are the program planning, execution, and evaluation. Within the execution function are the functions necessary for management of the waste, generally identified as generation, storage, treatment, and disposal. Another key element is the identification and implementation of requirements and constraints. These include regulatory requirements, commitments or agreements with regulatory or oversight bodies, programmatic requirements, and technical or process requirements.

> <u>Planning</u>. Applying a systematic approach to planning results in a process which can be used to support decision-making related to radioactive waste management activities and should involve consideration of the following topics which are discussed below in more detail:

- Establishing goals, objectives, and milestones;
- Establishing priorities and prioritizing the goals, objectives, and milestones;
- Describing the radioactive waste management boundaries and interfaces;
- Waste projections;
- Identifying the constraints and assumptions;
- Establishing the integrated site strategy;
- Performing life-cycle radioactive waste management planning;
- Defining the schedule; and
- Identifying funding needs.

Goals, Objectives, and Milestones. Long-range goals, interim objectives, and specific milestones, meaningful to the program are to be established. The site-wide program goals should reflect complex-wide direction as well as site-specific goals. The site-wide program should also include site-specific activities necessary to accomplish site missions and result in the safe, effective, and efficient management of radioactive waste in a proactive manner and support the complex-wide established goals, objectives, and milestones as appropriate. Goals, which are long-range in nature, should include descriptions of end-state conditions for facilities, operations, activities, or waste categories, and should be challenging yet achievable. Interim objectives and specific milestones should be established to provide measurements of progress towards goals.

Example 1:
Complex-wide goal: close high-level waste storage tanks.

Supporting site-wide goal: complete closure of all high-level waste storage tanks at the site.

Objective: complete closure of all high-level waste storage tanks in Area 1 by December 2010.

Specific milestones:
- *Complete negotiations with State regulators on criteria for tank closures–August 1999.*
- *Gain acceptance by DOE Headquarters and technical assistance from NRC on guidelines for determining residual tank waste is incidental to reprocessing–February 2000.*
- *Complete partial closure of Tank 1A–September 2002.*
- *Complete partial closure of Tank 1B–June 2003.*
- *Complete partial closure of Tank 1C–October 2005.*

Example 2:
Complex-wide goal: dispose of all defense transuranic waste at the Waste Isolation Pilot Plant.

Supporting site-wide goal: ship all defense transuranic waste stored at the site to the Waste Isolation Pilot Plant.

Objective: begin shipping transuranic waste to the Waste Isolation Pilot Plant (WIPP) by May 2008.

Specific milestones:
- *Develop and get WIPP approval of waste certification program-June 1999.*
- *Initiate retrieval of waste from bermed storage-January 2001.*
- *Complete preparation and authorization of TRUPACT-II loading facility-March 2003.*
- *Complete retrieval of waste from bermed storage-September 2005.*
- *Ship 2000 cubic meters of waste to WIPP-May 2008.*

Example 3:
Complex-wide goal: dispose of all low-level waste placed in storage prior to 1998.

Site-wide goal: eliminate waste placed in storage at the site prior to 1998.

Objective: reduce volume of legacy waste in storage by 50 percent by December 2000.

Specific milestones:
- *Obtain authorization to ship low-level waste to Nevada Test Site-June 1998.*
- *Begin monthly shipments of 50 drums from Building 300-August 1998.*

Priorities and Prioritizing the Goals, Objectives, and Milestones. Site-wide priorities should be established and then be used to prioritize the site-wide goals, objectives, and milestones. The site-wide priorities should reflect complex-wide policy and integration efforts and should also include priorities which reflect site-specific conditions and needs that will result in the safe, effective, and efficient management of radioactive waste in a proactive manner. Establishing priorities should involve consideration of providing protection to workers, the public, and the environment; meeting regulatory requirements, legal commitments, or agreements; availability of technologies, facilities, and capacities; and available funding.

Example:

1) *Ensure continued safe storage of site radioactive waste inventories.*
2) *Reduce radiation exposures to workers.*
3) *Acquire necessary characterization technology, including assay capabilities.*
4) *Obtain approval of waste certification programs for all generating facilities at the site.*
5) *Reduce storage inventories of radioactive waste at the site.*

Boundaries and Interfaces. The site-wide radioactive waste management program is to be clearly defined and described, including: organization and responsibilities; facility, operation, and activity descriptions; existing and projected radioactive waste inventories; and storage, treatment, and disposal capacities.

The organizational and functional responsibilities of participants in the site-wide program and their interrelationships are to be identified and described. In addition to site organizations, interfaces with both Headquarters and other Field organizations are also identified and described, as appropriate, including a discussion of their respective roles and interactions in planning, executing, and evaluating site-wide radioactive waste management program activities.

Program documentation should include a brief description of the facilities, operations, and activities that constitute the site-wide radioactive waste management program and the interfaces between the site facilities, operations, and activities and other site facilities, operations, and activities, as well as other programs (e.g., Environmental Restoration or Defense Programs). A brief discussion of new facilities that have been identified as necessary to implement the radioactive waste management program, and the plans for funding, constructing, and obtaining authorization to operate these facilities is included at appropriate.

An accounting of the current radioactive waste inventories and treatment, storage, and disposal capacities by facility and expected waste generation and receipt projections should also be included. Site personnel should be made cognizant of the need for accurate inventory and projection data to support the planning, execution, and evaluation of site-wide radioactive waste management activities, as well as, the complex-wide programs. The purpose is to ensure that all radioactive wastes the site is expected to manage and site capacities are considered in planning, executing, and evaluating site-wide radioactive waste management activities.

Example: A site develops a document which is the compilation of the information provided to Headquarters for the "Accelerating Cleanup: Paths to Closure"

report. This site specific report represents a summary of the site baseline and includes disposition maps to aid in visualizing the system.

Waste Projections. A primary element in the Complex-Wide Radioactive Waste Management Program, waste projections should be implemented by the Site-Wide Programs, where data collection can be made most efficiently.

The methodology used for projecting waste data is to be documented. The major assumptions used in developing the estimates, the known activities and operations being undertaken at the facilities included in the projections, and the steps (treatment, storage, disposal) required for managing the radioactive waste should be included in the documentation. The estimation techniques used are to rely on documented information wherever possible, such as Remedial Investigation studies for cleanup projects and shipment manifests for operational radioactive waste. The information is to be consistent in detail and content with that being used to characterize ongoing waste generation.

The projections data developed through site-wide program should be collected, formatted, and reported so that they are easily integrated into the Data Management System that is established under the DOE M 435.1-1, Section I.2.D.(2), *Waste Management Data System.* The projections data should also be consistent and collected so that they can be easily integrated into life-cycle planning; complex-wide configuration of radioactive waste management facilities; and evaluations of treatment, storage, and disposal facilities capacities.

Example: As part of the update to the "Accelerating Cleanup: Paths to Closure" report, a site revises and updates its waste projection data. The data are input into a complex-wide standardized system and reports are generated.

Constraints and Assumptions. The site radioactive waste management program should document the significant constraints which affect planning, execution, and evaluation. These are generally those pre-existing conditions, commitments, or other factors that affect activities that can be performed or must be performed, or that otherwise limit the flexibility of the site-wide program. The constraints and assumptions should include basic tenets and policies adopted by DOE and the site, assumptions made by the site, interagency agreements, regulatory requirements or commitments (e.g, compliance orders), records of decision from *National Environmental Policy Act* evaluations, physical capacity constraints (space or through-put limits of facilities), and other resource constraints (e.g., capacity, resources, funding), and direction in the Complex-Wide Radioactive Waste Management Programs. Uncertainties should be identified along with the assumptions which provide a basis for proceeding.

Example 1: Complex-wide basic tenet: disposal of high-level radioactive waste shall be in accordance with 40 CFR Part 191.

Example 2: Complex-wide assumption: it is assumed that under current legislative constraints, non-defense transuranic waste will not be disposed of at WIPP.

Example 3: Site-wide constraint: funds for shipping stored waste to a disposal facility are limited and will result in only being able to ship 45 percent of the waste that is ready for shipment.

Example 4: Site-wide assumption: the Q Area disposal facility for non-mixed low-level waste will continue to operate for the indefinite future.

<u>Integrated Site Strategy</u>. The program is to document the strategy that will be used and the associated rationale to accomplish the site-wide program goals, objectives, and milestones. This strategy should address the allocation of funds and resources, consider the configuration of existing and the need for new physical assets, be based on current and projected inventories of radioactive waste (including current waste streams, stored waste with a path to disposal, and stored waste without a path to disposal), support the site goals, objectives, and priorities, consider land-use (present and future), and respond to stakeholder input. Incorporation of waste minimization and pollution prevention philosophies into site-wide radioactive waste management activities, and research and development needs and activities also are to be addressed in the strategy.

Example 1: A site needs to increase its current high-level waste evaporation capacity to meet the requirements of an agreement with the State regulator. One option is to enhance the current capacity by upgrading it, however, this may pose risks to operating personnel in terms of radiation exposure, as well as reduced evaporator availability and long-term reliability. Another option is to replace the existing evaporator(s) with a new one, however, this option will require time (e.g., Congressional support, State acceptance) to gain project line-item funding. The selection of the option to upgrade is documented to be consistent with the site-wide and complex-wide program goals, objectives, and milestones; stakeholder input; schedule commitments; and expected funding.

Example 2: A site needs transuranic waste assay capability. One option is to plan for and indicate the activities and schedule for using a portable assay facility. A second option is to build a new assay facility at the site. The selection of the option to build a new facility is documented to be consistent with site-wide program goals, objectives, and milestones; stakeholder input; and schedule

commitments. The plans for the funding, constructing, and obtaining authorization to operate the facilities are also documented. The strategy was also documented to be consistent with complex-wide goals, objectives, and milestones for making WIPP shipments from the site.

Life-cycle Radioactive Waste Management Planning. It is the intent of the requirement for life-cycle planning that disposition for all radioactive waste at a site is addressed. By evaluating all phases in the life-cycle of the waste, adequate capabilities can be provided and ensured for handling the radioactive waste and identifying any potential issues that need to be resolved. Life-cycle waste management planning is to address current waste streams (also see guidance on Waste Generation Planning in Sections II.K, III.H, and IV.H), stored waste with a path to disposal, and stored waste without a path to disposal.

The following are elements that are to be included in the life-cycle waste management planning process for a waste stream:

Waste identification - waste is identified in terms of its source (what facilities and what activities are the sources of the waste), and its characteristics. The waste characteristics should include radiological, chemical, and physical characteristics that need to be considered in determining the disposition of waste.

Waste management steps and locations - the steps necessary for managing the waste are described along with an identification of the specific means for accomplishing the steps. This should include:

- Characterization/certification;
- Storage;
- Treatment/pre-treatment/immobilization;
- Transportation; and
- Disposal.

Example 1: Site Z generates low-level waste streams which are collected once a month from three buildings by central waste management. Central Waste Management certifies it in accordance with an existing certification program and ships it to the Nevada Test Site for disposal on an arranged schedule. The life-cycle waste management planning documentation simply includes that the waste will be characterized in Laboratory L, collected weekly by the Waste Management Organization and staged in Storage Building S, certified in accordance with an existing program, and transferred for disposal at Nevada Test Site Area 5 when sufficient waste to justify a shipment is available (every 6-8 months).

Example 2: Scheduling waste shipments to the WIPP facility is highly complex, requiring the scheduling of TRUPACT-II shipping containers and their associated tractor-trailer units, and the opening and closing of transportation corridors from each DOE transuranic waste management site to the WIPP. A site managing transuranic waste would plan site waste management activities and transportation preparations so that waste is ready to ship on the schedules identified in the National Transuranic Waste Management Plan (CAO, 1996b).

Scheduling. A schedule of activities necessary to implement the site-wide program is to be developed. The schedule should address developing and maintaining the infrastructure for managing waste and the management of current waste streams, stored waste with a path to disposal, stored waste without a path to disposal, and projected wastes.

Funding. The site program documentation is to include cost estimates, as appropriate, for addressing the site-wide management of radioactive waste. These cost profiles should be consistent with the integrated site strategy and anticipated funding levels. Cost and budget information should be provided in sufficient detail, by fiscal year, to identify key programs, activities, and projects. Proposed privatization efforts, planned productivity improvements, and other efforts of interest should be identified separately.

Execution. The systematic execution of the site waste management program is the actions taken to manage the waste and develop the attendant documentation. The documentation is prepared consistent with the site's management of radioactive waste, operating procedures, radioactive waste generator requirements (waste characterization, waste certification, and waste transfer), radioactive waste acceptance requirements, closure plans, etc.

Example: Documentation of the execution of the waste management activities for a storage facility include:

- *personnel training records,*
- *safety documentation governing the facility,*
- *facility waste acceptance criteria and procedures,*
- *certification program description,*
- *receipt records,*
- *certification records,*
- *waste transfer records,*
- *monitoring program/procedures,*

- *monitoring records, and*
- *corrective action records.*

Evaluation. An important part of any program is evaluating progress in the program. Progress should be measured and compared with programmatic goals as well as environmental, health, and safety parameters. A systematic evaluation should include the following elements:

- Performance Measures - metrics to be used in evaluating performance against program, environment, health, and safety goals;
- Performance Data - collection of performance data to support the evaluations;
- Performance Evaluation and Reporting - reduction of data interpretation and evaluation; and
- Feedback - identifying and recommending potential changes in program policies, strategies, goals, priorities, or interfaces.

Example: A site has the goal of eliminating waste placed in storage at the site prior to the year 2000. The Site's objective is to reduce volume of waste in storage by 50 percent by December 2002. A milestone for this goal and objective is obtaining permission to ship waste in storage to the Nevada Test Site by June 2000, beginning monthly shipments of 50 drums from Building 300 by August 2000. Performance measures were identified which would evaluate performance against both the interim objective and specific milestones since both provide measurable progress towards meeting the goal. For the objective, the volume of waste in storage was determined and verified. The reduction in volume of this waste was used to measure progress towards meeting the objective. For the milestone to obtain permission to ship waste to the Nevada Test Site, the steps were identified and a schedule developed which ended with receiving permission in June 2000. This schedule was then used to measure progress towards meeting this milestone. The performance measures for the monthly shipments were identified assuming shipments were able to begin in August 2000 and continue through December 2002. The number of shipments per month and drums per shipment, and the total number of shipments and drums shipped to date were used as performance measures. The performance data were collected monthly and compared to the reference data and performance evaluated and reported. Evaluation indicated that progress towards meeting the specific milestone was on track to successful completion.

The process of planning, execution, and evaluation is an iterative process. The lessons learned from the activities undertaken during one fiscal year, or changes in the assumptions on which the program strategy was originally based will require revising the program planning.

Compliance with this requirement is demonstrated if a site-wide program plan(s) is developed for each of the waste types specified in DOE M 435.1-1. The site-wide plan(s) should support the complex-wide plans by incorporating the direction of the complex-wide plan into site-level planning, execution, and evaluation activities.

Supplemental References:

1. CAO, 1996a. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April, 1996.

2. CAO, 1997. *The National Transuranic Waste Management Program*, Revision 1, DOE/NTP-96-1204, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1997.

3. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, August 1997. (users should refer to the current version).

4. DOE, 1996. *Low-Level Waste Projection Program Guide*, U.S. Department of Energy, Office of Waste Management, December 18, 1996.

5. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

6. DOE, 1998. *Quality Assurance*, DOE O 414.1, U.S. Department of Energy, Washington, D.C., November 24, 1998.

7. DOE. *Occupational Radiation Protection*, 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

8. DOE. *Quality Assurance Requirements and Responsibilities*, 10 CFR Part 120, Washington, D.C.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(2) Radioactive Waste Management Basis. Ensuring a radioactive waste management basis is developed and maintained for each DOE radioactive waste management facility, operation, and activity; and ensuring review and approval of the basis before operations begin. The Radioactive Waste Management Basis shall:

(a) Reference or define the conditions under which the facility may operate based on the radioactive waste management documentation;

(b) Include the applicable elements identified in the specific waste-type chapters of this Manual; and

(c) Be developed using the graded approach process.

Objective:

The objective of this requirement is to ensure that the hazards associated with radioactive waste management facilities, operations, and activities have been identified, their potential impacts analyzed, and appropriate controls documented, implemented, and maintained for the protection of workers, the public, and the environment.

Discussion:

DOE M 435.1-1 states that it is the responsibility of the Field Element Manager to ensure development and approval of a radioactive waste management basis for a radioactive waste management facility. Guidance on the requirement is provided below under the headings entitled, Facilities with an Authorization Basis, Review and Approval of the Radioactive Waste Management Basis, Timing of the Radioactive Waste Management Basis, and Maintaining the Radioactive Waste Management Basis. Subrequirement (a) is discussed under the heading Documentation of the Radioactive Waste Management Basis. Subrequirement (b) is discussed under Elements in the Waste Type Chapters. Subrequirement (c) is discussed under the heading Graded Approach. Also, at the end of the guidance, Radioactive Waste Management Basis Statement Examples are presented for some of the hypothetical situations discussed throughout this guidance.

The requirements in DOE O 435.1 and DOE M 435.1-1 were developed following a systematic analysis of the hazards associated with management of radioactive waste and the conditions and

weaknesses that need to be controlled to prevent or minimize the risks due to these hazards. A principal concept in this analysis is that a significant amount of the waste will present hazards for a long time. Therefore, in addition to hazards that need to be controlled during operations and other near-term activities, there are many conditions and weaknesses inherent in managing radioactive waste that are required to be controlled leading up to disposal and after disposal to protect future generations from the continuing hazard of the waste.

> *Example: A liquid waste stream containing high concentrations of long-lived radionuclides requires stabilization to be disposed at the Site Y disposal facility in order to provide for site stability and to retard the migration of the long-lived radionuclides for a long period of time. An incorrectly processed batch of this waste form degrades prematurely and causes instability in the Site Y disposal facility and leads to significant migration of radioactivity. As a consequence, the site Y disposal facility must be remediated.*

The hazards analysis used to develop the requirements indicated that many weaknesses and conditions that could result in consequences in the near-term for workers, the public, and the environment from radioactive waste management are sufficiently addressed through requirements, processes, procedures, documentation, and evaluations required by existing regulations and requirements, particularly those for occupational and nuclear safety. DOE M 435.1-1 identifies many of these in Section I.1.E, Requirements of Other Regulations and DOE Directives. Key directives that address many of the significant risks from operations and other near-term management of radioactive waste are DOE 5480.21, *Unreviewed Safety Question*, and DOE 5480.23, *Nuclear Safety Analysis Reports*. As a result, the requirements in DOE M 435.1-1 principally address weaknesses and conditions that are not addressed in these other directives or address weaknesses associated with radioactive waste management activities. Requirements also address weaknesses associated with particularly vulnerable radioactive waste management steps, such as waste transfer, or address the weaknesses and conditions associated with the long times that management of radioactive waste is required.

The requirements in DOE M 435.1-1 are framed primarily as performance-oriented requirements, and are implemented through documented processes, programs, and procedures on a facility-, operation-, or activity-specific basis. The oversight of performance-oriented requirements such as these involves a decision by a DOE authority (e.g., the Field Element Manager) that there is a basis for a facility to operate. The basis is demonstrated through a review and analysis of the procedures that concludes that the necessary controls to meet the requirements and operate safely are in place. DOE 5480.21 contains some performance-oriented requirements, and its implementation involves development of an Authorization Basis for a facility to safely operate.

During the development of the DOE M 435.1-1 requirements, it was recognized that a basis was needed similar to the authorization basis that ensured that the potential hazards from management

of radioactive waste were being sufficiently evaluated and that adequate controls were in place to provide assurance that the public, workers, and the environment were being protected. As discussed above, for some aspects of radioactive waste management (e.g., preparation of waste for disposal), these assurances include consideration of potential future hazards.

Thus, the concept of a radioactive waste management basis was adopted to provide assurances that controls are developed, documented, in place, and properly implemented for management of radioactive waste. The term controls used here and elsewhere in the discussion of a radioactive waste management basis refers to processes, procedures, equipment, instruments, and other items that are intended to reduce the likelihood of, or the consequences from, a problem that could arise from managing radioactive waste. Controls include such things as placards, alarms, tools, shielding, training, checklists, duplication of critical steps, redundant monitoring, analysis, sampling and testing, etc.

The radioactive waste management basis will involve activities such as characterizing and certifying waste, establishing constraints on the acceptance of waste consistent with a facility or operation's characteristics, processing waste, containing waste with or without processing, and disposing of the waste, including its possible impacts following disposal. Controls will be implemented on a facility-, operation-, and activity-specific basis consistent with the earlier discussion about the implementation of performance-oriented requirements.

Facilities with an Authorization Basis. In the case of nuclear facilities with Authorization Basis documentation, it is likely that most of the controls required for a radioactive waste management basis are implemented by the Authorization Basis. DOE 5480.21, *Unreviewed Safety Question*, defines Authorization Basis as:

> "Those aspects of the facility design and operational requirements relied upon by DOE to authorize operation. These aspects are considered to be important to the safety of facility operations. The authorization basis is described in documents such as the facility Safety Analysis Report and other safety analyses; Hazard Classification Documents, the Technical Safety Requirements, DOE-issued safety evaluation reports, and facility-specific commitments made in order to comply with DOE Orders or policies."

As prescribed in DOE 5480.23, *Nuclear Safety Analysis Reports*; DOE STD-3009-94, *Preparation Guide for US DOE Nonreactor Nuclear Safety Analysis Reports*; and DOE-EM-5502-94, *DOE Limited Standard, Hazard Baseline Documentation*, an Authorization Basis is required for all nuclear facilities that have a hazard categorization of Category 1, 2, and 3. While there are currently no radioactive waste management Category 1 facilities (reserved for nuclear reactors), some radioactive waste facilities are Category 2 or 3, as defined by the methodology outlined in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. Thus, these radioactive

waste management facilities have, or are required to have, an approved Authorization Basis. For these facilities, the radioactive waste management basis requirements are very likely already met by the implementation of the facility's Authorization Basis. This should be determined through a review of the Authorization Basis documentation that leads to a determination that adequate controls are in place to meet the DOE M 435.1-1 requirements (see additional discussion under <u>Review and Approval</u>).

Example: A review of the Authorization Basis documentation for the Liquid Radioactive Waste Handling Facilities at the Savannah River Site (includes F and H Area Tank Farms, the In-Tank Precipitation Process, the Replacement High-Level Waste Evaporator, and the Effluent Treatment Facility) found that the Authorization Basis includes the following documents and associated programs:

- *Safety Analysis Reports (SARs);*
- *Technical Justification for Continued Operation/Basis for Interim Operation/Design Basis Accident Analysis Report;*
- *Operational Safety Requirements/Technical Safety Requirements;*
- *Technical Standards;*
- *SAR Update Request Packages;*
- *Other Documents Identified by DOE-SR and WSRC as Authorization Basis Documents (Safety Evaluations, Exemptions, Unreviewed Safety Questions Evaluation);*
- *DOE Safety Evaluation Reports; and*
- *Listing of documents that are to be subject to configuration management but are not Authorization Basis Documents.*

Included within these documents are what DOE-SR considers to be the complete set of operational requirements relied upon by the site to ensure that the public, workers, and the environment are protected from the hazards associated with the management of the radioactive waste handled in the facilities (e.g., the establishment of limits of fissionable materials and chemical constituents that can be transferred to the waste tanks by the generators is included in the SARs. These limits are essentially equivalent to the limits required to be set by the waste acceptance requirements (II.J) of the high-level waste chapter of DOE M 435.1-1). The existing Authorization Basis documentation contains all the information demonstrating that DOE O 435.1 and DOE M 435.1-1 are met. This is documented in a memorandum from DOE-SR to the contractor organization operating the facilities.

Other radioactive waste management facilities are covered by similar documentation prepared to meet the requirements of the above Safety Orders and their implementation, such as an Auditable Safety Analysis, or a DOE- or contractor-established interim safety basis for facility operation

such as a Basis for Interim Operations (BIO). Facilities operating under one of these may also have the necessary programs and documentation in place to satisfy the requirements for a radioactive waste management basis. A review of the existing programs and documentation is to be conducted for their adequacy in providing the controls needed to meet the DOE M 435.1-1 requirements and determining whether any additional documentation or program is required to demonstrate that the requirements of DOE O 435.1 and DOE M 435.1-1 will be met.

Radioactive waste management operations and activities that take place in facilities which are radiological (non-nuclear) facilities are likely to not already have an Authorization Basis or similar safety-related documentation to consider in evaluating whether the radioactive waste management basis for the facility already exists. However, programs and controls already implemented at the facility may wholly or partially fulfill the requirements for a radioactive waste management basis. For these facilities, a thorough review should be conducted that identifies where additional programs or controls are needed, and includes the critical step of ensuring that a radioactive waste management basis exists when these programs and controls are appropriately implemented.

The radioactive waste management basis plays a key role in the self-correcting system employed by DOE Elements in accordance with DOE P 450.4, *Safety Management System Policy*. The radioactive waste management controls forming the basis are evaluated periodically to ensure they continue to address the hazards of managing the radioactive waste. Adherence to and compliance with the critical elements of the radioactive waste management basis should become items measured in accordance with DOE O 210.1, *Performance Indicators and Analysis of Operations Information*, and which is reported in accordance with DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information* when incidents occur. As such, the critical elements of the radioactive waste management basis should be considered similar to the Technical Safety Requirements (TSRs) described in DOE 5480.21. The responsibility should be clear to all personnel involved in implementing radioactive waste management basis controls that violations and operations inconsistent with the radioactive waste management basis should be reported, and steps made to correct the situation consistent with the sections of the Manual entitled Corrective Actions.

Review and Approval of the Radioactive Waste Management Basis. The requirement states that the Field Element Manager's responsibility is to ensure review and approval of the radioactive waste management basis for each radioactive waste management facility under his/her authority. This review should be done by DOE staff. The DOE staff could be supported by staff of a contractor who has no conflict of interest. However, the Field Element Manager is responsible and accountable for the radioactive waste management basis approval.

The approval that is required means the facility, operation, or activity has been determined to have adequate controls to manage radioactive waste in accordance with the requirements of DOE O 435.1 and DOE M 435.1-1 and is authorized to manage radioactive waste. For new facilities or

major modifications to existing facilities, this approval should be provided prior to the beginning of the activities that will create waste. The Field Element Manager must determine how and when to approve radioactive waste management bases for existing and ongoing waste management facilities, operations, and activities (see additional discussion under Graded Approach).

In order to approve management of radioactive waste, the requirement calls for review of the basis. This statement implies review of documents, and in fact, some of the elements identified as crucial to the radioactive waste management basis for a facility are large documents (e.g., the composite analysis for a low-level waste disposal facility). While documentation should always be prepared for all critical activities affecting the management of radioactive waste, it is recognized that several methods may be employed for meeting requirements in DOE directives and in documenting compliance with requirements. Thus, the review could include reviewing documentation, preparation of documentation, the organization assigned the job of document preparation and its criteria or processes for preparing documentation, or audit results to conclude the facility, activity, or operation is satisfactorily meeting the DOE O 435.1 and DOE M 435.1-1 requirements. The review called out in this requirement is not supposed to imply the need for reviewing ALL documentation that is associated with the requirements or implementation of the requirements. The review should involve appropriate steps to ensure that DOE O 435.1 and DOE M 435.1-1 requirements are being met.

> *Example 1: A large DOE facility has several hundred generators, and a system is established for centralized certification of wastes for treatment and disposal. Generators submit waste profiles to the central waste management organization for each of their waste streams as part of certification. Therefore, there are thousands of waste profiles managed by the central unit. The review by the Field Element Manager at this facility to ensure the waste certification element of the radioactive waste management basis is being implemented appropriately includes a review of the procedure used by the central waste management organization for certification (which includes minimum information that must be on profiles and criteria for finding them complete), and an annual program review that assesses all aspects of the central organizations activities.*

> *Example 2: A DOE facility consisting of many small operations and activities operates several storage areas. Its central waste management unit develops a generic waste acceptance requirements document that each storage area must follow, at a minimum, plus instructions for adding specific technical criteria to the set of generic requirements for any specific wastes they are handling. Central waste reviews and approves the specific criteria developed. The Field Element Manager's staff has reviewed the generic waste acceptance requirements with the instructions and finds this adequately addresses the DOE O 435.1 and DOE M 435.1-1 requirements for this element of the radioactive waste management basis. The Field staff does not investigate any of the specific waste acceptance criteria that have been developed and approved.*

Documentation of the Radioactive Waste Management Basis. The radioactive waste management basis is to be documented for all radioactive waste management facilities, activities, and operations. The documentation of the radioactive waste management basis consists of results of reviews and analyses, where appropriate, and a description of radioactive waste management controls that are in place for protection of the public, workers, and the environment. The results of the reviews, analyses, and descriptions of the controls that must be in place for the safe and efficient management of radioactive waste are already prepared, documented, and implemented by DOE Elements for most radioactive waste management facilities, operations, and activities. The radioactive waste management basis includes the analysis, programs and their procedures, and documents that are identified in the waste-type chapters of DOE M 435.1-1, *Radioactive Waste Management Manual*.

> *Example 1: For the Liquid Radioactive Waste Handling Facilities at the Savannah River Site described in the above section* Facilities with an Authorization Basis*, of the list of documents cited in the example, all Safety Analysis Reports, the Safety Evaluation Report, and the Technical Justification for Continued Operation, plus several Technical Standards, Technical Safety Requirements, SAR Update Request Packages, several Exemptions and Unreviewed Safety Question Evaluations, plus many facility procedures, and several chapters from the Configuration Management list of documents constitute the radioactive waste management basis documentation.*

> *Example 2: Storage Facility B200 operates under the following procedures and documents that constitute the radioactive waste management basis: Safety Analysis of Facility B200; Facility B200 Waste Acceptance Criteria; Procedure B200 - Acceptance of Waste for Storage, Quality Implementation Procedure (QIP) for Facility B200; Procedure C200B - Certification of Waste to Disposal, and; Training Module 200W.*

> *Example 3: At Storage Facility B200 in the example above, each of the documents and procedures listed above is assigned a number [RWMB-xxx], indicating it is a radioactive waste management basis document, which can easily be found by site personnel who perform a search for radioactive waste management basis documents in accordance with the record management system instructions.*

The documentation of a radioactive waste management basis includes a documented conclusion that there is adequate protection from the hazards of management of the radioactive waste as a result of the Field Element Manager, or his/her designee's review and approval. This documentation, called a radioactive waste management basis statement in this guidance, is to be prepared for every radioactive waste management facility, operation, or activity to demonstrate that a DOE authority has concluded that the hazards associated with management of radioactive waste have been addressed and that the performance-oriented requirements of DOE O 435.1 and DOE M 435.1-1 will be met by the implementation of the described controls. The radioactive

waste management basis statement should include, or reference, the documentation used to provide the conclusion, (e.g., list of facility procedures), or reference to other reports that contain the key conclusions (the facility's DOE Safety Evaluation Report). This key element of a complete radioactive waste management basis is not already prepared and documented by DOE Elements for many radioactive waste management facilities, operations, and activities.

For facilities with an Authorization Basis, or other safety-related documentation discussed under Facilities with an Authorization Basis, the radioactive waste management basis statement should document that the safety-related documents describe the controls required to ensure that DOE O 435.1 requirements will be met, describe the critical controls that provide compliance with DOE O 435.1 and DOE M 435.1-1, and provide information on the location of the controls. If appropriate, the radioactive waste management basis evaluations and conclusions could be incorporated into the Authorization Basis or other safety-related authorization if desired by the Field Element Manager.

> *Example: A radioactive waste management basis statement is prepared for the Savannah River Site example described under Facilities with an Authorization Basis. It contains a full list of facilities that are covered by the statement and it has two attachments. The first attachment is a complete list of the documents referred to in the previous example in which all radioactive waste management controls that must be in place to meet DOE M 435.1-1 are found (see Example 1 under Documentation of the Radioactive Waste Management Basis to see this list). The second attachment is a crosswalk of DOE M 435.1-1 requirements showing which documents and where in the documents analysis and descriptions of controls can be found to meet that requirement.* [An example of this radioactive waste management basis statement is provided as Example A at the end of this guidance.]

Elements in the Waste Type Chapters. Each of the waste-type specific chapters in DOE M 435.1-1 contains a list of specific programs, processes, and documents that must be included in the radioactive waste management basis for facilities that manage these waste types. These programs, processes, and documents represent implementation of critical radioactive waste management controls which are based primarily or exclusively on DOE M 435.1-1 requirements. These should not be considered as a complete list of all of the elements that may need to be included in a radioactive waste management basis.

Many weaknesses and conditions associated with radioactive waste management are controlled by processes, procedures, and documentation developed and implemented to meet other sets of requirements, both Federal and State regulations and DOE directives. Many of these are identified in Section I.1.E, Requirements of Other Regulations and DOE Directives. Controls based on these other directives and regulations should also be evaluated to ensure that the critical

aspects to radioactive waste management are adequate, and therefore, contribute to a radioactive waste management basis finding.

> *Example 1: A small DOE laboratory includes a storage operation for small amounts of low-level waste. Waste is accumulated over about a nine-month period of time, after which it is shipped to the Nevada Test Site for disposal. The radioactive waste management basis for this facility includes the waste acceptance requirements (DOE M 435.1-1), the waste certification program (DOE M 435.1-1), the radioactive waste management module of the laboratory training program (DOE O 360.1 and DOE 5480.20A), the facility's implementation procedure of the site quality assurance program plan (10 CFR 830.120), and the document control procedure used for maintaining records of waste that is in storage (DOE O 200.1 and 10 CFR 830.120).*

> *Example 2: Operation at the storage facility discussed in Example 1 above is modified to store a small amount of classified waste. The radioactive waste management basis includes the items above, plus Section 14 of the laboratory's security and safeguard implementation procedure (DOE O 470.1), which requires appropriate labeling of the containers of classified waste.*

Additional controls are sometimes needed to address situations and conditions that were not evaluated in the development of requirements and directives, or which are identified through facility-, process-, or activity-specific hazard analysis. These specific controls also must be evaluated to ensure the aspects of them that are critical to radioactive waste management are adequate and contribute to the radioactive waste management basis finding.

> *Example: The operating procedures for a storage facility containing transuranic waste includes the items identified in Chapter III; facility-specific procedures implementing two other DOE directives; and conditions specified in its RCRA storage permit. It also contains actions from a facility-specific audit conducted by the Carlsbad Area Office in its radioactive waste management basis to fully cover the hazards associated with the facility. The radioactive waste management basis statement includes the specific requirements from the audit report to document the commitments to meet these action items for safe management of radioactive waste.*

The radioactive waste management basis should be limited to only those processes or controls that are needed based on the hazards that may be present in the facility or operation, the complexity of activities to manage the waste, and the time that controls are warranted to provide protection. Controls critical to a radioactive waste management basis at one facility are not necessarily warranted to be included at all facilities within a site, for example. Thus, a standard listing of radioactive waste management basis documents cannot be developed.

Graded Approach. The scope of Departmental activities leads to a great deal of diversity in what constitutes the radioactive waste management basis for a given operation, and the documentation of the basis should reflect the hazards associated with these diverse activities. In general, generation and treatment of radioactive waste are more dynamic than storage and disposal, so it would be expected that the radioactive waste management bases for these types of facilities would be different, i.e., different topics need to be covered, and different levels of detail are necessary for proposed controls. Similarly, when identical activities (such as storage and certification to a disposal facility) are being conducted at many facilities on one site, it is expected that the same radioactive waste management bases may apply to all of these facilities.

For facilities where little hazard exists or where activities are not dynamic, the radioactive waste management basis statement may be abbreviated, such as a memorandum which references the appropriate documents. For facilities where many interrelated activities are occurring and/or where higher hazards are present, a radioactive waste management basis statement could be prepared that provides the operational conditions of a radioactive waste management facility , similar to a license for a facility regulated by the Nuclear Regulatory Commission.

> *Example 1: An operating low-level waste disposal facility has approved revisions of all of the following documents (listed in Chapter IV); the waste acceptance requirements, the performance assessment, the composite analysis, the disposal authorization statement, and the monitoring plan. The preliminary closure plan reviewed with the performance assessment has not been approved, pending an extensive update. Several disposal site procedures are also approved and implemented. The Field Element Manager determines that the facility may operate while it updates the closure plan. The Field Element Manager also identifies the Site Radiation Control Manual and the Site Health and Safety Plan and an additional document requested by the State mixed waste regulating authority to include as part of the basis to allow operations for management of radioactive waste. In this case, the radioactive waste management basis statement prepared incorporates the aforementioned documents by reference, and contains other conditions that the facility must adhere to for safe disposal of the low-level waste. One of these added conditions is that the updated closure plan must be submitted within 15 months of the issuance of the radioactive waste management basis to include consideration of the comments addressing deficiencies in the preliminary closure plan.* [An example of this radioactive waste management basis statement is provided as Example B at the end of this guidance.]

> *Example 2: A laboratory facility stores transuranic and low-level waste in four temporary storage buildings. Following an approved time period, the waste is collected by a central waste management operation of the laboratory and consolidated in a permanent storage facility. The transuranic waste is stored there indefinitely, while the low-level waste is stored until a sufficient amount is accumulated for shipment to a low-*

level waste disposal facility. The low-level waste is certified to a specific disposal facility's waste acceptance criteria, while the transuranic waste is certifiable to WIPP requirements. The radioactive waste management basis statement for all of these facilities and activities is documented with one radioactive waste management basis statement. The statement consists of a memorandum that references five laboratory operating procedures on storage of waste and certification of waste, and the low-level waste disposal facility and WIPP waste acceptance requirements since the waste is certified to meet these two disposal facilities' requirements without any changes being made to the waste. [An example of this radioactive waste management basis statement is provided as Example C at the end of this guidance.]

Timing of the Radioactive Waste Management Basis. The requirement states that the radioactive waste management basis is to be reviewed and approved before operations begin. The requirement is written from the viewpoint of applying the provisions to a new facility, and thus emphasizes that the basis must be in place prior to the generating of any radioactive waste. For existing facilities, the Field Element Manager should establish a schedule for approvals of radioactive waste management bases to bring existing facilities into compliance with this requirement. It may be appropriate to consider the hazards associated with each facility and the radioactive waste managed at it when establishing the implementation schedule for approvals of radioactive waste management bases. Therefore, a facility with a great deal of hazard or complexity, such as a multi-waste stream treatment facility, may have a bases approved before facilities that engage in less complicated or hazardous activities. Implementation is to be consistent with the requirements of DOE M 435.1-1 as set forth in paragraph (i) 4.

Maintaining the Radioactive Waste Management Basis. The radioactive waste management basis should be reviewed periodically and whenever there is a change to the subject facility, operation, or activity, or the requirements of DOE O 435.1 or DOE M 435.1-1. Appropriate changes should be made to the documentation of the radioactive waste management basis, if warranted. These reviews should evaluate the status of the radioactive waste management basis and its continued validity over time. The review should evaluate whether the existing documentation still adequately identifies the hazards associated with a radioactive waste management facility, operation, or activity; the analysis of the potential impacts of those hazards is still valid; and the controls that are in place for protection of workers, the public, and the environment address the hazards. Existing processes, programs, or documentation that can satisfy this guidance should be used to the extent possible. Elements of the radioactive waste management basis in the self-correcting system employed at the site in accordance with the integrated Safety Management System employed in accordance with DOE P 450.4 should be included as an effective way to achieve adequate maintenance of the radioactive waste management basis.

The requirement for a radioactive waste management basis is successfully met if all radioactive waste management facilities, operations, and/or activities at each DOE site has a radioactive

waste management basis, which concludes that appropriate controls are documented and implemented for the protection of workers, the public, and the environment. The conclusion should be appropriately documented. The documentation should provide, at a minimum, a complete list of the controls that implement the requirements of DOE O 435.1 and DOE M 435.1-1 for all waste types being managed at the site, and provide evidence that the radioactive waste management controls are included in the site's implementation of the integrated Safety Management System.

Additional information on the radioactive waste management basis is contained in Chapter II, *High-Level Waste Requirements;* Chapter III, *Transuranic Waste Requirements*; and Chapter IV, *Low-Level Waste Requirements* of this guidance.

Supplemental References:

1. DOE, 1991. *Unreviewed Safety Question*, DOE 5480.21, U.S. Department of Energy, Washington, D.C., December 24, 1991.

2. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

3. DOE, 1994. *Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports*, DOE STD-3009-94, U.S. Department of Energy, Washington, D.C., July 1994.

4. DOE, 1994. *DOE Limited Standard: Hazard Baseline Documentation*, DOE-EM-5502-94, U.S. Department of Energy, Washington, D.C., December 1994.

5. DOE, 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C., December 1992.

6. DOE, 1996. *Safety Management System Policy,* DOE P 450.4, U.S. Department of Energy, Washington, D.C., October 16, 1996.

7. DOE, 1995. *Performance Indicators and Analysis of Operations Information,* DOE O 210.1, U.S. Department of Energy, Washington, D.C., September 27, 1995.

8. DOE, 1997. *Occurrence Reporting and Processing of Operations Information*, DOE O 232.1A, U.S. Department of Energy, Washington, D.C., July 21, 1997.

9. DOE, 1999. *DOE Radiological Control Standard - Radiological Health and Safety Policy*, Draft, U.S. Department of Energy, Washington, D.C., April 1999.

Attachments: Example Radioactive Waste Management Basis Statements

Example A
Radioactive Waste Management Basis Statement
Savannah River Waste Handling Facilities
(See Example on Pg I-X, Example 1 on Pg I-X, Example on Pg I-X)

MEMORANDUM FOR: Joseph Smith, Field Element Manager, DOE/SR

THRU: Robert Jones, Director, Division of Waste Management, DOE/SR

FROM: Wilburt Littleguy, Operations Manager, SRS Contractor

SUBJECT: RADIOACTIVE WASTE MANAGEMENT BASIS FOR THE WASTE HANDLING FACILITIES

DATE: June 1, 1999

This memorandum documents the approval of a radioactive waste management basis for the following facilities, operations, and activities, which are collectively known as the Waste Handling Facilities at H Area of the Savannah River Plant: F Area Tank Farm, H Area Tank Farm, In-Tank Precipitation Process, Replacement High-Level Waste Evaporator, and the Effluent Treatment Facility.

The approval of the radioactive waste management basis for the Waste Handling Facilities is based on a review of the documents on the attached list granting an Authorization Basis to operate the Waste Handling Facilities under DOE 5480.21. The radioactive waste management basis review consisted of reviews of targeted chapters and sections of the Authorization Basis documentation to ensure that the requirements of the revised Order on Radioactive Waste Management, DOE O 435.1, were being met. The review of the Authorization Basis documents, and processes and procedures implemented as described, concluded that the requirements of DOE O 435.1 are being met. A crosswalk is also attached indicating the DOE M 435.1-1 requirements that are being met at the Waste Handling Facilities and the procedure or document which is the approved implementation of the requirement.

Unless additional review is required due to changes in the facilities or in the DOE 435.1 requirements, the radioactive waste management basis for the Waste Handling Facilities will remain valid until June 1, 2004.

Original signed by:
W.G. Littleguy
Operations Manager, Waste Handling Facilities
SRS Contractor

Attachments: As Listed

Attachment 1
Radioactive Waste Management Basis
Waste Handling Facilities / Savannah River Plant

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1. Safety Analysis Reports (SARs) [Report Nos. WHF-WSRC-003, WHF-WSRC-006, WHF-WSRC 015]

2. Technical Justification for Continued Operation/ Basis for Interim Operation/Design Basis Accident Analysis Report - [Memorandum dated April 1, 1996 with Attachments].

3. Operational Safety Requirements/Technical Safety Requirements [SRC-J-092, SRC-K-063, SRC-U-012]

4. Technical Standards - [WSRC-WMB-013 and OSHA-TYU-003]

5. SAR Update Request Packages - [Memoranda dated April 30, 1996, August 15, 1996, January 17, 1997]

6. Safety Evaluation Report - [Report No DOE-SRS-SER-003]

7. WSRC Operating Manual and Procedures:
   Waste Acceptance Requirements Implementation - [WSRC-OPSMAN-SC3-03]
   Waste Characterization Profiling - [WSRC-OPSMAN-SC4-02]
   Certification Process and Approval - [WSRC-OPSMAN-WA-W28]

8. USQ Package - [USQ-WHF-SER-98]

(Example of Attachment 2 not shown)

Example B
Radioactive Waste Management Basis Statement
Low-Level Waste Disposal Facility
(See Example 1 on Pg I-XX)

MEMORANDUM FOR: Robert Jones, Operations Manager, Site Y Low-Level Waste Disposal Facility

FROM: Joseph Smith, Deputy Field Element Manager, DOE/FO

SUBJECT: DOE M 435.1-1 RADIOACTIVE WASTE MANAGEMENT BASIS FOR SITE Y LOW-LEVEL WASTE DISPOSAL FACILITY.

This memorandum documents the radioactive waste management basis for the Site Y Low-Level Waste Disposal Facility. The basis is established as a result of reviews and approvals of the Site Y Performance Assessment (DOC-FO-PA-001) and the Site Y Composite Analysis (DOC-FO-CA-002), and the issuance of the EM-30 Disposal Authorization Statement (HQ-DAS-SITY-1), which is attached. The review and approval of the Performance Assessment and the Composite Analysis, and the issuance of the Disposal Authorization Statement included a review of several other documents, including a preliminary closure plan and a preliminary monitoring plan, which are listed in Appendix F in the April 1998 Low-Level Waste Review Group Team Report on the Site Y Performance Assessment and Composite Analysis Reviews.

The radioactive waste management basis is predicated on the continued adherence to the current revisions of the Site Y Radiation Control Manual, the Site Y Health and Safety Plan, and on meeting the commitments made in the April 27, 1997 letter from Smith, DOE/FO to Johnson, State/EPA for finalizing the monitoring well designs for the RCRA-regulated Site Y storage facilities plume.

The Disposal Authorization Statement contains twelve conditions that must be met in order for the operations at the Site Y Low-Level Waste Disposal Facility to continue. In addition to these twelve conditions, the following condition must also be met:

> *Condition 13: By August 1999, (15 months) the preliminary closure plan submitted with the performance assessment and composite analysis must be updated to reflect the designs of the monitoring system incorporated by reference above, letter Smith, DOE/FO to Jones, State/EPA, and the considerations documented in page 57 of the April 1998 Low-Level Waste Review Group Team Report on the Site Y Performance Assessment and Composite Analysis Reviews.*

Any questions about this memorandum or the radioactive waste management basis for the Site Y Low-Level Waste Disposal Facility should be directed to me at my office number.

Original Signed By:

Joseph Smith
Field Element Manager,
DOE/Field Office (FO)

Reference:
Site Y Low-Level Waste Disposal Facility Disposal Authorization Statement

Example C
Radioactive Waste Management Basis Statement
Several Waste Storage Facilities
(See Example 2 on Pg I-XX)

RADIOACTIVE WASTE MANAGEMENT BASIS STATEMENT
SITE Y CENTRAL WASTE STORAGE OPERATIONS.

This statement documents the radioactive waste management basis for the operations of the Site Y Central Waste Management Unit for storage of low-level and transuranic waste at all storage facilities (see list in Appendix A) at Site Y.

The radioactive waste management basis is founded based on the review and approval of the Site Y laboratory operating procedures on waste acceptance, certification, and storage which were found to meet the requirements of DOE O 435.1 and DOE M 435.1-1 (see list in Appendix B). The Site procedures on waste acceptance commit to meeting the requirements of the WIPP Waste Acceptance Criteria (WIPP-WAC-007), and the Nevada Test Site Waste Acceptance Criteria (NTSWAC) since all waste accepted at the storage facilities must be able to be certified for disposal at one of these two facilities. Therefore, these two documents, as approved by their respective Field Elements, are incorporated by reference into the radioactive waste management basis for storage activities at Site Y.

Appendix A - List of Site Y Storage Facilities
Appendix B - List of Site Y Radioactive Waste Management Basis Procedures

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(3) Waste Minimization and Pollution Prevention. Ensuring implementation of waste minimization and pollution prevention programs.

Objective:

The objective of this requirement is to ensure that emphasis is placed on the Field Element Manager's responsibility for minimizing the generation of radioactive waste and that waste minimization programs are implemented at radioactive waste management facilities.

Discussion:

The safety and hazards analysis indicated that an effective mitigating measure in management of radioactive waste was to avoid potential weaknesses and conditions through minimization of waste. The requirements analysis indicated that DOE's current programs implementing Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements and Responsibilities*, and Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, and DOE 5400.1, *General Environmental Protection Program*, were adequate in establishing effective waste minimization programs, especially for generators of waste. These directives are invoked in the General Requirement on other directives and regulations (DOE M 435.1-1, Section I.1.E.(20)). This General Requirement is added to emphasize the Field Element Manager's responsibilities in carrying out the requirements of the Executive Orders and DOE 5400.1 for radioactive waste management facilities, and ensuring that in the cases where radioactive waste is generated during the course of its management, for example, when ash is created from the incineration of radioactive waste, that this waste is also minimized. No additional guidance is needed beyond the documentation already prepared on the Field Element Manager's responsibilities for waste minimization and pollution prevention.

Compliance with this requirement is demonstrated if waste minimization and pollution prevention principles are incorporated into all radioactive waste management activities where appropriate.

Supplemental References:

1. DOE, 1992. *Waste Minimization Crosscut Plan Implementation*, SEN-37-92, U.S. Department of Energy, Washington, D.C., May 13, 1992.

2. O'Leary, 1994. H. O'Leary to Departmental Elements, memorandum, *Departmental Strategy for Compliance With Executive Order 12856*, "*Federal Compliance With Right-To-Know Laws and Pollution Prevention Requirements*," U.S. Department of Energy, Washington, D.C., December 27, 1994.

3. EPA, 1993. *Pollution Prevention and Right-to-Know in the Government, E.O. 12856,* EPA 100-K-93-001, U.S. Environmental Protection Agency, Washington, D.C., 1993.

4. EPA. *Federal Agency Environmental Management Program Planning Guidance*, EPA 300-B-95-001, U.S. Environmental Protection Agency, Washington, D.C.

5. EPA. *Federal Facility Pollution Prevention Project Analysis*, EPA 300-B-95-008, U.S. Environmental Protection Agency, Washington, D.C.

6. DOE, 1994. *Department of Energy Waste Minimization Reporting Requirements,* U.S. Department of Energy, Washington, D.C., November 1994.

7. DOE, 1996. *Pollution Prevention Program Plan*, DOE/S-0118, U.S. Department of Energy, Washington, D.C., 1996.

I. 2.F. <u>Field Element Managers</u>.

Field Element Managers are responsible for:

(4) Approval of Exemptions for Use of Non-DOE Facilities. DOE radioactive waste shall be treated, stored, and in the case of low-level waste, disposed of at the site where the waste is generated, if practical; or at another DOE facility. If DOE capabilities are not practical or cost effective, exemptions may be approved to allow use of non-DOE facilities for the storage, treatment, or disposal of DOE radioactive waste based on the following requirements:

(a) Such non-DOE facilities shall:

1. Comply with applicable Federal, State, and local requirements;

2. Have the necessary permit(s), license(s), and approval(s) for the specific waste(s); and

3. Be determined by the Field Element Manager to be acceptable based on a review conducted annually by DOE.

(b) Exemptions for the use of non-DOE facilities shall be documented to be cost effective and in the best interest of DOE, including consideration of alternatives for on-site disposal, an alternative DOE site, and available non-DOE facilities; consideration of life-cycle cost and potential liability; and protection of public health and the environment.

(c) DOE waste shall be sufficiently characterized and certified to meet the facility's waste acceptance criteria.

(d) Appropriate *National Environmental Policy Act* (NEPA) review must be completed. For actions taken under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), it is DOE's policy to incorporate NEPA values into the CERCLA documentation.

(e) Headquarters shall be notified of any exemption allowing use of a non-DOE facility and the Office of the Assistant Secretary for Environment, Safety and Health (EH-1) shall be consulted prior to the exemption being executed.

(f) Host States and State Compacts where non-DOE facilities are located shall be consulted prior to approval of an exemption to use such facilities and notified prior to shipments being made.

Objective:

The objective of this requirement is to indicate a clear preference for use of DOE facilities and to ensure that when it is determined to be necessary to use non-DOE facilities for the treatment, storage, and disposal of DOE radioactive waste only when such use is in the best interest of the Department and protective of the public, workers, and the environment.

Discussion:

It has been the Department's long-standing policy to dispose of low-level waste at the site where it is generated or at another DOE site if onsite capabilities are not practical. Exemptions to this policy have been allowed in cases where disposal at a DOE site is not practical and it can be shown that the action is in compliance with applicable requirements and is protective of the public, workers, and the environment and that there is a substantial benefit to the Department. However, use of non-DOE facilities has not been allowed without such justification because of the potential long-term liabilities and possible negative impacts on DOE-wide or commercial disposal programs associated with commercial disposal. Additionally, because of the economics associated with operating onsite disposal facilities, use of non-DOE facilities can result in higher overall costs for all DOE disposal.

The Department has previously addressed a number of issues related to the use of non-DOE facilities for the disposal of low-level waste. The Office of Environmental Management, in consultation with the Office of Environment, Health, and Safety, approved the use of non-DOE facilities for the disposal of waste originating from remedial activities the Department was performing at non-DOE sites and for the disposal of small quantities of mixed low-level waste. Subsequently, Headquarters delegated the authority to make decisions on the use of non-DOE facilities for disposal of low-level waste to the Heads of Field Elements under certain conditions. The current requirement and this guidance continue the practice of allowing the Field Element Managers to grant exemptions for using non-DOE waste management facilities. Exemptions granted prior to the issuance of DOE O 435.1 remain valid.

During the development of DOE M 435.1-1, it was also recognized that the evaluation performed to justify use of non-DOE facilities for low-level waste disposal, e.g., determining that the action is protective and in the best interest of the government, was a best management practice that should be employed for any use of non-DOE waste management facilities. Therefore, the requirement was broadened to also address storage and treatment.

This requirement allows the Field Element Manager to approve the use of non-DOE facilities where use of DOE facilities is not practical after meeting minimum requirements to ensure that the waste management decision is in the best interest of the government and will not pose an undue threat to public and worker health and safety, or to the environment.

This requirement does not extend to residues that result from the use of commercial laboratories to perform analyses on radioactive samples, whether they are waste samples or not. Laboratories that have the capability to accept radioactive samples for analysis generally have provisions for disposal of the waste resulting from their activities. This includes excess sample, i.e., sample that is not used in analyses, as well as sample residue, laboratory equipment, etc. When contracting for such laboratory services, it is not required that samples be returned to DOE for disposal if the laboratory has such provisions. The policy for use of non-DOE facilities does not require or prefer that waste from commercial analysis of samples be returned to the DOE site for waste management. It is acceptable for the laboratory to dispose of the waste in accordance with the provisions of their radioactive materials license. However, return of sample waste to the DOE site is acceptable if it is economically beneficial to DOE.

Use of DOE Capacity. As directed in the current requirement, there is a preference for treatment, storage, or disposal of DOE radioactive waste to occur at a DOE site. Nevertheless, DOE sites are explicitly encouraged to seek the most practical disposal option for low-level waste, especially if there is a lower cost alternative with adequate environment, safety, and health protection. Prior to using a non-DOE facility, a determination must first be made that the waste management activity being considered is not practical at the DOE site that generates the waste. Then a second determination must be made that management of the waste is not practical at another DOE site. The practicality of performing a waste management function at a particular site depends on the availability of facilities or capacity, and also the cost associated with performing the activity. As part of the planning process, a range of waste disposal alternatives must be considered and documented, including on-site disposal, an alternative DOE disposal site, and available non-DOE facilities. When evaluating the cost effectiveness of performing a waste management activity at a DOE versus a non-DOE site, managers should consider the complex-wide implications of this decision, e.g. if many sites choose non-DOE facilities over a particular DOE facility for a waste management activity, this facility, losing much of its incoming volume, may become prohibitively expensive per unit of waste it handles or may not be able to continue operating. This may have a great impact on waste for which with this facility is the only option. This is particularly true for low-level waste disposal because the Department must maintain the capability to dispose of low-level waste since the waste acceptance criteria at currently available commercial facilities do not accommodate significant amounts of the Department’s waste. Therefore, one should not only consider the short term impact of a decision that DOE capacity is not practical, but also consider the implications across the complex and for the long term.

Acceptable Performance. In making a decision to use a non-DOE facility for managing DOE radioactive waste, the Field Element Manager must ensure that the decision is protective of the public and the environment. This responsibility is effected by ensuring that the non-DOE facility is properly licensed and/or permitted, that the facility complies with applicable regulations, and that the facility has an acceptable history of operational and regulatory performance. Based on the characteristics of the waste that is being considered for transfer to the non-DOE facility, a review should be conducted of the licenses and permits held by the facility to determine if they provide appropriate coverage for management of the waste. This should be accomplished through a reading of the licenses and permits and through discussions with the issuing authority (Federal, State, or local licensing/permitting authority). This review should confirm that the facility is authorized to receive the radionuclides in the waste to be transferred, and if the waste contains constituents subject to RCRA or TSCA, that the facility has the appropriate authorization to receive and manage those constituents. Discussions with regulatory authorities and reviews of inspection reports should also be used to determine whether the facility has a history of acceptable operational and regulatory performance. Occasional and minor violations should not be a basis for deciding not to use a non-DOE facility. Significant violations of regulations and controls which could lead to releases of material or exposure to workers should be cause for concern and may be a basis for deciding against use of a particular facility.

> *Example: A DOE site has a mixed low-level waste stream but lacks treatment capability for meeting the land disposal restriction treatment standards under RCRA. The site personnel determine that no other DOE site can treat the waste either. Therefore, the site personnel look for other options and discover there is a non-DOE facility which will contract with DOE to treat the waste for treatment standards under RCRA. The site personnel confirm that the non-DOE facility has the necessary radioactive materials license, hazardous waste permit, and air permit. The site DOE personnel recommend to the Field Element Manager that the waste be treated at the non-DOE facility. The Field Element Manager agrees and directs his employees to make arrangements for contracting with the treatment facility.*

Once a determination has been made by a DOE organization that a non-DOE facility has an acceptable operational and regulatory history, this determination can be used by other DOE organizations, e.g., a DOE organization can use the results of a review performed by another DOE organization or DOE contractor in making a decision on the acceptability of the non-DOE facility's performance. However, it is the responsibility of a DOE organization using a non-DOE facility to ensure, on an annual basis, that the facility is maintaining an acceptable performance record, either through their own review or that conducted by another DOE organization or contractor. Documentation of the results of the evaluation of regulatory compliance and acceptable operational history as discussed above is adequate for showing that the use of the non-DOE facility will be protective of public health and the environment.

Example: Site Z has previously contracted with a non-DOE low-level waste treatment facility for size reduction, sorting, and compaction services. As part of their effort to evaluate the regulatory and operational history of the facility, they conducted a thorough review of the radioactive materials permit of the facility, the waste acceptance criteria, and the regulatory authority's inspection reports. The Site Z personnel also contacted the regulatory authority and followed up on some of the items which had been identified as concerns in the inspection reports. Site Z personnel documented a description of their review and presented their conclusions in a report to the Field Element Manager. Six months later when Site A personnel were considering using the non-DOE treatment facility, they obtained a copy of the report from Site Z personnel. On the basis of the Site Z report, and after confirming that the waste acceptance criteria also encompass their waste, the Site A personnel make a determination that the regulatory and operational performance of the non-DOE facility is acceptable.

Cost Effectiveness. In addition to ensuring that use of a non-DOE facility is protective of the public health and the environment, use of such a facility is to be evaluated for cost-effectiveness. The evaluation of cost-effectiveness is to consider the cost of onsite management, if it is practical, the cost of management at another DOE site, and the cost of management at a non-DOE facility. Cost evaluations consider the cost of the specific management action being contemplated (usually treatment or disposal), and need to consider collateral management costs such as transportation and storage, and life-cycle costs. It is appropriate to consider the cost-related complex-wide implications of not using a DOE facility. The evaluation should include qualitative consideration of the costs associated with safety and liability of the different options considered. Generally when all costs are considered, the differential between using a DOE facility and using a commercial or non-DOE facility needs to be significant before a decision to use the non-DOE facility will be considered cost effective.

Example: A facility has low-level waste which cannot be disposed of on-site due to site characteristics which prevent safe disposal. The site contacts the other DOE facilities which could accept and dispose of this waste. The waste characteristics and packaging do not pose problems and it is determined that several DOE facilities could accept this waste. In discussing disposal charges with the DOE sites, the generator site determines that they have insufficient funds to dispose of all of the low-level waste at these DOE facilities. Discussions with the DOE facilities does not resolve this issue. It is determined that a non-DOE facility will accept this waste. The non-DOE facility has lower disposal costs for the specific waste stream, which will allow the generator site to dispose all of the radioactive waste. (The non-DOE facility has also been determined by a DOE organization to have an acceptable operational and regulatory history.) A justification statement supporting the decision to use the non-DOE facility is written and accompanies the approval request to the Field Element Manager or designee. The Field Element Manager reviews the request to authorize use of a non-DOE facility for disposal

of the waste. Following discussions with his staff and managers at another DOE site which could dispose the waste, the Field Element Managers decides to keep as much waste as current storage capacity allows and dispose of the rest at the non-DOE facility. The waste placed in storage is sent to another DOE site for disposal following receipt of the next fiscal year budget in order to keep the unit costs at the DOE site at a manageable level.

Evaluations of alternatives which lead to a decision that use of a non-DOE facility is cost effective are to be documented and should be included with the assessment of acceptable performance discussed above when the request for approval to use the facility is submitted to the Field Element Manager.

Meeting Waste Acceptance Criteria. Site personnel must characterize waste to meet the minimum requirements cited in DOE M 435.1-1, and in sufficient detail to evaluate conformance with the waste acceptance criteria of the non-DOE facility to which waste is being transferred. The site should ensure that certification and transfer requirements of DOE M 435.1-1 are implemented for waste to be sent to a non-DOE storage, treatment or disposal facility. Implementing the certification and transfer requirements provides a structured process for making sure that the waste acceptance criteria of the non-DOE facility are met, and that the information necessary for safe handling is transferred along with the waste.

National Environmental Policy Act. Implementing this requirement and using non-DOE facilities for reasonably small quantities of waste and special circumstances does not represent a change in DOE policy that requires a Department-wide review under the *National Environmental Policy Act* (NEPA). However, as part of approving the use of non-DOE facilities, the Field Element Manager must ensure that adequate evaluation under NEPA is performed and documented. For actions taken under the *Comprehensive Environmental Response, Compensation, and Liability Act*, NEPA values should be incorporated in the CERCLA documentation. Important considerations include (1) impacts of the facility receiving the waste, and (2) impacts of transporting the waste to the facility, and (3) an evaluation of alternative disposal facilities.

Consultation and Notifications. The requirements for granting and implementing an exemption for use of a non-DOE facility include consultation and notification both within and external to the Department. Prior to the Field Element Manager granting an exemption, site personnel must consult the State agency responsible for radioactive materials regulation. If the proposed exemption is for disposal of low-level or mixed low-level waste, and the state is in a low-level waste compact, the compact organization also must be consulted. This consultation with the compact organization is to occur even if the disposal is planned for a non-compact facility. The consultation is intended to provide information and enable DOE to consider any views that the state or compact might have regarding the use of the facility for management of DOE radioactive

waste. Since consultation with the state and compact are prerequisites to granting an exemption, sites are to include documentation of the consultation in the exemption request.

Once the Field Element Manager has signed the exemption request to use a non-DOE facility, prior to exercising the exemption, notification of Headquarters, specifically to include consultation with the Headquarters Office of Environment, Safety, and Health, is required. Information provided to Headquarters, including the Office of Environment, Safety, and Health, is to include:

- A description of the waste stream including characteristics and expected quantities;
- Alternatives evaluated for the management of the waste, including onsite management, management at another DOE site, and management at a non-DOE facility, including a description of why a DOE facility is not available or the use of one is impractical;
- Documentation of the conclusions made regarding the facility's regulatory and operational acceptability;
- Documentation of the cost analysis for alternative disposal sites evaluated;
- A description of the environmental review and documentation supporting the action;
- Documentation of consultation held with the host state and, if applicable, state compact; and
- Documentation showing the approval of the exemption request by the Field Element Manager.

The requirement to consult with the Office of Environment, Safety, and Health may be met without obtaining written confirmation. The process requires that 1) a copy of the complete exemption request be provided to the Office of Environmental Policy and Assistance (EH-41), and 2) exemption requests may not be considered approved until after completion of appropriate environmental review and documentation, adequate demonstration of need for the exemption and coordination with appropriate officials of the state and state compact where the non-DOE facility is located.

The Office of Environmental and Policy Assistance will review the exemption and coordinate with other EH offices as needed. If EH-41 believes that the exemption would raise environmental concerns, it will respond to the Field Element Manager within 15 working days. If a response is not received from EH 41 within the 15 working days, Field Element Managers can assume that

there are no environmental objections and further consultation with EH is not required. Therefore, Field Elements must send a copy of the exemption to EH-41 for its review and wait 15 working days before considering the exemption request approved. A copy of the exemption should also be transmitted to the responsible Program Office and the Office of Waste Management (EM-30).

In exercising the responsibility assigned under this requirement, Field Element Managers and their staffs should avoid pursuing the use of State Compact disposal facilities. The Department has a long-standing practice of avoiding actions which have the potential to affect State Compact disposal facilities. The Department would only consider the use of State Compact disposal facilities if petitioned by the State Compact for reasons such as economic viability.

Finally, the Field Element Manager must ensure that the state hosting the radioactive waste management facility is notified prior to actually shipping waste to the facility. Notification can be on a campaign or waste stream basis; it is not necessary under this requirement that notification be made for each shipment.

Compliance with this requirement is demonstrated by a site having a process for performing and documenting the actions necessary to get an exemption for use of non-DOE facilities, and by the site having records which show that the necessary evaluations, consultations, approvals and notifications have occurred.

Supplemental References:

1. Whitfield, 1991. R.P. Whitfield to L.P. Duffy, memorandum, *Commercial Disposal of Department of Energy Radioactive (By-Product and Low-Level) and Mixed Wastes*, U.S. Department of Energy, Washington, D.C., September 13, 1991.

2. Lytle and Whitfield, 1993. J.E. Lytle and R.P. Whitfield to L.P. Duffy, memorandum, *Commercial Disposal of Department of Energy Radioactive (By-Product and Low-Level) and Mixed Wastes*, U.S. Department of Energy, Washington, D.C., October. 12, 1993.

3. Alm, 1996. A.L. Alm to Department of Energy Operations Office Managers and Department of Energy Field Office Managers, memorandum, *Delegation of Authority to Grant Exemptions to Department of Energy Order 5820.2A to Allow for the Use of Commercial Facilities for Department of Energy Low-Level Waste,* U.S. Department of Energy, Washington, D.C., October. 24, 1996.

4. DOE, 1999. *Commercial Disposal Policy Analysis for Low-Level and Mixed Low-Level Wastes*, U.S. Department of Energy, Washington, D.C., March 9, 1999.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(5) Environmental Restoration, Decommissioning, and Other Cleanup Waste. Ensuring the management and disposal of radioactive waste resulting from environmental restoration activities, including decommissioning, meet the substantive requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual. Environmental restoration activities using the CERCLA process (in accordance with Executive Order 12580) may demonstrate compliance with the substantive requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual (including the Performance Assessment and performance objectives, as well as the Composite Analysis) through the CERCLA process. However, compliance with all substantive requirements of DOE O 435.1 not met through the CERCLA process must be demonstrated. Environmental restoration activities which will result in the off-site management and disposal of radioactive waste must meet the applicable requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual for the management and disposal of those off-site wastes. Field Elements performing environmental restoration activities involving development and management of radioactive waste disposal facilities under the CERCLA process shall:

(a) Submit certification to the Deputy Assistant Secretary for Environmental Restoration that compliance with the substantive requirements of DOE O 435.1 have been met through application of the CERCLA process; and

(b) Submit the decision document, such as the Record of Decision, or any other document that serves as the authorization to dispose, to the Deputy Assistant Secretary for Environmental Restoration for approval.

Objective:

The objective of this requirement is to ensure that radioactive waste generated as a result of environmental restoration, decommissioning, or other cleanup is managed in a manner that meets the requirements of DOE O 435.1, *Radioactive Waste Management*, and DOE M 435.1-1, *Radioactive Waste Management Manual*.

Discussion:

This requirement applies to sites undergoing environmental restoration (including decommissioning) pursuant to regulatory authorities including, but not necessarily limited to, the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), the *Resource Conservation and Recovery Act* (RCRA), the *Atomic Energy Act of 1954,* as amended, and applicable state requirements. This guidance clarifies how sites developing and managing facilities for management and disposal of radioactive waste resulting from environmental restoration activities are to comply with the requirements of DOE O 435.1, *Radioactive Waste Management*. The requirements of DOE M 435.1-1 do not apply to other cleanup requirements addressed by CERCLA or other authorities, such as determinations of protectiveness, cleanup levels, or cleanup methods associated with remediation of spills and releases. Additionally, these requirements do not apply to actions performed under environmental restoration which involve commercial facilities. The original guidance on this topic was articulated in: 1) Policy for Demonstrating Compliance with DOE 5820.2A for Onsite Management and Disposal of Environmental Restoration Low-Level Waste under the *Comprehensive Environmental Response, Compensation, and Liability Act*, May 31, 1996 (DOE, 1996); and 2) Guidance for Complying with DOE 5820.2A, Radioactive Waste Management, for Onsite Management and Disposal of Low-Level Waste (LLW) from Environmental Restoration Activities (Alm, 1997). These policies were prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2. In its recommendation, the Board had indicated the need to demonstrate how disposal and waste management activities performed during environmental restoration activities ensured compliance with DOE's radioactive waste management requirements. The major concepts of these policies are:

- the CERCLA requirements and DOE M 435.1-1 requirements include significant overlap in their substantive requirements given both are designed to ensure safe management and disposal of waste;

- the CERCLA process is to be used to comply with the requirements of DOE M 435.1-1 for environmental restoration actions;

- the substantive requirements of DOE M 435.1-1 should be directly incorporated into the CERCLA process to the extent practical and consistent with site-specific technical and regulatory issues; and

- the Department must demonstrate compliance with the substantive requirements of DOE M 435.1-1 to fulfill its *Atomic Energy Act* responsibilities.

To fulfill DOE's *Atomic Energy Act* responsibilities, the Department must demonstrate compliance with the substantive requirements of DOE M 435.1-1 for low-level waste disposal

facilities managed under CERCLA. A crosswalk between the CERCLA and the DOE M 435.1-1 requirements needs to be prepared and reviewed as described below when the cleanup action involves development and management of a radioactive waste disposal facility. It is not necessary to prepare a crosswalk to demonstrate compliance with DOE M 435.1-1 requirements for environmental restoration activities that do not involve development and management of a radioactive waste disposal facility.

Regarding the distinction between substantive and administrative requirements, DOE follows the guidance provided in the rulemakings published for the National Contingency Plan (NCP) (59 FR 47384, September 15, 1994). The preambles to the NCP notices in the *Federal Register* (53 FR 51394, December 21, 1988; 55 FR 8666, March 8, 1990; and 59 FR 47384, September 15, 1994) state that substantive requirements are those that set environmental protection requirements, criteria, or limitations; all other requirements are considered administrative.

Management and Disposal of Environmental Restoration Wastes. The sites to which the crosswalk requirement applies are those using the CERCLA process to develop and manage facilities for disposal of radioactive waste resulting from environmental restoration activities. (An important exception is the disposal of 11e.(2) byproduct material wastes which are subject, instead, to the requirements of the *Uranium Mill Tailings Radiation Control Act*). These sites may be following CERCLA either because they are listed on the National Priorities List (NPL) or because the regulatory structure established in cleanup strategies (e.g., negotiated agreements) is based on CERCLA authority and procedures. Under Executive Order 12580, Superfund Implementation, DOE is the lead agency for responding to a release or threatened release of hazardous substances, including radionuclides, from any facility or vessel under the jurisdiction, custody, or control of DOE. As such, DOE has the authority to take appropriate response actions in accordance with CERCLA at sites not listed on the NPL. Response actions, consisting of removal actions (40 CFR 300.415) or remedial actions (40 CFR 300.430 and 300.435), may include onsite disposal, use of access/institutional controls, or other appropriate and feasible actions which ensure protection of human health and the environment.

A site which is not listed on the NPL may also perform corrective or remedial actions which result in onsite disposal of environmental restoration wastes. Such activities may be conducted pursuant to regulatory authorities other than CERCLA including, but not necessarily limited to, RCRA, applicable state requirements, and the *Atomic Energy Act of 1954*, as amended. When DOE is conducting cleanup work at a non-NPL site under its *Atomic Energy Act* authority or under any other non-CERCLA authority, the substantive and full procedural requirements of DOE M 435.1-1 apply. When using CERCLA authority to conduct a response action that involves onsite waste disposal at a non-NPL site, responsible DOE elements need to act consistent with the NCP as promulgated in 40 CFR Part 300 (including adherence to the requirements for regulatory agency involvement and public participation) if it is the intent of the Department for the CERCLA process to satisfy the requirements of DOE M 435.1-1.

The term onsite under CERCLA is defined as "the areal extent of contamination and all suitable areas in very close proximity to the contamination and necessary for implementation of the response action" [40 CFR 300.5]. Additionally, CERCLA Section 104 (d)(4) states "where two or more noncontiguous facilities are reasonably related on the basis of geography, or on the basis of the threat, or potential threat to the public health or welfare or the environment, the President may, in his discretion, treat these related facilities as one." Therefore, the definition of onsite for any specific Department installation may include noncontiguous facilities within an installation as agreed by the parties involved (e.g., DOE, EPA, the State, and stakeholders) and documented in interagency agreements and/or records of decision.

In selecting Applicable or Relevant and Appropriate Requirements (ARARs) for radioactive waste disposal facilities in accordance with EPA's guidance CERCLA Compliance with Other Laws Manual, performance objectives and substantive requirements of DOE M 435.1-1 are included as information "to be considered" (TBC) rather than specific ARARs because DOE Orders are not promulgated under the *Administrative Procedures Act*. However, to meet its *Atomic Energy Act* responsibilities, the Department must still demonstrate compliance with the requirements of the DOE M 435.1-1. To do this, a CERCLA/DOE M 435.1-1 crosswalk may be prepared, showing how DOE M 435.1-1 was addressed through the CERCLA process. If any substantive Order requirement was not satisfied through the CERCLA process, it would need to be applied separately and complied with under the DOE M 435.1-1 process.

An example of a crosswalk between CERCLA requirements and DOE's waste management requirements is provided in Attachment 1. This example appeared as an attachment to both the 1996 and 1997 policies referenced above. Although this example was developed to illustrate compliance with the requirements of DOE 5820.2A and was referred to as a roadmap rather than a crosswalk, it is nonetheless a valid illustration of the content and level of detail expected in crosswalks linking the requirements of DOE M 435.1-1 with the requirements of CERCLA. The example is drawn from the actual comparison performed for the Fernald Environmental Management Project.

The crosswalk should state if the specific DOE M 435.1-1 performance objective/requirement was identified as an ARAR/TBC in the CERCLA process, or whether an equivalent requirement from a promulgated Federal or State law was determined to be an ARAR and was met. The CERCLA/DOE M 435.1-1 crosswalk should provide specific references to applicable sections of the site-developed regulatory documentation (e.g., RI/FS) which provide the details that support the statements made in the crosswalk. The tabular summary shown in Attachment 1 should be included for completeness. The crosswalk should also provide a brief one or two paragraph summary of the employed technical review process (e.g., identify reviewing organizations, regulators, stakeholders, and major comments which resulted in significant changes to the remedy selection and design).

In essence, when the CERCLA process is being used to plan for onsite disposal of CERCLA waste, compliance with the performance objectives of DOE M 435.1-1 is essential and must be documented. While the format in which compliance is demonstrated is not prescribed, Attachment 1 offers a suggested means to satisfy this need. As noted above, the crosswalk presented in Attachment 1 is a real example of a crosswalk prepared in accordance with the original 1996 CERCLA policy for compliance with the requirements of DOE 5820.2A, and illustrates the content and level of detail expected. If certain substantive requirements of DOE M 435.1-1 cannot be incorporated into the CERCLA documents, then those requirements must be met separately and approved using the DOE M 435.1-1 process.

> *Example: Site B is not on the NPL but consistent with DOE policy and Executive Order 12580, is following the CERCLA process in identifying and addressing risks posed by radioactive wastes previously disposed of at the site. One of the remedial alternatives at the site calls for building a new onsite disposal facility. The FS includes calculations for the new facility that are the same as those required for a performance assessment under DOE M 435.1-1, and reports the results under the detailed evaluation of alternatives against the CERCLA criteria. In addition, the risk evaluation prepared for the onsite disposal remedial alternative includes an assessment of all interactive sources and was submitted as an appendix to the FS. Therefore, the site met the substantive requirements of DOE M 435.1-1 through their RI/FS and associated process, and documented this compliance by developing a crosswalk. The CERCLA process is sufficient and there is no need to conduct any separate analyses.*

In some situations, analyses performed under CERCLA will not be identical to those conducted under DOE M 435.1-1 due to differing assumptions or methodologies (e.g., related to land use, institutional controls, etc.). In these cases, the brief statement in the crosswalk should identify the issue and provide an explanation of how the assumption or methodology used under CERCLA demonstrates compliance with requirements of DOE M 435.1-1.

> *Example: At Site C, one of DOE's largest NPL sites, an onsite disposal cell is being considered as part of an overall remedial strategy under CERCLA. A risk evaluation is prepared in accordance with EPA's Risk Assessment Guidance for Superfund: Human Health Evaluation (Part A). For the remedial alternatives involving the proposed onsite disposal cell, an inadvertent intruder scenario is not evaluated based on the site's long term land use plan. In this case, the CERCLA/DOE M 435.1-1 crosswalk statement regarding compliance for this specific requirement, identifies the land use assumptions and explains how the site's regulatory process ensures compliance. The crosswalk explains that under CERCLA, the remedy would be evaluated no less than every five years to ensure it is functioning as intended and remains effective in reducing risks and complying with ARARs. This crosswalk statement and the accompanying table would then document compliance with this requirement of DOE M 435.1-1.*

CERCLA requires analysis of risks from all pathways/all sources [see 40 CFR 300.430(d) and 40 CFR 300.430(e)(2)(I)(A)]. However, there is no prescribed methodology for performing such an evaluation. The Department has established a consistent approach for assessing interactive sources; the document entitled *Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from LLW Disposal Facilities* can be used to evaluate the impacts potentially resulting from radioactive waste disposal facilities. The completed composite analysis will be an effective management tool for understanding the site-wide implications of multiple source-terms.

> *Example: Fernald, an NPL site, is following CERCLA for cleanup activities and is disposing of some environmental restoration wastes in an onsite low-level waste disposal facility. To meet the requirements of DOE M 435.1-1 and CERCLA, the site prepared a Comprehensive Response Action Risk Evaluation as part of its RI/FS process. This Evaluation was a key component of the document prepared by the site to demonstrate compliance with CERCLA and DOE M 435.1-1.*

Field Element Managers are to submit the appropriate CERCLA documentation to the Deputy Assistant Secretary for Environmental Restoration. For purposes of DOE O 435.1 and DOE M 435.1-1, the term "appropriate CERCLA documentation" means the written materials prepared to demonstrate compliance with the substantive requirements of DOE M 435.1-1 for low-level waste disposal facilities managed under CERCLA. Specifically included in such written materials are crosswalks between CERCLA requirements and DOE M 435.1-1 requirements which are used as the basis for issuance of a disposal authorization by the Deputy Assistant Secretary for Environmental Restoration. Based on the appropriate CERCLA documentation, the Field Element Manager certifies that compliance with the substantive requirements of DOE M 435.1-1 has been achieved through application of the CERCLA process. Any other analyses that have not been incorporated into the CERCLA process require a separate review. The Deputy Assistant Secretary may assign the LFRG the task of reviewing the information submitted by the Field Element Manager. In this instance, the documents would be reviewed against the criteria set forth in the guidance entitled, *Department of Energy LLW Disposal Facility Federal Review Group Performance Assessment and Composite Analysis Review Guidance Manual* (the *Review Guide*). Based on the content of the crosswalk, the LFRG will determine whether it needs to review the detailed analysis. The LFRG will report its conclusions to the Deputy Assistant Secretary for Environmental Restoration. The Deputy Assistant Secretary for Environmental Restoration will use this information as the basis for deciding whether to issue a disposal authorization based on DOE's *Atomic Energy Act* responsibilities.

The disposal authorization statement does not impact the decision documented in the CERCLA Record of Decision on whether to build a facility because this decision is made through the CERCLA process. The disposal authorization statement specifies limits and conditions on design, construction, operations, and closure of the radioactive waste disposal facility. The disposal

authorization statement could be included as part of the Record of Decision. If this is the case, then the guidance on disposal authorization (Chapter IV) should be followed during the development of a ROD on CERCLA radioactive waste disposal facilities, to the extent practical. However, it should be understood that compliance with requirements of a law (e.g., CERCLA) does not release DOE of compliance with another law (e.g., *Atomic Energy Act of 1954*, as amended). DOE must determine that whatever actions are taken, *Atomic Energy Act* requirements are met.

> *Example: At Site F, DOE and the stakeholders evaluated the disposal of environmental restoration waste in an onsite disposal cell. The site is using the CERCLA process. The CERCLA RI/FS team followed the DOE "Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from LLW Disposal Facilities" when assessing the sources potentially interacting with the proposed disposal facility. Therefore a separate composite analysis to comply with the requirements of DOE M 435.1-1 was not necessary. A crosswalk was developed showing the linkage between CERCLA requirements and DOE M 435.1-1 requirements. Based upon the crosswalk, the Field Element Manager certified that the facility would meet all of the DOE M 435.1-1 requirements and submitted the crosswalk to the Deputy Assistant Secretary for Environmental Restoration. The Deputy Assistant Secretary turned to the LFRG to review the crosswalk and the LFRG reported its conclusions to the Deputy Assistant Secretary. Based on the LFRG report, the Deputy Assistant Secretary issued a disposal authorization.*

Environmental restoration activities will generate radioactive waste requiring off-site disposal. Management of wastes that will be disposed of off-site must meet all the requirements of DOE M 435.1-1. There is no need to prepare a crosswalk documenting how the DOE M 435.1-1 requirements have been addressed in the CERCLA documents and process.

In addition, if DOE plans to use the services of a commercial facility for management of radioactive waste from environmental restoration activities, the requirements of Section I.2.F.(4) must be met. These requirements can be included in the appropriate CERCLA documentation or handled separately.

<u>Demonstrating Compliance</u>. To fulfill DOE's *Atomic Energy Act* responsibilities, the Department must demonstrate compliance with the substantive requirements of DOE M 435.1-1 for low-level waste disposal facilities managed under CERCLA. Appropriate CERCLA documentation (define above) may be used to demonstrate compliance with the substantive requirements of DOE M 435.1-1. This may include a crosswalk prepared to demonstrate that the CERCLA process addresses the requirements of DOE M 435.1-1. In addition, the Field Element Manager must submit certification to the Deputy Assistant Secretary for Environmental Restoration that the

substantive requirements have been met for the disposal facility. A disposal authorization must be issued by the Deputy Assistant Secretary for Environmental Restoration.

Supplemental References:

1. Alm, 1997. Alvin L. Alm (DOE) to John T. Conway (DNFSB), letter, *Guidance for Complying With DOE Order 5820.2A, Radioactive Waste Management for Onsite Management and Disposal of Low-Level Waste Resulting from Environmental Restoration Activities*, U.S. Department of Energy, Washington, D.C., January 9, 1997.

2. DOE, 1996. *Policy for Demonstrating Compliance with DOE Order 5820.2A for Onsite Management and Disposal of Low-Level Wastes Under the Comprehensive Environmental Response, Compensation, and Liability Act*, U.S. Department of Energy, Washington, D.C., May 31, 1996.

3. EPA. *National Oil and Hazardous Substances Pollution Contingency Plan*, 40 CFR Part 300, U.S. Environmental Protection Agency, Washington, D.C.

4. EPA, 1988. "Proposed Rule; National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300," *Federal Register*, Vol. 53, No. 245, U.S. Environmental Protection Agency, Washington, D.C., December 21, 1988.

5. EPA, 1990. "Final Rule, National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300," *Federal Register*, Vol. 55, No. 46, U.S. Environmental Protection Agency, Washington, D.C., March 8, 1990.

6. EPA, 1994. "Final Rule, National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Parts 9 and 300," *Federal Register*, Vol. 59, No. 178, U.S. Environmental Protection Agency, Washington, D.C., September 15, 1994.

7. EPA, 1988. *CERCLA Compliance with Other Laws Manual, Draft Guidance*, EPA/540/G-89/006, U.S. Environmental Protection Agency, Washington, D.C., August 8, 1988.

8. EPA, 1989. *CERCLA Compliance with Other Laws Manual, Part II - Clean Air Act and Other Environmental Statutes and State Requirements, Interim Final*, EPA/540/G-89-009, U.S. Environmental Protection Agency, Washington, D.C., August, 1989.

9. *Superfund Implementation*, Executive Order 12580, Washington, D.C., October 26, 1993.

10. EPA, 1989. *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual (Part A),* Interim Final, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C., December 1989.

ATTACHMENT 1

SELECTED PORTIONS FROM A SAMPLE CERCLA/DOE ORDER 5820.2A [CROSSWALK]

INTRODUCTION

This example of a crosswalk between CERCLA requirements and DOE's waste management requirements appeared as an attachment to both the 1996 and 1997 CERCLA policies referenced above. Although this example was developed to illustrate compliance with the requirements of DOE 5820.2A and was referred to as a roadmap rather than a crosswalk, it is nonetheless a valid illustration of the content and level of detail expected in crosswalks linking the requirements of DOE M 435.1-1 with the requirements of CERCLA. The example is drawn from the actual comparison performed for the Fernald Environmental Management Project.

This [Crosswalk] provides specific examples of how the Fernald Environmental Management Project (FEMP) has substantively met the objectives/requirements of DOE 5820.2A. Each example specifically identifies how each performance objective or requirement was/will be satisfied at the FEMP via the CERCLA process.

DOE Order 5820.2A is applicable to the FEMP because selected remedies for three of the five operable units (OUs) include onsite disposal. The FEMP onsite disposal facility (OSDF) will contain LLW from the remedial activities to be conducted under CERCLA. This [Crosswalk] demonstrates that the FEMP CERCLA remedial activities of evaluation, design, construction, and waste placement in the onsite disposal facility has/will substantively satisfy the applicable requirements and intent of DOE Order 5820.2A, Chapter III, Management of LLW.

The CERCLA process satisfies the requirements and intent of DOE Order 5820.2A through compliance with ARARs, TBCs, and the information and planning that is derived during the implementation and completion of the CERCLA process, such as the completion of the CERCLA mandated remedial investigations, feasibility studies, remedial designs, and remedial planning documents. This [Crosswalk] will refer to the requirements that mandate these remedial investigations, feasibility studies, remedial designs, remedial planning documents, and the guidance used for implementation, as CERCLA Drivers. The ARARs, TBCs, and CERCLA Drivers serve as the basis for complying with the requirements of DOE 5820.2A and the [Crosswalk] document demonstrates that compliance has been attained. This [Crosswalk] is specific to the FEMP alone. The FEMP CERCLA process and associated ARARs, and TBCs that have been utilized will differ slightly from the ARARs, and TBCs that will be employed at other CERCLA sites within the DOE complex. Page A2-8 includes a table that summarizes the requirements of DOE 5820.2A that have been satisfied through the FEMP CERCLA process.

IDENTIFICATION OF COMPLIANCE WITH THE SUBSTANTIVE REQUIREMENTS OF DOE ORDER 5820.2A

DOE ORDER 5820.2A CHAPTER III (3) (a) PERFORMANCE OBJECTIVES

Purpose

This section of DOE 5820.2A identifies the performance based objectives that a LLW disposal facility must achieve. The objectives are: (1) protection of public health and safety; (2) releases to the environment from the LLW disposal facility shall be ALARA, and must not result in an effective dose equivalent (EDE) that exceeds 25 mrem/year to any member of the public; (3) prevent the possibility of a 100 mrem/year continuous exposure or 500 mrem acute exposure of an inadvertent intruder after institutional controls have terminated (100 years); and (4) protect ground-water resources consistent with Federal, State, and local requirements.

Statement of Compliance for 3(a)(1)

Compliance with this requirement was attained through applying the two CERCLA threshold criteria as identified in the NCP, which are protecting human health and the environment and identifying and complying with ARARs. Substantive compliance with this requirement was further accomplished through the design of the Onsite Disposal Facility (OSDF) and the establishment of waste acceptance criteria (WAC), which will result in the dose to the public being lower than the established exposure limits and by providing protection to ground-water resources.

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(a)(1)

ARARs: 40 CFR 300.430 (e)(9)(iii)(A), CERCLA Threshold Criteria

Statement of Compliance for 3(a)(2)

Compliance with this requirement was attained through the evaluation of all sources of risk to the public which was completed in the CERCLA Feasibility Study (FS) risk assessments and the Comprehensive Response Action Risk Evaluation (CRARE) performed for the FEMP. The designed containment system (multi-layer cap and liner) of the OSDF eliminates all exposure pathways except groundwater. Protecting the public through the groundwater pathway was addressed by meeting applicable *Safe Drinking Water Act* (SDWA) maximum contaminant level (MCL) groundwater standards. The established waste acceptance criteria (WAC) for the OSDF ensure that the MCLs are not exceeded in the groundwater for 1,000 years. By meeting the proposed SDWA uranium MCL of 20 parts per billion (ppb), the exposure dose from

groundwater will be below the 25 mrem per year EDE requirement for 1,000 years into the future.

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(a)(2)

ARARs: OAC 3745-27-08 (C), Landfill Construction
40 CFR 61.92-93, National Emissions Standards for Hazardous Air Pollutants (NESHAPS) for emissions of radionuclides other than radon from the Department facilities
40 CFR 61.192, NESHAPS for emissions of radon from Department facilities

TBCs: DOE 5400.5 Chapter II (1)(a), (b), (3)(a)(5), Chapter IV (4)(c), Radiation Protection of the Public and the Environment
DOE 5820.2A Chapter III (3)(a)(2), Protection of the General Population from Releases of Radioactivity

CERCLA Drivers: 40 CFR 300.430, Remedial Investigation/Feasibility Study (RI/FS) and selection of remedy
40 CFR 300.435, Remedial Design (RD)/Remedial action (RA), operation and maintenance
US EPA, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA
US EPA, 1988, Superfund Exposure Assessment Manual
US EPA, 1989, Risk Assessment Guidance for Superfund: Human Health Evaluation manual, Part A, Interim Final
US EPA, Guidance on Preparing Superfund Decision Documents: The Proposed Plan (PP), The Record of Decision (ROD), Explanation of Significant Differences, the ROD Amendment

Statement of Compliance for 3(a)(3)

Compliance with this requirement was satisfied through the implementation of permanent institutional controls, and the long-term permanence design of the OSDF. The Operable Unit 2 (OU2) and Operable Unit 5 (OU5) RODs specify that the final land use for the OSDF be restricted with perpetual federal ownership and maintenance of institutional controls (such as warning signs and fencing). The NCP and the OU2 and OU5 RODs also specify the design of a containment system with long-term permanence. The OSDF has a designed nine-foot multi-layer cap system which includes a three-foot rock barrier layer, and a five-foot multi-layer liner system. To ensure proper performance of the institutional controls and the containment system, their overall performance will be reviewed every five years as required by the NCP. The

implementation of perpetual institutional controls and the designed containment system precludes the inadvertent intrusion exposure scenario.

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(a)(3)

ARARs: OAC 3745-27-08 (C), Landfill Construction
OAC 3745-27-11 (H), Landfill Final Closure
OAC 3745-27-14 (A), Landfill Post-Closure Care

TBCs: DOE 5400.5 Chapter II (1)(a)(b), Radiation Protection of the Public and the Environment

CERCLA Drivers: 40 CFR 300.430, RI/FS and selection of remedy
US EPA, 1988, Guidance for Conducting RI/FS Under CERCLA
US EPA, 1988, Superfund Exposure Assessment Manual
US EPA, 1989, Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A, Interim Final
US EPA, Guidance on Preparing Superfund Decision Documents: The PP, the ROD, Explanation of Significant Differences, and the ROD Amendment

Statement of Compliance for 3(a)(4)

Compliance with this requirement was met through the development of the WAC and design of the OSDF. These actions resulted in the protection of the groundwater resources in accordance with all applicable groundwater standards. The groundwater modeling for the OSDF WAC development demonstrated that the aquifer would be protected to the proposed uranium MCL for 1,000 years into the future. The DOE Fernald Area Office (DOE-FN), DOE Headquarters (DOE-HQ), the United States Environmental Protection Agency (USEPA), and Ohio Environmental Protection Agency (EPA) have approved the modeling in the OU2, and OU5 FSs.

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(a)(4)

CERCLA Drivers: 40 CFR 300.430, RI/FS and selection of remedy
40 CFR 300.435, RD/RA, operation and maintenance
US EPA, 1988, Guidance for Conducting RI/FS Under CERCLA
US EPA, 1988, Superfund Exposure Assessment Manual
US EPA, 1989, Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A, Interim Final
US EPA, Guidance on Preparing Superfund Decision Documents: The PP, the ROD, Explanation of Significant Differences, the ROD Amendment

References for Requirement 3(a)

OU2 Risk Assessment (OU2 FS, Appendix C Risk Evaluation), OU5 Risk Assessment (OU5 FS, Appendix F Fate and Transport Modeling, Appendix G Short Term Risk Assessment, and Appendix H CRARE), and OU3 Risk Assessment (OU3 FS, Appendix H Short Term Risk Assessment, Appendix I CRARE), OU2 ROD, OU5 ROD, and OU3 ROD, Onsite Disposal Facility (OSDF) Design Criteria Package (OSDF Design Specifications Package, OSDF Design Calculations Package, OSDF Design Drawings Package), OSDF Support Plans (Appendix A Impacted Materials Placement Plan)

DOE ORDER 5820.2A CHAPTER III (3)(h) LONG-TERM STORAGE

Purpose

This section requires that the long-term storage of LLW be conducted in a manner in which the performance objectives of Chapter III (3)(a) are maintained.

Statement of Compliance for 3(h)(1), (2), (3), and (4)

The long-term storage requirements specified in DOE 5820.2A are not applicable to the remedial activities associated with the disposal of waste in the OSDF because there are no plans that include the long-term storage of waste prior to final disposal in the onsite disposal facility.

DOE ORDER 5820.2A CHAPTER III (3)(k) ENVIRONMENTAL MONITORING

Purpose

This section requires that the LLW disposal facility be monitored by an environmental monitoring program that can measure (through the monitoring of the applicable environmental media) operational effluent releases, migration of radionuclides, disposal facility subsidence, and changes in the disposal facility and site parameters that may effect the long-term performance of the disposal facility.

Statement of Compliance with 3(k)(1)

Compliance with this requirement will be satisfied by utilization of the Integrated Environmental Monitoring Plan (IEMP) developed for the FEMP and the OSDF Support Plans. These plans will include monitoring of OSDF associated ground water, surface water, air, leachate, leak detection system, and subsidence.

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(k)(1)

ARARs: OAC 3745-27-10, Ground-water Monitoring Program
OAC 3745-27-19(E)(26), Sanitary Landfill Operation; maintain integrity of landfill components
OAC 3745-27-19(J)(1), (4) - Sanitary Landfill Operations; surface water control structures

TBCs: DOE 5820.2(A) Chapter III(3)(k), Environmental Monitoring

CERCLA Drivers: 40 CFR 300.435, RD/RA, operation and maintenance

Statement of Compliance with 3(k)(2)

See discussion above stating compliance with 3(k)(1).

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(k)(2)

ARARs: OAC 3745-27-10, Ground-water Monitoring Program
OAC 3745-27-08(C)(1), (2), (3), (4), (5), (6), (7), (9), Leachate collection and storage; structures must be monitored
OAC 3745-27-19(E)(26), Sanitary Landfill Operation; maintain integrity of landfill components
OAC 3745-27-19(J)(1), (4) - Sanitary Landfill Operations; surface water control structures

TBCs: DOE 5820.2(A) Chapter III(3)(k), Environmental Monitoring

CERCLA Drivers: 40 CFR 300.435, RD/RA, operation and maintenance

Statement of Compliance with 3(k)(3)

See discussion above stating compliance with 3(k)(1).

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(k)(3)

ARARs: OAC 3745-27-10, Ground-water Monitoring Program
OAC 3745-27-19(K)(1), (2), (3) - Sanitary Landfill Operations; leachate detection

TBCs: DOE 5820.2(A) Chapter III(3)(k), Environmental Monitoring

CERCLA Drivers: 40 CFR 300.435, RD/RA, operation and maintenance

Statement of Compliance with 3(k)(4)

See discussion above stating compliance with 3(k)(1).

Identification of ARARs, TBCs, and/or CERCLA Drivers for 3(k)(4)

ARARs: OAC 3745-27-10, Ground-water Monitoring Program

TBCs: DOE 5820.2(A) Chapter III(3)(k), Environmental Monitoring

CERCLA Drivers: 40 CFR 300.435, RD/RA, operation and maintenance

References for Requirement 3(k)

IEMP, Onsite Disposal Facility Support Plans (Appendix C Surface-Water Management and Erosion Control, and Appendix F Air Monitoring Plan)

FEMP CERCLA REVIEW PROCESS

The CERCLA process at the FEMP involves many resources, organizations, and agencies, which provides for a thorough review and approval process. Several subject matter expert resources are utilized during the internal review process at the FEMP by the Department contractor. Additionally, resources from the major contractor teaming partners are utilized during the internal review.

The Fernald Area Office reviews and approves all CERCLA documents. The public stakeholders also have review and comment capabilities throughout the process. Direct involvement in information exchange meetings and technical review of CERCLA documents by US EPA and Ohio EPA in the FEMP CERCLA process is required, pursuant to the terms of the 1986 Federal Facility Compliance Agreement, and a 1990 Consent Agreement between the Department and US EPA, and a Consent Decree between the Department and Ohio EPA. The US EPA including the US EPA Radiation and Risk Assessment specialists, the US EPA environmental contractor, the Ohio EPA, and the Ohio EPA environmental contractor have review and approval authority on all CERCLA documents.

REQUIREMENTS IN DOE ORDER 5820.2A, RADIOACTIVE WASTE MANAGEMENT, CHAPTER III, SECTION 3, MANAGEMENT OF LLW, SATISFIED THROUGH THE CERCLA PROCESS

The following table identifies requirements a. through m. of DOE 5820.2A, Chapter III, Section 3 that have been satisfied at the FEMP via the CERCLA process. These requirements have been satisfied through the compliance with ARARs, TBCs, and other drivers of the CERCLA process. Since these requirements were incorporated as part of the CERCLA process, they do not need to be applied separately.

For completeness, the table also identifies those requirements that are not incorporated or satisfied through the CERCLA process. In the case of the FEMP, none were identified for this category. if any had been identified, they would need to be applied separately and complied with under the DOE 5820.2A process.

DOE 5820.2A, Radioactive Waste Management, Chapter III, LLW Waste Management, Section 3, Requirements	Requirements satisfied via the FEMP CERCLA process	Requirements not satisfied via the FEMP CERCLA process
a. Performance Objectives	a.1, a.2, a.3, a.4	
b. Performance Assessment	b.1, b.2, b.3	
c. Waste Generation	c.1, c.2, c.3, c.4	
d. Waste Characterization	d.1, d.2, d.3	
e. Waste Acceptance Criteria	e.1, e.2, e.3, e.4, e.5	
f. Waste Treatment	f.1, f.2, f.3, f.4	
g. Shipment	Not Applicable	
h. Long-Term Storage	Not Applicable	
i. Disposal	i.1, i.2, i.3, i.4, i.5, i.6, i.7, i.8	
j. Disposal Site Closure/Post Closure	j.1, j.2, j.3, j.4, j.5, j.6	
k. Environmental Monitoring	k.1, k.2, k.3, k.4	
l. Quality Assurance	all	
m. Records and Reports	m.1, m.2	

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(6) Radioactive Waste Acceptance Requirements. Ensuring development, review, approval, and implementation of the radioactive waste acceptance requirements for facilities that receive waste for storage, treatment, or disposal. Radioactive waste acceptance requirements shall establish the facility's requirements for the receipt, evaluation, and acceptance of waste.

Objective:

The objective of these requirements is to establish limits and technical criteria which waste and/or waste containers must meet, based on the hazards of the waste, to ensure that waste is manageable at receipt and can subsequently be safely stored, treated, or disposed, as applicable.

Discussion:

The discussions that follow provide guidance on the above requirement for radioactive waste acceptance requirements. Specific guidance for waste acceptance requirements for each of the waste types is contained in Chapter II, *High-Level Waste Requirements;* Chapter III, *Transuranic Waste Requirements*; and Chapter IV, *Low-Level Waste Requirements* of this guide.

The analysis of the hazards associated with management of radioactive waste in development of DOE O 435.1 and DOE M 435.1-1 indicated that a critical point where controls are needed to prevent or minimize the risks due to the hazards of radioactive waste is when waste is transferred from one major functional area to another. That is, when waste moves from storage, for example, to treatment or disposal. There is not only a physical transfer of the waste, but a change in the management activities that are to be carried out with the waste, possibly a change in potential risks or hazards, a transfer of the knowledge of the specific content and hazards of the waste, and also a transfer of the responsibility for management of the waste. This transfer of waste, knowledge, and responsibility can take place a large distance from where the waste was generated or treated, or previously stored, or in some cases, after many years in storage. Therefore, development of and implementation of waste acceptance requirements for storage, treatment, and disposal facilities is a critically important control that leads to safe and efficient management of radioactive waste.

Waste Acceptance Requirements.

The definition of "waste acceptance requirements" (DOE M 435.1-1, Attachment 2) is:

> Waste acceptance requirements are waste acceptance criteria, and all other requirements that a facility receiving waste for storage, treatment, or disposal must meet to receive waste (e.g., waste acceptance program requirements, receiving facility operations manual).

The waste acceptance requirements include both the program implemented by the facility receiving the waste, such as waste handling procedures and training, and any technical and administrative criteria to address the hazards associated with the waste that arise from handling and managing the waste, and technical and administrative criteria that are provided to waste generators who transfer waste to the receiving facility that waste must meet in order to be acceptable, known as "waste acceptance criteria."

The waste acceptance requirements should include all of the technical limitations and criteria for radioactive waste to be acceptable for storage, treatment, or disposal at the receiving facility. The safety analysis report, criticality analysis, and any other appropriate safety, authorization basis, or performance assessment documents should be used to establish the technical waste acceptance requirements for the receiving facility, including radioactivity (concentration and inventory) limits, waste classes or categories, waste form and/or packaging stability requirements, allowable chemical content, percent liquid, and any other necessary waste container or form requirements to ensure that the facilities' design bases, performance, and operating bases are protected.

The waste acceptance requirements should include establishment of a process by which the receiving facility evaluates incoming waste for acceptability and confirms that a waste meets the acceptance criteria of the facility. The process should include one of, or a combination of, physical evaluations of waste, such as sampling and testing, or reviews, audits, or observations of generating facilities' certification processes and procedures. The process should establish the procedures and mechanisms for dealing with incoming waste that does not meet the waste acceptance requirements of the receiving facility. The waste type chapters contain additional guidance on this element of waste acceptance requirements.

Waste Acceptance Criteria.

The definition of "waste acceptance criteria" (DOE M 435.1-1, Attachment 2) is:

> Waste acceptance criteria are the technical and administrative requirements that a waste must meet in order for it to be accepted at a storage, treatment, or disposal facility.

The waste acceptance criteria are those technical requirements, such as radionuclide concentration and package weight limitations, that a waste must meet, and administrative requirements, such as forms and certification statements, that a generator must prepare, for radioactive waste to be accepted at a storage, treatment, or disposal facility. Waste acceptance criteria must be documented, and in fact, for facilities that receive waste from many differing generators, are commonly known documents, such as the Waste Isolation Pilot Plant Waste Acceptance Criteria document, or the WIPP WAC.

The waste acceptance criteria should specify the documentation requirements regarding waste generation, characterization, transport, treatment, storage, disposal, and any other information that must be prepared by the generator, retained by the generator, sent to the receiving facility, and accompany the waste in order for waste to be acceptable at the receiving facility. The waste acceptance criteria should define the key elements to be included in a waste generator's certification program to confirm that radioactive waste has been properly prepared to meet the receiving facility's acceptance requirements.

Development of Waste Acceptance Requirements. The facility receiving waste for storage, treatment, or disposal must document its waste acceptance requirements. The documentation should be as thorough, clear, concise, and unambiguous as possible to minimize the potential for unacceptable waste being sent to the facility.

The waste acceptance requirements and documentation should be developed using a graded approach commensurate with the hazards associated with the management of the waste in the facility and the complexity of the activities to be conducted in the facility and on the waste. The complex activities that can involve many hazards that take place at a low-level waste disposal facility or a high-level waste storage tank would likely involve numerous and/or detailed waste acceptance requirements. By contrast, a facility which will only pass-through properly packaged waste directly to a disposal facility may have a minimum set of requirements that refer to the disposal facility waste acceptance requirements and are often more general in nature. A facility engaged only in staging of waste for shipment to another facility may not have separate waste acceptance requirements apart from the facility to which it will eventually be shipped.

> *Example: Facility 200 at Site W contains a high-level waste treatment process. The treated high-level waste is transferred to Facility 400 for transportation to another DOE site. Low-level waste and transuranic waste that result from the treatment process are solidified for disposal at Site W, and transferred to Storage Building A while it waits for disposal. The waste acceptance and processing documentation for Facility 200 contains detailed procedures and technical specifications for the acceptance of high-level waste streams for processing. The documentation contains details that make it clear that, as long as operations are maintained within appropriate parameters, the solidified low-level waste and transuranic waste are certifiable to the Site W disposal facility. No additional*

waste acceptance requirements are prepared for Storage Building A where the waste is stored prior to disposal.

A radioactive waste management facility may have individual, stand-alone requirements, if warranted by the hazards involved or the complexity of the activities conducted. Or a site may have general acceptance requirements applicable to all waste management facilities at the site, in which case separate facilities would add facility-specific acceptance requirements to the site acceptance requirements, as necessary. This may be the practice at a site with many facilities which manage small quantities of waste with multiple locations for staging, storage, and/or central management of waste. At such a facility, most of the process and procedural acceptance requirements could be in one document applicable to the whole site, which would be supplemented with specific technical requirements for acceptance at each of the management locations. If activities at various facilities are the same, they could share the same supplemental waste acceptance requirements documents. Likewise, if several activities are carried out at locations that are close to one another, or are managed by the same entity, then it may be advantageous for one supplemental technical document to be prepared to cover those activities.

Waste acceptance requirements for treatment and storage facilities should consider the waste acceptance criteria for facilities in subsequent steps of waste management in development of their waste acceptance criteria. Particular attention should be paid to the requirements for treatment facilities to prevent generation of waste streams, following treatment, that would have no path forward to disposal. Waste acceptance requirements should also clearly delineate different requirements for on-site generators as opposed to off-site generators, if differences exist. Similarly, if there are any specific requirements for, or accommodations made, at the receiving facility for small volume generators, these should be specified in the waste acceptance documentation. Waste acceptance requirements should also address any specific inspections for leakage, contamination, or presence of hazardous materials required by other DOE Orders or Department of Transportation regulations.

Example: Processes in the Site W Treatment Building include packaging of low-level and mixed low-level waste, compaction of low-level waste, incineration of mixed low-level waste, solidification of low-level waste, and storage and staging of waste prior to disposal. The Site W Treatment Building Waste Acceptance Requirements document contains provisions that address Department of Transportation requirements, RCRA Permit requirements, State Hazardous waste law permit requirements, waste acceptance criteria from the disposal facilities to which waste will be transferred, as well as DOE O 435.1 and DOE M 435.1-1 requirements.

<u>Review and Approval of Waste Acceptance Requirements</u>. The waste acceptance requirements for DOE facilities that receive waste for storage, treatment, or disposal are a key element of the radioactive waste management basis, and should be thoroughly reviewed for completeness,

adequacy, and consistency with the hazards that may be encountered at the facility. The Field Element Manager, or his/her designee, is responsible for conducting this review. At his/her discretion, review and approval of facility waste acceptance requirements can be delegated to a contractor. The waste acceptance requirements document should be finalized and approved prior to the issuance of a facility's radioactive waste management basis. The radioactive waste management basis for the receiving facility should reference the waste acceptance requirements document, or cite specific acceptance requirements, as critical elements of the radioactive waste management basis for the facility. Likewise, generating facilities, operations, or activities that send waste to the receiving facility should also cite or reference the waste acceptance requirements document for the receiving facility in the radioactive waste management basis statement applicable to the waste generation.

Implementation. The implementation of the waste acceptance requirements for radioactive waste management facilities should also follow the graded approach process that is consistent with the hazards associated with the management of the waste in the facility and the complexity of the activities to be conducted in the facility and on the waste. Some radioactive waste management facilities or operations that receive large amounts of waste for storage, treatment, or disposal from many different generator organizations, should establish a waste acceptance program that has separate responsibility for receipt, evaluation, and approval of receipt of waste. On the other hand, waste acceptance at a group of several small facilities at which similar management steps, like storage, are being undertaken, may require little in the way of an active program for receiving waste.

> *Example: The Site D Disposal Facility accepts waste from several generators in the DOE Complex. Site D establishes a Waste Acceptance Program which runs the receipt and acceptance of waste, including establishment of the waste acceptance criteria (WAC) documentation and waste receipt operations (including: container inspection upon arrival, unloading, transfer to disposal emplacement operators). The Site D Waste Acceptance Program performs waste certification audits of generators at all other DOE sites which send waste to the Site D Disposal Facility. By way of contrast, at Site E, where waste is generated, treated, and stored, and then transferred to Site D for disposal, the Waste Generator Program handles all waste generation documentation, waste certification, waste acceptance at Site E treatment and storage facilities, and all transfer responsibilities to Site D. Site E personnel participate in Site D waste generator certification audits, but do not conduct separate ones of their own.*

Compliance with the requirement for radioactive waste acceptance requirements is demonstrated if all radioactive waste management storage, treatment, and disposal facilities have approved, documented waste acceptance requirements that include all necessary technical requirements and limitations for waste to be acceptable upon receipt at the facility, documented waste acceptance criteria that a generator uses to transfer acceptable waste to the receiving facility, and all

necessary administrative requirements that include a process for evaluation and acceptance of incoming waste as meeting the acceptance requirements of the receiving facility.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria*, NTSWAC (Revision 1), U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

2. DOE, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, DOE/WIPP-069, Revision 5, U.S. Department of Energy, Carlsbad, NM, April 1996.

3. DOE, 1991. *Hanford Site Solid Waste Acceptance Criteria*, WHC-EP-0063-3, U.S. Department of Energy, Richland Operations Office, Richland, WA, September 1991.

I. 2.F. <u>Field Element Managers</u>.

Field Element Managers are responsible for:

(7) Radioactive Waste Generator Requirements. Ensuring development, review, approval, and implementation of a program for waste generation planning, characterization, certification, and transfer. This program shall address characterization of waste, preparation of waste for transfer, certification that the waste meets the receiving facility's radioactive waste acceptance requirements, and transfer of waste.

Objective:

The objective of radioactive waste generator requirements is to promote the development of effective programs for managing the front end of radioactive waste management cycles. Front end activities consist of those activities performed by waste generators in preparation for turning over waste for management in systems intended to lead to disposal. The Field Element Manager is assigned responsibility for ensuring that effective programs are developed and implemented for managing radioactive wastes in a manner that promotes their eventual disposal.

Discussion:

The requirement for a waste generator program provides for development and implementation of systematic, integrated capabilities for four key elements: (1) considering waste management needs prior to and during generation of waste streams (planning), (2) obtaining and maintaining knowledge about the waste that supports effective decision-making about the waste (characterization), (3) documenting that waste generated by one facility meets the receiving facility’s waste acceptance requirements (certification), and (4) and ensuring that waste to be shipped satisfies certain documentation, authorization, and manifest requirements (transfer). Hazards associated with the physical aspects of radioactive waste transfer are addressed in transfer requirements for specific waste types.

The definition of generator (Chapter I, Attachment 2) is;

> “Organizations within DOE or managed by DOE whose act or process produces radioactive waste or, for the purposes of the generator requirements in this Order and Manual, transfer radioactive waste to a treatment, storage, or disposal facility.”

Therefore, a waste generator program is to be implemented by all organizations who produce waste as a byproduct of a mission or process, and all organizations who transfer waste to a treatment, storage, or disposal facility, even if they don’t produce waste. Some elements of the

waste generator program may not be applicable to organizations who only transfer waste, such as waste characterization or approval to generate waste with no path to disposal. Organizations that transfer waste are not required to implement any waste generator program elements that are not necessary to perform a compliant waste transfer. Each generator must determine the elements of the waste generator program that apply to the specific radioactive waste management facilities, operations, and activities, and ensure that they are included in the facility's approved generator program.

> *Example: At Site Q, 1400 Area, there are three facilities who generate low-level waste, and a storage building. The three generator facilities implement all four elements of the 1400 Area waste generator program; planning, characterization, certification, and transfer. Waste generated at 1400 Area is certified to the Site Q Disposal Facility waste acceptance criteria, and transferred to the storage building, where it is stored for 9 months prior to transfer for disposal. The storage building implements only two elements of the 1400 Area waste generator program; waste certification and waste transfer. The program is very minimal, as the storage building acts only to pass-through waste already certified to the Site Q Disposal Facility acceptance criteria. Certification involves only a signature by the storage facility manager on the waste certification statement that the waste continues to meet Site Q Disposal Facility criteria.*

Field Element Managers are required to ensure that their subordinate organizations and personnel establish and carry out these programs. Field Element Managers are also responsible for ensuring the adequacy of the programs for achieving the more detailed requirements identified for waste types and then approving the programs. Finally, Field Element Managers are to ensure that the programs are implemented as designed and approved.

Specific guidance on the four key elements of waste generator programs (i.e., planning, characterization, certification, and transfer) and on issues such as reliance on proposed facilities, conditions under which waste with no path forward can be generated, and demonstration of acceptable performance is provided in Chapter II, *High-Level Waste Requirements;* Chapter III, *Transuranic Waste Requirements*; and Chapter IV, *Low-Level Waste Requirements* of this guide.

Some of the conditions and weaknesses that need to be controlled to prevent or minimize the risks due to the hazards of radioactive waste management are a result of technical and administrative weaknesses and conditions in generator activities. In some cases, waste has been generated without due consideration of the benefits of the activity that generated the waste compared to the work required to manage and dispose of the waste generated. Waste generator requirements focus on systematic attention to the need for generating a waste and effective processes for turning over the waste to waste management facilities. The waste generator program is closely related to other requirements in this Manual, such as waste acceptance requirements, and the implementation of these related requirements should be integrated.

Development and Implementation of a Waste Generator Program. A facility that generates waste should have a program in place that provides for integration of four key elements -- planning, characterization, certification, and transfer. Facilities who transfer waste must also have a waste generator program that integrates whatever elements of the program are being implemented. Documentation of the program should be thorough, clear, concise, and unambiguous to promote integration of these elements and to clearly specify roles and responsibilities. The program does not need to be managed by a discrete organization with dedicated staff and offices. Rather the program is intended to describe the processes and procedures needed to integrate and document the four key elements and to establish roles and responsibilities for carrying out these elements, even across organizational boundaries.

A separate program need not be developed for each facility or each waste type. The establishment of a single waste generator program for an entire site may be the most effective and least expensive option, but depends on the complexity of the facilities and operations and other practical considerations at the site. Some of the waste generator requirements in DOE M 435.1-1 are identical across the waste types and others are very similar among the waste types. Ultimately, the structure and organization of the waste generator program are left to the discretion of Field Element Managers.

The waste generator program and its documentation should be developed using a graded approach commensurate with the hazards associated with the waste generated, the quantities of waste generated, and the complexity of the characterization, certification, and transfer activities to be conducted. Facilities that generate relatively benign radioactive waste with known management and disposal approaches should not have generator program requirements at the same level of detail as activities that produce very hazardous (high radiation) wastes whose management and disposal challenge existing capabilities. For some large, high-hazard facilities, it may be appropriate to establish a waste generator program that has separate responsibility for planning, characterization, certification, and transfer of waste. Facilities who are only pass-throughs (i.e., storage) from one management step (e.g., generation of waste certified to a treatment facility) to another will have minimal waste generator programs.

A radioactive waste generation facility may have individualized requirements if warranted by the hazards involved or the complexity of the activities conducted. Alternatively, a site may have site-wide generator requirements applicable to all waste generators at the site with separate generators supplementing the site requirements with facility-specific requirements as necessary. This would be a particularly good practice at a site with many facilities that generate small quantities of similar waste. At such facilities, most of the process and procedural generation requirements could be articulated in one document applicable to the entire site, which could be supplemented by specific technical requirements for waste generation at each of the management locations. If waste generation activities at some of the facilities are the same or very similar, then they could share the same supplemental waste generator documents. Likewise, if several wastes are

generated at locations that are close to one another, or are managed by the same entity, then it may be advantageous for one supplemental technical document to be prepared to cover those activities.

> *Example: Site X had dozens of operations that each generate approximately one package of radioactive waste each year and one large facility that generates truckloads of waste every week. The Field Element Manager decides to require the development of a site-wide waste generator program that applies to all of the small generators and to require the large volume generator to develop a separate program that applies only to its operation.*

Waste generator certification and characterization requirements are directly linked to the waste acceptance requirements for the facility to which a generator will transfer waste. The generator must certify that waste to be sent to the receiving facility meets its waste acceptance criteria, and waste characterization determines whether the waste acceptance criteria have been satisfied. The waste generator program should include a process for reviewing waste acceptance criteria of the receiving facilities and tailoring certification, characterization, and transfer elements to fully comply with the applicable waste acceptance criteria. The waste acceptance criteria for the receiving facility should be thoroughly reviewed to establish the conditions that the waste to be transferred must meet, as well as the corresponding characterization methods that will be used to ensure that the wastes meet the criteria. If it is determined that the waste acceptance requirements of a facility receiving waste for storage, treatment, or disposal have not been met, the generator bears the financial responsibility for corrective actions necessary to make the waste acceptable or for return of the waste.

Review and Approval of Waste Generator Requirements. The Field Element Manager is responsible for ensuring the proposed generator program(s) are reviewed and approved. As decided by the Field Element Manager, the review and approval may be done by DOE staff or by the contractor. Waste generator program documentation should confirm that the generators consider and plan for waste that will be generated; that a process is included for approving generation of waste that has no path forward to disposal; that waste will be certified to meet acceptance requirements for a receiving facility prior to transfer; that adequate characterization capability is in place; and that transfer requirements will be met. The program should document the roles and responsibilities for carrying out the component elements and should describe interfaces between the elements that will provide for appropriate integration. Documented evidence of the waste generation program approval, based on review of the written description of the program, will serve as the performance measure for this requirement.

> *Example: Upon completion of the draft written waste generator requirements program, the Field Element Manager directs his staff to review the process used by the contractor to review and approve the program against the requirements of DOE M 435.1-1 for*

waste generation planning, waste characterization, waste certification, and waste transfer. The contractor review is performed using procedures developed and documented for this purpose. Once any deficiencies in the programs are corrected, the contractor management provides written approval of the program for implementation. The DOE staff report to the Field Element Manager that they are satisfied with the process used by the contractor for reviewing and approving the program.

Planning Requirements. The goal of the waste generation planning element of this requirement is to provide ultimately for the disposal of all radioactive waste that is generated in the future. This requirement emphasizes analysis of the activities necessary to manage and dispose of waste prior to generating the waste. The objective of this requirement is to increase assurance that necessary waste management facilities are available. Planning is required for all new waste streams. All aspects of waste management up to and including disposal are included. The planning requirements for specific waste types in this Manual are structured to discourage sites from generating waste that does not have an identified path for storage, treatment, and disposal; and to promote the development of plans for resolving issues that prevent disposal of those radioactive wastes that must be generated, but do not have an identified path to disposal. The general requirement for waste with no identified path to disposal (see DOE M 435.1-1, Section I.2.F.(19)) requires approval for generation of such wastes.

Example: A batch of spent fuel stored at Site X is deteriorating, and reprocessing is necessary to reduce risk. The reprocessing will begin two years after the effective date of DOE O 435.1 in an existing reprocessing canyon. The spent fuel is different from that previously reprocessed in the canyon, and necessary process changes will produce a waste stream unlike those previously produced. The high-level waste produced will be subjected to pretreatment and treatment. Prior to disposal, the high-level waste will be solidified. At various stages in this series of operations, temporary or long-term storage will likely be required. Satisfactory performance of the waste generation planning requirements will include preparation of a high-level waste stream life cycle description consisting of identification and explanation of each of these steps and explanation of the interfaces between the steps. Prior to beginning reprocessing, the generator of the waste holds discussions with operators of facilities that may be able to manage the waste and incorporates relevant information on waste management needs and the availability of facilities to meet those needs in written plans.

Characterization Requirements. The waste characterization element of the waste generator process is a critical control used by other elements (e.g., waste acceptance requirements, certification, transfer) to ensure that sufficient knowledge of a waste's characteristics is available to support effective decision-making for its management. Waste characterization is a necessary control to mitigate potential vulnerabilities if a waste stream is not adequately described. The requirements contained in this section, and in the respective waste type chapters, address the

identified vulnerabilities by specifying the minimum characterization data, and requiring the use of a data quality objectives, or similar, process.

> *Example: A waste stream from an actinide processing building is sampled and analyzed and determined to consist of three primary nuclides: Pu-239, Am-241, and Pu-238. Multiple samples are found to contain the three radionuclides in essentially the same ratio, and the process does not vary significantly over time. Therefore, the contents of future waste packages are routinely characterized based on a gamma energy analysis which detects gamma radiation from the Am-241 and the Pu-238. The characterization program requires the collection and full analysis of samples once a month to confirm that the ratio of the three radionuclides falls within an acceptable range (based on application of the data quality objectives process).*

Certification Requirements. The waste certification element of the waste generator program is one part of the controls put in place as a result of the hazards analysis performed when developing DOE O 435.1 and DOE M 435.1-1. Certification requirements address confirmation that the waste acceptance criteria of a receiving facility have been met.

> *Example: The Building Five Storage Facility has low-level waste that it has received for storage over the last year. Facility personnel plan to continue to receive low-level waste and store it until it can be transferred to the Nevada Test Site disposal facility. The organization responsible for the storage facility will be considered a generator when the waste is shipped to the Nevada Test Site disposal facility. The storage facility must develop and implement a certification program that provides documented confirmation that the Nevada Test Site Waste Acceptance Criteria have been met.*

Transfer Requirements. The waste transfer requirement ensures that waste is transferred to a receiving facility only with the authorization of the receiving organization. It also ensures that the waste transfer is accompanied by transfer of relevant information and by appropriate transfer of responsibility for maintaining, as necessary, the integrity of the waste and its container. Waste should not arrive at a receiving facility until the sending facility has been authorized to send it by personnel responsible for the receiving facility. The transferred waste should be accompanied by relevant documentation about the waste and designation of the individuals in the receiving organization who will be responsible for maintaining the integrity of the waste and its container. This requirement is the responsibility of the individual or organization that is transferring (sending) the waste. While this approach ensures that the receiving organization is aware of and prepared for arrivals of waste, this requirement is also intended to promote communication between the sender and the receiver regarding waste acceptance criteria, available capacity of the receiving facility, and other important coordination information.

Example: In preparation for transfer of low-level waste to a disposal facility, characterization and packaging information is documented and, as required, accompanies the waste to the disposal facility. However, the generator had not received authorization to transfer the waste to the disposal facility and no disposal capacity was available when the waste arrived. The waste was shipped back to the generator.

Compliance with this requirement for a radioactive waste generator program can be demonstrated if all radioactive waste generator facilities have a documented waste generator program that includes, as appropriate, the four key elements -- planning, characterization, certification, and transfer -- and the Field Element Manager or his designee monitors those activities to verify that they are being implemented as described in the program.

Supplemental References:

1. EPA, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

2. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(8) Closure Plans. Ensuring development, review, approval, and implementation of closure plans for radioactive waste management facilities in accordance with the applicable requirements in the waste-type chapters of this Manual.

Objective:

The objective of this requirement is to ensure closure plans for radioactive waste facilities reflect the engineered and administrative controls established by the facility's radioactive waste management basis and that the closure plans and other documentation include sufficient technical specifications of the final closure of the facility to justify the bases for evaluating the protection of the public and the environment that are presented in the performance assessment and composite analysis of the facility, or similar prospective assessments.

Discussion:

The safety and hazard analysis for management of radioactive waste conducted to develop the essential requirements for DOE O 435.1 and DOE M 435.1-1 indicated that disposal is a critical activity requiring controls because disposal is the last function conducted on the waste, but yet, the potential hazards from radioactive waste will continue far into the future. Thus, there are specific requirements for the disposal of radioactive waste that are critical to protection of the public, workers, and environment. One of the most important of these controls is the closure plan for the facility, the elements of which represent the last line of defense against the possible interaction of buried radioactive materials with the public, workers, and the environment. The development, review and approval, and implementation of radioactive waste disposal facility closure plans are necessary to assure disposal is being conducted safely and effectively and that the disposal facilities will remain safe far into the future. The closure of deactivated high-level waste facilities and sites also poses potential hazards from radioactivity far into the future, similar to radioactive waste disposal activities. The development, review and approval, and implementation of closure plans and other closure documentation for deactivated high-level waste facilities and sites are also crucial in assuring that the public, workers, and the environment are protected far into the future.

The DOE M 435.1-1 requirement states that it is the responsibility of the Field Element Manager to develop, review and approve, and implement radioactive waste facility closure plans. The discussions that follow provide guidance on these aspects of the requirement for low-level waste disposal facilities and deactivated high-level waste sites and facilities. As indicated in the requirement, closure plans required by the Manual must meet the requirements for closure plans in

the waste type chapters of DOE M 435.1-1. Additional guidance on the following subjects, is found in the guidance on Chapter II, *High-Level Waste Requirements* and Chapter IV, *Low-Level Waste Requirements*.

Low-Level Waste Disposal Facility Preliminary Closure Plan. A preliminary closure plan must be submitted to Headquarters as part of the review documentation necessary for issuance of a disposal authorization statement for a low-level waste disposal facility. The preliminary closure plan documents the closure of the disposal facility that is assumed and evaluated in the performance assessment and composite analysis submitted for the disposal facility. Detailed guidance on the contents and submittal of this preliminary closure plan is discussed in guidance, on DOE M 435.1-1, Section IV.Q.(1).

Development of Low-Level Waste Disposal Facility Closure Plan. The development of a closure plan is necessary for a planned or operating disposal facility to ensure waste disposal operations are performed in a manner which is consistent with the assumptions made about closure in the performance assessment and composite analysis, and so that the actual closure of the facility is ultimately protective of the public and the environment. The closure plan provides the technical specifications to be addressed during waste disposal operations and closure of the facility. The closure plan is developed after consideration and evaluation of such factors as the activities that will occur at the facility during its use, the expected condition of the facility at the time of closure, the intended use of the facility following closure, land use plans for the facility, and institutional control of the disposal facility following closure. The closure plan establishes the conditions to be met to provide protection to workers, the public and the environment when active disposal operations have ceased. The specifications and conditions presented in the closure plan provide the bases for the long-term projection of the performance of the disposal facility and related facilities that are addressed in the performance assessment and composite analysis for the disposal facility. Detailed discussions on low-level waste disposal facility closure plans are included in the guidance on DOE M 435.1-1, Section IV.Q.

> *Example: The performance assessment and composite analysis for the Site X low-level waste disposal facility include assumptions regarding waste degradation, infiltration of water, and leaching of waste that correspond to descriptions of disposal unit closure in those documents. The closure plan describes the partial closure of the disposal units and provides technical specifications and conditions for the closure of units and the partial closure of the facility that are consistent with achieving an infiltration rate of water and degree of degradation of waste as assumed in the performance assessment and composite analysis. The closure plan also indicates preliminary plans for the installation of monitoring wells that will measure infiltration to confirm the assumptions used in the evaluations, and so appropriate adjustments can be made once closure activities begin.*

Review and Approval of Low-Level Waste Disposal Facility Closure Plan. The preliminary closure plan for a low-level waste disposal facility must be submitted along with the performance assessment and composite analysis for review prior to issuance of a disposal authorization statement. Therefore, review and approval of the closure plan for a low-level waste disposal facility is to be conducted by the Field Element Manager, and the approved closure plan then becomes part of the radioactive waste management basis for the disposal facility. The preliminary closure plan for a disposal facility comprises the documentation of the assumed closure configuration of the facility with some additional detail on how this closure can be achieved. The closure plan will be a living document that is constantly updated through the operational life of the facility with specific information about contents, partial closure (e.g., caps on trenches) of disposal units, and other information necessary (e.g., monitoring locations) to support the final closed state. It is imperative that the relationship between the closure plan and the analyses conducted in the performance assessment and composite analysis be considered as the facility is being operated. Any information that is incorporated into the closure plan or any changes made to closure of the facility that impact the analysis in the performance assessment or composite analysis need to be incorporated into these evaluations immediately, to determine their impact. This allows any changes to waste acceptance, or other aspects of operation, to be made effective as soon as possible. This relationship between the performance assessment and composite analysis and the closure plan is discussed in detail in the guidance on DOE M 435.1-1, Section IV.Q.(1). When major changes are required to the closure plan, based on operational changes or impacts as evaluated in the long-term assessments, re-approval by the Field Element Manager should be considered.

Development of Closure Plans and Other Closure Documentation for Deactivated High-Level Waste Facilities/Sites. The development of closure plans and other closure documentation for deactivated high-level waste facilities/sites is necessary to ensure that the process of closure results in a closed facility that is protective of the public and the environment. Closure of deactivated high-level waste facilities/sites can be accomplished by one of three paths. Documentation requirements and review/approval requirements for the first path, decommissioning, are defined in DOE O 430.1A and DOE 5400.5, and refer to these Orders for information on these topics. Documentation and review/approval requirements for the second and third paths, CERCLA process and closure, are defined in DOE M 435.1-1, Section II.U, Section I.2.F.(8), and Section I.2.E.(2). Section II.U defines the documentation requirements while the two General Requirements sections define the roles and responsibilities of the Field Element Manager and the Deputy Assistant Secretaries for Waste Management and Environmental Restoration, respectively.

As discussed in the guidance Section II.U, the development of closure plans and other closure documentation, e.g., CERCLA plans and analyses, are necessary for a planned closure action to ensure the closure activities are consistent with the assumptions made about the closure in the analysis, e.g., assessments of projected performance and projected composite performance, and so

that the actual closure is protective of the public and environment. Refer to Section II.U for the specific information that is required.

Review and Approval of Site Closure Plans and Other Closure Documentation for Deactivated High-Level Waste Facilities/Sites. The site closure plans and other closure documents required by Section II.U must be reviewed and approved by the Deputy Assistant Secretaries for Waste Management and/or Environmental Restoration, as appropriate, as required by DOE M 435.1-1, Section I.2.E.(2). Guidance on Section I.2.E.(2) discusses the review and approval process in detail. The responsible Field Element Manager needs to take the appropriate actions to ensure that the closure documentation for a facility or site meets the technical and administrative requirements of Section II.U and that the package of information submitted for the DOE Headquarters review and approval is adequate. To accomplish these tasks it is expected that the Field Element Manager will need to develop and implement a formal review and approval process that is completed prior to submission of the documentation to DOE Headquarters.

The authorization by the Deputy Assistant Secretaries to the Field Element Manager to proceed with closure activities should be viewed as analogous to a license that would be issued by the U.S. Nuclear Regulatory Commission or another regulatory agency. As explained in the guidance to Section I.2.E.(2) and II.U., an authorization to proceed with closure activities is issued by the Assistant Secretaries to the Field Element Manager responsible for closing the deactivated facility and contains the conditions of the authorization and controls deemed necessary for the long-term protection of the public and the environment. Thus the closure documentation is to contain information on the configuration of the closed facility or site as well as the details on how the closure will be achieved. It is envisioned that the closure plan, required by Section II.U(3), will be a living document that is updated as necessary to ensure the assumptions and analysis contained in the plan are consistent with the conditions at the site. It is imperative that the relationship between the closure plan and the analysis conducted in the assessment of performance and composite analysis be kept in mind as the facility or site is being closed. Any information that becomes available during the closure activity or any changes made to closure of the facility that impact the analysis in the assessment of performance or composite analysis needs to be incorporated into these evaluations immediately to determine needs to their impact. Any information that is incorporated into the closure documentation, or any changes to the closure activities, that impact the analysis in the performance assessment or composite analysis in the closure documentation should be incorporated into these evaluations immediately, to determine the extent of their impact. Once a closure action is authorized by the appropriate Deputy Assistant Secretary, as provided in Section I.2.E.(2), the Field Element Manager is responsible for ensuring that the closure plan or other closure documentation, with emphasis on the performance assessment and composite analyses, remain current with accurate and up-to-date information. This maintenance function is discussed in the guidance to Section II.U and ensures the data and analyses are accurate and reflective of current conditions at the closure site. When major changes or revisions are required to the closure plan or other closure documentation, it is the responsibility

of the Field Element Manager to perform a review and approval of the revised analysis to ensure the bounding conditions contained in the closure plan, and authorization to proceed with closure activities, is not exceeded. As explained in the guidance to Section I.2.E.(2), if these bounding conditions are exceeded, the closure plan needs to be revised and submitted to the appropriate Deputy Assistant Secretary within the Office of Waste Management for review and/or approval.

Closure Plan Implementation. The closure plan for a radioactive waste facility is a living document and needs to be implemented during facility operations and continue through final closure. The aspects of closure that are to be implemented during operations are generally limited but then increase as the time of final closure of the disposal facility nears. The Field Element Manager is responsible for ensuring the various aspects of the closure plan are properly implemented throughout the life cycle of the facility.

> *Example: The closure plan for a low-level waste disposal facility requires daily cover as wastes are disposed, and that the wastes and cover material are to be compacted to a specified density. A Field Element staff member makes periodic site visits to the disposal facility to ensure these disposal closure criteria are being met as part of facility operations. In the fifth year of operation, a performance monitoring well is installed at the north side of the disposal units filled to date. The staff member monitors the progress of the monitoring well installation, and ensures that the information concerning the well is incorporated into the closure plan.*

Compliance with this requirement is demonstrated if closure plans for radioactive waste facilities are developed, approved, maintained, and implemented throughout the life cycle of the facility.

Supplemental References:

1. DOE, 1998. *Life Cycle Asset Management,* DOE O 430.1A, U.S. Department of Energy, Washington, D.C., October 14, 1998.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(9) Defense-In-Depth. Ensuring that defense-in-depth principles are incorporated where potential uncertainties or vulnerabilities warrant their use when reviewing and approving radioactive waste management activities and documents. These principles advocate the use of multiple levels of engineered and administrative controls to provide protection to the public, workers, and the environment.

Objective:

The objective of this requirement is to ensure that defense-in-depth principles are appropriately evaluated and applied to the management of radioactive waste where uncertainties or vulnerabilities warrant multiple levels of controls to provide protection to the public, workers, and the environment.

Discussion:

Defense-in-depth is the use of multiple levels of protection to compensate for potential human and mechanical failures which could result in the release of radioactive material. Defense-in-depth as an approach to radioactive waste management safety has precedent in nuclear safety philosophy. The requirements analysis conducted to develop the requirements in DOE O 435.1 and DOE M 435.1-1 employed the defense-in-depth philosophy as a fundamental approach to hazard control for radioactive waste management facilities and operations even though they do not pose the catastrophic accident potential associated with nuclear power plants. In keeping with the performance-oriented approach to the development of DOE M 435.1-1, there is no requirement to demonstrate a minimum number of layers of defense-in-depth. However, evaluating and justifying that defense-in-depth is appropriate at a given facility is necessary for establishing a safety basis and/or a radioactive waste management basis. Operators of radioactive waste management facilities should use the rigorous application of defense-in-depth thinking in their designs and operations. Such an approach is representative of industrial operations with an effective commitment to public and worker safety and the minimization of environmental releases.

Implementing defense-in-depth can include use of both administrative and design controls. Administrative controls include plans (e.g., program management, emergency response, and characterization), training and qualification requirements, written procedures, safety reviews, quality assurance programs, evaluations, authorization bases, waste acceptance criteria, waste certification, and other actions. Design controls include secondary confinement, leak detection, environmental monitoring, backups to critical systems, and other engineered barriers or

redundancies. The degree to which defense-in-depth is implemented (i.e., graded approach) needs to be commensurate with the risk that the facility or operation poses to workers, the public, or environment.

Most radioactive waste management facilities, operations, and activities typically have defense-in-depth. The first layer of defense is a high level of design quality that ensures important systems, structures, and components will perform their required functions reliably. The next layer of defense is administrative controls such as training and written procedures. The final measure of protection is emergency response actions to minimize consequences of a given event for releases that might occur despite the other layers of defense.

> *Example: A low-level waste storage facility is authorized to store 100 55-gallon drums of solid waste. However, the low-level waste acceptance criteria allows up to 5 percent liquid by volume. Thus the liquid that could be released from a single drum is 2.75 gallons, or 275 gallons for the entire inventory of drums. Historical operational data indicate that failure of a drum can occur as often as five times per year for a 100 drum inventory. However, historical data support that the likelihood of failure of all 100 drums is near zero. Using the graded approach facility personnel determine that spill controls need to be implemented for a spill the size of less than 15 gallons and not the entire inventory of liquid of 275 gallons. Additional layers of defense-in-depth (other than the spill controls) include personnel training, container inspections, waste acceptance criteria, and an emergency response plan.*

DOE Standard DOE-STD-3009-94 provides further discussion on the use of safety-significant structures, systems, and components as contributors to defense-in-depth for DOE nonreactor nuclear facilities.

Compliance with this requirement is demonstrated by documentation in the radioactive waste management basis that describes and provides a rationale for the layers of controls (defense-in-depth) in place to provide the protection for the public, workers, and the environment.

Supplemental References:

1. DOE, 1994. *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-3009-94, U.S. Department of Energy, Washington, D.C., July 1994.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(10) Oversight. Ensuring oversight of radioactive waste management facilities, operations, and activities is conducted. Oversight shall ensure radioactive waste management program activities are conducted in accordance with a radioactive waste management basis and meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to ensure Field Element oversight of radioactive waste, management facilities, operations, and activities is carried out.

Discussion:

A key to successful compliance with any DOE Directive is oversight. This is particularly true of directives which, like DOE O 435.1 and DOE M 435.1-1, have performance-oriented requirements that call for review and approval of site- or facility-specific implementation of procedures and other controls to ensure the requirements are being met. Oversight is defined (DOE M 435.1-1, Attachment 2) as:

> The responsibility and authority assigned to line management to assess the adequacy of DOE and contractor performance. Independent Oversight refers to the responsibility and authority assigned to the Assistant Secretary for Environment, Safety, and Health to independently assess the adequacy of DOE and contractor performance.

The DOE Complex has initiated the integrated Safety Management System under Secretarial policies DOE P 450.4, *Safety Management System Policy*, DOE P 450.5, *Line Environment, Safety, and Health Oversight*, and DOE P 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy*. These policies are invoked by DOE M 435.1-1, I.1.E.(17) for the purposes of emphasis and clarity. DOE P 450.4 provides the overall goals and objectives of the DOE integrated Safety Management System. Core function No. 5, "Provide Feedback and Continuous Improvement," calls for a system of evaluations and reporting in order to continuously improve in achieving the goals and requirements for safety and protection of the environment. DOE P 450.5 explains that line management has the responsibility for oversight of DOE facilities, operations, and activities, including those involving management of radioactive waste.

DOE G 450.4-1, *Integrated Safety Management System Guide, Revision 0*, contains guidance on Core Function No.5. Included with this guidance is Appendix D, which references other DOE publications and handbooks for conducting environmental audits and other types of assessments that can be conducted during self-assessments or which can be used by line management or parties with independent oversight responsibilities to conduct oversight assessments of contractor work performance. The guidance in DOE G 450.4-1, *Integrated Safety Management System Guide, Revision 0*, is sufficient guidance on oversight of radioactive waste management facilities, operations, and activities.

It is expected that the revised requirements of DOE O 435.1 and DOE M 435.1-1 will be incorporated into the contractor self-assessments established under the integrated Safety Management System, and incorporated into the Field Office oversight of the contractor programs, as appropriate. Similarly, under the Safety Management System policies, Headquarters line management has the responsibility to monitor the Field Office oversight and participate in Field Office oversight functions, as appropriate. Likewise, under the Safety Management Systems policies, the Assistant Secretary for Environment, Safety, and Health (EH-1) has the responsibility to assess the adequacy of Field Office and contractor performance, and it is expected that the revised DOE O 435.1 and DOE M 435.1-1 requirements will be assimilated into the Assistant Secretary's programs for independent oversight at his/her discretion.

Compliance with this requirement is demonstrated by appropriate incorporation of DOE O 435.1 and DOE M 435.1-1 requirements within the functions, responsibilities, authorities, and requirements explained in the set of Safety Management System directives. This should result in thorough and effective oversight of radioactive waste management facilities, operations, and activities, and assurance that the public, workers, and the environment are protected from the hazards associated with management of radioactive waste.

Supplemental References:

1. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE P 411.1, U.S. Department of Energy, Washington, D.C., January 28, 1997.

2. DOE, 1996. *Safety Management System Policy*, DOE P 450.4, U.S. Department of Energy, Washington, DC, October 15, 1996.

3. DOE, 1997. *Line Environment, Safety and Health Oversight*, DOE P 450.5, U.S. Department of Energy, Washington, D.C., June 26, 1997.

4. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

5. DOE, 1992. *Environmental Audit Program Guidance*, DOE/EH-0232, U.S. Department of Energy, Washington, D.C., January 1992.

6. DOE. *Performance Objective and Criteria for Conducting DOE Environmental Audits,* DOE/EH-0229, U.S. Department of Energy, Washington, D.C.

7. DOE, 1999. *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 98-1, Department of Energy Plan to Address and Resolve Safety Issues Identified by Internal Independent Oversight*. U.S. Department of Energy, Washington, D.C., March 10, 1999.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(11) Training and Qualification. Ensuring that a training and qualification program is implemented for designated radioactive waste management program personnel, and the training is commensurate with job duties and responsibilities. Only those personnel who have been trained and qualified shall design or operate safety (safety class and safety significant) structures, systems, and components.

Objective:

The objective of this requirement is to ensure that Field Element Managers establish the process and criteria for designating personnel that should be trained on the management of radioactive waste and establishing the appropriate level of training for those individuals.

Discussion:

It is the responsibility of the Field Element Manager to ensure a program is in place that includes a process for designating those field personnel for which a training and/or qualification program is required, and a process, for establishing the appropriate training and level of rigor for those personnel designated to be trained or qualified.

The selection, qualification, and training requirements for personnel involved in the operation, maintenance, and technical support of DOE-owned nonreactor nuclear facilities is contained in DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. The requirements for establishing, implementing, documenting, and evaluating training programs for Federal employees is contained in DOE O 360.1, *Training*. These two DOE Orders are invoked by DOE M 435.1-1, Section I.1.E.(19), and are emphasized here only as an indication of the importance of training to the successful implementation of the requirements in DOE O 435.1 and DOE M 435.1-1.

The Technical Qualification Program specified in DOE O 360.1 is required of DOE Federal technical employees whose position requires them to provide management direction or oversight that could impact the safe operation of a defense nuclear facility. The Technical Qualification Program is an example of the process used to determine that personnel possess the necessary knowledge, skills, and abilities to perform their specific duties and responsibilities. This program (or a similar program) may be specified by the Field Element Manager for a non-defense or nonnuclear related DOE waste management activity.

Use of the National Environmental Education and Training Center of Excellence (A. Alm memorandum, January 30, 1998) ensures DOE takes a corporate approach to optimizing and standardizing environmental training across the complex. The Center assesses training needs and develops and provides training courses on crosscutting environmental management topics. The Field Element Manager can use this resource in fulfilling the training needs of radioactive waste management personnel.

The second part of this requirement pertains to those personnel designing or operating safety (safety class and safety significant) structures, systems, and components. The hazards analysis conducted for preparation of DOE O 435.1 and DOE M 435.1-1 indicated a weakness in the design process that could lead to moderate or high hazard conditions if design personnel were not adequately trained and qualified. DOE 5480.20A does not have a requirement for personnel designing safety significant/safety class components to be qualified. Note that this requirement is targeted to design authority personnel and does not apply to design agency personnel.

Compliance with this requirement can be demonstrated by documentation that a Technical Qualification Program or similar personnel training process has been used to ensure that radioactive waste management personnel are sufficiently trained to perform these duties.

Supplemental References:

1. Alm, A., 1998. A. Alm to Distribution, memorandum, *Environmental Management Training Policy*, U.S. Department of Energy, Washington, D.C., January 30, 1998.

2. DOE, 1994. *Personnel Selection, Qualification and Training Requirements for DOE Nuclear Facilities,* U.S. Department of Energy, Washington, D.C., November 15, 1994.

3. DOE, 1995. *Training,* U.S. Department of Energy, Washington, D.C., May 31, 1995.

I. 2.F. <u>Field Element Managers</u>.

Field Element Managers are responsible for:

(12) As Low As Reasonably Achievable (ALARA). Ensuring ALARA principles for radiation protection are incorporated when reviewing and approving radioactive waste management activities.

Objective:

The objective of this requirement is to emphasize implementation of the ALARA process in the management of radioactive waste.

Discussion:

A hazards analysis was conducted as part of the process for developing DOE O 435.1 and DOE M 435.1-1. In that analysis, there were many functions and activities with the potential for personnel exposure to radioactivity and radioactive releases to the environment. Application of the ALARA process was found to be a mitigating factor for these circumstances. ALARA means "As Low As is Reasonably Achievable," which is the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits as is reasonably achievable.

An underlying principle of radiation control is that there should be no exposure to workers or the public, or releases to the environment of ionizing radiation without the expectation of an overall benefit from the activity causing the exposure or release. This principle advocates the use of administrative and design controls in work processes to minimize exposures to radiation. These controls are incorporated into the radioactive waste management system from initial design through operation. The fundamental outcome the ALARA process seeks to achieve is an absolute balance between detriment and benefit. Approved ALARA programs which provide the frame work for making ALARA determinations are probably in place for radioactive waste management facilities. The purpose of this requirement is to reinforce this concept. The ALARA process must be incorporated into all radioactive waste management activities. Line management involvement and accountability at the highest levels must be maintained. The governing directives on implementing an ALARA process, 10 CFR Part 835 *Occupational Radiation Protection* and DOE 5400.5 *Radiation Protection of the Public and the Environment*, have been previously noted in DOE M 435.1-1, Section I.1.E. under Applicability of Other Regulations and DOE Directives.

DOE waste management operations are to be conducted so that radiation exposures to workers and members of the public are maintained as far below regulatory limits as possible, and releases to the environment are minimized, commensurate with sound economics and operating principles. ALARA requires judgment with respect to what is reasonably achievable. Factors that relate to societal, technological, economic, and other public policy considerations are evaluated in making such judgments. Integration of this process into radioactive waste work plans with continuous feedback for improvement are essential to achieving the goal of ALARA and thus protecting the worker, public and the environment. Additional guidance may also be found in the *Implementation Guide for Use With Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection*.

> *Example: At a DOE site, an analysis of data on doses to maintenance workers at a radioactive waste treatment facility shows that doses rose rapidly after four hours in a radiation area. This was attributed to worker fatigue, since work in radiation areas requires extra caution and concentration, when compared with work in non-radiation areas. Additionally, this fatigue factor causes tasks performed after four hours to take disproportionately longer exposing the workers to the radiological environment longer and is compounded by their being less efficient than they are in the first four hours. The net result is more exposure with less productivity during the second four hours. Limiting work in radiation areas to four hours and alternating maintenance workers between radiation and nonradiation areas contributes to achieving ALARA where all other factors are equal.*

Compliance with this requirement is demonstrated by documented analyses showing the application of the site's approved ALARA process to the planning for the construction modification, operation, and closure of radioactive waste management facilities, operations, and activities.

Supplemental References:

1. DOE. *Occupational Radiation Protection*, 10 CFR Part 835, U.S. Department of Energy, Washington, D.C., November 1998.

2. DOE, 1994. *Implementation Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection*, G-10 CFR Part 835/B1-Rev.1, U.S. Department of Energy, Washington, D.C., November 1994.

3. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

4. DOE, 1990. *Department of Energy (DOE) Radiological Control Manual*, DOE/EH 0256, U.S. Department of Energy, Washington, D.C., October 30, 1990.

5. DOE, 1997. ALARA Training for Technical Support Personnel, DOE-HDBK-1110-97, U.S. Department of Energy, Washington, D.C., 1997. (This document is available from the Radiation Safety Training home page, http://tis-nt.eh.doe.gov/wpphm/rst/rst.html.)

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(13) Storage. Ensuring all radioactive waste is stored in a manner that protects the public, workers, and the environment in accordance with a radioactive waste management basis, and that the integrity of waste storage is maintained for the expected time of storage and does not compromise meeting the disposal performance objectives for protection of the public and the environment when the waste is disposed.

Objective:

The objective of this requirement is to properly store radioactive waste by providing for containment of the waste during storage, protecting the ability of packages to maintain containment, and ensuring waste is handled in storage in a way that facilitates proper disposal and contributes to the long-term performance of the disposal facility.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the storage of radioactive waste was identified as an activity that presented potential risk to the public, workers, and the environment. Numerous weaknesses and conditions were identified during the safety and hazards analysis conducted in support of the Manual documentation. In addition, previous reviews of radioactive waste storage conditions and management practices (e.g., *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities)* revealed inadequately or improperly stored waste, which presents the possibility of human exposure to radiation and the potential for adverse environmental effects.

The evaluations of storage that were conducted during development of the Order and Manual revealed a variety of current practices, desired end-states, and required lengths of storage among DOE's radioactive waste types. For instance, high-level waste has been in storage, and will remain in storage, for an indefinite period of time in many different forms (liquids in tanks, calcine in vessels, vitrified forms in canisters). Transuranic waste has been stored in many locations in dense-pack, until disposal capacity at WIPP was available. Low-level waste is planned for short term storage, unless unforeseen circumstances require otherwise. Besides these differences, in storage times, there are differences in the radiological and chemical hazards posed by storage of the waste types. Because of these differences, there are numerous waste-type specific storage requirements that must be met to maintain safe storage. The general requirement is performance based and states that storage must protect public, workers, and the environment. Waste packages must be maintained during the storage period, and DOE must ensure that nothing occurs to the

waste or waste packages that is detrimental to the final disposal of the waste or to meeting the disposal performance objectives of DOE M 435.1-1.

Integrity of Waste Packages. An essential element of proper storage of radioactive waste is the assurance that the waste is adequately contained in waste packaging and the package is protected from conditions that could cause it to degrade. Degradation could lead to failure and result in the spread of contaminated materials, leading to worker, public, or environmental exposure. It could also result in non-acceptance by a receiving facility.

Radioactive waste storage facilities should establish waste package design, inspection and corrective action programs to ensure that package integrity is maintained throughout the storage period. The inspection and corrective action program should evaluate storage conditions and eliminate conditions that could lead to package failure.

> *Example: Bulk contaminated soil and debris was packaged in untreated wooden boxes and stored outside. Inspection of the storage area revealed that the boxes degraded to the point that they no longer provide proper containment of the waste. The corrective action included repackaging the waste and storing the waste packages in a protected area.*

Periodic radiation and contamination surveys of storage areas and waste package should be performed to provide an indication of waste package integrity and ensure worker protection. It is not advisable to conduct inspections or surveys at a frequency or within a proximity that may lead to unnecessary exposure. As Low As Reasonably Achievable (ALARA) practices should always be considered during radioactive waste storage. Detailed guidance on monitoring of radioactive waste storage is discussed for high-level waste (Section II.T), transuranic waste (Section III.Q), and low-level waste (Section IV.R).

New radioactive waste storage facilities should be designed, constructed, and operated so that the minimum amount of residual radioactive material that requires cleanup prior to closure remains in the facility. Consideration should be given to facility design to meet other potential requirements. For example, mixed radioactive waste must be stored in facilities that meet RCRA storage requirements. Therefore, the facility should be designed to accommodate storage of RCRA wastes. For facilities storing liquid radioactive waste, the facility should be designed to allow liquid level, waste volume, and significant tank chemistry parameters, to be monitored.

Support Meeting Disposal Objectives. Storage of radioactive waste is usually done to facilitate future disposal of the waste. Disposal options may not be immediately available and long periods of storage may be required. Storage systems should be designed to last significantly longer than the anticipated need for capacity to allow for unexpected delays. The optimization of storage periods and storage conditions, with the waste and the waste packaging should be performed, as

part of the Site-Wide Radioactive Waste Management Program required in Section I.2.F. of this guidance.

> *Example: The need exists to store a certain radioactive waste stream that has no identified path to disposal. An analysis is performed by the Site-Wide Radioactive Waste Management Program to determine the probable storage period and all other requirements for a potential storage facility. An acceptable storage location is identified that meets all the storage facility requirements and is compatible with the waste package and the anticipated storage period for the waste.*

Particular consideration should be given to the design and operation of storage facilities to meet the eventual requirements of the disposal facility. Thus, maintaining the certified status of waste that is already certified for disposal, and protecting the waste from conditions, either man-made or natural, that would change the certification status and the acceptance of waste at the disposal facility is essential. (Further guidance on certification of waste and maintaining certification status of waste is in the guidance for each of the waste type chapters.) For waste that will be in storage for a short period, this may not require much additional effort. For waste that remains in storage for longer than anticipated, this could be quite challenging. Storage facilities should have the capability of differentiating between waste that is already certified to a disposal waste acceptance criteria and managing it appropriately.

Compliance with this requirement is demonstrated if the public, the workers, and the environment are protected from radioactive waste in storage while maintaining complete waste package integrity during the entire storage period plus that period of time necessary to facilitate proper disposal. As discussed above, each waste type chapter contains numerous specific storage requirements, and meeting those requirements is essential in achieving the desired safe storage that is the objective of this requirement. Additional information on the waste-type specific storage requirements is contained in the guidance on Chapter II, *High-Level Wastes;* Chapter III, *Transuranic Waste*; and Chapter IV, *Low-Level Waste*.

Supplemental References: None.

I. 2.F. <u>Field Element Managers</u>.

Field Element Managers are responsible for:

(14) Treatment. Ensuring all radioactive waste requiring treatment is treated in a manner that protects the public, workers, and the environment and in accordance with a radioactive waste management basis.

Objective:

The objective of this requirement is to ensure that when radioactive waste treatment technologies are utilized, they provide the necessary protection to the public, workers and the environment from treatment operations and from the resulting treated waste.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the treatment of radioactive waste was identified as an activity that presented potential risk to the public, workers, and the environment. Numerous weaknesses and conditions were identified that required controls during the safety and hazards analysis conducted in support of the Manual documentation. As with the other major functions that were evaluated (i.e. generation, storage, and disposal), most of the weaknesses and conditions were found to be already covered by controls in numerous DOE Directives and external regulations, especially those concerning safety during operations. In addition, the analysis also confirmed that, although treatment is a separate management step taken with waste and was evaluated as a distinct function, disposal technologies and requirements are the primary driving force behind the need for treatment and the type of treatment. Except for some hazardous waste requirements based on RCRA, (e.g., certain constituents must be destroyed), the desire for an improved waste form behavior after disposal is usually the reason for treating waste. There may also be a need for reduced volumes to minimize the amount of disposal capacity utilized, but this is likewise, a disposal requirement driving the need for treatment. Additionally, the hazards and requirements analysis resulted in identifying characteristics of radioactive waste that are unsuitable for long-term storage. These wastes require treatment prior to their acceptance for storage.

Thus, the controls that must be implemented at a treatment facility in addition to those concerning operations address the waste forms resulting from the treatment process. Several objectives may be achieved through treatment such as enhancing the waste form, rendering waste suitable for storage, reducing disposal waste volumes, minimizing the number of transportation shipments, enhancing the monitorability of waste disposal facilities, or minimizing the long-term risks to the public and the environment from waste disposal. This requirement basically forms an umbrella performance-oriented requirement that requires that treatment technologies used must protect the

public, workers, and the environment. The treatment and waste form requirements in each of the specific waste-type chapters must also be complied with to treat radioactive waste successfully in accordance with DOE O 435.1 and DOE M 435.1-1.

Compliance with this requirement is demonstrated by the issuance of a radioactive waste management basis for a treatment facility that demonstrates that the public, workers, and the environment will be protected from the hazards inherent in the treatment facility. The radioactive waste management basis will ensure that waste form requirements for the resultant treated waste will be met in addition to the safety and environmental protection objectives of this requirement.

Specific requirements for treatment are in Chapter II, *High-Level Waste;* Chapter III, *Transuranic Waste*; and Chapter IV, *Low-Level Waste* of the Manual. Guidance on those requirements can be found in the sections of this document corresponding to the treatment requirements for each waste type.

Supplemental References: None.

I. 2.F. <u>Field Element Managers</u>.

Field Element Managers are responsible for:

(15) Disposal. Ensuring radioactive waste is disposed in a manner that protects the public, workers, and the environment and in accordance with a radioactive waste management basis. Reviewing specific transuranic or low-level waste documentation including the performance assessment and composite analysis, or appropriate CERCLA documentation, prior to forwarding them to Headquarters for approval, and obtaining and ensuring the facility is operated in accordance with the disposal authorization statement. Conducting performance assessment and composite analysis maintenance.

Objective:

The objectives of this requirement are to ensure that: (1) transuranic waste is disposed so there is a reasonable expectation that the disposal standards in 40 CFR Part 191 will be met; (2) and low-level waste is disposed so that there is a reasonable expectation that the performance objectives of Chapter IV of DOE M 435.1-1 will be met. The objectives are also to ensure that the performance assessment for a transuranic waste disposal facility and the performance assessment and composite analysis for a low-level waste disposal facility are technically adequate, logical, complete, and defensible for establishing the controls on disposal of waste for protection of the public, and the environment into the future. Lastly, the objectives are to ensure that data are collected and studies conducted to verify these analyses and that they are updated whenever necessary.

Discussion:

The safety and hazard analysis for management of radioactive waste that was conducted to develop the essential requirements for DOE O 435.1 and DOE M 435.1-1 indicated that disposal is a critical activity requiring controls because disposal is the last function in managing waste, yet the potential hazards from radioactive waste continue into the future. There are specific requirements for disposal of radioactive waste included in the DOE M 435.1-1 to ensure the protection of the public, workers, and environment. The analyses conducted in the performance assessment for a transuranic or a low-level waste disposal facility, and the composite analysis for a low-level waste disposal facility, are critical in determining the nature and extent of the controls that need to be put in place. The review and approval of these evaluations is important for the management of radioactive waste to ensure it is being conducted safely and effectively. This responsibility is placed with senior management in the Office of Environmental Management (see Section I.2.E.(1)).

Even more important is the implementation of the controls that are deemed necessary as a result of these evaluations. The radioactive waste management basis is intended to coordinate implementation of the necessary controls for disposal of radioactive waste, the performance assessment and composite analysis, and related documents that are based on the evaluations in them (e.g., waste acceptance). These analyses and the controls derived from them form the core of the radioactive waste management basis for a disposal facility. Additional guidance can be found in the guidance on the requirement for a Radioactive Waste Management Basis (Section I.2.F.(2)).

DOE M 435.1-1 gives the Field Element Manager responsibility for disposing of radioactive waste safely, reviewing the performance assessment (and composite analysis if applicable) for radioactive waste disposal facilities under his/her authority, submitting the evaluations to Headquarters for review and approval, and ensuring that the evaluations in the performance assessment and composite analysis are maintained. The discussions that follow provide guidance on the above requirement for review of the documents and submittal to Headquarters. DOE M 435.1-1, Section I.2.E.(1) contains the requirements of Headquarters for review and approval of the performance assessment and composite analysis. In order to achieve the safe disposal of waste, the Field Element Manager is responsible for implementing the controls in the radioactive waste management basis documentation, which includes the performance assessment, composite analysis, and disposal authorization statement.

<u>Disposal of Transuranic Waste (not at WIPP)</u>. In cases where the Department disposes of transuranic waste in a facility other than WIPP (e.g., Greater Confinement Disposal at the Nevada Test Site), the Department is currently responsible for determining compliance with 40 CFR Part 191, and ensuring the transuranic waste is disposed of safely. The requirement includes the responsibility for ensuring safe disposal of transuranic waste disposed at a facility other than WIPP, and reviewing performance assessments for any transuranic waste disposal facility, including WIPP, before submittal to Headquarters. Since performance assessment is defined, and the requirements for compliance and what must be included in a performance assessment for a transuranic waste disposal facility are fully discussed in 40 CFR Part 191, the transuranic waste chapter only contains reference to the 40 CFR Part 191 standards, with no additional minimum requirements for disposal. Guidance on the transuranic waste disposal requirements at Section III.P should be consulted for additional discussions.

<u>Safe and Environmentally Sound Disposal of Low-Level Waste</u>. DOE M 435.1-1 contains requirements that must be met for the siting, design, operations, closure, and maintenance of DOE low-level waste disposal facilities. Achieving the goals of protecting the public, workers, and the environment from the potential hazards of disposal of low-level waste requires linking the functions of design, siting, operation, closure, and maintenance to the performance assessment objectives of DOE M 435.1-1, Section IV.P.(1), taking into consideration the waste and radionuclides to be disposed. It is the Field Element Manager's responsibility to link these critical

functions for control of low-level waste disposal facilities to the performance assessment and composite analysis evaluations, and to determine the level of controls within each of these functions that need to be imposed to continue to achieve the low-level waste disposal facility performance objectives. This responsibility is embodied in the concept of a radioactive waste management basis for a disposal facility. The linkage between the controls on these operational functions of the disposal facility and the evaluations in the performance assessment and composite analysis forms the critical components of the radioactive waste management basis for the facility. An important aspect of this linkage is the incorporation of changes in disposal facility operations, closure, monitoring, waste acceptance criteria, or other low-level waste management functions by the implementation of the conditions spelled out in the disposal authorization statement from Headquarters.

> *Example: The Field Element Manager for the Site R Low-Level Waste Disposal Facility approves the radioactive waste management basis for the disposal facility. He has thoroughly reviewed the performance assessment, disposal authorization statement, preliminary closure and monitoring plans, quality assurance plan, performance assessment maintenance procedure, and training manual. He also has a thorough understanding of the relationship of the controls described in the procedures and manuals, and of the results of the evaluation explained in the performance assessment and the conclusions of Headquarters documented in the disposal authorization statement.*

Section IV.P. contains the detailed requirements for disposal of low-level waste, and design, siting, maintenance, closure, and operations of a low-level waste disposal facility. More discussion on safe disposal of low-level waste, and the link between disposal operational functions and the performance assessment, composite analysis, and the disposal authorization statement, appears in the guidance on Chapter IV.

<u>Reviewing and Submitting Low-Level Waste Performance Assessments and Composite Analyses</u>. It is the responsibility of the Field Element Manager to submit the performance assessment and composite analysis to Headquarters for review. Chapter IV of the DOE M 435.1-1 contains the detailed requirements for performance assessments and composite analyses for a low-level waste disposal facility. More guidance appears on this subject in the guidance on Chapter IV. DOE G 435.1-1, *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (under preparation), will provide details on the format and content of performance assessments and composite analyses. Preparers need to follow that guidance document to ensure that complete information is included.

Prior to submitting these documents to Headquarters for review, the Field Element Manager reviews them to ensure they are complete and consistent with planned disposal facility operations and use. An independent organization or group may review these documents to assist the Field Element Manager in ensuring that all manual requirements identified have been properly

addressed. This review process will ensure that once the document is submitted to DOE Headquarters it will not be determined to be deficient in content. It also enables the responsible organization to obtain an independent opinion on the technical adequacy and defensibility of the information presented.

> *Example: Prior to submittal to Headquarters for review and approval, the performance assessment and composite analysis are reviewed against the Standard Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses by two former members of the DOE Peer Review Panel, funded by the appropriate Field Element Manager. Consideration of their comments results in a more complete and technically defensible evaluation.*

The performance assessments and/or composite analyses are submitted to the Deputy Assistant Secretary for Waste Management, unless the facility being evaluated is an onsite low-level waste management unit being developed under CERCLA. In the case of a CERCLA onsite low-level waste management facility, documentation including a crosswalk from CERCLA to DOE O 435.1 (see Section I.2.E) and a separate composite analysis if one is prepared, are submitted to the Deputy Assistant Secretary for Environmental Restoration. For CERCLA onsite low-level waste management facilities, the *Standard Format and Content Guide*, DOE G 435.1-1, should be consulted and implemented in the development of the CERCLA documentation to ensure that adequate analysis is included to demonstrate compliance with the DOE O 435.1 and DOE M 435.1-1 (see guidance on DOE M 435.1-1, Section I.2.F.(5)).

<u>Low-Level Waste Performance Assessment and Composite Analysis Maintenance</u>. Once authorized to operate, a low-level waste disposal facility may be in operation for many years. Uncertainties may exist in certain aspects of the technical decisions when assumptions were made during the performance assessment and the composite analysis. Additionally, information about waste receipts and knowledge concerning the disposal facility environs could change. Therefore, DOE M 435.1-1 requirements include maintaining the performance assessment and composite analysis through regular collection of data and studies designed to reduce uncertainties, and a regular schedule of evaluations to update the analysis. It is the responsibility of the Field Element Manager to ensure these requirements are carried out. DOE M 435.1-1 Chapter IV contains the detailed requirements for maintenance of the performance assessment and composite analysis for a low-level waste disposal facility. Also, DOE G 435.1-3, *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (under preparation), will provide guidance on performing the critical function of keeping these important analyses updated.

> *Example: The Field Element Manager with responsibility over a low-level waste disposal facility at Site A issues a procedure, in accordance with Site A Manual WM-100-5, mandating performance assessment and composite analysis maintenance that*

follows the guidance in DOE G 435.1-3, Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses.

Compliance with this requirement is demonstrated through the low-level waste disposal facility documentation, that shows the siting, design, operation, closure, and maintenance of the facility are linked to the evaluations in the performance assessment and composite analysis, and that these documents have been properly submitted to Headquarters for review in accordance with guidance in DOE G 435.1-1, *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. Additionally, the documentation demonstrates that a program/process has been put in place for conducting performance assessment and composite analysis maintenance in accordance with DOE 435.1-3, *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*.

Supplemental References:

1. DOE, 1999. *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (in preparation), DOE G 435.1-1, U.S. Department of Energy, Washington, D.C., 1999.

2. DOE, 1999. *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses.* (in preparation), DOE G 435.1-3, U.S. Department of Energy, Washington, D.C., 1999.

3. EPA, 1985. "Final rule; 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

4. EPA, 1993. "Final rule; Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 58, No. 242, U.S. Environmental Protection Agency, Washington, D.C., December 20, 1993.

5. DOE, 1996. *Interim Format and Content Guide, and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments*, U.S. Department of Energy, Washington, D.C., October 1996.

6. DOE, 1996. *Maintenance of US Department of Energy Low-Level Waste Performance Assessments*, U.S. Department of Energy, Washington, D.C., September 1996.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(16) Monitoring. Ensuring monitoring is conducted for all radioactive waste management facilities as required. Ensuring that disposal facilities are monitored, as appropriate, for compliance with conditions of the disposal authorization statement.

Objective:

The objective of this requirement is to ensure that all monitoring is conducted as required, including monitoring of storage, treatment, and disposal facilities with respect to key parameters and conditions of their authorization statements.

Discussion:

The safety and hazard analysis identified that monitoring for releases of radiation and radioactive material to the environment was an especially important mitigating factor for potential weaknesses and conditions in radioactive waste management. The requirements analysis concluded that the environmental monitoring programs and plans, as required by DOE 5400.1, *General Environmental Protection Program;* and DOE 5400.5, *Radiation Protection of the Public and Environment*, implemented monitoring that would address the kinds of concerns evaluated in the analysis.

However, monitoring of disposed radioactive waste, because it must remain effective for a long time period following cessation of operations, presents a unique challenge. Additional monitoring of low-level waste disposal facilities is addressed in DOE M 435.1-1, Section IV.R. Implementation guidance for those requirements should be consulted for information on incorporating additional low-level waste disposal facility performance monitoring into the environmental monitoring program and plans already required to be in compliance with the subject DOE Orders on environmental monitoring.

Additionally, while the general environmental monitoring program and the environmental monitoring plans mandated by these DOE Orders are adequate for most circumstances, they were judged to not be sufficient in requiring identification of specific warning signs of impending conditions that would lead to releases, especially for storage of liquid low-level waste. DOE M 435.1-1, Sections IV.R.(1) and IV.R.(2) address these aspects of additional monitoring for low-level waste facilities. Also, the environmental monitoring requirements did not sufficiently address monitoring of the performance of a low-level waste disposal facility, for identification of specific signs that assumptions made in evaluations of the facility (i.e., performance assessment)

were incorrect or for warning signs of conditions that should be addressed in a timely fashion to prevent conditions that were not evaluated. DOE M 435.1-1, Section IV.R.(3) addresses additional monitoring needed for low-level waste disposal facilities.

Additionally, through the conduct of safety analyses, whether they are formal safety analysis reports or auditable safety analyses, facility personnel identify the quantity and form of radioactive and/or hazardous material to be handled at the facility and the operations for managing the waste. The safety analysis establishes a basis for defining the acceptable operations envelope for the facility, and provides the basis for technical safety requirements (TSRs). The technical safety requirements may include requirements for monitoring. Review of the safety analysis will determine if the analyses indicate other monitoring that would be prudent.

The DOE M 435.1-1 requirement states that it is the responsibility of the Field Element Manager to ensure that monitoring is conducted for all radioactive waste management facilities as required, including ensuring that disposal facilities are monitored, as appropriate, for compliance with conditions of the disposal authorization statement.

The requirements for monitoring low-level waste disposal facilities are additional requirements beyond the Chapter I requirements which are applicable to all facilities. Site-specific performance assessments and composite analyses are required for all low-level waste disposal facilities by DOE M 435.1-1, Sections IV.P. (2) and (3). These documents have the purpose of evaluating the long-term performance of the disposal facility and providing reasonable assurance that the performance objectives for low-level waste disposal are met. Assessments of the long-term performance of natural systems often have large uncertainties, and include many assumptions of the behavior of natural systems over extended periods of time. The performance assessment and composite analysis of a disposal system identifies these uncertainties and assumptions along with the results. An effective way to verify assumptions, reduce uncertainties, and build confidence in the results and conclusions of the performance assessment and composite analysis is to monitor the performance of the disposal facility.

Thus, the performance assessment and composite analysis are used as primary tools for establishing the monitoring plan to collect data to develop an understanding of the actual performance of the disposal facility. The performance assessment and composite analysis should provide sufficient information to identify the important migration pathways for the transport of radionuclides, primary mobile radiological and chemical constituents, logical monitoring locations, monitoring parameters, and sampling frequencies.

With respect to long-term performance of the low-level waste disposal facility to ensure the performance objectives are met, monitoring data are reviewed periodically against the action levels contained in the monitoring plan (see guidance on DOE M 435.1-1, Section IV.R.(3)(c)). This review is conducted routinely throughout the operational, closure and post-closure periods

of the facility to evaluate the performance of the facility as compared to the results contained in the performance assessment and composite analysis, detect trends in the performance of the facility sufficiently in advance to allow for necessary corrective actions, and to provide justification for changes in the monitoring plan for the facility. Additional guidance on this aspect of monitoring data evaluation is provided with the discussion of Section IV.R.(3)(c).

Compliance with this requirement is demonstrated if monitoring plans are developed, approved, maintained, and implemented throughout the life cycle of the facilities.

Supplemental References:

1. DOE, 1988. *General Environmental Protection Program*, DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

2. DOE, 1990. *Radiation Protection of the Public and the Environmental*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

3. NRC, 1989. *Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility*, NUREG-1388, U.S. Nuclear Regulatory Commission, Washington, D.C., 1989.

4. NRC, 1983. *Subsurface Monitoring Programs at Sites for Disposal of Low-Level Radioactive Waste*, NUREG/CR-3164, U.S. Nuclear Regulatory Commission (by U.S. Army Corps of Engineers Waterways Experiment Station), Washington, D.C., 1983.

5. DOE, 1990. *Environmental Monitoring for Low-Level Waste Disposal Sites: Low-Level Management Handbook Series*, Revision 2, DOE/LLW-13Tg, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

6. DOE, 1991. *Environmental Regulatory Guide for Radiological Monitoring and Environmental Surveillance*, DOE/EH-0173T, U.S. Department of Energy, 1991.

7. DOE, 1981. *A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations*, DOE/EP-0023, U.S. Department of Energy, Washington, D.C., 1981.

8. NRC, 1979. *Quality Assurance for Radiological Monitoring Programs (Normal Operations)--Effluent Streams and the Environment*, Regulatory Guide 4.15, U.S. Nuclear Regulatory Commission, Washington, D.C., February 1979.

9. DOE, 1986. *Experience and Improved Techniques in Radiological Environmental Monitoring at Major DOE Low-Level Waste Disposal Sites*, DOE/LLW-54T, U.S.

Department of Energy, National Low-Level Radioactive Waste Management Program, Idaho Falls, ID, 1986.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(17) Material and Waste Declassification for Waste Management. Ensuring, to the extent practical, radioactive material and waste generated under a program that is classified for national security reasons is declassified or rendered suitable for unclassified radioactive waste management.

Objective:

The objective of this requirement is to reduce unnecessary management costs and maintain national security by ensuring that radioactive material and waste is, as practical, declassified and managed as unclassified waste.

Discussion:

Some radioactive waste is the product of activities that are classified for national security reasons and therefore the waste may require special handling and protection. The waste may be any classified substance regardless of its form, e.g., fabricated or processed items, machinery, or equipment which inherently contains sensitive information. It may be classified for a variety of reasons such as dimensions, configuration, potential for reverse engineering to determine its function, or radionuclide content.

The management of classified radioactive waste could be more costly and difficult than unclassified waste. The Department has an ongoing effort to declassify or sanitize classified material including waste. Declassification of waste was a requirement in the management of transuranic waste in the previous order on Radioactive Waste Management. In reviewing requirements for inclusion in DOE M 435.1-1, it was realized that declassification/sanitization is a sound management practice that needs to be applied across all waste types. Declassification or sanitization of radioactive material that will become waste can enhance efficient and cost effective management of radioactive waste since it allows the Department to avoid the security costs associated with classified material.

Declassification means a determination by an appropriate authority that information, documents, or material no longer require protection against unauthorized disclosure for national security reasons. At one time, many alloys were considered classified, however, as a result of the Department's Openness Initiative, the Director of Security Affairs has determined that some of these alloys no longer require protection as classified information and has declassified them. The information remains the same, but it no longer requires security protection.

In contrast, sanitization means the irreversible modification or destruction of a component or part of a component of a nuclear weapon, device, trainer, or test assembly as necessary to prevent revealing classified or otherwise controlled information. Figure I.2.F.I provides a description of the declassification and sanitization process:

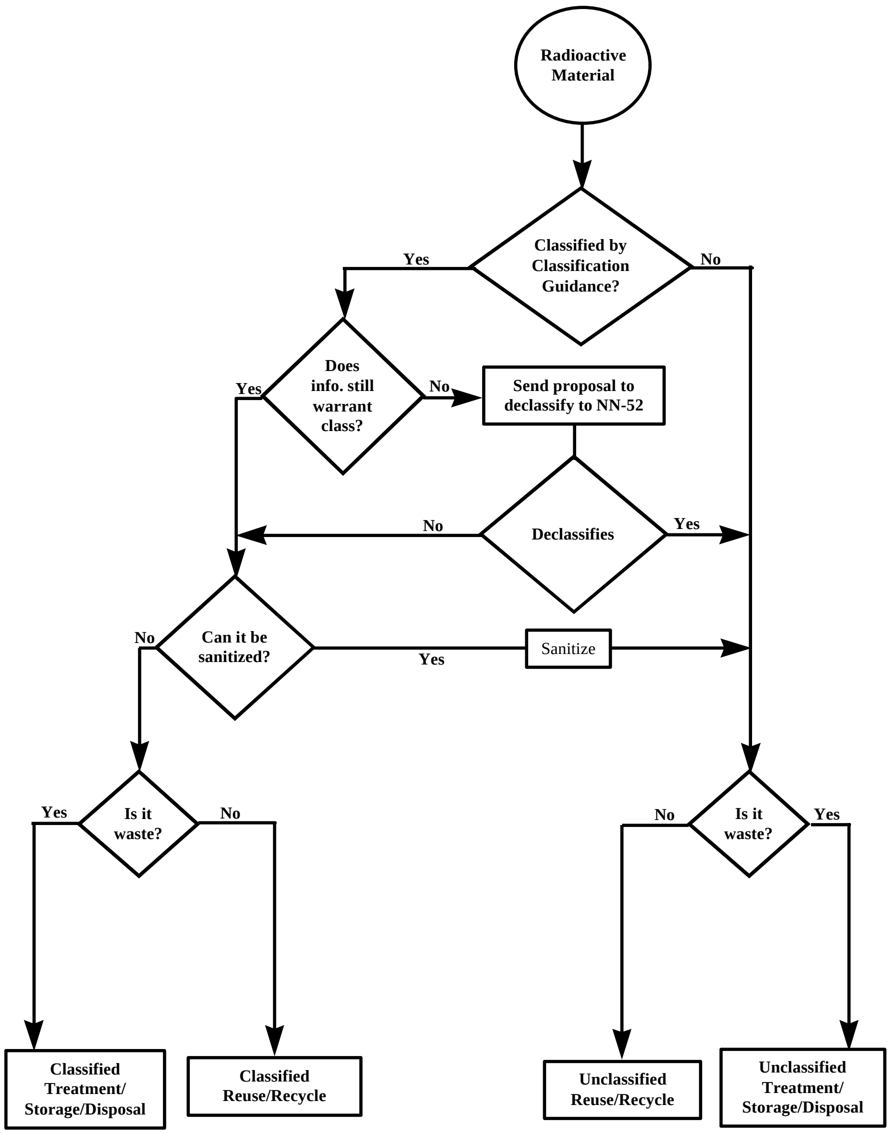

Figure I.2.F.1. Flow Diagram for Declassifying or Sanitizing Material for Waste Management

Example 1: As a result of weapons disassembly, components that are made of a classified alloy have become excess. Some of these components are contaminated by radioactivity. The custodian of the component believes that the alloy no longer warrants protection in the interest of national security. The custodian proposes to the Office of Declassification, that the alloy be declassified. The decision is made that the alloy no longer needs to be classified and it is declassified. The component is handled as unclassified excess material and an evaluation made to determine if it has any future programmatic value. The result of that analysis leads to the conclusion that the components are radioactive waste so they are treated, stored, and disposed without classified controls. Since the alloy has been declassified, future decisions concerning components made of it may be made by a Derivative Declassifier.

Example 2: As a result of weapons disassembly, a component whose shape is classified is being excessed. It can be sanitized by melting it into another shape or by pulverizing it, thus destroying the information that needs to be protected. The component can be handled as unclassified excess material, or if determined to be a radioactive waste, it can be treated, stored, or disposed without classified controls.

Material that is classified and can be declassified or sanitized should be handled in accordance with current classification guidance. However, certain classified material, once it is determined to be of no future programmatic use (i.e., waste), cannot be declassified or sanitized, and thus, is ultimately disposed of in a classified disposal site.

Example: A radioactive material has been determined to be of no future use due to advances in technology and is therefore determined to be a radioactive waste. The characteristics of the radioactive contamination i.e., the level of enrichment, requires protection to preclude revealing sensitive weapons information. As a waste classified which cannot be decontaminated, the waste must be afforded security protection and ultimately disposed of in a classified disposal site.

Classified waste is to be minimized whenever practical to reduce costs and increase efficiency in waste management programs. Decisions to continue to manage a waste as classified need to be based on careful consideration of requirements in the areas of environment, safety and health, safeguards and security, proliferation, and of total cost factors.

If waste can be declassified or economically sanitized, it can be disposed of in conventional facilities not requiring special protection and it avoids the cost of security during transport. Declassifying or sanitizing waste also preserves capacity in classified disposal facilities for that waste that cannot be declassified or sanitized.

Example: A facility has a classified waste. The facility's manager analyzes the options for managing the waste and discovers that it cannot be declassified, but can be sanitized. However, the treatment required in order to sanitize it would equal or exceed the cost of the necessary protections during transportation and disposal of the classified waste, with no increase in the protection of workers, the public, or the environment and no significant reduction in security or proliferation concerns. Therefore, the manager decides that the waste need not be sanitized and that use of a classified disposal facility is appropriate.

Compliance with this requirement is demonstrated by documented determinations that waste has been declassified or sanitized or by documented evaluations that support maintaining the classification for either national security or economic reasons.

Supplemental References:

1. DOE, 1998. *Identifying Classified Information* , DOE M 475.1-1, U.S. Department of Energy, Washington, D.C., May 8, 1998.

2. *Classified National Security Information*, Executive Order 12958, Washington, D.C., April 17, 1995.

I.2.F. Field Element Managers.

Field Element Managers are responsible for:

(18) Waste Incidental to Reprocessing. Ensuring that waste incidental to reprocessing determinations are made by either the "citation" or "evaluation" process as described in Chapter II of this Manual. Ensuring consultation and coordination with the Office of Environmental Management for waste determined to be incidental to reprocessing through the "evaluation" process.

Objective:

The objective of this requirement is to ensure that the processes and responsibilities for making waste incidental to reprocessing determinations are understood and implemented.

Discussion:

As discussed in Section II.B, Waste Incidental to Reprocessing, there are certain waste streams that may be generated during the management of high-level waste that may not have to be managed as high-level waste and therefore can be managed as another type (transuranic or low-level waste). To make such determinations, DOE M 435.1-1 establishes two processes, the citation process and the evaluation process. These are described in detail in Section II.B. In addition, Section II.A, Definition of High-Level Waste, provides assistance in determining whether a waste stream should be classified as high-level waste.

Determinations. To meet the first part of the requirement, the Field Element Manager, or designee, needs to establish a process or method that documents waste incidental to reprocessing decisions. Such a method is required by the evaluation process (see Section II.B.(2)) and is recommended for the citation process, although not required. While the level of formality of the process is left to the discretion of site management, the following elements are considered necessary:

1. Organization and Responsibilities: Identification of the site organizations that are responsible for formulating and approving the determinations.

2. Procedures: The process is formalized in procedures, including a requirement confirming the determination process has been followed correctly.

3. Quality Assurance: The determination process is subject to a quality assurance program that ensures the validity of the information used to make the determinations.

4. Document/Record Control: The principal documents that constitute the documentation of the determination process are controlled and retained.

5. Training: At a minimum, the process requires training of personnel that will implement the process (e.g., procedures, quality assurance program, document control).

The above elements have been recommended by the Nuclear Regulatory Commission (NRC) (Bernero, 1993), and adopted by DOE, as good practices for performing and documenting waste incidental to reprocessing determinations. Invoking existing programs (e.g., quality assurance program) and processes (e.g., document control) to implement the waste incidental to reprocessing determination process is appropriate. Additionally, site management may conclude that instead of making determinations for individual waste streams, it may be cost effective to establish categories of wastes that meet the citation and the evaluation process requirements and therefore avoid a determination for each candidate waste.

Example: At Site X, management of the high-level waste tank farm involves periodic sampling and analysis of tank contents. When taking these samples, operations personnel generate job wastes, including protective clothing, work tools, and personnel protective equipment. In implementing the Site's "Citation Determination Process," a determination is made that such job wastes are not high-level waste. The Site's procedures for making citation process (waste incidental to reprocessing) determinations requires that an initial documented determination is necessary for each waste stream. However, following this determination, and with the appropriate documentation and approvals, e.g., a basis for concluding the waste stream meets the citation criteria, similar wastes can be considered to be non-high level waste by inclusion within this determination. Thus, future generation of similar wastes from similar activities do not have to be subjected to the citation determination process if it can be shown that they fit within the existing determination.

Citation Process. The Field Element Manager, using the process described in Section II.B.(1), is responsible for determining if a waste meets the citation process requirements. While not required, it is recommended that the process described for the evaluation process be implemented for the citation process as well. These elements are considered important to making defensible and consistent citation determinations and would be valuable if such determinations are questioned or challenged.

Guidance for Section II.B.(1), Citation, provides information and examples of the types of wastes and waste streams that have been considered to be non-high-level waste by use of the citation process. However, it is emphasized that these are examples only, and it is the Field Element

Manager's responsibility to make, and defend, citation process determinations. While challenges to these determinations are not expected, prudence suggests that a process similar to that required for the evaluation process (see below) be considered for the citation process by site management. In addition, consultation and coordination with the DOE Office of Environmental Management to support consistent interpretations of citation determinations is encouraged.

Evaluation Process. As noted in the guidance to Section II.B.(2), Evaluation, waste incidental to reprocessing determinations using the evaluation process require the involvement of two organizations: the program (site) management responsible for the management of the high-level waste (includes the Field Element Manager, or designee) and the DOE Office of Environmental Management (DOE EM). In using the evaluation process, the elements described under Determinations above need to be implemented to ensure that the requirements of Section II.B.(2) are met. These requirements are met by the use of good record-keeping practices, with an adequate quality assurance process, and documented to support the determination(s). The documentation is prepared in a manner that defends and supports the conclusions and provides adequate information to support outside organizations' review and approval. During the preparation of the determination package, the Field Element Manager is responsible for ensuring it is coordinated with the Office of Environmental Management, to ensure consistency of evaluation determinations between DOE sites. At the time of the preparation of this guidance the office within the Office of Environmental Management that is responsible for fulfilling this consultation role is the Office of Waste Management.

As discussed in the guidance to Section II.B, it is recommended that groups of waste streams or waste items that have similar characteristics, or will require similar processing/treatment, be grouped within one evaluation process analysis in lieu of preparing/submitting analysis for individual waste streams or waste items. Such grouping is expected to be possible and avoid duplication of preparation and review efforts by Site and the Office of Environmental Management personnel and expedite management of the wastes. In addition, grouping the waste streams promotes the best use of resources at both the DOE site level and the Office of Environmental Management and reduces the number of determinations that need to be processed.

NRC Role in Waste Incidental to Reprocessing Determinations. In September 1998 the DOE General Counsel (Letter, Mary Anne Sullivan to John T. Greeves, NRDC Petition, September 30, 1998) concluded, in response to a Natural Resources Defense Council Petition, that the NRC has no licensing authority over the 51 high-level waste tanks at the Savannah River Site. This conclusion was based on the following summary statement:

> "Section 202(4) of the ERA *(Energy Reorganization Act*) gives the NRC licensing authority over DOE facilities 'authorized for the express purpose of subsequent long-term storage of high level radioactive waste generated by [DOE and its predecessor agencies].' As explained in greater detail in the discussion below, this statutory language, the

> legislative history and governing case law establish that this licensing authority exists only with respect to facilities that are (i) authorized by Congress for the express purpose of long-term storage of HLW and (ii) developed and constructed after the passage of the ERA. None of the SRS tanks have been authorized for the express purpose of long-term storage of HLW and only 18 of the newer tanks were constructed after the passage of the ERA. As a result, NRC has no licensing authority over the SRS tanks."

From this determination DOE has taken the position in DOE O 435.1 and DOE M 435.1-1 that, unless determined otherwise, NRC does not have licensing authority over DOE's current high-level waste tanks and the waste contained in them. While it is acknowledged that similar determinations have not been made for the high-level waste tanks at Hanford, INEEL, and West Valley and that Departmental decisions in the future could change this position, it is believed that the approach defined in the Order and Manual is reasonable for all DOE-managed high-level waste. It should be noted, however, that the *West Valley Demonstration Project Act* specifies a review and consultation responsibility for the NRC which may include oversight of the high-level waste tanks. If this position changes, i.e., it is determined that the NRC has regulatory authority over some of the high-level waste tanks within the DOE complex, the requirements in Sections II.B. and I.2.F.(18) will be revised accordingly.

The Waste Incidental to Reprocessing requirement in Section II.B and the requirement in Section I.2.F.(18) support the position that formal involvement by NRC in making incidental waste determinations is <u>not</u> required. However, NRC involvement as a consultant to Field Offices and Programs on technical issues, is recommended, particularly for those waste streams that are expected to be controversial or contentious with other regulators or stakeholders. The NRC staff has conducted several reviews recently on compliance with criteria similar to the evaluation requirements in Section II.B.(2) and thus possess a level of expertise that is expected to complement the Field Office and DOE Office of Environmental Management reviews.

> *Example: Site X anticipates removing and disposing of many contaminated mixers/pumps and instrument trees from high-level waste tanks in the next few years. Characterization data and past experience in handling and disposing of this equipment indicate that the contamination levels, following decontamination activities, will likely allow these pieces of equipment to be managed and disposed as low-level waste, assuming they can meet the evaluation requirements under the DOE M 435.1-1, Waste Incidental to Reprocessing, Section II.B.(2). Plans over the next three years for removal and disposal of this equipment are reviewed and used to prepare the analysis required by Section II.B.(2). The decision is to use the most conservative (highest) contamination levels expected for this grouping of contaminated equipment for the three-year period to avoid continual preparation/review of separate evaluations. The analysis is prepared and concludes that the evaluation process requirements at Section II.B.(2)(a) 1., 2., and 3., can be met, and therefore, these waste items qualify for management as low-level waste. This analysis is*

prepared under Site X's quality assurance program, is coordinated with the Office of Waste Management, and is reviewed and approved by Site X waste management personnel in accordance with Site X procedures. During preparation of the analysis, the NRC is requested by Site X management to review and provide their position on the adequacy of the performance assessment prepared to meet the requirement in Section II.B.(2)(a)2. Following this review and the Site X's review and acceptance, the Site X High-Level Waste Program Manager approves the determination allowing these wastes, as defined in the determination, to be managed and disposed as low-level waste for the next three years without further review. The analysis and results of the determinations are incorporated into the facility's safety documentation and a copy is provided to the Office of Waste Management.

Compliance with this requirement is demonstrated by developing and implementing a process for documenting waste incidental to reprocessing determinations as specified in Section II.B. Specific to the evaluation process, the documentation includes analysis that supports the conclusions reached, as well as DOE Office of Environmental Management concurrence, that the waste meets the evaluation requirements in Section II.B of DOE M 435.1-1.

Supplemental References:

1. Bernero, 1993. R. Bernero, USNRC, to J. Lytle, DOE-EM, letter, *Hanford Waste Tank Management*, U.S. Nuclear Regulatory Commission, Washington, D.C., March 2, 1993.

2. Paperiello, 1997. C. Paperiello, USNRC, to J. Kinzer, DOE-RL, letter, *Classification of Hanford Low-Activity Tank Waste Fraction*, U.S. Nuclear Regulatory Commission, Washington, DC, June 9, 1997.

3. Sullivan, 1998. Mary Anne Sullivan, DOE General Counsel, to John T. Greeves, Director, Division of Waste Management, USNRC, letter, *Natural Resources Defense Council Petition to Exercise Licensing Authority over Savannah River Site High-Level Waste Tanks*, U.S. Department of Energy, Washington, DC, September 30, 1998.

4. *West Valley Demonstration Project Act,* as amended, October 1, 1980.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(19) Waste with No Identified Path to Disposal. Ensuring a process is developed and implemented for identifying the generation of radioactive waste with no identified path to disposal, and reviewing and approving conditions under which radioactive waste with no identified path to disposal may be generated. Headquarters shall be notified of the decisions to generate a waste with no path to disposal.

Objective:

The objective of this requirement is to bring issues associated with generating waste with no identified path to disposal to the attention of appropriate DOE managers before the waste is generated to resolve the problems that will prevent it from being disposed, to ensure that the waste has appropriate long-term safe storage until it can be disposed, and to minimize the generation of waste with no path to disposal.

Discussion:

The Complex-Wide Review of DOE Low-Level Waste ES&H Vulnerabilities conducted in response to Defense Nuclear Facilities Safety Board Recommendation 94-2 identified storage of low-level waste with no identified path forward to disposal as a major complex-wide vulnerability. DOE M 435.1-1 addresses this vulnerability in several ways. The Safety and Hazards Analysis conducted as part of the preparation of DOE O 435.1 also identified significant weaknesses and risks associated with wastes being generated with no path to disposal for all radioactive waste types, particularly weaknesses associated with long-term storage of waste, potential loss of characterization data from generators, and the problems associated with re-characterization.

This requirement is intended to cover newly generated waste streams. Waste streams generated in the past with no path to disposal which are now in storage should be addressed in the Site-Wide Radioactive Waste Management Program required by DOE M 435.1-1, Section I.2.F.(1). (See discussion entitled, Relationship to Site-Wide Radioactive Waste Management Program.)

Waste streams without a path to disposal that currently are being generated are also to be addressed by the Site-Wide Management Program. A periodic evaluation of whether no path to disposal waste should continue to be generated should be included in the management plans for this waste. This evaluation should consider the same conditions for approval for continuing to generate the waste stream that are described below under Conditions for Review and Approval. If a facility that currently generates no path forward waste is shutdown, or for any other reasons a

no path forward waste stream is temporarily not being generated, consideration should be given to including those wastes in the identification, approval, and notification process described in this section of the guidance.

> *Example 1: All transuranic and low-level waste streams to be generated from the New Mixed Waste Treatment Facility at Site X, scheduled to begin operations three years after issuance of DOE O 435.1, are all considered new waste streams. A full life-cycle planning process is applied to all waste from the facility to identify potential disposition issues and approve its generation.*

> *Example 2: A filter system in Building 440 at Site Y is changed out four months after issuance of the Order. The resultant filter process waste is mixed low-level waste. Change out of the filter media has occurred repeatedly in the past, and the mixed low-level waste is in storage awaiting a disposal path. This is not considered a new waste stream and is not included in the Site's procedures for identification of potential no path forward waste, for approval, and for HQ notification. However, it is described in the Site's Waste Management Program documentation, along with the steps being taken to achieve disposal. The Site's program documentation also includes an evaluation of the need to continue to generate this no path forward waste.*

> *Example 3: One year after issuance of the Order, Building 440 is shutdown for major upgrades, and does not resume operation for 18 months. When operations are resumed, all waste streams, including the existing filter media waste, will be included in the identification process and the waste stream generation will be in accordance with the approval process established by the Field Element Manager.*

By requiring Field Element Managers to be involved with the decisions for generating wastes without a path to disposal prior to waste generation, and notifying Headquarters of the decisions to generate waste without a path to disposal prior to generation, senior management attention is directed to the long-term commitment made with the generation of such waste. The long-term commitment comes from the prolonged storage of the waste and from the work necessary to resolve issues which prohibit the disposal of the wastes.

The requirement calls for the Field Element Manager to ensure that three items are established in the programs implemented by waste generators (see DOE M 435.1-1, Section I.2.F.(7)): (1) a process for identifying the generation of no path forward waste prior to its generation, (2) approved conditions under which no path forward to disposal waste may be generated, and (3) a process for notifying appropriate Headquarters management of decisions to generate no path forward waste. Each of these three items is discussed in the following guidance.

No Path Forward Identification Process. The first part of the requirement is directly related to the general requirement calling for the Field Element Manager to ensure generation planning is occurring by all generators (DOE M 435.1-1, Section I.2.F.(7)), and to the subrequirement in each waste type chapter that requires generator planning to include life-cycle planning for all wastes prior to their generation (DOE M 435.1-1, Sections II.K.(1), III.H.(1), and IV.H.(1)). As discussed previously, “prior to their generation” applies to the stage before any of the waste is produced (e.g.,preceding the activity that will result in the waste). Therefore, this requirement is not intended to be applied to the generation of an individual waste drum, source, box, etc.

The situations which may lead to the generation of waste without a path to disposal are many. The life-cycle planning that is required under DOE M 435.1-1, Sections II.K.(1), III.H.(1), and IV.H.(1) needs to include the necessary elements and components to identify the possible generation of waste which will have no path to disposal prior to their generation and a process by which the Field Element Manager is informed of the potential to generate the waste. This element of the life-cycle planning required under DOE M 435.1-1 is considered very important. No path forward waste issues and problems may be complicated and should be dealt with early in the life cycle of the waste to prevent situations that could require expenditure of large amounts of resources to reverse erroneous steps taken in the managing of the waste.

> *Example 1: The life-cycle planning process at Facility 300 includes a semi-annual submittal by individual generators to the waste certification official of known or suspected new waste streams (i.e, waste streams not already approved for disposal at Site Q). The waste certification official's duties include an analysis of these waste streams to decide if they have a path to disposal. In one such exercise, a suspected waste stream is determined as not acceptable at disposal Site Q. The waste certification official submits this information as required in his procedures to the DOE Field Office, Assistant Manager for Waste Management.*

> *Example 2: Site R has signed a Record of Decision requiring remediation of a seepage basin by excavation and re-disposal of the contaminated soils. Contaminants include heavy metals, organics, and radionuclides. Because the waste that will be generated from this remedial action is a mixed low-level waste, there may be no path forward for disposal. Therefore, Site R will prepare an analysis for consideration by the Site Manager, regulators, and other stakeholders identifying the need to generate the waste (the relevant compliance agreement/Record of Decision), the characteristics of the waste to be generated (radioactive and hazardous constituents), the plans for storing the waste after generation (a RCRA-compliant mixed low-level waste storage facility), and the plans for identifying a disposal option for the waste.*

The identification process should occur early enough before the waste is generated so that alternatives to generating the no path forward waste can be examined as an option. Also,

notification of Headquarters (see guidance below on Notification to Headquarters) prior to waste generation appropriately involves Headquarters managers into the final decisions for generation and management of waste with no path to disposal. More detailed guidance for life-cycle planning for generation of new waste streams is included in guidance for life-cycle planning requirements in each of the waste type chapters (Sections II.K.(1), III.H.(1), and IV.H.(1)).

The determination of whether a waste stream has an identified path to disposal should be based on the availability of existing or planned facilities and operations and on the technical acceptability of the waste at the facility. A planned facility is considered to be available if it has been authorized (e.g., a line item in a Congressional appropriation or equivalent approval for design and construction). For purposes of planning for treatment and/or disposal of waste, a facility or capability that is part of a program or strategic plan, but has not been authorized, should not be considered available. A facility is also not considered available if it is not authorized to accept or manage a particular waste type or concentration. If an available planned facility used in life-cycle planning is canceled, the generator should revise the planning for the life-cycle of the waste and an alternate path to disposal should be identified and documented. If an alternate path to disposal is not available, then approval to continue to generate the waste should be obtained in accordance with this requirement, even though it had not needed approval when the waste was initially generated.

> *Example: Several no path forward waste streams generated throughout the Complex are approved because of a planned new High-Activity Borehole Disposal Facility which has received initial line item funding. In the FY2003 budget, Congress does not approve further funding of the facility. The approval to continue to generate these wastes is re-examined by several Field Offices in light of this development.*

Whether a path to disposal can be identified should also be based on the acceptability of the waste at the facilities at which it must be managed. For existing facilities, this involves no more than an evaluation of the waste stream properties against the waste acceptance requirements of the facility and determining there are no impediments for its management. For planned facilities, this determination is more involved. For some waste streams, the acceptability at a planned facility could be determined based on similar circumstances already known to exist in the Complex. This may be a common situation for wastes that do not have a full path to disposal because of issues that are not entirely technical (e.g., non-defense transuranic waste without a disposal option). For other waste streams, particular those with a technical impediment to disposal, the acceptability may need to be evaluated and a judgement made that a planned facility will be able to accept the waste provided some necessary treatment is performed (e.g., waste with explosive properties is made non-explosive), or some administrative step is successfully accomplished (e.g., a RCRA permit is obtained so that mixed waste can be accepted).

Example: A new project will generate 2 waste streams for which a path to disposal is unclear. One waste stream is a typical dry active transuranic waste stream, but it is non-defense transuranic waste, therefore, planned storage at Storage Facility B followed by disposal at the new borehole disposal facility under construction is evaluated. The waste stream is determined to be acceptable at both facilities through a comparison to the waste acceptance criteria for the two facilities. The second waste stream is a unique mixed low-level waste stream that can be stored at Facility B, but for which a disposal facility has not yet been determined. The acceptability of the waste is evaluated by comparing it to a similar waste stream in the Site Treatment Plan (STP), and determining that the treatment described in the STP will also work for the new waste stream.

Conditions for Review and Approval. The second part of the requirement calls for the Field Element Manager to be involved in the decision to generate waste without a path to disposal, prior to the generation of the waste. This requirement intends to ensure that wastes are generated with no identified path to disposal only under approved conditions and known circumstances and are considered to be acceptable by both the Field Managers and Headquarters. The waste type chapters contain requirements that these conditions for generating a no path to disposal waste stream must meet.

The review and approval of the generation of waste without a path to disposal is the responsibility of the Field Element Manager. The approval process and approved waste streams should be documented. In some cases, the Field Element Manager may approve the conditions under which an individual waste stream is generated, while in other cases, he/she may approve a process that confirms the conditions are being met, perhaps through the certification program. The latter circumstances may be appropriate for the routine generation of waste streams having no path forward to disposal.

Example 1: A large scale facility dismantlement is about to begin. Life-cycle planning evaluations indicate that several large components that will be removed from the facility cannot meet the current acceptance criteria for disposal at WIPP or at any other disposal facility. The Field Element Manager is directly involved in exploring alternatives to the generation of this waste, and if appropriate, approving the decision to proceed with the dismantlement and the plans for long-term storage for the components.

Example 2: A laboratory facility on Site B routinely generates small amounts of several mixed low-level waste streams. Prior approval to generate two of the waste streams was necessary in accordance with the guidelines discussed here. DOE Field staff has approved a process that includes conditions and decision criteria being implemented at the laboratory as part of its waste certification program. The process allows laboratory personnel to approve generation of additional mixed low-level waste streams.

The conditions for generating a waste without an identified path to disposal should include evaluations and considerations that involve both the waste generating and waste management organizations. Guidance on Sections II.K.(2), III.H.(2), and IV.H.(2) discusses the evaluations that must be included in the conditions for generating a no path forward waste.

For many newly generated waste streams identified as having no path to disposal, programmatic or technical problems and issues contributing to the lack of a disposal path may be the same as ones already experienced by other waste streams at the site, or within the Complex. All or part of the solution towards disposing of problem waste stream may therefore be actions being taken or planned as part of the Site-Wide Radioactive Waste Management Programs. Likewise, the issues or problems may have also been elevated and are being addressed in the Complex-Wide Waste Management Program for one of the waste types. The relationship of this General Requirement to the requirements for the Radioactive Waste Management Programs is discussed at the end of this guidance under Relationship to Site-Wide Radioactive Waste Management Programs.

> *Example: A new process at a DOE laboratory facility will result in the generation of some non-defense transuranic waste. This is a programmatic and complex-wide issue requiring resolution that is being addressed as a high priority item at Headquarters in accordance with the FY 2000 Transuranic Waste Management Program Plan. Information is prepared under the four topics (a) - (d) discussed above. The information on plans in place to take care of the no path forward waste identifies the complex-wide actions, and the actions being taken specifically at the site.*

Notification of Headquarters. The third part of the requirement calls for the Field Element Manager to inform DOE Headquarters of the decision to generate waste without a path to disposal. As previously mentioned, only newly generated waste streams are subject to this requirement. Notifications do not have to be made for wastes already generated at the time DOE O 435.1 is issued. Documentation of approvals should be provided to the cognizant Program Secretarial Officer (PSO) for the activity or program generating the waste, with an information copy to the Assistant Secretary for Environmental Management (EM-1). The notification should summarize the conditions for approval as described in the previous discussion, and should include an expiration date for the approval or other conditions that would require a new approval of the Field Manager. This notification should be accomplished in a timely fashion following the identification of the potential generation of no path forward waste so that Headquarters management is fully informed of the situation resulting in no path forward waste, and any Headquarters management concerns can be appropriately considered and included in the final Field Element Manager approval to generate the waste.

> *Example: A new waste generating process is developed that requires a waste treatment process not currently available for the waste to be acceptable for disposal. The needed waste treatment process has been approved, but the necessary hardware will not be*

available for five years. The waste generating process is approved by the Field Element Manager with the conditions that (a) the waste is stored in Storage Building 5, and (b) satisfactory progress is made toward the installation of the additional waste treatment process. The approval is documented, and sent to the PSO with an information copy to EM-1.

Relationship to Site-Wide Radioactive Waste Management Program. As previously discussed, waste streams generated in the past with no path to disposal which are now in storage, and waste streams without a path to disposal that are currently being generated are intended to be addressed in the Site-Wide Radioactive Waste Management Programs required by DOE M 435.1-1, Section I.2.F.(1) (and elevated to the waste type Complex-Wide Waste Management Program, if appropriate). Waste streams being generated when DOE O 435.1 is issued should also be evaluated for whether they should continue to be generated. This requirement for an identification process, approved conditions, and Headquarters notification is intended to cover newly generated waste streams only.

Since life-cycle planning should be a major element of the Site-Wide Radioactive Waste Management Program implemented at each site, information on waste streams generated at the subject site is expected to be documented as part of the program in accordance with the site's documentation protocol. It should be understood that the identification, approval, and notification process called for in this requirement for waste streams not being generated is a proactive part of the program, and as such, should be included in a site's operating processes or procedures.

However, once generation of a waste stream with no path forward is approved, then it should be included in the site's life-cycle planning program documentation so that complete waste stream information is maintained in one place. Revisions of the Site-Wide Management Program documents should contain appropriate actions to address new issues and problems of no path forward waste incorporated into them especially from any waste streams not covered in prior revisions of the documentation. Likewise, information already documented about past waste streams with no path forward should be updated because of developments concerning new no path forward wastes.

Example: Three new non-defense transuranic waste streams are approved and generated at Facility 200 in FY1998. In the FY1999 Site Radioactive Waste Life-Cycle Management Plan, these three waste streams are added to the list of previously generated non-defense transuranic wastes that have been managed at the site for years. The actions already documented in the current Life-Cycle Plan (FY1998) are evaluated and considered appropriate to pursue for the new as well as previous waste streams. This is documented, and progress on meeting the actions is updated in the FY1999 Plan.

Waste without a path to disposal which received approval in accordance with these requirements, and which have become part of the Site-Wide Program planning information, should continue to be observed with additional scrutiny. At a minimum, the approval to generate the wastes should be considered annually, with the primary focus being an evaluation of the progress toward identifying a path to disposal. Repeated or numerous one-time approvals for the generation of waste streams without a path to disposal should not be acceptable. The Site-Wide Program Documentation should be used as the vehicle for the evaluation and continued approval of no path forward waste streams on an annual basis. The evaluation of waste streams with no path to disposal should be consolidated with the annual evaluation discussed here.

> *Example: For the example above, the actions referred to in the Life-Cycle Plan are updated for the FY2000 Life-Cycle Plan for the site. Progress on meeting those actions is evaluated by a task force established by the Field Element Manager, and it is determined that progress is adequate. This decision is documented in the FY2000 Plan as a renewal of the approval of these three non-defense transuranic waste streams.*

Major changes to the planned management of waste without a path forward (e.g., changes for developing the treatment facility or disposal facility to handle the waste) should also result in a re-evaluation and re-confirmation of the acceptability of continuing to generate no path forward waste. Headquarters should be notified of changes of this magnitude. On the other hand, if the assumptions for the planned management of approved no path forward waste are only slightly impacted (e.g., as a result of testing, design, changes in funding, or DOE policy), the information in the Site-Wide Program documentation should be updated. Slight changes to assumptions and to the planned management of the waste should not necessarily be a basis for re-evaluating the generation of the waste.

> *Example 1: For the three new non-defense transuranic wastes at Facility 200, the FY2000 Life-Cycle Plan, minor changes in the actions between the FY1999 and FY2000 Life-Cycle Plans are explained in the text of the plan. These minor items include a decision to add a peer review of one study, and a delay in the scheduled completion dates for three actions. The text states that the approvals for continuing generation of the non-defense transuranic wastes were not evaluated because these were deemed minor items.*

> *Example 2: Continuing example 1 above, after the FY2000 Life-Cycle Plan is issued, the peer review convened on the study finds some of the conclusions in the study to be invalid. This finding has a significant impact on whether the technology selected for solidification of the non-defense transuranic waste can still be a cornerstone of the plan for the site's no path forward waste. This is considered a major item concerning the continuing generation of the non-defense transuranic wastes. The continuing approvals were re-evaluated because of this item, and only two are re-approved. The FY2001 Life-Cycle Plan incorporates these new facts into its updated text.*

Compliance with this requirement is achieved if the life-cycle planning implemented at generator sites includes a documented process for identifying waste streams which may be generated that will not have an identified path to disposal; if a documented process is included for review and approval of the conditions for generation of the waste; if approved conditions are documented for any new no path forward waste streams being generated; if the approvals of generation of no path forward waste is appropriately considered in the Site-Wide Radioactive Waste Management Program documentation; and if Headquarters is being notified of the approval of and conditions under which new no path forward waste can be generated.

Supplemental References: None.

I. 2.F. Field Element Managers.

Field Element Managers are responsible for:

(20) Corrective Actions. Ensuring a process exists for proposing, reviewing, approving, and implementing corrective actions when necessary to ensure that the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met, and to address conditions that are not protective of the public, workers, or the environment. The process shall allow workers, through the appropriate level of management, to stop or curtail work when they discover conditions that pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Objective:

The objective of this requirement is to ensure that processes to identify, manage, and resolve radioactive waste management deficiencies in complying with DOE O 435.1 and address conditions that are not protective of the public, workers or the environment are established and implemented.

Discussion:

Corrective actions taken prior to events occurring that pose a threat to the workers, the public, or the environment can avert serious occurrences. Actions may include improvements to documentation (e.g., procedures, plans, authorization basis documents), training and qualification programs or procedures, or physical and process design changes. Corrective actions routinely occur as part of the implementation of DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information* (ORPS). The requirement to implement a corrective actions process in managing radioactive waste includes those ORPS Corrective actions as well as corrective actions initiated by circumstances that do not rise to the threshold of reportable incidents.

Potential problems range from minor ones to those which pose an immediate threat to safety and health. Additional information on problem identification can be found in Section I.2.G.(1), Problem Identification. For situations where a problem could pose an immediate risk to a worker, member of the public, or damage to the environment, the immediate corrective action of shutting an operation down may be appropriate until the threat can be controlled. Guidance on shutting down or curtailing radioactive waste activities is provided in Section I.2.G.(2), Shutdown or Curtailment of Activities.

The corrective action process includes problem identification and tracking through resolution; proposal, review, and implementation of solutions, and a method for approval and assigning

accountability. Provisions need to be made for interfaces with the lessons learned program when others could benefit from an action taken. In the corrective actions process, review and approval by cognizant managers is necessary to assess the effectiveness of the corrective action in eliminating the problem and preventing recurrence, its practicality, cost effectiveness, and timeliness. Additional information on corrective action processes may be found in DOE O 232.1A, DOE-HDBK-1089-95 *Guidance for Identifying, Reporting and Tracking Nuclear Safety Noncompliances,* and DOE G 452.2A-1A *Implementation Guide for DOE Order 452.2A, Safety of Nuclear Explosive Operations*. These guides are specific to the topics for which they are written, but may have generic applications adaptable for use by radioactive waste management personnel.

> *Example: At the recommendation of the Defense Nuclear Facilities Safety Board, the department performed a Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities. Site personnel performed a self evaluation followed by an assessment team visit. Based on the problems identified, Corrective Action Plans (CAPs) were prepared to address both complex-wide and site specific corrective actions. These CAPs identify and allow tracking of actions necessary to address the identified problems, including their time lines, milestones and relative resource impacts. The staff responsible to ensure that the corrective actions are completed are also identified. The CAPs were reviewed and approved by senior DOE managers.*

Compliance with this requirement is demonstrated by a site corrective actions program that addresses radioactive waste management-related occurrence reporting and processing of operations information reports citing corrective actions taken, and by records of changes to procedures or processes reflecting that changes were made to correct a problem.

Supplemental References:

1. DOE, 1997. *Occurrence Reporting and Processing of Operations Information,* DOE O 232.1A, U.S. Department of Energy, Washington, D.C., July 21, 1997.

2. DOE, 1995. *Guidance for Identifying, Reporting and Tracking Nuclear Safety Noncompliances,* DOE-HDBK-1089-95, U.S. Department of Energy, Washington, D.C., December 1995.

3. DOE, 1997. *Implementation Guide for DOE Order 452.2A, Safety of Nuclear Explosive Operations,* DOE G 452.2A-1A, U.S. Department of Energy, Washington, D.C., January 17, 1997.

I. 2.G. All Personnel.

All personnel are responsible for:

(1) Problem Identification. Identifying and reporting radioactive waste management facilities, operations, or activities that do not meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual, or pose a threat to the safety of the public, workers, or the environment.

Objective:

The objective of this requirement is to clearly state the responsibility and right of each individual to identify and report unsafe conditions so that action can be taken to ensure protection of workers, the public, and the environment.

Discussion:

During the development of DOE M 435.1-1, it was recognized that achievement of safe working practices and conditions could be realized only if all personnel are involved and constantly critical of activities and operations. Comprehensive worker protection programs should already exist in compliance with DOE O 440.1A *Worker Protection Management For DOE Federal And Contractor Employees.* Detailed guidance is available in the multiple guides associated with that Order. This requirement is included in DOE M 435.1-1 to reinforce that accomplishing work safely is critical.

Safe and environmentally sound operations are not, and cannot be, solely the responsibility of management or safety professionals. Coordinated and integrated efforts and constant vigilance are required. Every individual must act in the role of a safety observer. Managers are typically accountable for the overall worker protection program, including planning and allocating resources. Supervisors are accountable for ensuring that worker protection plans, programs, and procedures, including hazard identification and abatement activities, are implemented on a day-to-day basis at the front line. Employee/worker accountability involves following procedures, using safe work practices, and reporting hazards. Formal roles may vary, but everyone has the role of identifying and reporting threats to safety.

Example 1: A subcontractor at a DOE site is performing roofing repairs in an explosives processing area which is a non-smoking area. The subcontractor, however, has permission to have an open flame on the roof because the work involves tar and a hazards analysis indicated that there was no threat from the flame at that location. The subcontractor and crew receive the standard safety briefing upon being awarded the

contract, including an explanation of the rules regulating smoking in the restricted area, i.e. smoking is authorized only in designated areas. As a DOE employee is walking in the area, the roofer's crew is leaving to go to lunch. The employee observes that a laborer is smoking a cigarette in the bed of the truck. He immediately calls the security post to have the truck stopped and security personnel inform safety and contract management personnel to take appropriate action.

Example 2: The approved radioactive waste management basis for a storage facility requires low level waste to be stored on concrete pads with suitable leak detection and spill control. The facility manager has allowed two slightly corroded drums of low level waste to be stored temporarily in a grassy area beside the pad due to a lack of storage space on the pad. A DOE employee familiar with the radioactive waste management basis notices the drums on the grass, and notifies his supervisor, who contacts the facility manager about the situation. The facility manager immediately rectifies the situation by transferring the waste to an acceptable storage pas at another facility.

Compliance with this requirement is demonstrated by records showing what corrective actions were taken to remedy situations in the radioactive waste management system.

Supplemental References:

1. DOE, 1998. *Worker Protection Management for DOE Federal and Contractor Employees,* DOE O 440.1A, U.S. Department of Energy, Washington, D.C., March 27, 1998.

2. DOE, 1997. *Worker Protection Management for DOE Federal and Contractor Employees Guide for Use with DOE Order 440.1A,* DOE G 440.1-1, U.S. Department of Energy, Washington, D.C., July 10, 1997. (This guide has applicable standards and guidance documents listed at the end of each chapter.)

I.2.G(2) Shutdown or Curtailment of Activities. Stopping or curtailing work, through the appropriate level of management, to prohibit continuation of conditions or activities which pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Objective:

The objective of this requirement is to ensure that the operation of radioactive waste management facilities or the performance of radioactive waste management activities is discontinued or controls put in place if it poses an imminent danger or serious hazard to the public, workers, or the environment.

Discussion:

The shutdown and curtailment of activities requirement complements DOE M 435.1-1, Section I.2.G.(1), Problem Identification, and requires that the Field Element Manager has a system in place to ensure that corrective actions are initiated when necessary. The need for corrective actions has long been recognized in the management of radioactive waste. However, the responsibility for individual actions was not clearly assigned. Stop work procedures, which are not specific to radioactive waste management, are anticipated to be already in place and workers need to be trained to those procedures. DOE O 440.1A requires that DOE elements and contractors implement procedures to allow workers, through their supervisors, to stop work when they discover employee exposures to imminent danger or other serious hazards. A worker has the right to decline to perform an assigned task because of a reasonable belief that, under the circumstances, the task poses an imminent risk of death or serious bodily harm to that individual, coupled with a reasonable belief that there is insufficient time to seek effective redress through the normal hazard reporting and abatement procedures.

Accomplishing work safely is an important DOE goal. When a situation with an imminent danger is discovered, immediate action must be taken either to correct the dangerous condition or practice, or to remove all employees from exposure to the dangerous condition until the condition or practice has been removed. Imminent danger means a situation that could reasonably be expected to cause death or serious physical harm unless immediate actions are taken. This requirement to shut down or curtail activities is included in DOE M 435.1-1 to complement DOE O 440.1A by broadening its application to include threats to the public and environment, and to emphasize that it applies in radioactive waste management.

Any stop work authority must be exercised in a justifiable and responsible manner. All workers, supervisors, managers, and safety professionals are responsible for being cognizant of the conditions in their workplaces and for being prepared to stop work if conditions pose a serious threat to health or safety, or a detriment to the environment. Hazards analyses and hazard prevention/abatement processes result in routine hazards being controlled. This requirement is intended to address extraordinary or unanticipated circumstances and situations where there is a breakdown in controls. When a reasonable person views the circumstances as having the potential to cause injury, serious impairment, harmful health effects, or serious damage to the environment, a stop work order is to be issued. However, the full implications of what will occur

must be recognized. Any work stoppage must alleviate the hazard without creating unintended consequences that are worse than the hazard. Whenever workers see a need to stop work, they are to advise their supervisors. Before a stop work order is issued, the person issuing it needs to ensure the work stoppage itself will not negatively impact workers or public health and safety or the environment.

> *Example: At a site, radioactive waste is stored in an approved storage facility in drums. These drums are in groups of four on wooden pallets and are strapped together for stability. In order to remove them for transfer to a treatment facility, the pallets are lifted by forklifts and placed in trucks. In the course of moving a pallet from the third tier, an adjacent pallet load becomes unstable. Any further movement would cause it to fall on support workers who are inventorying and processing the drums for the transfer. The supervisor recognizes that the pallet load is an imminent threat to those support workers with the potential to cause serious physical harm. The supervisor immediately suspends work in the immediate area, clearing all personnel until a second forklift can be made available to stabilize the threatening pallet load. In accordance with site procedures, appropriate occurrence reporting and processing system (ORPS) reports are made.*

Compliance with this requirement is demonstrated by having the necessary procedures, mechanisms, and training in place to effect shutdown or curtailment of activities which pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Supplemental References:

1. DOE, 1998. *Worker Protection Management for DOE Federal and Contractor Employees,* DOE O 440.1A, U.S. Department of Energy, Washington, D.C., March 27, 1998.

2. DOE, 1997. *Worker Protection Management for DOE Federal and Contractor Employees Guide for Use with DOE Order 440.1A*, DOE G 440.1-1, U.S. Department of Energy, Washington, D.C., July 10, 1997. (This guide has additional topic specific standards and guidance documents listed at the end of each chapter.)

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IMPLEMENTATION GUIDE
for use with DOE M 435.1-1

Chapter II

High-Level Waste Requirements

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II. A. Definition of High-Level Waste.

High-level waste is the highly radioactive waste 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 other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

Objective:

The objective of this requirement is to provide the criteria for determining which DOE radioactive wastes are to be managed as high-level waste, and therefore, in accordance with DOE M 435.1-1, Chapter II, *High-Level Waste Requirements*, and Chapter I, *General Requirements and Responsibilities*.

Discussion:

As required in DOE M 435.1-1, Section I.1.C., Radioactive Waste Management, all radioactive wastes subject to DOE O 435.1 shall be managed as either high-level waste, transuranic waste, low-level waste, or mixed low-level waste. To assist in determining whether a particular waste stream is high-level waste, another waste type, or not addressed by DOE O 435.1 and DOE M 435.1-1, see the guidance that accompanies the requirement at Section I.1.C. For those waste streams that meet the definition of high-level waste cited above, the requirements of Chapter II of DOE M 435.1-1 shall be met.

This definition is consistent with the definition provided in the *Nuclear Waste Policy Act of 1982* (NWPA), as amended. It is slightly modified from the *Nuclear Waste Policy Act of 1982*, as amended, definition and, as discussed below, allows DOE to make a determination of what is high-level waste based on existing law.

The identification of high-level waste is considered relatively straightforward since it is primarily linked to the source from which it was derived, i.e., it is the highly radioactive material resulting from the reprocessing of spent nuclear fuel. However, the definition does imply a concentration limit by including solid material derived from liquid waste that contains fission products in sufficient concentrations. Background and knowledge of both the *Nuclear Waste Policy Act of 1982*, as amended, definition and the Nuclear Regulatory Commission definition, at 10 CFR Part 60, is needed to ensure that waste that is to be managed as high-level waste has been properly characterized to be high-level waste. High-level waste must be managed in accordance with Chapter II of DOE M 435.1-1.

<u>Background</u>. The following discussion is provided in terms of the *Nuclear Waste Policy Act of 1982*, as amended, definition but is fully applicable to the definition at Section II.A of DOE M 435.1-1. The *Nuclear Waste Policy Act of 1982*, as amended, provides for the disposal of high-level radioactive waste and establishes a program of research, development, and demonstration regarding the disposal of high-level radioactive waste. In the *Nuclear Waste Policy Act of 1982*, as amended, the term high-level radioactive waste is defined as:

> "(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."

Thus the *Nuclear Waste Policy Act of 1982*, as amended definition for high-level waste provides for the inclusion of both source-based material and concentration-based material as high-level waste.

Note that the *Nuclear Waste Policy Act of 1982*, as amended, does not mandate that materials regarded as high-level waste pursuant to this definition be disposed of in a geologic repository. Indeed, the *Nuclear Waste Policy Act of 1982*, as amended, directs the Secretary of Energy to continue and accelerate a program of research, development, and investigation of alternative means and technologies for the permanent disposal of high-level waste. DOE has not been specifically authorized by Congress to construct or operate facilities for disposal by alternative means, and it is not clear whether additional authorization might be needed in order to dispose of high-level waste by means other than emplacement in a deep geologic repository (*52 FR 5994*).

Also note that the *Nuclear Waste Policy Act of 1982*, as amended, definition and the definition for high-level waste in DOE's predecessor directive for radioactive waste management, DOE 5820.2A, are fundamentally the same. However, there is one exception. The *Nuclear Waste Policy Act of 1982*, as amended, provides for an additional mechanism for determining a waste is high-level waste. This mechanism is to allow the Nuclear Regulatory Commission (NRC) to determine, by rule, that a waste requires permanent isolation. The wording in Section II.A is slightly different than the *Nuclear Waste Policy Act of 1982*, as amended, to allow DOE to make a determination based upon existing law in Sections 202(3) and 202(4) of the *Energy Reorganization Act of 1974*.

The NRC has posited that, "radioactive wastes that have historically been referred to as high-level waste, i.e., reprocessing wastes, are initially both intensely radioactive and long-lived" (*52 FR 5994)*. However, these wastes contain a wide variety of radionuclides with some (e.g., Sr-90, Cs-137) having a relatively short half-life yet representing a large fraction of the radioactivity for the first few centuries after the wastes are produced. These nuclides produce significant amounts of

heat and radiation, both of which are of concern when managing such wastes. Other radionuclides, including C-14, Tc-99, I-129 and transuranic nuclides, have very long half-lives and thus constitute the longer-term hazard of the wastes. Some of these nuclides pose a hazard for sufficiently long periods of time that the term permanent isolation is used in the *Nuclear Waste Policy Act of 1982*, as amended, to describe the type of disposal required to isolate them from the environment. Permanent isolation does not, however, equate to repository disposal, and can be conceivably attained by other means which comply with the requirements of 40 CFR Part 191. The Nuclear Regulatory Commission "considers that these two characteristics, intense radioactivity for a few centuries followed by a long-term hazard requiring permanent isolation, are key features which can be used to distinguish high-level wastes from other waste categories" (*52 FR 5994*).

The *Nuclear Waste Policy Act of 1982*, as amended, identifies two sources of high-level waste. First, the *Nuclear Waste Policy Act of 1982*, as amended, definition of high-level waste refers to wastes produced by reprocessing spent nuclear fuel, which is essentially identical to the NRC's definition at 10 CFR Part 60 [(1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted]. However, there is one difference. The *Nuclear Waste Policy Act of 1982*, as amended, wording would classify solidified reprocessing waste as high-level waste only if such waste "contains fission products in sufficient concentrations." This phrase implies that liquid reprocessing waste may be partitioned or otherwise treated so that some of the solidified products will contain substantially reduced concentrations of radionuclides and thus not be high-level waste, i.e., incidental waste. Second, the *Nuclear Waste Policy Act of 1982*, as amended, authorizes the NRC to classify "other highly radioactive material" (other than reprocessing wastes) as high-level waste if that material "requires permanent isolation." Both of these elements of the *Nuclear Waste Policy Act of 1982*, as amended, definition are discussed further below by providing summaries of the Nuclear Regulatory Commission's attempt to revise the 10 CFR Part 60 definition of high-level waste.

In February 1987, the NRC published an Advanced Notice of Proposed Rulemaking, (*52 FR 5992*) announcing its intent to revise the definition of the term high-level radioactive waste that appears in 10 CFR Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories." In the Advanced Notice of Proposed Rulemaking, the Commission reviewed the previous statutory and regulatory uses of the term, the NRC's current regulations related to waste classification and disposal, and the pertinent provision of the *Nuclear Waste Policy Act of 1982*, as amended, with the purpose of considering a change to its own rules to conform to the *Nuclear Waste Policy Act of 1982*, as amended, definition. In particular, the NRC proposed to define high-level waste in a manner that would apply the term high-level radioactive waste to materials in amounts and concentrations exceeding numerical values that would be stated explicitly in the form of a table. Thus, high-level waste would be characterized by the kind of hazard that could only be

guarded against by disposal in a geologic repository or equivalent facility. Those wastes that could be disposed of safely in a facility less secure than a repository would continue to be classified as low-level radioactive waste rather than as high-level waste.

At issue was whether the Commission should specify numerically the concentrations of fission products which it considered sufficient to distinguish high-level waste from non-high-level waste or, define high-level waste so as to add the *Nuclear Waste Policy Act of 1982*, as amended, (clause (a)) wastes with those which have traditionally been regarded as high-level waste (*52 FR 5994*), i.e. by the waste's source. In addition, the Commission raised the issue as to whether to consider a material highly radioactive if it contains concentrations of short-lived radionuclides in excess of the Class C limits of Table 2 of 10 CFR Part 61. The Commission stated that such concentrations are sufficient to produce significant radiation levels and to generate substantial amounts of heat and should be considered highly radioactive. Finally, the phrase permanent isolation was discussed and was believed to be much less subjective than is the term highly radioactive. The Commission suggested that the term clearly implies the degree of isolation afforded by a deep geologic repository, and a waste "requires permanent isolation" if it cannot be safely disposed of in a facility that is less secure than a repository. Furthermore, the Advanced Notice of Proposed Rulemaking (*52 FR 5995*) states that the Commission could determine which wastes require permanent isolation by evaluating the disposal capabilities of alternative, less secure, disposal facilities. The Commission noted that such less secure facilities might make use of intermediate depth burial or various engineering measures, such as intruder barriers, to accommodate wastes with radionuclide concentrations unsuitable for disposal by shallow land burial. The Commission suggested that any such wastes which cannot be safely disposed of in such facilities could be deemed to require permanent isolation and, if also highly radioactive, could be classified as high-level wastes (*52 FR 5995*).

In May 1988 (*53 FR 17709-17711*), the NRC published its Proposed Rule at 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," and stated that the proposed amendments to this Rule obviated "the need for altering existing classifications of radioactive wastes as high-level or low-level." In short, the NRC received nearly 100 comments on its February 1987 Advanced Notice of Proposed Rulemaking and almost all agreed with the Commission on one point: the use of the term high-level radioactive waste as used in the clause (b) of the *Nuclear Waste Policy Act of 1982*, as amended definition, serves to identify those wastes which require the degree of isolation afforded by a deep geologic repository. However, comments differed widely regarding the specific wastes perceived to require that degree of isolation. Some comments advocated classification of all radioactive wastes, other than the most innocuous, as high-level waste while other comments preferred to reclassify, as low-level waste, large quantities of defense reprocessing waste long regarded as high-level waste. Conspicuously absent from the comments was any consensus regarding the means to be used by the Commission to distinguish high-level waste from non-high-level waste. For example, the concept of a numerical definition of high-level waste was criticized as an invitation to dilute or fractionate

wastes solely to alter their classification. From this discussion the Commission determined it would be best to proceed quite differently from its objective suggestion as set forth in the Advanced Notice of Proposed Rulemaking; i.e., the NRC abandoned their attempt to provide a risk-based definition for high-level waste. Instead, the Commission continued to embrace the definition at 10 CFR Part 60. In summary, the Commission stated that the preferable construction of the statute was to conform to the traditional definition, i.e., to define high-level waste by its source, not by its concentrations of fission products, and thus equate *Nuclear Waste Policy Act of 1982*, as amended, wastes with those wastes which have traditionally been regarded as high-level waste under Appendix F of 10 CFR Part 50 and the *Energy Reorganization Act of 1974* (ERA). The NRC stated that "NWPA (clause (a)) wastes have little significance for purposes of the NWPA since the Federal Government was already responsible for the disposal of all reprocessing waste at the time the statute was passed." Thus "materials that are high-level waste for purposes of licensing-jurisdiction provisions of the ERA will also be regarded as high-level waste under the NWPA. This would include the primary reprocessing waste streams at DOE facilities, though not the incidental wastes produced in reprocessing" (*53 FR 17709*).

Discussion. The above background information is intended to provide some background for the following discussion on determining what waste streams are, and are not, high-level waste. First, it is noted that the term reprocessing is not defined statutorily. However, reprocessing is considered by the Department to be those actions necessary to separate fissile elements (U-235, Pu-239, U-233, and Pu-241) and/or transuranium elements (e.g., Np, Pu, Am, Cm, Bk) from other materials (e.g., fission products, activated metals, cladding) contained in spent nuclear fuel for the purposes of recovering desired materials. Second, as discussed above, the concentration of fission products is not the primary consideration when making determinations using clause (a) of the *Nuclear Waste Policy Act of 1982,* as amended. The source of the waste is the primary parameter for making high-level waste determinations, not the activity or concentration of fission products. However, inclusion of solid wastes derived from the waste of spent nuclear fuel reprocessing activities is also a consideration if the concentration of fission products is sufficient. Third, it is recognized that the NRC's definition of high-level waste at 10 CFR 60.2, (which is consistent with the definition of high-level radioactive waste in 10 CFR Part 50, Appendix F), limits high-level waste to wastes that are the result of spent nuclear fuel reprocessing, beginning with the separation/first cycle solvent extraction step, or equivalent. Specifically it states high-level radioactive waste is:

> "(1) irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted." (10 CFR 60.2)

With regard to part (1) of this definition, it is noted that requirements for DOE-managed spent nuclear fuel, as of the time of the preparation of this guidance, have not been added to DOE O

435.1. Further, the hazards analysis performed to identify requirements for high-level waste did not address the functions associated with management of spent nuclear fuel. Thus the requirements contained in DOE M 435.1-1 do not apply to this DOE-managed spent nuclear fuel.

DOE M 435.1-1 supports the implementation of part (2) of the 10 CFR Part 60 definition to mean that high-level wastes are wastes that are generated as a product of reprocessing of spent nuclear fuel downstream of, and including, the first step in a separations process, and the consistent waste streams from subsequent extraction cycles or steps. Separation processes include aqueous separation processes, e.g., the Redox and the Purex processes, and nonaqueous processes, e.g., pyrometallurgical and pyrochemical processes. Wastes that are produced upstream of these separations processes, from such processes as chemical or mechanical decladding, fuel dissolution, cladding separations, conditioning, or accountability measuring, are not high-level waste. Such wastes are considered processing wastes and should be managed in accordance with the appropriate Chapters of DOE M 435.1-1, as either transuranic, mixed low-level, or low-level waste. In addition, these wastes may be commingled with materials-in-process that require further processing to separate desired materials from wastes. The following example is offered to clarify this interpretation.

> *Example: The spent nuclear fuel reprocessing operation at Site Z has been shut down for some time. In the haste of shutting down the operation a number of material streams and waste streams were left in the facility and are now being reviewed for disposition. The following table describes some of the streams, designation of the stream as high-level waste, or non-high-level waste, and the basis for the designation:*

Stream	***Designation***	***Basis***
Fuel cladding hulls (leached, partially leached, and unleached)	*Non-high-level waste*	*Hulls are generated upstream of (before) the first step of a separations process. They should be characterized to determine proper classification (e.g., LLW, MLLW, or TRU).*
PUREX process first-cycle raffinate stream, Pu purification raffinate stream	*High-level waste*	*Both waste streams are generated by the first step, or subsequent steps, of a separations/decontamination process.*

Stream	***Designation***	***Basis***
Contaminated equipment/components: *a) Fuel Shear* *b) Fuel Dissolver* *c) First cycle solvent extraction column*	*a) Non-high-level waste* *b) Non-high-level waste* *c) High-level waste unless WIR Evaluation Process criteria are met.*	*a) Waste contained/trapped in a fuel shear was generated upstream of first step of separations process. Fuel shear should be characterized to determine proper classification (e.g., LLW, MLLW or TRU).* *b) Same as a).* *c) Waste contained/trapped in column was generated during first step of separations process. May be managed as non-high-level waste if column meets the Waste Incidental to Reprocessing Evaluation Process criteria.*
Electrometallurgical treatment products: *a) Metal waste form (includes uranium, fission products, noble metals)* *b) Ceramic waste form (includes fission products, some actinides)*	*a) High-level waste* *b) High-level waste*	*a) & b) Both waste streams are generated by the first step, or subsequent step, of a separation/decontamination process.*

As stated above, the Department recognizes that the *Nuclear Waste Policy Act of 1982*, as amended, grants the NRC the authority, through the rulemaking process, to designate other highly radioactive materials as high-level waste under existing law. For DOE, such existing law would primarily be sections 202(3) and (4) of the *Energy Reorganization Act of 1974*.

Components and Equipment Contaminated with High-Level Waste. As discussed in detail in the guidance to Section II.B, Waste Incidental to Reprocessing, components and equipment contaminated with high-level waste are not considered high-level waste by the application of the high-level waste definition in Section II.A, or the *Nuclear Waste Policy Act of 1982*, as amended, definition, provided they meet the conditions of either the Waste Incidental to Reprocessing Citation or Evaluation Process. In defining high-level waste both definitions use the term "highly

radioactive material" which is interpreted to mean waste material that is a result of reprocessing spent nuclear fuel and any liquid waste or solid material derived from such liquid. There is no precedence nor basis for including high-level waste-contaminated components and/or equipment within the definition. In fact, the identification of items excluded from high-level waste by the Atomic Energy Commission and subsequently by the Nuclear Regulatory Commission, includes not only radioactive (fuel) hulls and other irradiated and contaminated fuel structural hardware but also "ion exchange beds, sludges, and contaminated laboratory items, clothing, tools, and equipment" (*52 FR 5993*). Thus, inclusion of these items as candidates for the incidental waste process supports the DOE M 435.1-1 position that such contaminated items may not be high-level waste. If they are not, they are subject to management and disposal as another waste type, provided adequate protection is provided by their disposal as another waste type (e.g., low-level waste or transuranic waste).

Spent Nuclear Fuel. Spent nuclear fuel is defined in the *Nuclear Waste Policy Act of 1982*, as amended, as "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." Because this definition was developed with commercially-generated spent nuclear fuel in mind, it fails to differentiate between defense-related spent nuclear fuel (drivers) and target elements (materials irradiated to produce defense nuclear materials). For the purposes of managing high-level waste under DOE M 435.1-1, spent nuclear fuel includes spent driver elements and/or irradiated target elements that contain transuranium elements. Excluded from spent nuclear fuel are target elements, that after irradiation, contain no transuranium elements (e.g., those for the production of tritium) since such spent target elements contain neither fissile material nor long-life transuranic isotopes that require permanent isolation. Historically, such spent targets (reprocessed and unreprocessed) have been assayed, treated, and disposed of as low-level waste (Final Environmental Impact Statement, DOE/EIS-0271, *Construction and Operation of a Tritium Extraction Facility at the Savannah River Site*, DOE 1999). DOE M 435.1-1 supports the continuation of this practice.

In April 1992, the Secretary of Energy approved a recommendation to phase out reprocessing of spent nuclear fuel at DOE's Savannah River Site and Idaho National Engineering Laboratory for the purpose of recovering highly enriched uranium for the weapons program (Secretary of Energy Decision Memo, dated April 28, 1992). In a similar action in December 1994 the Secretary of Energy approved a recommendation to prohibit the use of plutonium-239 and highly enriched uranium separated and/or stabilized during facility phaseout, shutdown, and cleanout activities for nuclear explosive purposes (Memorandum for the Secretary, approved December 20, 1994). From these actions it is evident that DOE no longer plans to reprocess spent nuclear fuel for the purposes of recovering fissile materials and significant quantities of additional high-level waste will not be generated in the future from these operations. However, it is recognized there may be limited reprocessing at some of the high-level waste sites for spent nuclear fuel that is considered "at risk materials." Similarly, for cost effective reasons as well as others, most DOE high-level waste sites continually add radioactive liquid wastes (e.g., cooling, water, decontamination

solutions) that may, or may not be, high-level waste to their high-level waste storage systems. This practice effectively increases the volume of high-level waste to be managed, however, the net amount is usually minor due to the evaporation capabilities at the sites. Such co-mingling of high-level waste with other waste types should be performed considering the waste minimization objectives of DOE M 435.1-1, Section I.1.E.(20), Waste Minimization and Pollution Prevention.

Disposition of Surplus Weapons-Usable Plutonium. The Department has the authority to emplace surplus weapons-usable plutonium in immobilized high-level waste canisters and dispose of this waste form in the geologic repository constructed under the *Nuclear Waste Policy Act of 1982*, as amended, (NRC letter, C.J. Paperiello to L.H. Barrett, January 25, 1999). Thus this composite waste form (plutonium can in a high-level waste canister) is considered high-level waste and should be managed as such. Although the hazards analysis and requirements analysis prepared to support the development of the high-level waste chapter of DOE M 435.1-1 did not consider the inclusion of this waste form, its addition is not expected to change the requirements contained in the chapter.

Non-Routine High-Level Waste. There is acknowledgment of a sub-category of high-level waste, "non-routine high-level waste," that includes secondary radioactive solid wastes that meet the source-based portion of the definition for high-level waste, but may not meet the current immobilized high-level waste specification for a standard waste form, as defined by the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS). The current EM-WAPS document was written to allow acceptance of a standard waste form, borosilicate glass canistered waste, but does recognize the production of "nonconforming canistered high-level waste forms" from the high-level waste form producers. Examples are expected to include immobilized waste that is suspected of being contaminated by foreign materials and glass samples that were generated during production. Such waste forms may be nonconforming and thus, may require review/acceptance by the DOE Office of Civilian Radioactive Waste Management. If accepted, they will be a nonstandard waste form. Such Office of Civilian Radioactive Waste Management acceptance is expected to include satisfying the requirements in the EM-WAPS and approval of a treatment and disposition plan.

Example: At Site X, non-conforming high-level waste has been generated as a result of high-level waste storage, pretreatment, and treatment activities. This waste includes:

- *glass chipped from high-level waste glass melters,*
- *glass deposited on equipment*
- *spilled high-level waste glass that was not captured in a canister,*
- *glass samples/shards.*

The Site is currently managing these wastes as nonconforming high-level wastes since there are issues regarding contamination by foreign materials and the need to place

> *these wastes in canisters. However, each canister is expected to meet the EM-WAPS specifications and be accepted by the Office of Civilian Radioactive Waste Management as non-standard canistered waste forms. If any do not meet the EM-WAPS specifications, they will be managed as non-conforming and the Office of Civilian Radioactive Waste Management acceptance, as nonstandard waste form, will be necessary by way of an Office of Civilian Radioactive Waste Management-approved action plan. The requirement for an action plan is included in the EM-WAPS, specifications 4, Quality Assurance.*

The high-level waste scraps identified in the above example are considered non-routine high-level waste forms. Currently both the Defense Waste Processing Facility at Savannah River and West Valley Demonstration Project vitrification processes have produced small amounts of this material and are storing it until a path forward can be determined.

Waste Incidental to Reprocessing. Those waste streams that meet the requirements of the waste incidental to reprocessing processes, either by citation or by evaluation, are also excluded from the scope of high-level waste. DOE M 435.1-1, Section II.B describes the process for making such determinations and the accompanying guidance on this section provides further details on this subject.

Interfaces Between the Office of Environmental Management and Office of Civilian Radioactive Waste Management. The guidance for high-level waste disposal (DOE G 435.1-1, Section II.S) provides information on the responsibilities and interfaces between the Offices of Environmental Management and Civilian Radioactive Waste Management.

Supplemental References:

1. *Nuclear Waste Policy Act of 1982,* as amended, Public Law 97-425, Section 2.(12), January 7, 1983.

2. *Energy Reorganization Act of 1974*, as amended, Public Law 93-438, Section 202 (3) and (4).

3. AEC, 1969. “Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities; Statement of Proposed Policy, 10 CFR Part 50, ‘Licensing of Production and Utilization Facilities’,” *Federal Register*, Vol. 34, No. 8712, Atomic Energy Commission, Washington, D.C., June 3, 1969.

4. AEC, 1970. “Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities, 10 CFR Part 50, ‘Licensing of Production and Utilization

Facilities',” *Federal Register*, Vol. 35, No. 17530-17533, Atomic Energy Commission, Washington, D.C., November 14, 1970.

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9. *Atomic Energy Act of 1954*, as amended, Public Law 83-703, Title II, Section 11, (dd), August 30, 1954.

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11. Barrett, 1998. L.H. Barrett to C.J. Paperiello, letter, [no title], U.S. Department of Energy, Washington, D.C., December 10, 1998.

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14. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

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II. B. <u>Waste Incidental to Reprocessing</u>.

Waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not high-level waste, and shall be managed under DOE's regulatory authority in accordance with the requirements for transuranic waste or low-level waste, as appropriate. When determining whether spent nuclear fuel reprocessing plant wastes shall be managed as another waste type or as high-level waste, either the citation or evaluation processes described below shall be used:

(1) Citation. Waste incidental to reprocessing by citation includes spent nuclear fuel reprocessing plant wastes that meet the description included in the Notice of Proposed Rulemaking (34 FR 8712) for proposed Appendix D, 10 CFR Part 50, Paragraphs 6 and 7. These radioactive wastes are the result of reprocessing plant operations, such as, but not limited to: contaminated job wastes including laboratory items such as clothing, tools, and equipment.

(2) Evaluation. Determinations that any waste is incidental to reprocessing by the evaluation process shall be developed under good record-keeping practices, with an adequate quality assurance process, and shall be documented to support the determinations. Such wastes may include, but are not limited to, spent nuclear fuel reprocessing plant wastes that:

(a) Will be managed as low-level waste and meet the following criteria:

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

3. Are to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*; or will meet alternative

requirements for waste classification and characterization as DOE may authorize.

(b) Will be managed as transuranic waste and meet the following criteria:

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

2. Will be incorporated in a solid physical form and meet alternative requirements for waste classification and characteristics, as DOE may authorize; and

3. Are managed pursuant to DOE's authority under the *Atomic Energy Act of 1954,* as amended, in accordance with the provisions of Chapter III of this Manual, as appropriate.

Objective:

The objective of this requirement is to ensure the implementation of a consistent and defensible process to make waste incidental to reprocessing determinations across the DOE complex. Implementation of the process will ensure DOE manages these waste streams within its regulatory authority for disposal.

Discussion:

Certain waste streams produced during the generation of high-level waste may be determined to be non-high-level waste through the waste incidental to reprocessing determination process. The processes for making such determinations are included as requirements in DOE M 435.1-1, Section II.B, and are described below. In conjunction with Section II.B is a requirement in Section I.2.F.(18), Waste Incidental to Reprocessing, which delineates the responsibilities of the Field Element Manager and the DOE Office of Environmental Management for making and reviewing such waste incidental to reprocessing determinations. The information and analysis necessary to support these determinations is included.

Background. In the Statement of Proposed Policy (*34 FR 8712*) for Appendix D, 10 CFR Part 50, "Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities," the Atomic Energy Commission (AEC) noted that the term high-level waste, as used in the proposed Appendix D, did not include all wastes originating from (spent nuclear fuel) reprocessing plant operations (Paragraphs 6 and 7). Such wastes, later referred to as incidental wastes by the Nuclear Regulatory Commission (NRC) (*52 FR 5993*), included waste streams such

as ion exchange beds, sludges, and contaminated laboratory items, clothing, tools, and equipment. Additionally, this category included radioactive hulls and other irradiated and contaminated fuel structural hardware. Although this language (Paragraphs 6 and 7) concerning incidental waste was deleted from the final Policy under Appendix F, pending additional study (*35 FR 17530-17533*), the principle of incidental wastes has been continually supported by both the Department of Energy and the NRC , as well as their predecessors, even before the Proposed Rulemaking.

In its Advance Notice of Proposed Rulemaking for the Definition of High-Level Radioactive Waste at 10 CFR Part 60 (*52 FR 5992-6001*), the NRC introduced the term incidental wastes and stated that high-level waste does not include such waste streams. Additionally, the Commission stated (footnote 1, *52 FR 5993*) that "incidental wastes generated in further treatment of HLW (e.g., decontaminated salt with residual activities on the order of 1,500 nCi/g Cs-137, 30 nCi/g Sr-90, 2 nCi/g Pu, as described in the Department of Energy's FEIS on long-term management of defense HLW at the Savannah River Plant, DOE/EIS-0023, 1979) would also, under the same reasoning, be outside the proposed Appendix D definition," if they met certain chemical concentrations. Additionally, in the NRC's Proposed Rule for 10 CFR Part 61, for shallow-land disposal of radioactive waste, the Commission stated that the preferable construction of the statute "...is to conform to the traditional definition (for high-level waste). Under this approach, materials that are HLW for purposes of the licensing-jurisdiction provisions of the *Energy Reorganization Act of 1974* will also be regarded as high-level waste under the *Nuclear Waste Policy Act of 1982*, as amended. This would include the primary reprocessing waste streams at DOE facilities, though not the incidental wastes produced in reprocessing" (*53 FR 17709*).

More recently, in response to a petition regarding disposal of waste at the Hanford site, the NRC (States of Washington & Oregon: Denial of Petition for Rulemaking, *58 FR 12342-12347*) commented that:

> "Assuming implementation of DOE's plans as described above, the Commission concludes that any radioactive material from the double shell tanks that is deposited in the grout facility would not be high-level radioactive waste subject to NRC's licensing jurisdiction. The responsibility for safely managing those wastes rest with the Department of Energy. The basis for the Commission's conclusion is that the reprocessing wastes disposed of in the grout facility would be 'incidental' wastes because of DOE's assurance that they:
>
> (1) have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical;

(2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C LLW as set out in 10 CFR Part 61; and

(3) are to be managed, pursuant to the *Atomic Energy Act of 1954,* as amended, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied." (*58 FR 12345*)

A similar characterization was made for the West Valley Demonstration Project in the Technical Evaluation Report prepared by the NRC Office of Nuclear Material Safety and Safeguards, dated November 1988, which concluded there is reasonable assurance that the cement solidification of the decontaminated supernatant (incidental waste) will meet the waste form stability requirements of 10 CFR Part 61 (NRC Technical Evaluation, 11/88). This is an implicit recognition by the NRC that the separated low-activity fraction of high-level waste need not be managed and disposed as high-level waste.

The question of whether the NRC or DOE has the authority to make incidental waste determinations (using the evaluation process) was raised by NRC Commissioner Curtiss in December 1992 (SECY-92-391), as a precursor to the Commission's action on the 1993 Denial of Petition for Rulemaking. In response, the NRC staff (memo for Commissioner Curtiss from J. M. Taylor, 1/14/93) stated that DOE has the responsibility to make an initial determination, and if DOE concludes that the action is <u>not</u> subject to NRC jurisdiction, then DOE can undertake the activity without involving the NRC in any manner. However, if DOE concludes that NRC jurisdiction is unclear (i.e., the waste may be high-level waste and therefore potentially subject to NRC licensing), then DOE has two options: (1) consult with the NRC and then make a decision based on the results of the consultation; or (2) proceed without communication with the NRC. The staff response then cites the proposed letter from Bernero (USNRC) to DOE (transmitted March 2, 1993) that the NRC would call upon DOE to provide relevant technical information that would enable the NRC to make its own determination, should that be appropriate. (Although this decision applied to the Hanford case only, DOE's interpretation, based on discussions with NRC staff, is that it can be applied more broadly through DOE M 435.1-1.) These two memoranda are interpreted to mean that the NRC expects the DOE to consult with them for those waste streams that the DOE has some question of whether the waste stream is high-level waste. In addition, as discussed in the guidance to Section I.2.F.(18), the NRC has licensing authority over DOE facilities "authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by DOE and its predecessor agencies" (Sullivan, 1998).

<u>Determination Processes</u>. Consistent with these concepts, Section II.B of DOE M 435.1-1 offers two distinct processes by which DOE can determine whether reprocessing wastes can be managed as low-level or transuranic waste under DOE's *Atomic Energy Act* authorities: (1) by citation, and (2) by evaluation.

The citation process refers to those reprocessing waste items of the type that were discussed in the Statement of Proposed Policy for Appendix D, 10 CFR Part 50, as not being high-level waste. Although the exclusion of such items from the high-level waste definition was dropped from the final rule (Appendix F), the concept of incidental waste has been supported by DOE and the NRC. If a positive determination is made, the waste may require further characterization and/or acceptable (process) knowledge to determine its final waste classification and disposition, i.e., low-level or transuranic waste.

The evaluation process refers to those reprocessing wastes that have met, or will meet, the evaluation criteria cited above or other consistent protective criteria approved by the Department. Satisfying these criteria ensures the waste to be regulated and managed for disposal by the DOE according to the requirement for low-level or transuranic wastes, as appropriate.

Finally, if the requirements of neither of these processes can be met, the reprocessing waste is to be managed as high-level waste and its disposal must be in accordance with 10 CFR Part 60 and 40 CFR Part 191.

The distinction between the two processes is important because it is clear from background events that citation process waste streams were so identified because of the ease of determining up front that they do not pose the long-term hazards associated with high-level waste. Evaluation process wastes, on the other hand, generally require a case-by-case evaluation and determination. Consistent with this understanding, the responsibility for citation interpretations rests solely with the DOE Field Element Manager, although consultation with the Office of Environmental Management is encouraged. However, the Office of Environmental Management consultation is required for waste that has been determined to be incidental through the evaluation process. In addition, it is recommended that consultation with the NRC staff be considered for evaluation process determinations, although this is not required. Roles and responsibilities are further explained in the guidance to Section I.2.F.(18) of the General Requirements to DOE M 435.1-1.

Several meetings were held between staff personnel from the NRC and DOE to discuss the acceptability of this dual determination approach. NRC staff agreed with this approach, but recommended that sufficient guidance be developed for the implementation of both processes. This guidance document is provided, in part, to meet the NRC staff recommendation. The NRC staff also confirmed that it supports the position that DOE has authority to make incidental waste determinations that involve waste streams that are incidental by use of the citation process. For waste streams that are considered to be incidental by the evaluation process, and may be subject to NRC licensing if contained in a facility authorized by Congress for the express purpose of long-term storage, the staff suggested that communications with the NRC be maintained. This suggestion is consistent with the staff position discussed above and the letter from R. Bernero, USNRC, to J. Lytle, DOE-EM, dated March 2, 1993 and is provided in DOE M 435.1-1 by recommending consultation with the NRC staff on evaluation determinations. Such

communication needs to: a) document the results of the analyses supporting DOE's conclusions; b) be adequate for review; c) be developed with good record-keeping; and d) be conducted under an adequate quality assurance process. Guidance for DOE M 435.1-1, Section I.2.F.(18),Waste Incidental to Reprocessing, provides additional information on these elements and the roles and responsibilities of the Field Element Manager, the DOE Headquarters , and the NRC.

The NRC staff also indicated that if they are requested to consult on such reviews that they would prefer to review evaluation process waste stream candidates on a macro basis, in lieu of reviewing individual waste streams or waste items. This is interpreted to mean that the NRC staff would prefer to review an analysis for a group of high-level waste streams that have similar characteristics or will require similar processing to meet the evaluation criteria, in lieu of individual waste streams or waste items. Such grouping of waste streams is expected to make the most efficient use of the NRC staff's resources and to avoid its involvement in each evaluation process determination for each candidate waste stream or item within the DOE complex. The Office of Environmental Management also prefers to see such grouping be submitted for consultation and coordination. Further discussion on this subject is provided below under the evaluation process.

DOE M 435.1-1 is not intended to create, or support the creation, of a new waste type titled incidental waste. Waste incidental to reprocessing refers to a process for identifying waste streams that would otherwise be considered high-level waste due to their sources of generation or concentration, but can be managed in accordance with the DOE requirements for transuranic or low-level waste, if the requirements for waste incidental to reprocessing are met.

Additionally, it is not the Department's intent to use the waste incidental to reprocessing process to circumvent high-level waste disposal standards by not disposing of high-level waste in the NRC-licensed geologic repository. The goal of the waste incidental to reprocessing determination process is to safely manage and dispose of a limited number of reprocessing waste streams that do not warrant geologic repository disposal because of their lack of long-term threats to the environment and man. Moreover, meeting the evaluation process requirements are difficult and resource intensive and therefore, the DOE high-level waste sites are encouraged to manage high-level waste in a manner that will permit treatment and disposal in a geologic repository. Therefore, non-standard high-level wastes, discussed in the guidance for Section II.A, may be one of the primary waste streams targeted for application of the waste incidental to reprocessing determination process.

To assist in making waste incidental to reprocessing determinations, Figure 1, "Decision Tree for Waste Incidental to Reprocessing Determinations," has been included in this guidance. This figure is a simple decision tree that provides some examples of reprocessing wastes and reprocessing waste streams that are interpreted to be included within each determination process, however, these examples are not considered all inclusive. It is expected that interpretations and

determinations by the DOE sites, in conjunction with DOE Headquarters, may revise this list. Updates to this guidance will reflect such determinations and interpretations.

Application of the citation and evaluation processes is for two primary purposes: to support the determination to manage specific waste streams as non-high-level waste, i.e., as low-level or transuranic wastes; and to support closure activities of deactivated high-level waste facilities/sites. Table 1, "Citation and Evaluation Process Results," is provided to illustrate the six (positive) possible results that can result from applying the citation and evaluation process requirements to a waste stream. A negative result to applying both the citation and evaluation processes is possible with the result being that the waste stream is managed as high-level waste. The check symbols under the columns Low-Level Waste, Transuranic Waste, and Facility/Site Closure denote the Section II.B requirements that must be met in order for the waste stream to be managed as indicated by the column heading.

Table 1. Citation and Evaluation Process Results (NA = not applicable)

Requirement(s) Section	**Low-Level Waste**	**Transuranic Waste**	**Facility/Site Closure**
II.B.(1) Citation Process	✔	✔	**NA**
II.B.(2)(a)(1), (2), & (3) Evaluation Process	✔	**NA**	✔
II.B.(2)(b)(1), (2), & (3) Evaluation Process	**NA**	✔	✔

Following is a discussion on each of the determination processes, citation and evaluation. Included, where appropriate, is additional guidance/discussion on the analysis and documentation necessary for reprocessing waste streams to be managed as low-level waste or transuranic waste. Additional information on deactivated high-level waste facility/closure process is provided by the guidance to DOE M 435.1-1, Section II.U, Site Closure.

Citation Process. The citation process refers to those reprocessing waste items of the type that were discussed in the Statement of Proposed Policy for Appendix D, 10 CFR Part 50, as not being high-level waste (*34 FR 8712*). Figure 1 includes examples of wastes that have been interpreted to be included within the citation process. Included are:

- contaminated job wastes, a general category of wastes that are generated during high-level waste transfer, pretreatment, treatment, storage and disposal activities.

Included is protective clothing, personal protective equipment (PPEs), work tools, ventilation filter media, and other job-related materials necessary to complete high-level waste management activities;

- sample media (e.g., sampling vials, crucibles, other hardware);
- decontamination media and decontamination solutions (e.g., swabs, other decon work-related materials); and
- laboratory clothing, tools, and equipment.

Interpreted to be excluded from the citation process are the following:

- ion exchange beds;
- sludges;
- fuel cladding hulls and fuel structural hardware;
- process filter media; and
- contaminated components and equipment.

This list excludes three items: ion exchange beds, sludges, and fuel cladding hulls that were included in the Appendix D proposed language. The first two of these have been excluded from the citation process examples because of the potential long-term hazards their disposal may pose. However, they may be candidates for the evaluation process. The third example that has been excluded is fuel cladding hulls and fuel structure hardware. As explained in the guidance for Section II.A, wastes from processes preceding the first step in a separations process are not considered high-level waste and therefore are not subject to the waste incidental to reprocessing process. Fuel structural hardware and fuel cladding hulls are generated prior to the first cycle solvent extraction process, or equivalent, and are therefore not considered high-level waste. Also excluded from the examples of citation waste is high-level waste contaminated components and equipment. As discussed in the guidance to Section II.A, review of available supporting documentation has concluded that although contaminated components and equipment are not high-level waste, they can, and often do, retain significant amounts of residual waste even after extensive decontamination efforts. Therefore, it is considered inappropriate for such components and equipment to qualify under the citation process. However, they are considered candidates for the evaluation determination process described below.

The following examples of process filter media and ventilation filter media are provided to clarify the use of the term in the citation process examples above:

> *Examples: (1) At Site X, the high-level waste pretreatment process uses a filtration process to filter precipitated Cs-137 from the tank solution. Disposal of the failed (process) filter media from this process as transuranic, low-level, or mixed low-level, using the <u>citation</u> process, is considered inappropriate. However, the filter is a candidate for disposal as low-level or transuranic waste using the evaluation process. (2) The*

high-level waste storage tanks at this site include a HEPA filtration system. Disposal of the HEPA filters from this system as low-level or transuranic waste, using the citation process, is considered appropriate. (3) The same site has an effluent treatment facility (ETF) that treats overheads (evaporator distillate) from a high-level waste evaporator. Since these overheads are not considered to be high-level waste (there is no carryover of high-level waste to the waste stream) disposition of these failed filters does not need to be subjected to the waste incidental to reprocessing processes. They are managed as low-level or transuranic waste, as appropriate.

As indicated in Table 1, meeting the requirement in Section II.B.(1) can result in the waste being managed as low-level waste or transuranic waste. The responsibility of interpreting the Appendix D proposed language and using the citation process is within the DOE's authority. As delineated in DOE M 435.1-1, Section I.2.F.(18), the authority to implement the citation process and make these interpretations rests with the DOE Program Office responsible for the management of the waste. In the case of high-level waste this responsibility has been assigned to the Field Element Manager at the DOE Field Office or Operations Office. Consultation and coordination with the DOE Office of Environmental Management for the citation process is encouraged to support consistent interpretations across the DOE complex, but is not required.

Evaluation Process. As shown in Figure 1, waste streams resulting from the reprocessing of high-level waste that not interpreted to be included within the citation process may be assessed for compliance with the evaluation process requirements. Examples of wastes streams that are anticipated to be candidates for the application of the evaluation process include:

- residual radioactive tank wastes whose removal is not considered to be technically and economically practical;
- contaminated storage, pretreatment, and treatment equipment (e.g., tank mixer/pumps, waste slurry processing tanks);
- thermocouple trees;
- vitrification melter components;
- failed vitrification melters;
- process filter media;
- other process equipment that contains some amounts of waste in the form of slurry, salt or glass.

The examples provided above are anticipated to meet the three evaluation process criteria; however, note that the list provided above is not all inclusive. Other reprocessing waste streams may be candidates for the evaluation process. However, any wastes that are determined to meet these criteria must be supported by the necessary information and analysis as described in the guidance for DOE M 435.1-1, Section I.2.F.(18). While the DOE Office of Environmental Management consultation and coordination is required by the requirement in Section I.2.F.(18),

consultation with the NRC staff related to compliance with the evaluation requirements is also strongly encouraged. The NRC staff has participated in regulatory compliance reviews using these criteria in the past and has a level of expertise that is expected to complement the DOE Office of Environmental Management's review.

DOE maintains that contaminated equipment, components, etc., whose disposal can be demonstrated to not jeopardize the health and safety of the public, workers, and the environment can be managed as non-high-level waste. These waste streams could be managed as low-level waste, transuranic waste, or residual waste, which is part of a deactivated high-level waste closure action and meets the performance objectives of a low-level or transuranic waste disposal facility, provided the waste fits the requirements of the citation or evaluation process as delineated in Table 1. Guidance for each of the processes follows.

II. B.(2) **Evaluation. Determinations that any waste is incidental to reprocessing by the evaluation process shall be developed under good record-keeping practices, with an adequate quality assurance process, and shall be documented to support the determinations. Such wastes may include, but are not limited to, spent nuclear fuel reprocessing plant wastes that:**

(a) **Will be managed as low-level waste and meet the following criteria:**

1. **Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and**

Although key radionuclides are not defined by the NRC in either the Denial of Petition for Rulemaking or the letter from R. Bernero to J. Lytle, dated March 2, 1993, it is generally understood that key radionuclides applies to those radionuclides that are controlled by concentration limits in 10 CFR 61.55. Specifically these are: long-lived radionuclides, C-14, Ni-59, Nb-94, Tc-99, I-129, Pu-241, Cm-242, and alpha emitting transuranic nuclides with half-lives greater than five years and; short-lived radionuclides, H-3, Co-60, Ni-63, Sr-90, and Cs-137. In addition, key radionuclides are those that are important to satisfying the performance objectives of 10 CFR Part 61, Subpart C. Analysis to date at DOE sites indicates other isotopes important to satisfying these performance objectives include Se-79, Sn-126, and Np-237.

Processing to remove the key radionuclides to the extent technically practical could be a chemical treatment process or a physical removal process. The examination of such processes should include a range of alternatives; from processes that have been demonstrated by plant-scale experience to be practical to those that have been demonstrated to be impractical due to their

technological immaturity, uncertainty, or risk. Selection of the chosen "technically practical process" must be evaluated to a sufficient degree through a formal, documented assessment of such factors as technical risk, incompatible physical or chemical requirements with the waste, and potential impacts to the public, the worker and the environment.

The economically practical part of this requirement is determined by the development of total life-cycle costs for an alternative, or unit costs, e.g., cost per curie removed. Some subjectivity will be present in determining whether these costs are economically practical; however in general, the goal should be to determine a relationship between costs and removal of the key radionuclides and identify the point in this relationship at which removal costs increase significantly and thus become impractical. An economic assessment may not be considered necessary if a technology option is not first considered to be technically practical.

> *Example 1: To satisfy this criterion, Site X identified the available separation technologies for each of the main radionuclides of interest in the waste stream (Cs-137, Sr-90, transuranics, Tc-99, Se-79, Sn-126, C-14, I-129, H-3, and uranium), and individually, as well as collectively, evaluated each to determine the status of the technology and radionuclide removal efficiencies. A number of technologies were identified and evaluated, including some for which tests on actual waste had been conducted. The separation processes that were determined to be technically practical, due to their technical maturity and full-scale demonstrated applications, were then examined for economic practicability based on unit removal costs and process life-cycle costs. An initial evaluation determined that two separation technologies were deemed to be technically and economically practical and were selected for implementation for the removal of the key radionuclides identified. A report documenting the assessment of each of the technologies for technical practicality and economic practicality was issued by the site program manager. Since this was the first use of the Evaluation Process for this waste stream, or a similar waste stream, the site employed the consultation services of the NRC. Following their evaluation, the assessment, confirming that the requirement at II.B.(2)(a)1. had been met, along with the analysis that supports the position that the waste meets the other Evaluation requirements at II.B.(2)(a)2. and II.B.(2)(a)3., was forwarded to the DOE Headquarters for coordination and consultation, as required by Section I.2.F.(18).*

> *Example 2: The Site X facility and waste are the same as above except the economic evaluation determined that none of the separation technologies were deemed to be economically practical for removal of one of the radionuclides from a waste stream, due to excessively high unit costs ($/Ci removed) and life-cycle costs, when compared to direct disposal of the radionuclide as low-level waste. A report documenting this and the assessment of each of the technologies for technical practicality and economic practicality was issued by the site program manager. The waste stream that contained*

the radionuclide in question was analyzed for acceptance at a low-level waste disposal facility and it was concluded that the final waste form, incorporating the radionuclide, would meet the requirements at both II.B.(2)(a)2. (safety requirements comparable to the performance objectives in 10 CFR Part 61, Subpart C), and II.B.(2)(a)3. (solid physical form at a concentration that does not exceed the applicable limits for Class C, 10 CFR 61.55). Therefore, the waste stream was deemed acceptable for disposal as low-level waste.

II. B.(2)(a) Will be managed as low-level waste and meet the following criteria:

2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

<u>Low-level waste requirements</u>. When the waste stream is to be managed in accordance with low-level waste requirements, an assessment needs to be prepared that provides reasonable expectation that low-level waste performance objectives will be met. This assessment is consistent with the requirements for a performance assessment, as defined in DOE M 435.1-1, Section IV.P.(2). The Chapter IV performance objectives (Section IV.P.(1)) are considered comparable to those at 10 CFR Part 61, Subpart C. In some cases the requirement to prepare a performance assessment may be met in part, or totally, by the waste acceptance and waste certification programs established by Chapter IV of DOE M 435.1-1. As discussed in the guidance for Section IV.G, Waste Acceptance, performance assessment data are used to establish waste acceptance criteria. Additionally, a primary element of a performance assessment is analysis that demonstrates compliance with the performance objectives in DOE M 435.1-1, Section IV.P.(1). Therefore, if a waste form is certified as meeting a low-level waste disposal facility's waste acceptance criteria the waste form may meet the performance objectives in Section IV.P.(1) as well, provided performance assessment imposed limits, e.g., quantity of material, are also met. Documentation providing sufficient data to support this conclusion is submitted for coordination with the DOE Office of Environmental Management, as required by the requirement in Section I.2.F.(18).

Example: Site Y has a number of contaminated mixer/pumps that have been removed from a high-level waste storage tank and are considered waste. Following decontamination activities, characterization data show that the mixer/pumps can meet the waste acceptance criteria for an on-site low-level waste disposal facility. Documentation supporting this conclusion, and consistent with the requirements in Section IV.J, Waste Certification, is prepared. Additionally, documentation is prepared that concludes that meeting the disposal site's waste acceptance criteria meets the disposal facility's performance objectives which have been shown previously to be comparable to those in

the NRC's 10 CFR Part 61, Subpart C, Performance Objectives. Therefore Site Y concludes that the requirement at II.B.(2)(a)2. has been met and a stand-alone performance assessment for this waste stream is not necessary. The set of documentation supporting this conclusion is submitted to the DOE Office of Environmental Management for consultation and coordination as required by the requirement in Section I.2.F.(18).

Often the location and design of a low-level waste disposal facility are not finalized at the time such an assessment is needed. In such cases, a preliminary or interim performance assessment should be prepared, and submitted to the Office of Environmental Management for coordination. Preparation and approval of a preliminary, or interim, as well as a final performance assessment to support the meeting of this requirement, need to meet the requirements at DOE M 435.1-1, Section I.2.E.(1), Disposal.

Example: To meet requirement II.B.(2)(a)2., Site X prepared an interim performance assessment, in accordance with the requirements of DOE M 435.1-1, Section IV.P.(2), for a waste stream that meets the other two applicable evaluation process requirements. The performance assessment was considered interim because it was prepared before the selection of a disposal facility site and design were finalized and before the final low-level waste form was selected. The site forwarded a copy of the interim performance assessment and a draft authorization letter to the DOE Office of Environmental Management for coordination. The DOE Office of Environmental Management's review concluded that although the interim performance assessment was limited in information it did indicate that the performance objectives would be met. This finding was conditional on the review of subsequent performance assessments and other stipulations described in a site authorization letter. Although only an interim performance assessment, the review and concurrence requirements at DOE M 435.1-1 Section I.2.E.(1) for a performance assessment were applied.

In the case of facility/site closure with the residual waste characterized as low-level waste, the requirement to conduct a performance assessment to meet the criterion in Section II.B.(2)(a)2. should be coordinated with similar requirements in Section II.U, Site Closure, to avoid redundant analysis.

II. B.(2)(a) Will be managed as low-level waste and meet the following criteria:

3. Are to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10

CFR 61.55, *Waste Classification*; or will meet alternative requirements for waste classification and characterization as DOE may authorize.

10 CFR 61.55 Concentration Limits. To meet this criterion, DOE needs to demonstrate that the final waste form will not exceed the limits for Class C waste, as defined in 10 CFR 61.55. These calculations should compare, by major radionuclide, the expected concentration after the proposed treatment process with the limits as provided at 10 CFR 61.55. .

> *Example: To meet this criterion, Site X calculated an estimated total vitrified waste volume in conjunction with the projected radionuclide activities. From these calculations, the vitrified waste form is expected to meet the limits for 10 CFR 61.55 Class C, or less. This information was provided to the DOE Office of Environmental Management for coordination.*

Dilution of a waste stream to meet the concentration limits established in 10 CFR 61.55 is not permitted by the Department. While it is recognized that in the course of stabilizing a waste stream some changes in waste concentration may occur, actions to dilute a waste stream to meet the above concentration limits are prohibited. The NRC's Branch Technical Position on Concentration Averaging, dated January 17, 1995 (NRC, 1995), that supports the regulation at 10 CFR 61.55(a)(8), may be useful in making determinations. The Branch Technical Position states that, "the concentration of a radionuclide (in waste) may be averaged over the volume of the waste, or weight of the waste if the units (on the values tabulated in the concentration tables) are expressed as nanocuries per gram." This Branch Technical Position provides specific guidance to waste generators on the interpretation of the requirements in 10 CFR 61.55 as it applies to a variety of different types and forms of low-level waste.

Consistent with the discussion above for the requirement in Section II.B.(2)(a)2., certification that a waste form meets a low-level waste disposal facility's waste acceptance criteria may in part, or totally, meet this requirement since, in general, waste that meets the definition of low-level waste, as defined in Section IV.A, meets the concentration limits for Class C low-level waste, as set forth in 10 CFR 61.55. However, there are exceptions as discussed in the guidance for IV.A. For example, a waste form with a concentration of Cm-244 exceeding 100 nCi per gram meets the definition of low-level waste, per Chapter IV of DOE M 435.1-1 (Cm-244 is an alpha-emitting transuranic nuclide with a half-life of 18.1 years and is therefore not relevant to whether the waste is transuranic waste) however, it does not meet the concentration limits in Table 1 of 10 CFR 61.55 (Cm-244 has a half-life greater than 5 years and the concentration limit is 100 nCi per gram). Thus careful attention needs to be paid to ensure that the concentration limits set forth in 10 CFR 61.55 are not exceeded.

Alternative Requirements. If the limits contained at 10 CFR 61.55 for Class C low-level waste cannot be met, the DOE Field Element may request that the DOE Office of Environmental Management review and accept other provisions for the classification of the waste on a specific basis. This provision is similar to the requirement at 10 CFR 61.58, *Alternative Requirements for Waste Classification and Characteristics*. Analysis submitted to the DOE Office of Environmental Management must provide reasonable expectation that after evaluation of the specific characteristics of the waste, disposal site, and method of disposal, compliance with the low-level waste performance objectives can be achieved.

> *Example: Following consultation with the NRC, Site X requested the DOE Office of Environmental Management to review and accept an alternative to the Class C limits of 10 CFR 61.55 for the closure of a number of former high-level waste storage tanks. The provided analysis noted that the NRC method for deriving the Class C concentration limits in 10 CFR Part 61 is based on direct contact with the disposed waste by an inadvertent intruder scenario and that the overall standard for determining Class C concentrations limits is an annual dose equivalent to an inadvertent intruder of 500 mrem from all pathways. In the documentation provided to the DOE Office of Environmental Management the case was made that the intruder scenarios for the Class C determination are inappropriate because the residual waste in the tank will be immobilized and located at least 10 meters below the ground surface, and the tank system will be filled with a stable medium. A site-specific intruder analysis for a hypothetical closed tank system was provided to the DOE Office of Environmental Management for their review. The analysis concluded that the postulated site intruder would receive a dose well below the limit of 500 mrem per year and demonstrated that the tank closures will comply with the performance objectives of 10 CFR Part 61.*

II.B.(2)(b) Will be managed as transuranic waste and meet the following criteria:

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

This is the same requirement as II.B.(2)(a)1., and the process for meeting this requirement is the same. Therefore, the guidance for Section II.B.(2)(a)1. applies to this requirement.

II.B.(2)(b) Will be managed as transuranic waste and meet the following criteria:

2. Will be incorporated in a solid physical form and meet alternative requirements for waste classification and characteristics, as DOE may authorize; and

As discussed in the guidance above for Section II.B.(2)(a)3., Alternative Requirements, if the limits contained at 10 CFR 61.55 for Class C low-level waste cannot be met, the DOE Field Element may request that the DOE Office of Environmental Management review and accept other provisions for classification of the waste, on a specific basis. This provision is similar to the requirements at 10 CFR 61.58, *Alternative Requirements for Waste Classification and Characteristics*, which states:

> "The Commission may, upon request or on its own initiative, authorize other provisions for the classification and characteristics of waste on a specific basis, if, after evaluation, of the specific characteristics of the waste, disposal site, and method of disposal, it finds reasonable assurance of compliance with the performance objectives [P.O.] in Subpart C of this part."

In those cases where application of the alternative waste classification criteria results in the waste being characterized as transuranic waste, and disposal will be in a facility other than WIPP (e.g., onsite as part of a deactivated high-level waste closure activity or at another DOE transuranic waste disposal site), characterization/classification provisions may be proposed by a Field Element. In such cases, DOE Headquarters shall be consulted and an analysis submitted for review that provides reasonable assurance that after evaluation of the: (1) specific characteristics of the waste, (2) disposal site characteristics, and (3) method of disposal, compliance with applicable performance objectives can be achieved.

II.B.(2)(b) Will be managed as transuranic waste and meet the following criteria:

3. Are managed pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, in accordance with the provisions of Chapter III of this Manual, as appropriate.

In those cases where the waste stream will be managed as transuranic waste and disposal will be in a facility other than the Waste Isolation Pilot Plant (WIPP) (e.g., onsite or at another DOE transuranic waste disposal site), the Department is currently responsible for determining compliance with 40 CFR Part 191 and ensuring the transuranic waste is disposed of safely. As explained in the guidance to Section III.P., Disposal, sites other than WIPP are regulated by the implementing agency, in this case, DOE. As discussed in the General Requirements Chapter of this DOE M 435.1-1, Section I.2.F.(15), Disposal, the Field Element Manager is responsible for reviewing and submitting a performance assessment to DOE Headquarters. The DOE Headquarters Deputy Assistant Secretary for Waste Management will establish a process similar to that used for low-level waste disposal facilities for reviewing and approving performance assessments. Additional details on the criteria for reviewing and approving 40 CFR Part 191 performance assessments is included in the guidance to Section III.P. Since performance

assessment is defined, and the requirements for compliance and what must be included in a performance assessment for a transuranic waste disposal facility are discussed in 40 CFR Part 191, this section of the guidance and the transuranic waste chapter only contain reference to the 40 CFR Part 191 standards, with no additional minimum requirements for disposal.

As discussed in the guidance to Chapter III of DOE M 435.1-1, the Department plans to dispose defense transuranic waste at WIPP. Therefore, evaluations of treatment and disposal options for those streams must be taken into account.

As discussed above, the high-level waste sites are encouraged to group similar waste streams, that are to be subjected to the evaluation process, to support the process of coordinating with the DOE Office of Environmental Management and site review and approval. Such grouping is expected to expedite the decision process and make the most efficient use of limited resources in the DOE Office of Environmental Management. Following are two examples of grouping:

> *Example 1: At Site Y, the high-level waste treatment (vitrification) activities are nearing completion and plans for dispositioning the equipment contaminated with reprocessing wastes within the pretreatment and treatment processes are being formulated. Analysis indicates that decontamination activities can be held to a minimum if a number of contaminated pretreatment and treatment components (mixer/pumps, slurry transfer lines, slurry tanks, melter, process filter media) can be disposed as transuranic waste by way of the evaluation process. In lieu of submitting individual analysis for each of contaminated components, Site Y consults with the DOE Office of Environmental Management and the NRC staff on the methodology they propose for meeting the three appropriate evaluation requirements. Following such consultation, Site Y approves a methodology for meeting each of the three evaluation criteria for a group of these components.*

> *Example 2: At Site Z, closure analysis activities are underway for a number of high-level waste tanks. In reviewing the processes for removing the final amounts of high-level waste from the tanks, it is concluded that the evaluation process requirements can be met even if some small quantities of residual waste are allowed to remain in the tanks. In lieu preparing an analysis for each tank, the site submits a methodology for meeting each of the evaluation requirements for a group of the tanks. The methodology is submitted to the DOE Office of Environmental Management for coordination and acceptance of this methodology for the group of tanks is gained from the site program office. The closure activities proceed for the group of tanks.*

<u>Facility Closure</u>. Application of the evaluation process for deactivated high-level waste facility/site closures is to ensure that any residual waste or residual contaminated components are disposed appropriately. As indicated in Table 1, the requirements in Section II.B.(2)(a) 1., 2., and

3., or the requirements in Section II.B.(2)(b) 1., 2., and 3., must be met in order to manage the waste as non-high-level waste and allow the residual waste or residual contaminated components to be managed as low-level waste, or transuranic waste, as part of a deactivated high-level waste closure action. Closure actions for deactivated high-level waste facilities are distinguished from disposal of wastes incidental to reprocessing by the fact that closure actions normally involve facilities that are not total dismantled and remain in their operational location. However, because the residual material is part of a closure activity and will remain following closure, the disposal requirements in Section IV.P. and III.P. for low-level and transuranic wastes, respectively, are the appropriate requirements to satisfy Sections II.B.(2)(a)2. and II.B.(2)(b)3. The requirements for closure of these facilities and sites (groups of facilities) are in Section II.U, Site Closure.

The Field Element Manager is responsible for ensuring that the requirements of the evaluation process are met. DOE M 435.1-1, Section I.2.F.(18), Waste Incidental to Reprocessing, defines the responsibilities and roles of the Field Element Manager, the Office of Environmental Management, and the consultation role that NRC staff may take in implementing the evaluation process. Refer to the guidance for this section for additional information.

Mixed Waste. DOE M 435.1-1, Section II.C., Management of Specific Wastes, imposes the requirement that all high-level waste is to be considered mixed waste, unless demonstrated otherwise. This requirement applies to waste incidental to reprocessing determined wastes as well. Waste that is determined to be incidental to reprocessing by the application of the waste incidental to reprocessing determination processes should be considered mixed, unless demonstrated otherwise.

Compliance with this requirement is demonstrated by documented citation and evaluation processes that are implemented in a defensible manner and ensure that the Department is not exceeding its regulatory authority.

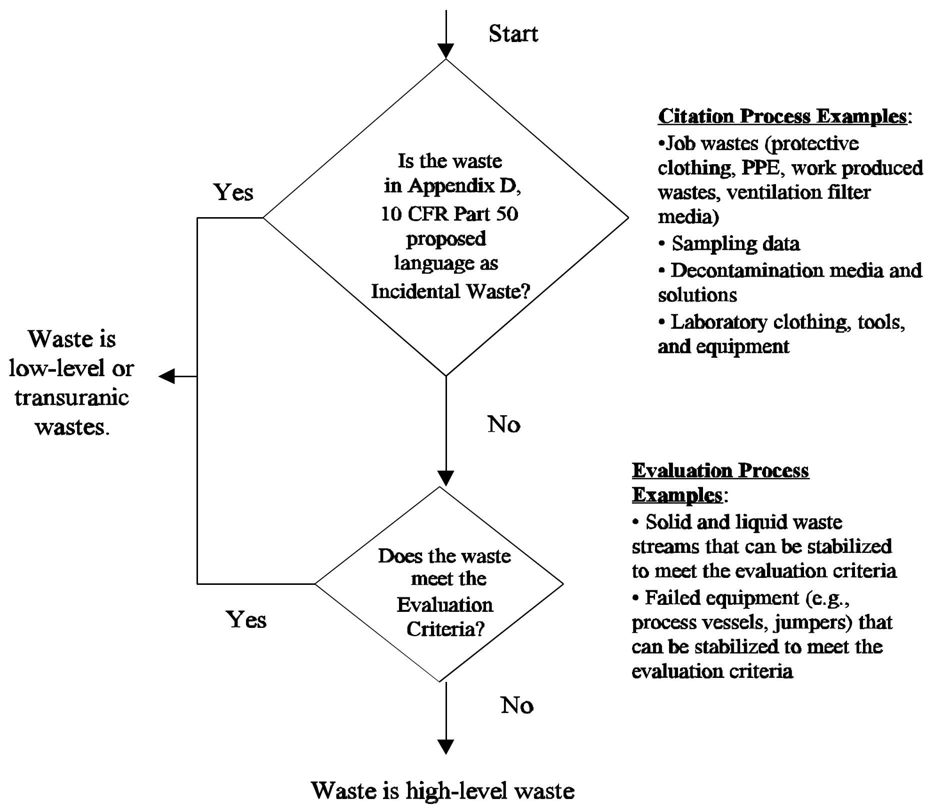

Figure 1 Decision Tree for Waste Incidental to Reprocessing Determinations

Supplemental References:

1. AEC, 1969. "Proposed Rule Making Statement of Proposed Policy; Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities, 10 CFR Part 50, 'Licensing of Production and Utilization Facilities,'" *Federal Register*, Vol. 34, No. 8712, Atomic Energy Commission, Washington, D.C., June 3, 1969.

2. AEC, 1970. "Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities, 10 CFR Part 50, 'Licensing of Production and Utilization Facilities,'" *Federal Register*, Vol 35, No. 17532, Atomic Energy Commission, Washington, D.C., November 14, 1970.

3. *Energy Reorganization Act of 1974*, Public Law 93-438, Section 202 (3) and (4).

4. DOE, 1979. *Final Environmental Impact Statement: Long-Term Management of Defense High-Level Radioactive Wastes*, DOE/EIS-0023, Savannah River Plant, November, 1979.

5. NRC, 1987. "Advanced Notice of Proposed Rulemaking; 10 CFR Part 60, 'Definition of High-Level Radioactive Waste,'" *Federal Register*, Vol. 52, No. 5992, U.S. Nuclear Regulatory Commission, Washington, D.C., February 27, 1987.

6. Curtiss, 1992. NRC Commissioner J.R. Curtiss to J.M.Taylor, Executive Director for Operations, memorandum, *SECY-92-391: Denial of PRM-60-4-Petition for Rulemaking Regarding Classification of Radioactive Waste at Hanford*, U.S. Nuclear Regulatory Commission, Washington, D.C., December 29, 1992.

7. Taylor, 1993. J.M. Taylor, Executive Director for Operations to Commissioner Curtiss, memorandum, *Staff Response to Concerns Raised by Commissioner James R. Curtiss on Denial of PRM-60-4-Petition for Rulemaking Regarding Classification of Radioactive Waste at Hanford*, January 14, 1993.

8. NRC, 1993. "Denial of Petition for Rulemaking, 10 CFR Part 60, 'States of Washington and Oregon: Denial of Petition for Rulemaking'," *Federal Register*, Vol. 58, No. 12342, U.S. Nuclear Regulatory Commission, Washington, D.C., March 4, 1993.

9. Bernero, 1993. R. Bernero, USNRC, to J. Lytle, DOE-EM, letter, *Hanford Waste Tank Management*, U.S. Nuclear Regulatory Commission, Washington, D.C., March 2, 1993.

10. Paperiello, 1997. C. Paperiello, USNRC, to J. Kinser, DOE-RL, letter, *Classification of Hanford Low-Activity Tank Waste Fraction*, U.S. Nuclear Regulatory Commission, Washington, D.C., June 9, 1997.

11. DOE, 1998. *Life-Cycle Asset Management*, DOE O 430.1A, U.S. Department of Energy, October 14, 1998.

12. DOE, 1997. *Deactivation Implementation Guide*, Draft DOE G 430.1-3, U.S. Department of Energy, October 1, 1997.

13. DOE, 1997. *Decommissioning Implementation Guide*, Draft DOE G 430.1-4, U.S. Department of Energy, October 1, 1997.

14. NRC, 1988. *Cement Solidification of Decontaminated Supernatant Waste for West Valley Project*, Technical Evaluation, Office of Nuclear Material Safety and Safeguards, November 1988.

15. EPA. *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level Waste and Transuranic Radioactive Wastes*, 40 CFR Part 191, U.S. Environmental Protection Agency, Washington, D.C.

16. NRC, 1995. *Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position*, U.S. Nuclear Regulatory Commission, Washington, D.C., January 17, 1995.

17. Sullivan, 1998. M.A. Sullivan, DOE, to J.T. Greeves, USNRC, letter, *Natural Resources Defense Council Petition to Exercise Licensing Authority over Savannah River Site High-Level Waste Tanks*, U.S. Department of Energy, Washington, D.C., September 30, 1998.

18. NRC, 1993. "Confederated Tribes and Bands of the Yakima Indian Nation: Denial of Petition to Require License Application," *Federal Register*, Vol. 58, No. 64783, U.S. Nuclear Regulatory Commission, Washington, D.C., December 9, 1993.

19. NRDC Inc. v. Administrator, Energy Research and Development Administration, 606 F. 2d 126, (D.C. Cir. 1979), *affirming in part, remanding in part, reversing in part, vacating in part*, 451 F. Supp. 1245 (D.D.C. 1978), *denying motion in part, granting motion in part*, 5 NRC 550 (1977) (Commission Decision).

20. NRC, 1994. "F. Robert Cook: Denial of Petition to Require License Application from DOE with Respect to High-Level Waste," *Federal Register*, Vol. 59, No. 10439, U.S. Nuclear Regulatory Commission, Washington, D.C., March 4, 1994.

II. C. <u>Management of Specific Wastes</u>.

The following provide for management of specific wastes as high-level waste in accordance with the requirements in this Chapter:

(1) Mixed High-Level Waste. Unless demonstrated otherwise, all high-level waste shall be considered mixed waste and is subject to the requirements of both the *Atomic Energy Act of 1954*, as amended, the *Resource Conservation and Recovery Act,* as amended, DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) TSCA-Regulated Waste. High-level waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act,* as amended and DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Objective:

The objective of this requirement is to ensure that all high-level waste is managed as mixed waste, unless demonstrated otherwise, and thus meets the requirements of both the *Atomic Energy Act of 1954,* as amended and the *Resource Conservation and Recovery Act* (RCRA), and that high-level waste that contains TSCA-regulated toxic components be managed in accordance with the requirements of the *Toxic Substances Control Act* (TSCA). The RCRA and TSCA (if applicable) statutes are to be met in addition to the requirements of DOE O 435.1 and DOE M 435.1-1.

Discussion:

DOE M 435.1-1 contains requirements for managing the radioactive character of high-level waste. Guidance for implementing those requirements is included elsewhere in this document. In developing DOE M 435.1-1 requirements, a safety and hazards analysis and an evaluation of the requirements necessary to control the identified hazards were performed. It was concluded that sufficient external regulations, promulgated pursuant to RCRA and TSCA, exist for controlling the non-radiological hazard.

<u>RCRA Regulations.</u> The reprocessing of Department of Energy spent nuclear fuel produces high-level waste that usually exhibits characteristics that render the high-level waste subject to the requirements of the *Resource Conservation and Recovery Act,* as well as the *Atomic Energy Act of 1954,* as amended.

Considering high-level waste to be a mixed waste is consistent with Department of Energy past practice. The previous Radioactive Waste Management Order, DOE 5820.2A (see page I - 1), specified that high-level waste was to be considered mixed waste unless demonstrated to the contrary.

The DOE Office of Civilian Radioactive Waste Management (OCRWM) has clearly stated that only spent nuclear fuel and high-level waste that is not regulated as hazardous waste under RCRA Subtitle C is planned to be disposed in the monitored geologic repository licensed by the Nuclear Regulatory Commission (NRC) under the *Nuclear Waste Policy Act of 1982*, as amended. Prior to acceptance for disposal, generators and custodians must determine and document that the waste is not regulated as a hazardous waste and is not prohibited from land disposal. Therefore, DOE must develop appropriate data to ensure State and/or EPA regulators that the applicable requirements have been addressed.

The processes that produce high-level waste from spent fuel usually involve the use of hazardous chemicals, so it is reasonable to assume that high-level waste is a mixed waste unless it is demonstrated to be otherwise. The reprocessing of spent nuclear fuel usually includes dissolution in acid followed by solvent extraction which is then often neutralized by addition of sodium hydroxide. The solvent is usually stripped from the component being extracted from the spent fuel. The solvent is recycled rather than disposed of as high-level waste. Furthermore, the fuel matrix and cladding are typically a source of hazardous metals. Thus, high-level waste typically exhibits the characteristics of corrosivity (pH < 2 or pH >12.5 (after neutralization)) and toxicity (because of the presence of one or more toxic metals).

Wastes exhibiting hazardous characteristics (see 40 CFR Part 261, Subpart C) must be treated for these characteristics prior to disposal. High-level wastes generated from the reprocessing of spent nuclear fuel exhibiting the characteristics of corrosivity (D002) and toxicity for metals (D004 – D011 corresponding to arsenic, barium, cadmium, chromium, lead, mercury, scandium, and silver) may be treated through vitrification in accordance with the Land Disposal Restriction (LDR) treatment standards specified in 40 CFR 268.40. The Environmental Protection Agency has determined that vitrification (HLVIT) is the best demonstrated available technology (BDAT) for treating high-level wastes that exhibit these characteristics. However, if additional characteristic waste codes become applicable to the high-level waste, e.g., D018: benzene, the treated high-level waste may need to meet the Universal Treatment Standards (40 CFR 268.48) for any underlying hazardous constituents (UHCs). A treatability variance (40 CFR 268.44) and/or determination of equivalent treatment (40 CFR 268.42(b)) may be necessary to fully comply with the LDR standards if a DOE site elects to use a technology other than vitrification, the BDAT, of if it is impractical to comply with all the standards applicable to individual waste codes.

High-level waste treated by vitrification but containing listed hazardous wastes (either from the reprocessing activities or from subsequent commingling of listed hazardous waste in high-level

waste storage tanks) will remain subject to RCRA, unless a delisting request is also approved by the Environmental Protection Agency. The Office of Environmental Management "Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms" requires that the producer of the high-level waste perform the appropriate tests and procedures to determine whether the waste is a hazardous waste (see Specification 1.5). That specification also requires that high-level waste producers petition the Environmental Protection Agency to delist the waste if any RCRA listed components are found in immobilized high-level waste. Currently, high-level waste at some sites has been determined to contain listed wastes and high-level waste at other sites has been determined not to contain listed wastes.

> *Example: In the previous example, the resulting high-level wastes were mixed with various listed hazardous wastes for which a petition for delisting has not been approved. Even after the high-level waste is treated by vitrification, it may not be disposed in the Office of Civilian Radioactive Waste Management-managed monitored, geologic repository because the high-level waste continues to be considered a mixed waste until the Environmental Protection Agency approves a petition for delisting of the hazardous waste components.*

The RCRA requirements described above may be imposed by the Environmental Protection Agency or by states that have been granted these RCRA authorities by the Environmental Protection Agency. The authorized states are permitted to promulgate hazardous waste requirements that are more stringent than the federal requirements, as well as specifying the treatment permitting approach. Any state-level hazardous waste requirements will need to be reviewed on a state-by-state basis.

In summary, the operations performed in reprocessing spent nuclear fuel often produce high-level waste that exhibits hazardous characteristics. DOE practice is to assume that high-level waste is a mixed waste unless demonstrated otherwise. This approach provides a conservative basis for developing effective plans for high-level waste management including the capabilities for dealing with hazardous components and characteristics.

PCB, Asbestos, and Other TSCA Wastes. High-level wastes contaminated with PCBs do not meet the definition of mixed waste, however, the situation is similar to RCRA in that there are external regulations promulgated under the authority of the *Toxic Substances Control Act* that need to be complied with in addition to the requirements of DOE O 435.1 and the Manual. Waste managers responsible for managing PCB-containing products should consult the EPA requirements at 40 CFR Part 761. The regulations impose requirements for the destruction, storage awaiting destruction, and disposal of PCBs. Like mixed wastes, there are currently no provisions to accommodate PCBs (exceeding 50 ppm) at a geologic repository. Review of the EPA handbook, “Vitrification Technologies for Treatment of Hazardous and Radioactive Waste,” (EPA/625/R-92-002) finds that the combination of the vitrification process and off-gas removal

are capable of eliminating 99.99%, or better, of the organic constituents, including TSCA-regulated organics, in a waste stream. Therefore, vitrification, the BDAT for high-level waste exhibiting RCRA characteristics of corrosivity and toxicity for metals, is expected to meet the treatment requirements for PCBs and other TSCA-regulated toxic components, for those high-level waste streams that are determined to contain these components. At the time of the preparation of this guidance, no DOE high-level waste site had declared the presence of TSCA-regulated toxic components in their high-level streams. Planning for management of high-level wastes that include a component which is regulated under TSCA should be addressed in the Complex-Wide High-Level Waste Management Program and the appropriate Site-Wide Waste Management Programs (DOE M 435.1, Sections I.2.B.(1) and I.2.F.(1)).

The DOE M 435.1-1 requirements imposed on the radioactive component of RCRA or TSCA waste should not create a duplication of management activities that can be satisfied by compliance with a RCRA or TSCA requirement. Also, documentation required by RCRA or TSCA regulations which provides the same or similar information as required by DOE M 435.1-1 should be used to satisfy the DOE M 435.1-1 requirement.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. EPA. *Characteristics of Hazardous Wastes*, 40 CFR Part 261, Subpart C, U.S. Environmental Protection Agency, Washington, D.C.

3. EPA. *Lists of Hazardous Wastes*, 40 CFR Part 261, Subpart D, U.S. Environmental Protection Agency, Washington, D.C.

4. EPA. *Applicability of Treatment Standards*, 40 CFR 268.40, U.S. Environmental Protection Agency, Washington, D.C.

5. EPA. *Treatment Standards Expressed as Specified Technologies*, 40 CFR 268.42, U.S. Environmental Protection Agency, Washington, D.C.

6. EPA. *Universal Treatment Standards*, 40 CFR 268.48, U.S. Environmental Protection Agency, Washington, D.C.

7. EPA. *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*, 40 CFR Part 761, U.S. Environmental Protection Agency, Washington, DC.

II. D. Complex-Wide High-Level Waste Management Program.

A complex-wide program and plan shall be developed as described under *Responsibilities,* 2.B and 2.D, in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure that development, documentation, and implementation of a complex-wide high-level waste management program. The complex-wide program and plan establishes the framework within which individual site programs operate.

Discussion:

The Department's management of high-level waste occurs at four sites that generate, store and treat waste, as well as at a to-be-determined disposal site which is to serve as the nation's central repository for high-level waste and spent nuclear fuel. A complex-wide program and plan are seen as necessary to establish the overall mission for the Department's management of high-level waste and to provide a framework within which the individual site programs operate. The *Radioactive Waste Management Manual*, DOE M 435.1-1, General Requirements (Section I.2.B) assigns the Assistant Secretary for Environmental Management's the responsibility for developing and maintaining complex-wide, waste-type programs. The *Manual* General Requirements (Section I.2.D) also assigns the Deputy Assistant Secretary for Waste Management the responsibility for developing and implementing complex-wide, waste-type program plans. The complex-wide high-level waste management program and plan should be developed following the guidance provided for General Requirements, Sections I.2.B and I.2.D.

Compliance with this requirement is demonstrated by the presence of a Complex-Wide High-Level Waste Management Program which includes the appropriate interfaces, technical information data inputs, and other elements described in Chapter I of this Manual.

Supplemental References:

1. *Toxic Substances Control Act*, as amended, October 11, 1976.

2. EPA, 1992. *Vitrification Technologies for Treatment of Hazardous and Radioactive Waste*, EPA Handbook, EPA/625/R-92/002, U.S. Environmental Protection Agency, Washington, D.C., May 1992.

II. E. Site-Wide High-Level Waste Management Program.

In addition to the items in Chapter I of this Manual, documentation of the Site-Wide Radioactive Waste Management Program shall include a description of the High-Level Waste Systems Engineering Management Program to support decision-making related to nuclear safety, including high-level waste requirements analysis, functional analysis and allocation, identification of alternatives, and alternative selection and system control.

Objective:

The objective of this requirement is to establish a structured and documented approach to evaluating alternatives as the preferred method for reaching informed decisions on any issue potentially affecting safety of high-level waste management safety systems, structures, components and processes. Such decisions include selecting the solutions for storage and treatment of high-level waste, through the design and fabrication of the hardware and the development of software required (if any) to process the waste.

Discussion:

In addition to the Site-Wide Radioactive Waste Management Program requirements in DOE M 435.1-1, Section I.2.F.(1), this additional requirement applies specifically to the management of high-level waste. The following guidance addresses that additional requirement only. Guidance on the implementation of the General Requirements can be found in DOE G 435.1-1, Section I.2.F.(1).

A systems engineering management program consists of requirements analysis, functional analysis/allocation, synthesis (developing alternatives), and systems analysis (evaluation of alternatives) and control. These elements of the process should be used progressively throughout the life cycle of the program to achieve objectives and to re-define requirements, designs and solutions for problems that may arise during program execution. A systems engineering management program should invoke a graded approach consistent with the importance to safety systems, structures, and components. Each of these elements is explained in detail in the interim standard for Systems Engineering (EIA/IS 632). This Interim Standard is also referenced in the Implementation Guide to DOE O 420.1. A brief overview of the systems engineering elements extracted from the standard is presented below:

(1) *Requirements Analysis*: An analysis of the needs, objectives, and requirements in the context of the mission, operations, environment, and the mandatory characteristics of the system should be performed to determine the functional and performance requirements for each primary system function.

An example of a functional requirement is to separate the high-level waste into a low activity stream and a high activity stream to minimize the waste required for disposal in the high-level waste repository. An example of a performance requirement is the percent of the total radionuclide source term that must be concentrated in the high activity stream (e.g. 98%) in order to qualify the low activity waste for non-repository disposal. In other words, the functional requirements tell what must be done and the performance requirements tell how well the function must be performed.

(1.1) Functional requirements identified in the requirements analysis should be used as the top-level functions for the functional analysis. Identification of requirements should include the degree of certainty in their estimate, their degree of criticality to mission success and their relationship to other requirements.

(1.2) Requirements should be validated to establish traceability, both upwards and downwards, so that each lower level requirement can be demonstrated to be derived from a higher level requirement.

(2) *Functional Analysis/Allocation*: A functional hierarchy should be defined and integrated down to the lowest level needed to support synthesis of solutions for people, products, and processes and management of risks. More than one logical set of functional and performance requirements could be developed to meet the high-level waste mission objectives.

(2.1) Functional requirements should be analyzed to determine the subsidiary functions required to accomplish the parent requirement.

For example, if the parent function is to separate the waste streams, subsidiary functions may be wash the sludge and perform ion exchange.

When time is critical to the performance or sequencing of a function, a time-line analysis should be performed. Functional requirements need to be logically sequenced with input, output and interface requirements clearly defined and traceable.

(2.2) Functional allocation should be performed to establish a <u>performance</u> requirement for each <u>functional</u> requirement. If all lower level functions are performed to meet their performance requirement, the performance requirement of the highest level function should also be satisfied.

Continuing the examples above, if sludge washing and ion exchange are the only two subsidiary functions contained under the parent function "separate the waste

streams," then their performance requirements together must produce a high activity waste stream that contains 98% of the waste.

(2.3) Verification of functional and performance requirements should be accomplished by traceability.

(3) *Synthesis (develop alternative ways to meet the mission/objectives)*: Solutions for each logical set of functional and performance requirements should be defined and designed. This synthesis should be performed interactively with functional analysis/allocation to define a complete set of potential solutions.

In the examples above, one logical solution may be to allocate the 98% concentration to only 2 subsidiary functions, while an alternative solution would include three (or more) subsidiary functions in order to remove additional radionuclide species.

(3.1) The output of the synthesis should describe the complete system, including interfaces within the system and to external systems.

(3.2) Care should be exercised to verify that the process and product design requirements, and their implementation, satisfies the overall system requirement.

(4) *Systems Analysis and Control*: Systems analyses, trade-off studies and other analytical tools should be utilized to select preferred alternatives. Decisions should be documented, together with supporting material. Implementation of the selected alternative should be coupled with control mechanisms, such as risk management, configuration management, data management, and performance-based progress measurements, to assess status, identify potential problems and to formulate alternative solutions for timely management consideration.

The systems engineering management program documentation should include an approved Systems Engineering Management Plan (SEMP), Systems Engineering Master Schedule (SEMS) and a Systems Engineering Detailed Schedule (SEDS). The content of the SEMP, SEMS, and the SEDS are explained in EIA/IS-632.

Outputs of the application of the systems engineering process (inputs to decision making) should be documented in an integrated decision data base that organizes the data used and generated. The documentation should provide the audit trail of the systems engineering process outputs, decisions and results, as well as traceability of the process. Traceability as used here is slightly different from traceability used in the functional and performance analysis. Here the mission, objectives, the environment under which the mission must be executed and mandatory overall system performance is also included. Should any of these parameters change during the course of

the project, this traceability will assist the decision manager to understand how the changes may impact on the decisions previously made.

Compliance with this requirement is demonstrated by a systems engineering management program based on EIA/IS-632, Systems Engineering, coupled with the identification of accountable individuals and their authorities. The implementation guide to DOE O 420.1 references EIA/IS-632 as an acceptable standard for systems engineering.

Supplemental References:

1. EIA, 1994. *Electronic Institutes Association*, Systems Engineering, EIA/IS-632, Washington, D.C., December 1994. (Standards Proposal No. 3537-A has been issued which proposes to upgrade and revise EIA/IS-632. When the proposed upgrade and revision is approved, the standard will be published as ANSI/EIA-632, and EIA-IS-632 will be CANCELED.)

2. DOE, 1995. *Facility Safety*, DOE O 420.1, U.S. Department of Energy, Washington, D.C., October 13, 1995.

3. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria*, (Implementation guide for DOE 420.1), DOE G 420.1-1, U.S. Department of Energy, Washington, D.C., September 1995.

II. F. Radioactive Waste Management Basis.

High-level waste facilities, operations and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Pretreatment and Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

Objective:

The objective of this requirement is to ensure that the hazards associated with high-level waste management facilities, operations, and activities have been identified, their potential impacts analyzed, and appropriate controls documented, implemented and maintained for the protection of workers, the public, and the environment.

Discussion:

As described in the guidance on Section I.2.F.(2), DOE M 435.1-1 requires the radioactive waste management basis to provide for development and documentation of measures to ensure the safe and efficient management of radioactive waste. The measures include processes, procedures, equipment specifications, instrument specifications, and other items that are intended to reduce the likelihood of, or the consequences from, a problem that could arise from managing high-level waste. Requiring an approved radioactive waste management basis for the initiation of new, or continuation of existing, radioactive waste management activities should prevent the operation of facilities for which safe design, configuration, and operation have not been demonstrated. The required elements of the radioactive waste management basis vary with the type of waste management operation or facility and the types of hazards associated with the operation or facility. The radioactive waste management basis documentation listed above for each of the three types of high-level waste management facilities, operations, and activities included in the scope of DOE O 435.1 are not complete lists of those items which should be included in a radioactive waste management basis. Several processes, procedures, and documents that are required by other directives and requirements describe radioactive waste management measures that should be considered part of the radioactive waste management basis.

The guidance at Section I.2.F.(2) discusses this aspect of the radioactive waste management basis in detail.

> *Example: At Site X a facility was designed and built for dry storage of vitrified high-level waste encapsulated in welded stainless steel canisters. Prior to transferring any high-level waste to the facility, the Field Element Manager reviewed and approved the documentation that was prepared and collected for the purpose of establishing the Radioactive Waste Management Basis. The documentation included two items required by DOE M 435.1-1— the waste acceptance requirements and the waste certification program. These two items are designed to ensure that the high-level waste transferred to the facility is appropriate and that the high-level waste transferred from the facility meets the waste acceptance requirements for the receiving facility. Additional documentation that established the Radioactive Waste Management Basis was prepared in response to requirements other than DOE M 435.1-1 and consisted of the facility-specific procedures implementing the Site X radiological control program, health and safety plan, training program, quality assurance program, and record-keeping plan.*

Also, as discussed in the Section I.2.F.(2) guidance, if a high-level waste management facility operates under an approved Authorization Basis, it may not need any additional controls to demonstrate that it has a radioactive waste management basis. In this case, the Authorization Basis documentation should be reviewed and evaluated to determine whether it sufficiently covers the requirements needed for a radioactive waste management basis. The Field Element Manager has the responsibility to ensure the high-level waste management facilities under his or her authority have a radioactive waste management basis.

> *Example: The Liquid Radioactive Waste Handling Facilities at Site A (which include the Tank Farms, the In-Tank Precipitation Process, and the Replacement High-Level Waste Evaporator) are used for management of highly radioactive and hazardous materials. They are Category 2 nuclear facilities which renders them subject to a wide range of DOE nuclear safety requirements. A review of the Authorization Basis documentation revealed that the Authorization Basis includes the following documents and the associated programs:*
>
> - *Safety Analysis Reports (SARs)*
> - *Technical Justification for Continued Operation/Basis for Interim Operation/Design Basis Accident Analysis Report*
> - *Operational Safety Requirements/Technical Safety Requirements*
> - *Technical Standards*
> - *SAR Update Request Packages*

- *Other Documents Identified by DOE-SR and WSRC as Authorization Basis Documents (Safety Evaluations, Exemptions, Unreviewed Safety Questions Evaluation)*
- *DOE Safety Evaluation Reports*
- *Listing of Documents that are to be Configuration Managed but are not Authorization Basis Documents*

Included within these documents are what the site considers to be the complete set of operational requirements relied upon by the site to ensure that the public, workers, and the environment are protected from the hazards associated with the management of the radioactive waste handled in the facilities. For example, the establishment of limits of fissionable material and chemical constituents that can be transferred to the waste tanks by the generators is included in the SARs. These limits are essentially equivalent to the limits that must be set for the waste acceptance requirements in this chapter (see Section II. J). A radioactive waste management basis statement is prepared that concludes the radioactive waste management basis is covered in the Authorization Basis documents.

For a facility that generates high-level waste, the radioactive waste management basis is to include the program for certifying that waste meets the waste acceptance requirements of the facility(ies) to which the waste will be sent. The waste certification program should be reviewed against the applicable requirements of DOE M 435.1-1 and approved in accordance with the manual before becoming part of the radioactive waste management basis. As discussed in guidance on Section I.2.F.(2), several other processes and procedures are also part of the complete radioactive waste management basis at a generating facility.

Example: A spent nuclear fuel reprocessing canyon generates high-level waste. The radioactive waste management basis includes the waste certification procedures, the safety and health plan, the training program, and the waste transfer procedure in addition to the Authorization Basis. These elements are documented in a facility-specific radioactive waste management basis statement covering the canyon, its operations, and its activities.

Facilities that store or treat high-level waste must have approved waste acceptance requirements (Section II. J of DOE M 435.1-1) prior to the issuance of a radioactive waste management basis. The waste acceptance requirements will usually suffice as the documentation of the radiological, physical, and chemical limitations on waste that can be safely received at the facility, provided they are developed correctly considering the hazards of the waste to be managed, and are kept up to date. A facility that stores or treats waste is expected to have a waste certification program. Waste from these facilities will have to be certified as meeting the waste acceptance requirements of the facility to which it will be transported, and the facilities have the potential for generating radioactive waste (e.g., secondary processing streams from treatment, monitoring and sampling,

radioactive release cleanup). Consequently, storage and treatment facilities should also have an approved waste certification program as part of their radioactive waste management basis.

> *Example: A storage facility that stores vitrified mixed high-level waste has approved waste acceptance requirements and a waste certification process to verify that the waste meets the Office of Environmental Management Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS). The radioactive waste management basis statement references the waste certification process and the waste acceptance requirement documentation, which in turn invokes the EM-WAPS. The basis statement also cites the RCRA permit issued for storage of mixed high-level waste*.

Requirements that apply to disposal of high-level waste have been developed by the Nuclear Regulatory Commission and will be applied to the disposal facilities, operations, and activities of the DOE Office of Civilian Radioactive Waste Management. Other facilities for high-level waste management must be covered by an approved radioactive waste management basis. At the end of the useful life of non-disposal facilities, most or all of the high-level waste will be removed in preparation for closure. (In this discussion the word "all" is enclosed in quotes to suggest removal of radioactive material to the extent that the facility can be released for unlimited use.) If all of the high-level waste is removed, then the facility need no longer be considered a radioactive waste facility and an approved radioactive waste management basis is no longer needed. In other cases residual high-level waste will be in the facility being closed, and the facility will be subject to an approved radioactive waste management basis. However, if the residual waste in the facility is determined to be incidental to reprocessing, then the waste is managed as low-level waste or transuranic waste, as appropriate. Under those conditions, either (1) the facility would be subject to an approved radioactive waste management basis appropriate for the category of the remaining radioactive waste as long as the waste remains in the facility or (2) the activities and operations leading to release of the facility for unlimited use would be performed under a radioactive waste management basis appropriate for the radioactive waste.

As part of the radioactive waste management basis, site personnel should implement a system or process for tracking the waste inventory at a storage, pretreatment or treatment facility. Tracking the waste inventory is a means of ensuring that radionuclide limits established in accordance with a safety analysis will not be exceeded. In addition, a system or process for accurately tracking waste received at a facility can facilitate providing information to the complex-wide waste management data system (see guidance for Section I.2.D.(2)).

Compliance with these requirements is demonstrated by a documented radioactive waste management basis statement signed by the Field Element manager or a designee (see I.1.A, Delegation of Authority) for each high-level waste management facility, operation, or activity. Using a graded approach, it may be possible to include multiple activities under a single radioactive waste management basis, but it should be possible to objectively identify which

activities are covered. Further, the radioactive waste management basis statement should include or reference the measures that are established on a facility-specific basis to address the unique waste management requirements and circumstances for each facility, operation, and/or activity.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS),* Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. NRC. *Disposal of High-Level Radioactive Wastes in Geologic Repositories,* 10 CFR Part 60, U.S. Nuclear Regulatory Commission, Washington, D.C.

II. G. <u>Quality Assurance Program</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Product Quality. The requirements of DOE/RW-0333P, *Quality Assurance Requirements and Description*, shall apply to those high-level waste items and activities important to waste acceptance/product quality.

(2) Audits and Assessments. The evaluation and assessment requirements of DOE/RW-0333P, *Quality Assurance Requirements and Description*, and associated implementing procedures shall be met for high-level waste acceptance and product quality activities, in addition to the assessment requirements of other DOE directives and requirements identified in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure that those items and activities important to waste acceptance/product quality are identified and controlled by a quality assurance program that implements the requirements of the Office of Civilian Radioactive Waste Management's Quality Assurance Program, as defined in DOE/RW-0333P, including the audit and assessment requirements.

Discussion:

In addition to the quality assurance requirements contained in Section I. 1.E.(12), Quality Assurance Program, of DOE M 435.1-1, General Requirements, the final high-level waste form must meet the quality assurance requirements published by the Office of Civilian Radioactive Waste Management . These quality assurance requirements are imposed on the waste form Producers by Specification 4., "Quality Assurance Specification," of the *Waste Acceptance Produce Specifications for Vitrified High-Level Waste Forms,* DOE/EM-0093 (EM-WAPS). The OCRWM requirements are contained in the "Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program (QARD)," (DOE/RW-0333P) which is the principal quality assurance document for the OCRWM Program.

The QARD establishes the minimum elements of the quality assurance program and identifies the program commitments necessary for the development and implementation of such a Quality assurance program. As stated in the Introduction to the QARD, the QARD applies to the following high-level waste activities: acceptance; transport and; high-level waste form development through qualification, production, and acceptance.

The current revision of the QARD is organized into sections, supplements, appendices, and a glossary. The 18 Sections contain requirements that are common to all OCRWM Program activities including high-level waste activities such as high-level waste form development. The five Supplements contain requirements for specialized activities, e.g, software, sample control, field survey and the three Appendices contain requirements that are specific to the high-level waste form production, storage and transportation, and the Mined Geologic Disposal System.

Waste form producers may, but are not required by OCRWM, develop specific quality assurance procedures that comply with the requirements of the QARD, or they may modify existing procedures, as necessary, to meet the QARD requirements. If the latter approach is taken, a crosswalk to demonstrate how the QARD requirements are met by the site quality assurance procedures should be generated.

Product Quality. Important to the subrequirement (1) is the concept that the QARD requirements apply only to those high-level waste items and activities that have been designated as important to waste acceptance/product quality. While a list of these items and activities is not included in either the EM-WAPS or the QARD, their identification is essential for identifying the bounds of applicability of the QARD. These items and activities are broadly defined as those which affect the ability of the waste Producers to produce a canistered waste form that meets the EM-WAPS requirements. Both of the existing vitrification facilities, DWPF and WVDP, have developed a methodology for identifying such items and activities for their respective site and have maintained a list of these items. Refer to these for further details on the approach taken at each site (references included below).

Audits and Assessments. Subrequirement (2) requires that in addition to the audits and assessments that are required under Section I.1.E., Requirements of Other Regulations and DOE Directives, or Section I.2.F.(10), Evaluations, Section 18.0 of the QARD, Audits, establishes specific requirements for performing internal and external Quality assurance audits to verify compliance with, and to determine the effectiveness of, the Quality assurance program. Refer to Section 18 for the specific requirements. In addition, numerous other assessment requirements are contained throughout the QARD that must be met for those items and activities that are applicable to the QARD requirements. Included are:

- Section 2.2.6 Surveillances
- Section 2.2.7 Management Assessments
- Section 2.2.8 Readiness Reviews
- Section 2.2.9 Peer Reviews

Responsibilities for conducting audits are identified in several documents. A Memorandum of Agreement between the Office of Civilian Radioactive Waste Management and the Office of Waste Management specifies quality assurance responsibilities between these two organizations

(see reference) while letters between the high-level waste sites and the Office of Waste Management assign audit responsibilities between these organizations.

Compliance with this requirement is demonstrated by documented evidence that the requirements of the QARD have been met for those items and activities that are determined to be waste product quality affecting; and the QARD audit, readiness reviews, and assessment requirements have been met.

Supplemental References:

1. DOE, 1997. *Office of Civilian Radioactive Waste Management, Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program*, Revision 8, DOE/RW-0333P, U.S. Department of Energy, November 13, 1997.

2. DOE, 1996. *Memorandum of Agreement Between the Office of Waste Management and the Office of Civilian Radioactive Waste Management for Coordination of Quality Assurance Activities Associated with High-Level Waste and Spent Nuclear Fuel*, U.S. Department of Energy, May 23, 1996.

3. DOE, 1996. *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, Revision 2, DOE/EM-0093, U.S. Department of Energy, December 1996.

4. DOE, 1997. *WVDP Waste Acceptance Manual*, Revision 7, WVDP-200, U.S. Department of Energy, April 22, 1997.

5. DOE, 1996. *DWPF Waste Acceptance Reference Manual*, Revision 4, WSRC-IM-93-45, U.S. Department of Energy, February 1996.

II. H. <u>Contingency Actions</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving high-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of waste contained in any one storage vessel, pretreatment facility, or treatment facility. Tanks or other facilities that are designated for high-level waste contingency storage shall be maintained in an operational condition when waste is present and shall meet all the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Objective:

The objective of this requirement is to mitigate the impacts on the public, workers, and environment in the event that a leak develops in a vessel storing high-level waste or in a facility processing high-level waste. The mitigation is provided by ensuring spare waste storage capacity is a required part of a site's emergency management program. To meet this objective, there needs to be both capacity to handle the largest volume of any single storage vessel or liquid waste in process, and the capability to transfer the waste.

Discussion:

This requirement shall be implemented through and included in site emergency management programs that are required by DOE O 151.1, *Comprehensive Emergency Management System.* The directive DOE O 151.1 is referenced in DOE M 435.1-1, Chapter I and is considered necessary for the safe management of radioactive waste. The Comprehensive Emergency Management System requires the development of a complex-wide system for preparing for and managing emergencies. At the site level, personnel are to establish an Operational Emergency Base Program that provides the framework for responding to events involving, among other impacts, health and safety, and the environment. The program requires a qualitative hazards survey to identify the emergency conditions, describe the potential impacts, and summarize the planning and preparedness requirements that apply.

During the development of the requirements of DOE M 435.1-1, *Radioactive Waste Management Manual*, a waste management hazard and safety analysis identified the loss of confinement of a storage tank or waste processing facility containing radioactive wastes as a hazard requiring mitigation. In addition to requiring facility designs to maintain waste confinement (see DOE M 435.1, Section II.P.(2)(b)), the ability to respond to leaks or other off-normal conditions if they occur was also considered necessary. Consequently, the requirements to have adequate spare capacity and the ability to transfer waste to the spare capacity were established. This requirement is applicable to storage and processing of both liquid high-level waste and solid high-level waste (e.g., calcine).

Operating procedures are to be developed and utilized for transfer of high-level waste to contingency storage. The procedures need to address maximum operational capacities and limits for components of the operational system (e.g., spare storage capacity available in vessels). The procedures are to define and address all possible emergency transfer scenarios needed to comply with this requirement.

<u>Contingency Storage</u>. Contingency storage is to be provided for both high-level waste storage and for high-level waste pretreatment and treatment facilities. In the case of storage vessels, adequate volumetric capacity must be available to receive the largest volume of waste stored in any single vessel. In the case of pretreatment or treatment facilities, adequate capacity must be available to allow in-process wastes in the facility to be moved as necessary to storage or holding tanks in the event of emergency or off-normal conditions. These storage or holding tanks may be other process vessels within the facility.

The requirement also requires that tanks, or other facilities, that are designated for high-level waste contingency storage be maintained in an operational condition when waste is present and that they meet all the requirements of DOE O 435.1 and DOE M 435.1-1. The operational requirement is to ensure that all the elements required for safe operation of a functional high-level waste storage tank that contains waste also are applied to a contingency storage tank. This is intended to include the implementation of an approved authorization basis, or radioactive waste management basis, as well as the implementation of operating procedures by trained and qualified personnel. Development and implementation of these operational elements need to be planned and completed prior to the designation of a tank or other facility as contingency storage since the need for contingency storage may be urgent.

The requirement that contingency storage facilities meet all of the Order and Manual requirements is recognized as demanding, and may be difficult for some DOE sites to meet. However, the requirement is considered necessary due to the hazardous nature of high-level waste and the potential consequences of loss of confinement of a tank's contents. Of particular importance to contingency storage units is complying with the requirements in Section II.Q, Storage, which provides for a structural integrity program. As discussed in the guidance to Section II.Q, a

structural integrity program ensures structural strength and leak-tightness of all tanks designed for use as high-level waste storage.

The requirement in DOE M 435.1-1, Section II.H.(1) does not preclude the designation of existing single-shell tanks (i.e., do not meet the secondary confinement (design) requirements of DOE M 435.1 Section II.P.(2)(b)) present at some DOE sites, from being designated contingency storage facilities. Existing single-shell tanks that can meet all the requirements of DOE M 435.1-1, Chapter II, without having to undergo significant modifications, may be candidates for designation as contingency storage units. As explained in the guidance to DOE M 435.1-1 Section II.P.(2)(b) the secondary confinement requirements apply to new, and modifications to existing, tanks. The requirement that must be met for single-shell tanks is the structural integrity program (DOE M 435.1-1, Section II.Q.(2)) which includes elements such as verifying leak-tightness and structural strength, identifying corrosion modes, and ultimately identifying the tank's safe operating envelope.

Spare capacity may be provided by a single vessel or by the combined available volume in multiple vessels. In cases where radiation protection considerations allow, spare capacity could be provided by portable vessels, tankers, e.g., rail-tank cars, or tank trucks if they meet the other requirements of DOE M 435.1-1. Due to the potential for airborne radioactive material, impoundments or bermed areas open to the air generally are not be used for spare storage capacity.

> *Example: Liquid high-level waste is stored in six underground storage tanks with a design capacity of 250,000 gallons each. The waste in the tanks has the same chemical and radiological characteristics. One tank contains 200,000 gallons and each of the others contain about 100,000 gallons. Capabilities exist to retrieve waste and transfer it among the six tanks. This system meets the requirement because the largest volume of 200,000 gallons can be distributed between any two of the other tanks.*

Spare capacity may be shared by different waste types, however mixing radioactive wastes of different types needs to be evaluated and is generally not acceptable.

> *Example 1: A tank farm has tanks containing high-level waste which has been determined not to be a mixed waste or high-level waste or has other tanks that are contaminated with listed hazardous wastes. A spare empty tank is maintained and available for emergency transfers of either waste.*

> *Example 2: A tank farm contains both liquid high-level waste and liquid transuranic waste in separate tanks. If the spare capacity were provided by excess capacity in tanks that contain high-level waste, use of the capacity for transuranic waste would be undesirable. Transferring transuranic waste into a tank containing high-level waste,*

would result in a mixture that would no longer be eligible for disposal at the Waste Isolation Pilot Plant which, by law, cannot dispose of high-level waste. Therefore, waste managers need to identify different spare capacity to accommodate the two different waste types.

In addition to the spare storage capacity discussed above, other measures may also need to be implemented. An obvious action is to immediately stop the flow of any materials into the tank system or tank annulus (if applicable), and inspect the system to determine the cause of the leak. If the leak site is determined to be above the tank bottom, transferring tank contents until it is at a level below the leak site would satisfy the requirement. Additionally, some tank systems include a partial secondary liner in the form of a drain pan or a leak sump. In general the volume capacity of these structures is limited; however, the viability of recirculating leaked contents from these structures to the primary tank or vessel as an initial mitigation measure may be assessed. Such re-circulation may preclude the release of a leaking tank's contents to the soil, while contingency transfer and storage systems are being prepared to remove the contents from a leaking tank or vessel.

<u>Transfer Equipment</u>. The ability to perform the transfer is just as important as having the capacity. Equipment necessary to transfer each vessel or treatment facility volume of high-level waste in the event of a leak or other off-normal condition is to be identified and documented.

Example: Calcined radioactive waste is stored in six underground bins with a capacity of 10,000 cubic feet each. The waste in all of the bins is similar, and each bin contains 3,000 cubic feet of calcined high-level waste. Although there are transfer lines to any of the bins from a central diversion box, the bins were constructed without the capability to retrieve the waste. This situation does not comply with the requirement at II.H.(2). Although there is adequate capacity, the ability to transfer the waste does not exist. An exemption would be required.

In addition, mechanisms must be in place to ensure the equipment identified as necessary to transfer the contents of each tank can be made available quickly. One approach is to inspect and/or test the identified equipment and components, as part of a routine waste management maintenance program (see DOE M 435.1-1, Section I.1.E.(9)).

If the cost of procuring and maintaining such items is economically impractical, an acceptable alternative would be to have agreements with vendors to procure the necessary equipment and have it shipped to the site within a specified period of time. Under this approach the use of other mitigative measures to reduce impacts to the environment from a leaking tank or vessel may be necessary. Such mitigative measures might include re-circulation of leaked contents from sumps or pans to the primary tank, as discussed above, or the initiation of emergency remediation actions in accordance with facility emergency plans.

The capability to perform an emergency transfer of high-level waste is to be maintained at all times. Procedures need to be prepared and operations personnel qualified in the operation of equipment and those procedures necessary for the transfer of high-level waste to contingency storage facilities.

> *Example: A large shielding block is in place over a diversion box that needs to be accessed during an emergency transfer of high-level waste. The block must be moved by a crane. Therefore, a suitable crane must be on-site or an agreement with a vendor that such a crane can be delivered within a specified time period, is in place. Additionally, operators qualified to operate valves within the diversion box must be available when needed.*

Many DOE sites have agreements in place with their State and/or EPA regulators that may overlap, or conflict, with the requirements in this section. Obviously such agreements must be honored and the intent of these requirements is not to interfere with them. Thus, some interpretation of these requirements will be necessary to ensure that spare waste storage capacity is available and that the necessary transfer equipment is available on a real time basis, i.e., at the earliest practicable time.

Compliance with these requirements is demonstrated if adequate spare capacity and transfer equipment exist for emergency transfers of all high-level waste. This includes maintaining high-level waste contingency storage facilities and transfer equipment/facilities in an operational condition when waste is present.

Supplemental References:

1. DOE, 1995. *Comprehensive Emergency Management System*, DOE O 151.1, U.S. Department of Energy, Washington, D.C., September 25, 1995.

II. I. <u>Corrective Actions</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

Objective:

The objective of this requirement is to ensure that actions will be taken to preclude, minimize, or mitigate hazards whenever a situation arises at a high-level waste management facility that could threaten worker or public safety, or the environment.

Discussions:

DOE M 435.1-1, Section I.2.G, states that all personnel have a responsibility to identify conditions that require corrective actions to achieve compliance with the Order and Manual requirements or to address health and safety conditions that pose an imminent or possible danger. The Manual states that this responsibility includes considering shutdown or curtailment of facilities and activities, if warranted by the seriousness of the circumstances. This requirement ensures that this responsibility is implemented for all high-level waste management facilities and activities. DOE M 435.1-1, Section I.2.F.(20), requires the Field Element Manager to ensure that a process exists for proposing, reviewing, approving, and implementing corrective actions when necessary to ensure that the requirements of DOE O 435.1 and DOE M 435.1-1 are met, and to address conditions that are not protective of the public, workers, or the environment.

Corrective actions are activities which, when implemented, will correct a noncompliant or hazardous condition. These activities can include improvements to documentation (e.g., procedures, plans, authorization basis documents), training and qualification programs or procedures, physical and process design changes, changes to operating conditions, or a combination of these activities.

<u>Corrective Action System.</u> A corrective action system exists for addressing noncompliant or hazardous conditions for high-level waste management facilities, operations and activities. Corrective actions in response to quality assurance program assessments are addressed in the *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120* and DOE O 414.1, *Quality Assurance.* The corrective action system provides for documenting noncompliant or hazardous conditions, identifying the organizations or individuals responsible for developing and implementing corrective actions, providing corrective action status, and tracking progress through final implementation of the actions. The corrective

action system is instituted as a fundamental part of the systematic evaluation of radioactive waste activities that is implemented by the site-wide radioactive waste management program (see guidance for Section I.2.F.(1)).

A problem requiring corrective action could range from a minor deviation from a procedure, to a situation that poses an immediate threat to health and safety from an uncontrolled release of large quantities of radioactive material. For situations where a problem could pose an immediate risk to a worker, member of the public, or damage to the environment, immediate shutdown of the process or facility may be appropriate as the first step in addressing the problem. (see guidance for Section II. I.(2)).

> *Example: An employee of the Site K high-level waste vitrification facility noticed that the procedure for taking a high-level waste slurry sample was not being followed correctly by a waste technician. Such action could allow a release of high-level waste slurry into the facility's operating corridor from the sampling station. The employee alerted the sampling shift manager who in turn alerted the facility operations manager. The facility corrective action system resulted in a corrective action plan that identified the sampling station manager as the responsible individual for assuring proper training of operations personnel on implementing sampling procedures. A reminder memo was sent to the affected staff and a follow-up review was scheduled for 45 days after the occurrence.*

If a facility or activity can be allowed to operate while a noncompliant or hazardous condition exists, the allowance and any associated limitations must be defined as part of the facility or activity's radioactive waste management basis and/or authorization basis documentation, identified as a configuration controlled item in a configuration management plan or included in a revision or modification to an operating procedure or similar controlled documentation. If a noncompliance impacts safety associated with use of a procedure, system, or facility, the corrective action system must provide for preventing the use (e.g., locking out) of the affected procedure, system, or facility.

> *Example: In the example above, slurry sampling activities were curtailed so that no slurry sampling was allowed. Due to the potential for a release of high-level waste slurry into the operating corridor of the facility and significant personnel contamination, waste sampling activities were curtailed until operator training was completed.*

Compliance with this requirement is demonstrated if a corrective action system addresses noncompliant or hazardous situations involving high-level waste management facilities in a systematic fashion, and allows identification of problems by all personnel.

Supplemental References:

1. DOE, 1996. *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance,* DOE G 414.1-1, U.S. Department of Energy, Assistant Secretary for Environment, Safety and Health, Washington, D.C., August 1996.

II. I.(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Objective:

The objective of this requirement is to limit the operation of waste management activities and facilities as necessary to avoid creation of near- or long-term safety or environmental hazards.

Discussion:

DOE M 435.1-1 requires that a radioactive waste management basis be established for each radioactive waste management activity or facility. The radioactive waste management basis is to include those additional constraints specific to waste management activities (e.g., requirements of the *Manual*) that are determined to be necessary for safety and environmental protection. Field Element Managers are responsible for ensuring a radioactive waste management basis is developed, reviewed, approved, and maintained for each DOE radioactive waste management facility, operation, or activity. (DOE M 435.1-1, Section I.2.F.(2)). The guidance for that requirement should be consulted for additional details on the development, review, and approval of a radioactive waste management basis. Also, additional discussion concerning the radioactive waste management basis for high-level waste generator, pretreatment, treatment, and storage facilities is discussed under guidance for the requirement at Section II. F.

As part of his or her responsibilities for maintaining the radioactive waste management basis for high-level waste management facilities, operations, and activities under his/her authority, the Field Element Manager evaluates the compliance of the facilities, operations, and activities with the constraints and controls documented in the radioactive waste management basis by ensuring that routine assessments are conducted. If the Field Element Manager determines, either through routine assessment or by virtue of an occurrence or off-normal event, that a facility, operation, or activity is not operating in compliance with an approved radioactive waste management basis, the operation must be curtailed or shut down. The action taken is commensurate with the hazards associated with the noncompliance and with the continued operation of the facility.

This requirement is to be implemented in a graded manner. Actions to be taken are based on assessments of adherence to radioactive waste management bases, and can range from shutdown of an operation or facility to placing limits or constraints on what activities can be performed or how the activities are to be performed. Shutdown of a facility involves stopping all operations in the facility except surveillance or monitoring activities necessary to maintain the facility in a safe standby condition. Shutdown is considered appropriate when there is either a potential imminent threat to safety or environmental protection that cannot be mitigated, or a blatant failure to establish or comply with a radioactive waste management basis.

Alternatively, there may be cases where the facility, operation, or activity assessment determines that the radioactive waste management basis is not current or has been violated but there is no imminent threat to public, worker, or environmental protection. In such a case, the Field Element Manager may decide that shutdown of the facility is not necessary. It may be sufficient to impose certain limits until the radioactive waste management basis is made current. The limits imposed may prohibit the generation, receipt, or processing of certain waste streams, or may involve constraints on the processes that may be performed.

> *Example: Site Z conducts biennial assessments of high-level waste Evaporator Y for compliance with its radioactive waste management basis. The 1996 biennial assessment found two non-compliance findings and five observations. The corrective action system implemented at Site Z requires the non-compliance findings to be entered and formally responded to with corrective action plans, but not the observations. The non-compliances were in document control and operations training, so evaporator operations were not curtailed in any way while both the document control and training procedures were revised. The facility was assessed again in 1997 to determine if the corrections were in place, which was an accelerated assessment schedule from the normal biennial assessments.*

The action taken in response to the failure to establish a radioactive waste management basis is to be clearly documented in a formal communication (e.g., letter, memorandum). Such communication needs to identify the reason for the shutdown or curtailment, and identify what is necessary to initiate restart. Generally, development of a corrective action that is implemented through the corrective action system, as discussed in the preceding section, would be appropriate for responding to a shutdown or curtailment of activities at a high-level waste management facility.

In concert with Core Requirement #6 of the Integrated Safety Management System, "Feedback and Improvement," the Field Element Manager should use the audits and assessments to identify opportunities for improvement in the implementation of an activity or facility's radioactive waste management basis. Identified improvement actions should be shared with like organizations and tracked by management to determine whether they are yielding the anticipated improvements.

Communicating the results of assessment upward in the DOE and contractor organization will allow the findings to reach the management level with the authority necessary to effect improvements.

Compliance with this requirement is demonstrated by a documented system of routine assessments to determine whether waste management activities and facilities are operating in accordance with an approved radioactive waste management basis that provides for graded limitations that can be placed on activities and operations that do not have, or are operating outside of, an approved radioactive waste management basis, including shutdown of the facility.

Supplemental References:

1. DOE, 1996. *Safety Management System Policy*, DOE P 450.4, U.S. Department of Energy, Washington, D.C., October 15, 1996.

2. DOE, 1997. *Line Environment, Safety and Health Oversight,* DOE P 450.5, U.S. Department of Energy, Washington, D.C., June 26, 1997.

3. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy,* DOE P 411.1, U.S. Department of Energy, Washington, D.C., 1997.

4. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

5. DOE, 1999. *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 98-1, Department of Energy Plan to Address and Resolve Safety Issues Identified by Internal Independent Oversight*, U.S. Department of Energy, Washington, D.C., March 10, 1999.

II. J. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all high-level waste storage, pretreatment, or treatment facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form that ensures the chemical and physical stability of the waste under conditions that might be encountered during transfer, storage, pretreatment, or treatment;

(c) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved; and

(d) Pretreatment, treatment, storage, packaging, and other operations shall be designed and implemented in a manner that will ultimately comply with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified immobilized high-level waste.

Objective:

The objectives of the waste acceptance requirements are to ensure that: high-level waste which is to be received at a facility contains only the radionuclides that the facility can safely manage, and only in concentrations and/or total activities which are compatible with the work to be undertaken in the facility; no high-level waste management activity jeopardizes compliance with waste disposal specifications, including DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS), or DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD), for non-vitrified immobilized high-level waste; and formal procedures exist and a decision process is clear concerning the granting of exceptions to waste acceptance requirements.

Discussion:

As discussed in the guidance to DOE M 435.1-1, Section I.2.F.(6), the waste acceptance requirements establish the conditions for waste that facilities can safely receive. Therefore, the acceptance requirements for high-level waste storage, pretreatment, or treatment facilities, operations and activities include all requirements that high-level waste must meet to be acceptable for receipt, and for the subsequent storage, pretreatment, or treatment that it will undergo.

In conducting the analyses for development of the DOE M 435.1-1 requirements, minimum acceptance requirements that must be specified in waste acceptance documentation for storage, pretreatment, and treatment facilities that must be specified in the waste acceptance documentation for these types of high-level waste management facilities in order for high-level waste to be safely handled were identified. Guidance on subrequirement (a) is provided below under Radionuclide Content or Concentration. Guidance on subrequirement (b) is provided under Waste Form. Guidance on subrequirement (c) is provided under Exceptions. Guidance on subrequirement (d) is provided under Waste Acceptance Product Specifications.

Development of Waste Acceptance Requirements. A facility receiving high-level waste for storage, pretreatment, or treatment is required to document the waste acceptance requirements for the facility. These requirements have their foundation in facility design capabilities such as volume, handling, weight, allowable contents, and radiological limits (i.e., criticality, radiation, contamination). Other requirements may include any number of regulations promulgated by the EPA, NRC, DOT, the host state, and DOE itself. The designer and operator of the facility receiving waste are likely to be most knowledgeable of the requirements and limitations of the facility and, therefore, are in the best position to establish the waste acceptance requirements or criteria that must be met for waste sent to the facility.

DOE is planning to dispose high-level waste in a geologic repository consistent with the *Nuclear Waste Policy Act of 1982*, as amended. This plan was outlined in Secretary Hodel's letter to President Reagan (DOE, 2/6/85), in which the Secretary recommended that "the Department proceed with plans and actions to dispose of defense waste in a commercial repository." President Reagan's finding, in accordance with Section 8 of the *Nuclear Waste Policy Act of 1982*, as amended (Presidential memo, 4/30/85), was that he found no basis to do otherwise and the Department has since implemented plans to dispose high-level waste in a geologic repository consistent with the *Nuclear Waste Policy Act of 1982,* as amended.

The DOE Office of Civilian Radioactive Waste Management has issued the WASRD that describes the functions to be performed and the technical requirements for a Waste Acceptance System for accepting spent nuclear fuel and high-level radioactive waste into the Civilian Radioactive Waste Management System. From this document, the Office of Environmental

Management has developed and implemented the EM-WAPS. Additional information on this document is discussed below under Waste Acceptance Product Specifications.

Personnel responsible for high-level waste storage, pretreatment, or treatment facilities are to consider the EM-WAPS in developing waste acceptance criteria. Criteria to be considered include limiting the concentrations of species that may inhibit the formation of glass, organic compounds, and RCRA-listed hazardous wastes.

The waste acceptance requirements and documentation for a facility receiving waste for storage, pretreatment, or treatment are prepared using a graded approach commensurate with the hazards associated with the management of the waste in the facility and the complexity of the activities to be conducted in the facility and upon the waste. The waste acceptance requirements document for a facility which receives large quantities of high-level waste, or high-level waste with highly variable contents, or both, may need to address many hazards and consequently may be more detailed. By contrast, an immobilized high-level waste storage facility that stores only EM-WAPS compliant waste may only need a minimal set of requirements.

The EM-WAPS, legislation, regulations, safety analysis reports, technical safety requirements, criticality analyses, and other appropriate safety or authorization basis documents are used to establish the waste acceptance criteria for facilities receiving high-level waste for storage, pretreatment, or treatment. These documents and analyses provide the basis for radioactivity (concentration and inventory) limits, allowable chemical content, waste form and/or packaging stability requirements, and other necessary waste canister or waste form requirements to ensure that the facilities design bases, performance, and operating bases are not compromised.

Radionuclide Content or Concentration. Radiological limits for storage, pretreatment, and treatment facilities may be derived from a number of technical as well as administrative sources. In developing limits for radionuclide concentrations, personnel need to consider storage and treatment facility limitations, the EM-WAPS, safety analysis reports, and criticality analyses.

At many high-level waste management sites, the storage and treatment facilities require the control of certain constituents or concentrations of species to ensure safe storage, pretreatment and treatment of the waste. Such limits, for example, support corrosion protection, prevent the accumulation of flammable or explosive species, limit the radionuclide content, or meet regulatory limits. Storage, pretreatment, and treatment facilities need to include appropriate waste acceptance requirements that protect their authorization or radioactive waste management basis.

The current EM-WAPS for vitrified waste forms contains a number of specifications to be considered during the development of the waste acceptance requirements for high-level waste pretreatment and treatment facilities. These include Specification 1.5, “Hazardous Waste,” which precludes the inclusion of RCRA-listed components in the final high-level waste form, and

Specification 3.5, "Chemical Compatibility," which requires that the waste producer ensure that the final waste form is compatible with the canister material.

The safety analysis report or authorization basis for a high-level waste management facility may identify specific radionuclides that warrant special attention from a worker safety standpoint or an offsite release standpoint due to an upset or accident condition.

> *Example: At Site Z the safety analysis for the high-level waste tank farm has established a limit on the concentration of Cs-137 in Type V Tanks to < 0.6Ci/gal. This limit is set for these tanks because they do not have secondary confinement. The limit ensures that the risk of the Cs-137 reaching the environment is comparable to the accepted risk associated with the waste in a double confinement tank.*

Any criticality analyses conducted in accordance with the Criticality Safety Program in conformance with DOE M 435.1-1, Section I.1.E.(4), may also result in limitations on acceptance of fissile radionuclides. These limitations should be included in the waste acceptance requirements, as appropriate.

<u>Waste Form</u>. Waste acceptance requirements specify that wastes received at the facility are in a physically/chemically stable form. Waste acceptance requirements for a high-level waste pretreatment or treatment facility need to specify the physical and chemical precautions and conditions under which untreated waste can be received at the facility so that facility safety and effective operations will not be compromised. Any physical or chemical stabilization of waste prior to transfer to a facility receiving waste for storage, pretreatment, or treatment needs to be done according to a systematic process that includes consideration of bench-scale testing and verification that the process is producing satisfactory results.

The waste acceptance requirements need to specify waste streams, classes, or categories of waste requiring application of specific physical or chemical stabilization methods, as determined by the results of safety analyses. Acceptable waste streams or waste forms are specified by the waste acceptance requirements. The waste acceptance requirements also need to identify any of the following specific technical requirements that must be included to ensure that waste received at any storage, pretreatment, or treatment facility is consistent with the operating/authorization basis of the facility:

- allowable heat generation rates;
- any specific radionuclides or chemical or hazardous materials that are prohibited from acceptance at the facility. This may include pyrophoric materials, explosives, or materials that might cause violent reactions during storage, pretreatment, or treatment; and

- any specific requirements associated with acceptance of high-level waste needing out-of-the-ordinary attention for receipt, storage, pretreatment, or treatment.

Exceptions. Waste acceptance requirements are established to ensure that facilities can safely manage the waste received for storage, treatment, or disposal. Waste acceptance requirements need to be documented, contain clear and precise criteria specifying the radionuclide limits in the form of contents or concentrations that can be accepted, the limitations and prohibitions on waste streams received, and the limits, prohibitions, or instructions concerning any other technical information to assure that the waste is compatible with the safety basis of the facility, and which will result in acceptable waste at subsequent steps in managing the high-level waste. Thus, exceptions or deviations to waste acceptance criteria must not be routine and must be carefully reviewed and documented. The procedures for granting exceptions need to clearly state the entire process for requesting an exception, describe acceptable bases for granting exceptions, and identify any additional information that is needed to supplement the documentation normally provided for waste transfers. The approval process is clearly stated, including identification of the officials who have the authority to approve the exception.

Example: At Site Y, the transfer of a high-level waste solution that is non-compliant with one or more of the receiving facility-specific waste acceptance requirements may be requested, and allowed, because analysis concludes that blending of the transferred waste with the existing tank inventory will result in the blended tank waste being compliant with the receiving tank's waste acceptance requirements. The Site Y procedure includes an administrative process that requires a technical basis for the proposed exception and requires the appropriate reviews, approvals and documentation.

Waste Acceptance Product Specifications. This subrequirement is intended to ensure that any high-level waste management activities such as storage, pretreatment, treatment, packaging, and any other operations shall be conducted in a manner that will facilitate the acceptance of the final immobilized high-level waste form by the Office of Civilian Radioactive Waste Management. The current EM-WAPS include are the technical specifications that waste form producers are required to meet in order to ensure acceptance of their vitrified high-level waste into the Civilian Radioactive Waste Management System. The Office of Environmental Management (EM) and the Office of Civilian Radioactive Waste Management have agreed the Office of Environmental Management is to provide the final waste form specifications to the waste form producers and the Office of Environmental Management will ensure that the EM-WAPS is consistent with the technical baselines as defined in the WASRD. The EM-WAPS governs all elements of the final, canistered, waste form which includes the borosilicate waste glass, the stainless steel canister, and the sealed canistered waste form.

As waste form requirements for immobilized high-level waste were developed, the Department and its operating contractors selected borosilicate glass as a reference waste form. Several high-level waste sites subsequently identified a vitrified waste form for their sites, and two high-level waste vitrification facilities are currently operating to produce canisters of borosilicate waste-glass. The EM-WAPS was written to such borosilicate glass specifications. Recently, however, several new high-level waste streams have been identified. One such high-level waste stream is the proposed insertion of small immobilized surplus plutonium containers within a standard high-level waste canister. Molten vitrified high-level waste is then poured around these plutonium cans yielding a matrix immobilized waste form. This composite high-level waste stream is considered high-level waste and can be disposed as such. Another proposed high-level waste stream results from immobilizing the waste resulting from reprocessing certain spent nuclear fuels using an electro-metallurgical process. In this case a non-vitrified waste form will result. In both these cases a product that adheres to all the existing requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, is not possible. The exact waste form specifications that these two proposed waste forms must meet are unknown at this time; however, they will be incorporated in DOE/RW-0351P, *Waste Acceptance System Requirements Document*. That document is therefore cited for those unique immobilized high-level waste forms that cannot meet the requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS).

The waste acceptance process requires demonstration of compliance with the EM-WAPS via four different documents, each prepared by the waste producers, reviewed and accepted by the Office of Environmental Management, and provided to the Office of Civilian Radioactive Waste Management. These four documents are: the Waste Form Compliance Plan (WCP); the Waste Form Qualification Report (WQR); production records and; the storage and shipping records. The producers included in Revision 2 of the EM-WAPS are Savannah River Site, the West Valley Demonstration Project, and Hanford. Decisions on a final waste form at the Idaho National Environmental Engineering Laboratory have not progressed to the point that it has been included in the current EM-WAPS.

The EM-WAPS provides detailed specifications that must be met by the producers in order for the final waste form to be acceptable to the Civilian Radioactive Waste Management System for disposal. Amplification on these specifications is considered beyond the scope of this guidance. Reference is made to existing Waste Compliance Plans for Defense Waste Processing Facility and the West Valley Demonstration Project, both of which provide a detailed description of the methods by which they comply with each specifications. Following are the titles of each of the summaries specification within the EM-WAPS:

- Waste Form Specifications;
- Canister Specifications;
- Canistered Waste Form Specifications;

- Quality Assurance Specification; and
- Documentation and Other Requirements.

Example: At Site Z, a vitrification operation's analysis concluded the potential for a significant savings in plant operating labor costs if the welding of canisters could be delayed until the vitrification melter operations were shut down for maintenance, which was normally every 30 days. Thus the proposal was to stage unwelded canisters in the facility, for as long as 30 days, until melter operations personnel were free to make the closure welds. However, review of the facility's Waste Compliance Plan, Waste Qualification Reports, and the EM-WAPS determined that there was a risk that organic contaminants may enter the open canisters that would be held for welding. Such contamination would violate the EM-WAPS, Specification 3.4, Organic Materials Specification, and the plan was rejected.

Compliance with these requirements is demonstrated by waste acceptance requirements that are well documented and contain clear and precise criteria specifying: allowable activities and concentrations; acceptance forms; a clear description of the process for obtaining an exception to the acceptance criteria; and operations shall be implemented in a manner that does not jeopardize the final waste form's ability to meet the EM-WAPS.

Supplemental References:

1. DOE, 1999, *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

2. DOE, 1996. *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, Revision 2, DOE/EM-0093, U.S. Department of Energy, December 1996.

3. DOE, 1994. *DWPF Waste Form Compliance Plan*, Revision 4, WSRC-IM-91-116-0, U.S. Department of Energy, December 1994.

4. DOE, 1997. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 12, WVDP-185, U.S. Department of Energy, December 1997.

5. DOE, 1985. *An Evaluation of Commercial Repository Capacity for the Disposal of Defense High-Level Waste,* DOE/DP/0020/1, U.S. Department of Energy, Washington, D.C., June 1985.

6. Hodel, 1985. Secretary Hodel to President Reagan, memorandum, *Use of Commercial Repository for Disposal of Defense High-Level Nuclear Waste*, U.S. Department of Energy, Washington, D.C., February 6, 1985.

7. Reagan, 1985. President Reagan to Secretary Herrington, memorandum, *Disposal of Defense Waste in a Commercial Repository,* Washington, D.C., April 30, 1985.

II. J.(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Objective:

The objective of this requirement is to establish a process by which a facility receiving high-level waste for storage, pretreatment, or treatment determines that the waste being transferred is acceptable in accordance with the waste acceptance requirements and for that process to specifically address the management of waste that does not conform with all of the requirements when it is received at the facility.

Discussion:

This requirement makes it the responsibility of officials at a facility to which waste is transferred to confirm that waste is in compliance with the established waste acceptance requirements, and also to provide a mechanism by which the officials confirm that waste can be accepted and safely managed at the facility.

Evaluation and Acceptance. The methodology for implementing the evaluation and acceptance of high-level waste needs to be flexible and defined on a facility-specific basis. The complete process and procedures, including the responsibilities of the generating facility, need to be clearly documented so that both the generator and the facility receiving the waste understand the process that will be used. As with the implementation of other parts of the DOE M 435.1-1, this requirement is implemented using the graded approach. Facilities receiving high-level waste from many generators may need to implement more detailed waste evaluation and acceptance processes than a facility receiving waste from a few generators.

The evaluation and confirmation process consists of one or more of the following approaches that can contribute to high confidence that the waste presented meets the waste acceptance requirements of the facility receiving waste for storage, pretreatment, or treatment:

- Testing, sampling, and analysis of the contents of a representative sample of waste packages as they are received at the facility;

- Testing and analysis of a number of samples taken by the generator facility;

- Detailed review of sampling and analysis data generated by the sending facility or an independent laboratory employed by the generating facility;

- Audit, surveillance, or observation of the sender's waste characterization activities and processes and waste certification programs.

Testing, sampling, and analysis of the contents of a representative sample of waste is complicated by the fact that additional risk is posed because of the process required to take and analyze a liquid sample. Therefore, consideration is given to the additional risk and potential worker dose when deciding which approach is appropriate. Likewise, analysis of the samples taken by the generator may involve additional risk, and also may be expensive to implement. If this method is employed, samples which are representative, either statistically or correlated with generator profiles, need to be obtained for analysis. This sampling includes samples from the generators sending the greatest amount of waste to the facility for storage, pretreatment, or treatment; or samples containing the critical radionuclides as identified in the waste acceptance requirements.

The use of detailed reviews of the sampling and analysis data gathered by others needs to include an evaluation of the methodologies used for collecting the sample, maintaining the integrity of the sample and data (e.g., through a chain of custody), and performing chemical analyses and radioanalyses. As above, the samples collected need to be representative of the waste, either statistically or with a bias towards large generators or generators of significant radionuclides (i.e., those that are most limiting for the storage, pretreatment, or treatment).

The use of assessments, audits, or reviews to verify compliance of the waste generators' certification programs with acceptance requirements are conducted on a regular schedule. The documentation of the verification process includes review of the organization and authorities; frequency of assessments; methods to be employed; the information that will be documented as a result; and the qualifications of personnel.

Example: At Site K, DOE and contractor management teams for the high-level waste program conduct a quarterly management assessment of waste generators' waste certification programs to ensure their programs are compliant with the current tank farm waste acceptance requirements. This assessment program is in addition to the receiving facility's (high-level waste tank farm) monthly audit program that reviews high-level waste generator sampling, transfer, packaging, and laboratory analysis procedures, and training requirements.

Non-Conforming High-Level Waste. Facilities receiving waste for storage, pretreatment, or treatment must have a documented process to be used in the event a non-conforming waste is received. Facility procedures need to discuss how non-conforming waste will be segregated from acceptable waste, the process for notifying the sender of the non-conformance, and the acceptable methods for dispositioning the non-conforming waste. The process includes prior notice to the waste sender of the actions to be taken by the facility receiving the waste and the sender's obligations, particularly regarding the cost of the actions, to support the disposition of the non-conforming waste.

> *Example: At Site X, a batch of supernate is transferred from a reprocessing canyon to a high-level waste storage tank, after which it is determined that the transferred batch is non-compliant with the receiving tank due to its low concentration of corrosion inhibitors (nitrites). Upon receipt and discovery of the non-compliance, an analysis indicates that even after blending of the transferred waste with the nitrite-rich waste in the tank, the blended waste is non-compliant with the waste acceptance requirements of the receiving tank. This condition will require the addition of sodium nitrite to the receiving tank to correct the molar concentration of the supernate. The cost for the addition of sodium nitrite is charged to the reprocessing canyon management.*

Compliance with this requirement is demonstrated by the waste acceptance requirements for a high-level waste management facility, including a process for evaluation and acceptance of incoming waste, to ensure that the acceptance criteria of the facility receiving the waste are met. The process includes one of, or a combination of: (1) testing, sampling, and analysis of representative samples of incoming waste; (2) testing, sampling, and analysis of samples of waste taken at the generator facility; (3) evaluation of testing, sampling, and analysis of data provided by the generator; or (4) audits, reviews, surveillances, or observations of generator waste certification programs and characterization activities. Additionally, waste acceptance requirements for storage, pretreatment, or treatment facilities need to have documented procedures if waste that does not conform to the waste acceptance criteria is received at a facility.

Supplemental References:

1. DOE, 1999, *Waste Acceptance System Requirements Document,* Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

2. DOE, 1996. *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, Revision 2, DOE/EM-0093, U.S. Department of Energy, December 1996.

3. DOE, 1994. *DWPF Waste Form Compliance Plan*, Revision 4, WSRC-IM-91-116-0, U.S. Department of Energy, December 1994.

4. DOE, 1997. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 12, WVDP-185, U.S. Department of Energy, December 1997.

II. K. Waste Generation Planning.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all high-level waste streams.

(2) Waste With No Identified Path to Disposal. High-level waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste (compliance with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*).

Objective:

The objective of this requirement is to provide for the disposal of all high-level waste that is generated by ensuring that: the specific waste management facilities necessary for safe management of the waste from the time it is generated up to and including its disposal are identified prior to the generation of a new high-level waste stream; plans are developed for resolving issues that prevent disposal, and for safe, long-term storage for high-level waste with no path to disposal; and sites are discouraged from generating high-level waste that does not have an identified path to disposal.

Discussion:

For purposes of this requirement, the term disposal has essentially the same meaning as compliance with the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS). The EM-WAPS was prepared by the Office of Environmental Management (EM) to document the applicable specifications for producing a high-level waste form acceptable to the Office of Civilian Radioactive Waste Management for disposal. The *Nuclear Waste Policy Act of 1982*, as amended, charges the Office of Civilian Radioactive Waste Management with responsibility for management and disposal of high-level waste. The Office of Civilian Radioactive Waste Management has prepared DOE/RW-0351P, *Waste*

Acceptance System Requirements Document (WASRD), which includes the waste acceptance requirements on which the EM-WAPS is based. The linkages described among these applicable documents and organizations are consistent with the related requirement of this Manual (Section II.S., Disposal) that high-level waste be disposed of "…in accordance with the provisions of the *Nuclear Waste Policy Act of 1982*, as amended." In the guidance for this requirement, the term disposal is, therefore, interchangeable with compliance with the EM-WAPS.

Life-cycle planning. Planning, prior to generating high-level waste, is intended to address high-level waste streams that have not yet been generated. High-level waste streams that are first generated after issuance of the Order are subjected to this requirement. Waste that has already been and continues to be generated is addressed in the site-wide program requirements (see Section I.2.F.(1)). Waste generator planning is closely linked to characterization, certification, and transfer requirements (see Sections II.L, II.M, and II.N) which comprise the waste generator requirements program described in DOE M 435.1-1 (see Chapter I, Section I.2.F.(7)).

> *Example 1: A batch of spent fuel stored at Site X is deteriorating and reprocessing is necessary to reduce risk. The reprocessing will begin two years after issuance of DOE O 435.1 in an existing reprocessing canyon. The spent fuel is different from that previously reprocessed in the canyon, and necessary process changes will produce a waste stream unlike those previously produced. Therefore, the waste generation planning requirements of DOE O 435.1 must be applied.*
>
> *Example 2: A reprocessing canyon that was operating when DOE O 435.1 went into effect continued to operate. Neither the spent fuel input nor the process chemistry or equipment was changed. In this case, the high-level waste generator planning requirements would not apply. The continued reprocessing would be addressed by the site-wide planning requirements (see Sections I.2.F.(1) and II.E).*

Planning needs to address the life-cycle of high-level waste from generation through compliance with the EM-WAPS, including the interim steps of high-level waste management. This can be accomplished by preparing a high-level waste stream life cycle description and reviewing it with managers of the facility(ies) that are expected to manage the high-level waste. The high-level waste stream life cycle description is a sequential description of each step in high-level waste treatment, storage, and transfer to the Office of Civilian Radioactive Waste Management. It provides sufficient information to determine what treatment and storage capabilities are needed so that their availability can be determined. The high-level waste generator needs to confirm with operators of each management facility to be used that based on the current knowledge of the high-level waste stream characteristics and planned facility capacity the high-level waste stream can be managed by the facility.

> *Example: The new Site X waste stream described in the first example above will be subjected to chemical dissolution and separations. The high-level waste resulting from the process will be solidified. At various stages in this series of operations, temporary or long-term storage will likely be required waste generation planning will include preparation of a high-level waste stream life cycle description consisting of identification and explanation of each of these steps and explanation of the interfaces between the steps. The generator of the waste holds discussions with operators of facilities that may be able to manage the waste and incorporates relevant information on waste management needs and the availability of facilities to meet those needs in written plans.*

A measure to determine whether a high-level waste stream has an identified path to compliance with the EM-WAPS is the availability of the necessary facilities and operations. A planned facility is considered to be available if it has been authorized (e.g., a line item in a Congressional appropriation or equivalent approval for design and construction). For purposes of planning for compliance with the EM-WAPS by a high-level waste stream, a facility or capabilities that are part of a program or strategic plan, but have not been authorized, are not considered available. If a planned or available facility is canceled, the generator site will need to revise the planning for the life cycle of the high-level waste. An alternate path to compliance with the EM-WAPS needs to be identified and documented, or approval to generate the high-level waste needs to be obtained from the cognizant Field Element Manager as required in DOE M 435.1-1, Section I.2.F.(19), and plans need to be made for ultimate compliance with the EM-WAPS.

The generator is responsible for ensuring that high-level waste is not generated unless there is due consideration of ultimate compliance with the EM-WAPS. However, it is not the objective of this requirement to prohibit, under all conditions, the generation of high-level waste that does not have an identified, achievable path to compliance with the EM-WAPS. In meeting the DOE O 435.1 planning requirement, it is appropriate for high-level waste management organizations to provide assistance to the generator in determining the high-level waste management path, particularly in cases where the high-level waste management organization may utilize offsite storage facilities for post-immobilization storage. Once the waste is determined to comply with the EM-WAPS, storage conditions are maintained to ensure continued compliance with the EM-WAPS.

Waste streams that do not satisfy the EM-WAPS. There are instances where programmatic needs may necessitate the generation of high-level waste without an identified path to compliance with the EM-WAPS. In these instances, the Field Element Manager must ensure development of a process for identifying generation of high-level waste with no path to compliance with the EM-WAPS and approving the conditions under which such high-level waste can be generated (DOE M 435.1-1, Section I.2.F.(19)). This process is intended to heighten the awareness of high-level waste generators that a long-term commitment is made with the generation of such a high-level waste. The long-term commitment arises from the potential for prolonged storage of

this high-level waste and from the work necessary to resolve issues that prevent compliance with the EM-WAPS.

Under the current DOE high-level waste management configuration, there is a process for the Office of Civilian Radioactive Waste Management acceptance of high-level waste that complies with the EM-WAPS. As noted above, the EM-WAPS is based on requirements such as those in the WASRD. In addition, there are facilities for pretreatment, treatment, and storage of some high-level waste that will be needed prior to compliance with the EM-WAPS.

The conditions for generating a high-level waste without an identified path to compliance with the EM-WAPS include various evaluations and considerations that involve both the high-level waste generator and high-level waste management organizations. The decision to proceed with the activity generating the high-level waste needs to consider the following:

(a) The need to generate the high-level waste. There needs to be a clear identification of the programmatic mission being served that results in the generation of high-level waste with no identified path to compliance with the EM-WAPS. Alternate means of accomplishing the mission without generating the high-level waste need to also be discussed.

(b) High-level waste characteristics which prevent compliance with the EM-WAPS. The reasons that a high-level waste cannot comply with the EM-WAPS need to be identified to support development of plans for ultimately achieving compliance with the EM-WAPS. These may be technical or programmatic reasons. For example, high-level waste needs to be vitrified in a borosilicate glass matrix (Specification 1.1) in order to comply with the EM-WAPS. If an appropriate vitrification facility is not available, the lack of such a facility would be identified as a reason the high-level waste does not have a path to compliance with the EM-WAPS. Similarly, if a high-level waste is categorized as mixed high-level waste because of the presence of a listed hazardous waste and approval for delisting has not been granted by EPA, that would be cited as a reason for no path forward to compliance with the EM-WAPS (Specification 1.5).

(c) Adequate containment capabilities and facilities for the expected duration of the storage period. If the high-level waste cannot comply with the EM-WAPS pending the resolution of programmatic or technical issues, safe storage must be available. In order to evaluate the ability to provide for the storage of the high-level waste, there needs to be an estimate of the amount of the high-level waste that will be generated, as well as an estimate of the time the high-level waste will be in storage. Identification of acceptable storage facilities should be a prerequisite to generating the high-level waste.

(d) Plans for resolving the issues that prevent compliance with the EM-WAPS. The decision to generate high-level waste with no identified path to compliance with the EM-WAPS also needs to be based on a plan to achieve compliance with the EM-WAPS eventually. The plan identifies the activities being pursued to resolve issues preventing compliance with the EM-WAPS and a schedule for their resolution. The activities described may be detailed if the issue is technical and involves only a few sites. For example, plans to develop vitrification capabilities necessary to make a high-level waste that complies with the EM-WAPS could be detailed. The plans would identify the studies, engineering analyses, environmental analyses, design and construction activities, and projected dates for performing them, as appropriate. In other cases that are more programmatic in nature, the activities and schedules will be less detailed. For example, providing for compliance with the EM-WAPS for failed vitrification melters may require a programmatic decision by DOE. The plan for addressing this requirement needs to identify the data collection and options analyses to be performed by the site and address how they fit with the actions being taken by the Complex-Wide High-Level Waste Management Program (see DOE M 435.1-1, Section II.D). Included in the EM-WAPS are provisions for addressing acceptance of non-standard wastes. The generator must obtain delivery and procedure confirmation from the Office of Civilian Radioactive Waste Management prior to transferring such wastes.

If the activities or schedules for conducting the activities are adversely impacted (e.g., as a result of testing, design, funding profile, DOE policy) then they need to be updated. Updates to the schedule and minor modifications of the activities would not be a basis for re-evaluating the generation of the high-level waste. However, major modifications of the activities (e.g., changes in plans for developing the treatment facility or changes in the WASRD) would result in a re-evaluation and re-confirmation of the acceptability of continuing to generate the high-level waste. All changes in plans for resolving issues preventing compliance with the EM-WAPS are coordinated with the Headquarters Office of Waste Management so their impact on the complex-wide high-level waste management program can be reflected in the High-Level Waste Program Plan (see DOE M 435.1-1, Section I.2.D.(l)).

Example: Processing of the new Site X high-level waste stream described in the first example above requires precipitation and removal of excess chromium to enable compliance with the product consistency specification in the EM-WAPS (Specification 1.3). Site X management plans to build a facility for chromium removal to supplement its existing reprocessing facilities, but Congress has not yet appropriated the funds for design and construction. For purposes of the waste generator planning, the chromium

removal facility was not available and the generator planning for the life cycle of the waste elected to seek approval from the cognizant Field Element Manager to generate the waste in the absence of an available path to compliance with the EM-WAPS. The generator considered elimination of the need for chromium removal, but that option was found to be technically infeasible. The Field Element Manager approved the generation of the waste anyway, based on consideration and documentation of the following four factors:

(a) the need to generate the high-level waste;
(b) high-level waste characteristics which prevent compliance with the EM-WAPS;
(c) adequate containment capabilities and facilities for the expected duration of the storage period; and
(d) plans for resolving the issues that prevent compliance with the EM-WAPS.

Compliance with this requirement is demonstrated by individual sites establishing a process for evaluating the life cycle of high-level waste prior to its generation, including the identification of high-level wastes with no path to compliance with the EM-WAPS and appropriate records justifying the newly generated high-level waste streams. The process would be considered acceptable if, before generating high-level waste, the Field Element Managers responsible for operation of the needed treatment and storage facilities approve generation of the high-level waste. Records substantiating high-level waste generation planning would be of two types. First, site personnel would have records showing the location(s) where high-level waste will be treated and stored, the estimated period of storage, and confirmation that the personnel managing the facilities agree that the high-level waste can be managed at those facilities. Second, the waste generation organization would have records documenting the decision to generate a high-level waste that does not have a known path to compliance with the EM-WAPS. This second set of records is judged to be adequate if they include an explanation of the need for the process that generates the high-level waste, a discussion of the reason it cannot be disposed of, and an up-to-date schedule of activities being pursued to resolve constraints to the compliance with the EM-WAPS of the subject high-level waste.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

II. L. **Waste Characterization.**

High-level waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

Objective:

The objective of this requirement is to ensure that sufficient knowledge of high-level waste's characteristics (e.g., chemical, physical, radiological) is available to support workers during handling the waste and to support effective decision-making for its management. This information is to be maintained from generation, through storage, pretreatment and treatment in sufficient detail to ensure that the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS) are met. Waste, that is identified through the waste incidental to reprocessing process to be non-high-level waste, shall be characterized in a manner that ensures subsequent treatment and disposal requirements for low-level waste and transuranic waste can be met.

Discussion:

The *Radioactive Waste Management Manual*, General Requirements, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the applicable waste acceptance requirements. Generator requirements address generation planning, waste characterization, waste certification, and waste transfer. The characterization requirement addresses the hazards associated with insufficiently characterizing the waste to ensure safe storage, and to ensure pretreatment or treatment operations result in a waste form that meets the requirements of the EM-WAPS. In addition, characterization data that are collected during generation, storage, and after pretreatment or treatment of high-level waste need to be reliable and in sufficient detail to ensure subsequent management can be conducted safely and to meet the waste acceptance requirements of all subsequent receiving facilities. Accurate characterization of high-level waste is essential to: 1) waste planning by generators, as required by Section II.K; 2) waste transfers by generators and other senders of waste, as required by Section II.N; and 3) waste certification by both senders and receivers, as required by Section II.M.

In conducting the analyses for development of the DOE M 435.1-1 requirements, minimum characterization requirements were identified as necessary to ensure safe management of high-level waste from generation, storage, pretreatment and treatment processes. Guidance for

requirements for minimum characterization for all high-level waste generation, storage, pretreatment, and treatment facility activities is provided in subrequirement (2) of Section II.L, paragraphs (a) through (d). Guidance for the requirements for data quality objectives and hazardous characteristics is provided in subrequirements (1) and (3), respectively, of Section II.L.

Waste characterization is defined as:

> "The identification of waste composition and properties, such as by review of process knowledge, or by nondestructive examination, nondestructive assay, or sampling and analysis, to comply with applicable storage, treatment, handling, transportation, and disposal requirements."

Thus, waste characterization is a tool for gathering information that will support defensible decisions regarding safety, process, and environmental matters in the management of high-level waste. The magnitude of such decisions may vary from whether individual high-level waste streams are compatible for mixing in a storage tank to whether their mixing may reduce the likelihood of producing an acceptable final (glass) high-level waste form. The following sections of guidance address elements of characterization activities that support defensible decision making: use of indirect methods, characterization documentation, characterization for safe storage, and characterization for treatment to meet the EM-WAPS.

Use of Indirect Methods. In the safety and hazards analysis performed in support of development of DOE M 435.1-1, the use of indirect methods of characterizing high-level waste was identified as a potentially significant factor in maintaining accurate characterization of high-level waste. The use of indirect methods is particularly applicable when nondestructive evaluation or sampling and analysis will potentially expose operations personnel to additional radiation. Indirect methods for characterization of high-level waste are based on the materials or processes used to generate the waste, as well as the analytical data obtained from the process or waste stream. Indirect methods for characterization are also considered to include information regarding the process that generated the waste stream, the physical form and materials composing the waste, the chemical constituents of the waste, and the nature of the radioactivity present.

Indirect methods may be used to describe high-level waste if the source information is consistent, defensible, and auditable. The use of indirect methods is justified by its potential to minimize personnel exposure and to reduce the high costs of intrusive sampling and analysis. In practice, indirect methods can be effectively used where high-level waste is generated in well known and tightly controlled processes for which the product is highly predictable.

By using indirect methods, where appropriate, the potential exists for minimizing the exposure of operating personnel to radiation and complying with the as low as reasonably achievable (ALARA) principle for keeping exposures to a minimum. Additionally, characterization of

high-level waste by the use of indirect methods reduces the volume of sample materials and laboratory equipment and expendables that would be contaminated due to the analyzing of the sample.

While the development of a process for identifying and documenting high-level information to support indirect methods is not required for high-level waste by DOE M 435.1-1, the following guidance provides an overview of elements of an acceptable process for assembling such documentation:

- Information to support indirect methods is compiled in an auditable record.
- Correlations within waste streams in terms of time of generation, waste generation processes, analytical data, and site-specific facilities should be clearly described.
- A reference list of applicable documents, databases, quality control protocols, and other sources of information that support the indirect methods is prepared.
- Procedures which outline the methodology that is to be used to identify and assemble auditable, acceptable records to support indirect methods, including the origin of the documentation, how the assembled information was or will be used, and any limitations associated with the information.

Characterization data gained by indirect methods must be within the acceptable range of certainty and precision. Additionally, the effects of time-dependent processes must either be negligible or predictable. Acceptable information to support indirect methods can be verified by collection and comparison of statistically valid analytical sampling of processing records. The periodicity of sampling and analysis should correlate with the nature of any changes in the process creating the waste or with changes that are being documented in characterization data. Finally, the data must be consistent with the requirements contained in the EM-WAPS. In particular, data collected and used for indirect methods that are considered "waste product affecting" must be verifiably correct and defensible and the strategy for its use must be described and defended by each waste producer in their waste compliance plan and waste qualification reports.

Indirect methods documentation should follow the process and include the documentation elements described below with particular emphasis on data quality assurance. As discussed in DOE M 435.1-1, Section II.N, Waste Transfer, this documentation needs to be organized and assembled in a manner that allows it to be transferred to the facility or operation that is to receive the waste.

> *Example: At the Site Z there is a high level of confidence in the mass balance data available from the generator (Q-Canyon) for a particular high-level waste stream that is scheduled to be transferred from a storage tank to the sludge wash (pretreatment) process. Review of the waste processing information by trained and knowledgeable personnel concludes that the data are reliable and that, in lieu of sampling and analysis,*

an indirect method will be used to characterize and certify the waste for transfer. This decision and the quality of the data is documented and included in the documentation that is transferred with the waste.

Characterization Documentation. The requirement states that characterization data shall be documented in sufficient detail to enable the waste acceptance requirements of the receiving facility to be met. The following elements are considered essential to this process for obtaining and controlling characterization data:

Organization(s) and Responsibilities - Identification of the organizations involved and responsible for characterization of high-level waste.

Quality Assurance - Characterization data need to be subjected to a clearly identified and well-documented quality assurance program. In the case of characterization data that applies to high-level waste, items and activities important to waste acceptance/product quality need to apply the quality assurance requirements of DOE/RW-0333P, *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program,* as specified in DOE M 435.1-1, Section II.G, Quality Assurance Program.

Procedures - The process for obtaining waste characterization data is formalized in procedures and need to describe how to follow the steps that are provided and the administrative process for ensuring the data are of acceptable quality. Procedures need to be developed for sampling, packaging, transportation, laboratory analysis, and data control.

Procurement/Purchasing Controls - The procurement and/or purchasing of items or services that are used in characterizing high-level waste need to be controlled and documented. Procurement includes the purchase of sampling equipment and sample transport containers as well as services such as laboratory analyses (onsite or offsite). Requirements are dictated by the type of procurement, but needs to include, or reference: the technical specifications for the item/service being procured; identification of quality assurance requirements including any required inspections; specifications of documentation requirements (e.g., certification of compliance or conformance, laboratory analytical results); and a statement ensuring access to the provider's facilities as necessary to perform audits and inspections.

Document/Data Change Control - Records that contain characterization data, whether they have been generated through sampling and analysis, nondestructive assay, or indirect methods, need to be subject to document and data change control. In addition, the documentation of waste characterization procedures and the quality assurance program

are subject to control. Document and data change control includes review, approval, and distribution to designated recipients (users), and a controlled process for making revisions to documents. Existing document and data control programs at a site may be adequate for high-level waste characterization data, but will need to be reviewed to ensure the objectives of DOE M 435.1-1 requirements are met.

Training - Characterization data are generated and managed only by personnel that are properly trained to recognize the significance of the data.

Records - Waste characterization records include those that are necessary to meet the waste acceptance requirements of receiving facilities and as specified by the waste certification program, as specified in Section II.M.

Existing programs at a site may provide the framework within which the elements of waste characterization can be addressed (e.g., quality assurance, training, document control). The waste acceptance requirements of a facility to which the waste is to be sent may impose additional requirements on what is to be included in the waste characterization data.

Characterization for Safe Storage. Characterization data for high-level waste streams are developed to ensure that the transfer and addition of a high-level waste solution, slurry, or sludge does not present an added risk to the storage systems that receive it, i.e, the transferred material must be compatible with the tank and its contents. These data are based on an analysis of the waste stream through either sampling, indirect methods, or a combination of both, and must be in a form consistent with the receiving facility's waste acceptance requirements. Consideration also is given, and documented, to facilities or operations downstream of the receiving facility to ensure that waste acceptance requirements for these facilities will not be violated.

Example: At Site Z, a high-level waste stream is planned to be transferred by a generator to the high-level waste tank farms. Characterization of the waste is conducted by the generator to ensure that not only are the waste acceptance requirements of the receiving tank satisfied, but also the waste acceptance requirements of the pretreatment and treatment facilities, downstream of the waste storage tanks. These downstream facilities require a more extensive chemical analysis to ensure that the waste is acceptable for making a quality glass waste form.

Various techniques can be employed to characterize high-level waste. Techniques include sampling and analysis, nondestructive assay techniques, and the use of indirect methods. In selecting the characterization technique for a particular waste stream, trade-offs are considered to determine which is most appropriate. Trade-off analyses are part of an ALARA process which needs to consider:

- radiation exposure to operations and sampling personnel;
- potential for contamination or other abnormal events;
- costs (personnel, resources and schedule);
- reliability and confidence level of the data;
- availability of data to support indirect methods;
- required management activities (audits, evaluations); and
- re-engineering of sampling operations to reduce worker hazards.

Balancing these competing considerations is considered necessary to meet the requirement. As discussed in the guidance for the data quality objectives process, Section II.L.(1), the characterization technique chosen is dependent on the data required, and the quality of such data.

> *Example: At Site K, additional characterization data for the contents of Tank 300 are needed promptly to ensure that the addition of 75,000 gallons of a decontamination solution to the existing 400,000 gallons of high-level waste slurry will not generate a vapor phase of waste product that is combustible. While the contents of the existing tank have not been characterized by sampling, its contents are well documented through the generator documentation (e.g., mass balance calculations). In addition, controls to ensure additional wastes have not been transferred to the tank are in place and considered reliable. Furthermore, plans to sample and analyze the tank contents conclude that a potential exists for significant worker exposure and unacceptable programmatic schedule delays due to laboratory workload. Thus the decision is made, through a documented "trade-off" analysis, that the risks of adding the solution to the tank, using indirect methods about the existing tank waste and knowledge about the decontamination solution, are lower than the risks of sampling and analyses.*

<u>Characterization for Treatment to Meet the Office of Environmental Management-Waste Acceptance Product Specifications (EM-WAPS)</u>. For high-level waste, an appropriate level of characterization data must be available from the time of generation of the waste stream through storage, pretreatment, treatment, and post-treatment storage to ensure that the final waste form meets the requirements of the EM-WAPS, applicable revision. The current EM-WAPS outlines the technical specifications the waste form Producers are required to meet in order to ensure acceptance of their vitrified high-level waste into the Civilian Radioactive Waste Management System. The Office of Environmental Management and the Office of Civilian Radioactive Waste Management have agreed that the Office of Environmental Management is to provide the final waste form specifications to the waste form producers and that the Office of Environmental Management will ensure that the EM-WAPS is consistent with the technical baselines as defined in the Office of Civilian Radioactive Waste Management's DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD). Thus, the EM-WAPS governs all elements of the final, canistered, waste form which includes the borosilicate waste glass, the stainless steel canister, and the sealed canistered waste form.

The waste acceptance process requires demonstration of compliance with the EM-WAPS through four different documents, each prepared by the waste producers, reviewed and accepted by the Office of Environmental Management, and provided to the Office of Civilian Radioactive Waste Management. These four documents are: the Waste Form Compliance Plan; the Waste Form Qualification Reports; the production records; and the storage and shipping records. The waste producers included in Revision 2 of the EM-WAPS are the Defense Waste Processing Facility at the Savannah River Site, the West Valley Demonstration Project, and the Hanford Site. Final waste form developmental work at the Idaho National Environmental Engineering Laboratory has not progressed to the point that it has been included in the current EM-WAPS.

The EM-WAPS provides detailed specifications that must be met by the waste producers in order for the final waste form to be acceptable to the Office of Civilian Radioactive Waste Management for disposal. Amplification on these specifications is considered beyond the scope of this Implementation Guide; however, Refer to the current Waste Compliance Plans and Waste Qualification Reports for the Defense Waste Processing Facility and the West Valley Demonstration Project, both of which provide a detailed description of the methods by which they comply with each of the specifications. Following are the titles of each of the summary specifications within the EM-WAPS:

1. Waste Form Specifications
2. Canister Specifications
3. Canistered Waste Form Specifications
4. Quality Assurance Specification
5. Documentation and Other Requirements

The level of characterization needed and the data required for the production of an acceptable final high-level waste form are described in the EM-WAPS (included in supplement references) and are not reproduced in this Guide. However, the strategy for complying with these specifications is left to each waste producer. Each strategy is defined in the waste producer's Waste Compliance Plan and demonstrated in their Waste Qualification Reports.

Examples: (1) Section 1.1, "Chemical Specification," of the EM-WAPS, requires that each waste producer project, in their Waste Qualification Report, the chemical composition of the final waste form, by oxides present that are in concentrations greater than 0.5 percent. (2) Section 1.2, "Radionuclide Inventory Specification," of the EM-WAPS requires that each waste producer project, in their Waste Qualification Report, the inventory of radionuclides that have half-lives longer than 10 years and that are, or will be, present in concentrations greater than 0.05 percent of the total radioactive inventory, indexed to the years 2015 and 3115. For both specifications each waste producer is required to provide a strategy on how these projections will be made.

Waste Incidental to Reprocessing. Waste streams that are subjected to the waste incidental to reprocessing determination processes (DOE M 435.1-1, Section II.B) need to be adequately characterized to support the conclusions reached in applying the two processes, i.e., the citation process and the evaluation process. For those waste streams that are determined to be non-high-level waste by the use of these processes, the applicable characterization requirements are included in DOE M 435.1-1, Section III.J for transuranic waste, and Section IV.I for low-level waste.

Compliance with this requirement is demonstrated by the existence of records that document characterization data for high-level waste that are consistent with the waste acceptance requirements of high-level waste storage, pretreatment, or treatment facilities. In addition, the records need to be consistent with the characterization data required by the current version of the EM-WAPS. For those waste streams that are subjected to the waste incidental to reprocessing process(es), adequate characterization data records must exist to support the conclusion.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, Revision 2, DOE/EM-0093, U.S. Department of Energy, December 1996.

2. EPA, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

3. DOE, 1994. *DWPF Waste Form Compliance Plan*, Revision 4, WSRC-IM-91-116-0, U.S. Department of Energy, December 1994.

4. DOE, 1995. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 11, WVDP-185, U.S. Department of Energy, February 1995.

5. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

II. L.(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Objective:

The objective of this requirement is to invoke a process for determining the type, quantity, and quality of characterization data needed to support the safe management of high-level waste so as to ensure that needed data are acquired, the data meet the objectives they are being collected for, and resources are not wasted on unnecessary, incomplete or unusable data collection efforts.

Discussion:

The type, quantity, and quality of characterization data obtained for the safe management of high-level waste need to be consistent with the purpose for which the characterization information will be used. As discussed in the guidance to DOE M 435.1-1, Section II.L., the uses of high-level waste characterization data include: complying with storage, pretreatment, and treatment facilities' waste acceptance requirements; meeting the final waste form specifications of the EM-WAPS; evaluating high-level waste confinement integrity; determining radiation shielding and other protective measures; evaluating compliance with processing requirements; and meeting regulatory commitments. This requirement is included in DOE M 435.1-1 to ensure that only the appropriate characterization data to support the safe management of high-level waste is generated. The requirement is intended to promote a structured process for the collection, and use, of high-level waste characterization data and avoid the collection of data that is neither necessary nor defensible.

The requirement invokes the use of a process to provide the structured approach for determining the type, quantity, and quality of characterization data needed. Such a process, called data quality objectives, has been developed by the US Environmental Protection Agency (EPA) and is documented in EPA's QA/G-4, *Guidance for the Data Quality Objectives Process*. However, use of other comparable processes that employ a structured process to yield similar results are also supported.

The objectives of applying a structured process such as the data quality objectives process are to:

- Manage and control the risks of making incorrect decisions;
- Determine the data required to support making specific decisions;
- Determine the type and quality of required data;
- Allow decision makers, stakeholders, data users, and relevant technical experts to participate in planning and assessment;
- Determine the quantity, location, and type of samples required;

- Quantify the uncertainty in data through development of statistical sampling plans; and

- Reduce overall costs by identifying resource-efficient sample collection and analytical methods by optimizing the sample and analysis plans.

The data quality objective process is a strategic planning approach based on the scientific method that is used to prepare for a data collection activity. The value of using this process to develop high-level waste characterization parameters is that it: saves resources by making characterization data collection operations more resource-effective; enables characterization data users and others to participate in characterization data planning; and provides a structured method for defining characterization data performance requirements, i.e., quality.

The process for establishing characterization needs via the data quality objectives process requires input from various waste management organizations and interested groups to establish a clear understanding of the characterization data needs and the level of data quality that is acceptable for making high-level waste management decisions.

The Field Element Manager is to ensure that managers of generator facilities assume responsibility for key activities in the data quality objectives (or similar) process by:

- Designating the author of the data quality objectives document.
- Participating in development of the initial data quality objectives strawman.
- Identifying the stakeholders.
- Participating in stakeholder meetings.
- Selecting members of the expert panel.
- Participating in the review of the final data quality objectives process.
- Approving the data quality objectives document prior to submission to the Field Element Manager.
- Identifying activities that initiate a data quality objectives revision based on the extent of the revision.

The managers of generator facilities should rely on personnel within the facility organization to support the elements of the data quality objectives process. Those personnel may be supplemented by subject matter experts (e.g., facilitators, samplers, laboratory personnel, statisticians, safety personnel, quality assurance personnel). The facilitator may be part of the generator organization or a consultant. The facilitator’s role is to keep meetings focused, maintain the document development schedule, and troubleshoot administrative and logistics problems.

The data quality objectives process consists of seven steps. The output from each step influences the choices that will be made later in the process. Even though the data quality objectives process is depicted as a linear sequence of steps, in practice it is iterative, e.g., the outputs from one step may lead to a reconsideration of prior steps. This iteration is encouraged since it will ultimately lead to a more efficient data collection design.

During the first six steps of the process, a team of process-cognizant personnel should develop decision performance criteria (data quality objectives) that will be used to develop the data collection design. The final step of the process involves developing the data collection design based on the data quality objectives developed in the first six steps. The first six steps should be completed before the team attempts to develop the data collection design because the design is dependent on a clear understanding of the first six steps taken as a whole.

Following is a listing and brief description of each of the seven steps. This is followed by an example of how the data quality objectives process can be applied to the generation of high-level waste characterization data.

1. State the Problem – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

2. Identify the Decision – Identify what questions the study will attempt to resolve, and what actions may result.

3. Identify the Inputs to the Decision – Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

4. Define the Study Boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.

5. Develop a Decision Rule – Define the statistical parameter of interest, specify the action level, and integrate the previous data quality objective outputs into a single statement that describes the logical basis for choosing among alternative actions.

6. Specify Tolerable Limits on Decision Errors – Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

7. Optimize the Design – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all data quality objectives.

Example: At Site Z, the operator of a spent nuclear fuel reprocessing facility plans to restart an existing fuel dissolution process line that will generate a new high-level waste stream that is significantly different in chemical/radionuclide composition than has been generated at the site before. Proper management of this new waste stream has been recognized by the site's waste management organization as a significant challenge to the high-level waste management program. It has also been recognized that proper characterization data, and the quality of this data, are critical to the safe management of this waste. For this reason, and to ensure unnecessary and unusable data are not generated, the high-level waste management organization organized a team of cognizant waste management personnel to implement the data quality objectives process with the purpose of defining the type, quantity, and quality of characterization data needed. The site team used the EPA Data Quality Objectives process as follows:

The problem was identified as the introduction of a new high-level waste stream to the site's high-level waste management system. The question that needed to be answered was: What characterization data are needed to support management of this new waste stream? (Management was defined to include all storage, pretreatment, treatment, and post treatment storage activities at the site that are needed.) Inputs needed were identified as: waste acceptance requirements for all affected facilities, authorization basis/limits for all affected facilities, radiological limits/ controls, RCRA requirements, state/local regulations, EM-WAPS, characterization data quality/accuracy requirements. The boundaries were defined as the high-level waste management system and the low-level/mixed low-level waste management system for secondary waste streams. Other boundaries identified were that the new waste stream would be generated for only 5 years, beginning in 12 months, and that the total quantity would not exceed 1,000,000 gallons of liquid waste. A major identified constraint/risk to data identification/ collection was the fact that this waste has been produced at bench-scale testing only, and that the characteristics of the waste at full-scale operations may vary from these results. Key parameters included: chemical composition, radionuclide composition, pH, nitrate/nitrite/hydroxide concentrations, volatile/flammable species, organics, RCRA-listed wastes, fissile material, challenges to receiving facility authorization bases, and receiving tank waste characteristics.

From the set of parameters identified above, key decision rules were developed. For example, if the pH of the waste is equal to, or less than, 9.5, the waste is unacceptable for transfer to the tank farm. For each of identified twenty parameters an acceptable range of errors was established. These were based on sampling/analysis and operational experience. For example, the calculation, or measurement, of the pH of the new waste stream must be within a 95% confidence range; with the most severe consequence being violation of the tank farm's authorization basis. Finally, with the individual characterization parameters identified, a review of the entire collection was conducted to

ensure consistency and completeness. This review resulted in the number of the parameters being deleted and the establishment of a final set of characterization parameters for the new waste stream. These parameters were incorporated into a waste characterization plan for the restarted fuel dissolution process.

The above description of the steps using the data quality objectives process, and the example, are provided as an introduction to the process. A more detailed description of the process can be found in the referenced EPA Guide. The data quality objectives process is most useful during the planning stages of identifying high-level waste characterization and uncertainty parameters, i.e., before the data are needed and collected. The value of the process is diminished significantly if the characterization data have already been collected and are being used.

Compliance with this requirement is demonstrated by the documented use of a data quality objectives, or comparable process, for determining the type, quantity, and quality of characterization data needed to safely manage high-level waste.

Supplemental References:

1. EPA, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Agency, Washington, D.C., September 1994.

II. L.(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any solidification media;

(c) Radionuclides or source information sufficient to describe the approximate radionuclide content of the waste; and

(d) Any other information which may be needed to demonstrate compliance with the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

Objective:

The objective of this requirement is to establish minimum high-level waste data that have been determined to be necessary for safe and effective management during the life cycle of the waste.

Discussion:

In the process of developing DOE O 435.1 and DOE M 435.1-1, characterization of high-level waste was identified as an activity in the life-cycle management of waste with a significant potential for loss of adequate waste management controls which could result in exposure or release of radioactivity. This requirement identifies those critical characterization data points that must be known at all times to ensure safe handling and proper management. These requirements are considered the minimum categories of data that the data quality objectives process (DOE M 435.1-1, II.L.(1)) should require and address. The sections below provide guidance on each of the specific characteristics.

Physical and chemical characteristics. The physical and chemical characteristics information needed should be guided by data needs of the storage, pretreatment, or treatment processes that the waste is expected to be exposed to and the waste acceptance requirements established for the facilities and processes that perform these operations. Physical properties should include a description of the material, its phase (solid or liquid), density, consistency, temperature, and conductivity. Chemical properties should include pH, reactivity, chemical compounds present, and hazardous and/or toxic constituents present. However, the complete list of properties that are needed is guided by the receiving facility's or operation's waste acceptance requirements. Additionally, the high-level waste EM-WAPS, Specification 1.1, "Chemical Specification," has specific requirements regarding the identification of the chemical composition of the final (immobilized) waste form that must be reported in the Waste Qualification Report, for each waste type, by high-level waste producers. Establishment of the characterization data requirements must consider these and other EM-WAPS data requirements.

Volume, including the waste and any solidification media. Volume and weight information is necessary for proper control of immobilized high-level waste storage, transportation, and disposal as well as control of canistered waste handling systems. The EM-WAPS, Specifications 3.6, "Fill Height Specification," and 3.11, "Specifications for Weight and Overall Dimensions," require that the filled canister volume, weight, and overall dimensions be reported in the Storage and Shipping Records that will accompany each canister to the geologic repository disposal site. The method and basis for meeting these EM-WAPS requirements are described by each waste producer in their Waste Compliance Plan and the Waste Qualification Reports.

Additionally, the EM-WAPS, in Specification 1.1, "Chemical Specification," requires waste producers to include chemical composition projections of the final high-level waste form. These

projections must include all elements, including waste material and solidification media, (e.g., glass frit) that are present in concentrations greater than 0.5 percent, by weight, in the final waste form. As with the volume and weight information, the methods and basis for meeting this EM-WAPS requirement must be described by each waste producer in their Waste Compliance Plan and the Waste Qualification Reports.

Radionuclides or source information sufficient to describe the approximate radionuclide content of the waste. Radionuclide information for liquid (pre-immobilized) high-level waste and the final waste form is necessary to support proper personnel radiation protection and control for managing high-level waste. It ensures that all high-level waste management facilities are inherently safe with respect to criticality. For the final waste form**,** the EM-WAPS, Specification 1.2, "Radionuclide Inventory Specification," requires that each waste producer project, in their Waste Qualification Reports, the total quantities of individual radionculides in each canistered waste form that are to be shipped to the repository. Additionally, Specification 3.9, "Specification for Maximum Dose Rates," of the EM-WAPS, sets limits on the surface (on contact) gamma dose rates and neutron dose rate at the time of shipment of the final waste form. Included in the Storage and Shipping Records must be either the calculated or measured values for both gamma and neutron dose rates at the time of shipment. Finally**,** Specification 3.7, "Specification for Removable Radioactive Contamination on External Surfaces," sets specific limits on the non-fixed (removable) radioactive contamination that is allowed on the exterior surface of each canistered waste form. The methods and basis for meeting these specifications must be described by each waste producer in their Waste Compliance Plan and Waste Qualification Reports. Following is an example of the type of characterization data that meet this requirement:

> *Example: Radionuclide characterization data for high-level waste sludge contained in a tank at Site X include:*
>
> > *Basis: Analysis based on results of 24 samples of dried sludge.*
> > *Volume: 37.9 m^3 or 10,000 gallons*
> > *Density: 2.4 g/cc*
> > *Chemical Composition: by element, wt. % and imprecision (% relative standard deviation)*
> > *Radionuclide Composition: by radionuclide, wt %, and imprecision (% relative standard deviation)*

For pre-immobilized high-level waste, the waste acceptance requirements for the storage, pretreatment, and treatment facilities at which waste will be received dictate the radionuclide parameters that are needed. Parameters which may be required include:

- total activity of the transferred waste, in curies;

- identity and activity per unit mass of the major radionuclides. For purposes of this guidance, major radionuclides are those which are determined to be of importance to the receiving pretreatment, storage, or treatment facility. These may be dictated by the facility's authorization basis and/or radioactive waste management basis.

All of the data requirements described above may not be required for all phases in the life-cycle management of high-level waste. The specific data needs will be determined by the waste acceptance requirements of a particular receiving pretreatment, storage, or treatment facility**.** To assure the receiving facility's waste acceptance requirements are met, follow the waste certification process which is included of Section II.M.

Compliance with this requirement is demonstrated by the existence of records that document characterization data for high-level waste that are consistent with the minimum characterization data requirements.

Supplemental References:

1. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, April 1999.

II. L.(3) Hazardous Characteristics. Waste characterization processes shall yield sufficient chemical and physical data to clearly identify any hazardous characteristics that may degrade the ability of structures, systems, and components to perform their radioactive waste management function.

Objective:

The objective of this requirement is to ensure availability of hazardous characteristics information about high-level waste that could impact the integrity of confinement and containment systems, the operation of process equipment, and the effectiveness of waste processes and other related activities.

Discussion:

In conducting the hazard analyses for the development of the DOE M 435.1-1 requirements, the identification and control of the hazardous constituents of high-level waste were identified as being potentially significant factors in maintaining the high-level waste management facilities' safety envelope for storage, pretreatment, and treatment operations. The term hazardous

characteristics, used in this requirement, is not to be confused with the RCRA use of the same term. Management of high-level waste streams that exhibit hazardous characteristics, as defined by RCRA, e.g., corrosivity or toxicity for metals, is discussed in the guidance to DOE M 435.1-1, Section II.C.

Hazardous characteristics of high-level waste are any qualities of the waste that pose a threat to the safe management of high-level waste. These can be derived from compounds, chemicals, or elements contained in the waste.

A facility's waste acceptance requirements and/or authorization basis will normally require characterization data that are necessary to prevent these characteristics from jeopardizing the safe confinement or containment of high-level waste. The following examples of parameters are provided for consideration:

- minimum pH of waste, since the high-level waste tanks at many of the sites are constructed of carbon steel. Solutions below a pH of 7 cause general corrosion of the steel;
- volatile species, e.g., benzene and ammonia, that may generate flammable or detonable concentrations of vapor in tanks and process vessels;
- corrosive species, e.g., chlorides and sulfates, that may cause corrosion of carbon steel waste storage tanks;
- organic compounds, e.g., tributyl phosphate, that may generate flammable or detonable concentrations of vapors in tanks and process vessels;
- shock sensitive compounds, e.g., silver nitride, that may breach the confinement systems of high-level waste system processes.

Compliance with this requirement is demonstrated by the existence of records that document the chemical and physical data for characteristics of high-level waste that may pose a hazard to high-level waste structures, systems, and components.

Supplemental References: None.

II. M. <u>Waste Certification</u>.

> **A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving high-level waste for storage, pretreatment, treatment, or disposal are met.**

Objective:

The objective of this requirement is to ensure that waste transferred to a facility for storage, pretreatment, treatment, or disposal meets the receiving facility's waste acceptance requirements to reduce the likelihood that transferred wastes contain unacceptable materials or characteristics, and to avoid hazards that would occur from the transportation and handling of waste packages which do not meet acceptance requirements. Certification also ensure that the storage, pretreatment, treatment, or disposal facilities receiving the waste operate within limits of established safety and/or performance assessments.

Discussion:

As discussed in the guidance for Radioactive Waste Generator Requirements (Chapter I, Section I.2.F.(7)), the Field Element Manager is to ensure development and approval of a program that addresses the responsibilities of a waste generator. The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the waste acceptance requirements of the facility to which it is transferred. The generator requirements address generation planning, waste characterization, waste certification, and waste transfer. As discussed in this guidance, a certification program is to be established by generators of radioactive waste to provide a mechanism for confirming that waste is in compliance with the waste acceptance criteria of the facility to which the waste is being transferred. The certification program is required by any organization or facility that transfers waste to another facility.

The certification program is part of the waste generator program that is developed and approved by the Field Element Manager, or designee. The certification program requires that an authorized official confirm that waste meets the waste acceptance requirements of the facility to which it is being transferred. Additional guidance, correlated to the specific requirements in Waste Acceptance Requirements, Section II.J, is provided below.

<u>Program Development and Documentation</u>. The waste certification program needed to meet this requirement consists of a documented, structured process that works in concert with the DOE M 435.1-1 requirements for waste acceptance (Section II.J) and waste transfer (Section II.N) to control the transfer of waste to storage, pretreatment, treatment, or disposal facilities. Development of the waste certification program involves defining and documenting controls for those items and activities that affect certifying that a waste and its packaging meets the waste acceptance criteria of the receiving facility. This includes confirmation that the final (vitrified) waste form meets the requirements of the EM-WAPS, thus ensuring acceptance of the waste into the Civilian Radioactive Waste Management System. The documentation should include the following:

(Note: For those "Items and Activities Important to Waste/Product Quality," as defined by each high-level waste producer as part of their Waste Compliance Program/Plan, additional requirements, as specified in RW-0333P (Quality Assurance Requirements and Description) apply (see DOE G 435.1-1, Section II.G, Quality Assurance Program, for details)).

Organization(s) and Responsibilities. Certification program documentation needs to identify the organizations involved in the certification process and the responsibilities of each. Official(s) who are authorized to certify waste are identified in the documentation.

Quality Assurance. The certification program is subject to a quality assurance program. The quality assurance program that applies to waste certification activities needs to be identified and documented. The use of an existing quality assurance program under which the certification activities will be performed is acceptable and appropriate.

Procedures. The process for certifying waste needs to be formalized in procedures. The procedures describe to the user the steps that are to be followed and the administrative process for ensuring waste streams are certified. The procedures also require a signed statement certifying waste meets the appropriate criteria.

Procurement/Purchasing Controls. The procurement and/or purchase of items or services that are significant to certifying that a waste package meets the waste acceptance criteria of a receiving facility need to be documented. Such procurements may include the purchase of materials such as waste containers or laboratory services (onsite or offsite). As dictated by the type of procurement, the documentation should include or reference the technical specifications for the item/service being procured, identification of quality assurance requirements, including any required testing or inspections, specification of documentation to be provided on delivery (e.g., fabrication inspection and/or test records, a certificate of compliance or conformance, laboratory analytical results), and a statement ensuring access to the provider's facilities as necessary to perform audits and inspections. The certification program ensures that the procurement documentation is reviewed and approved by an official with knowledge of the need, intent, and requirements for the procurement. The program also provides for documented verification commensurate with the relative importance and complexity of the items or services being procured.

Document Control. The principal documents that constitute the certification program need to be subject to document control. Program documentation will identify which documents are to be controlled. The waste certification program description, waste certification procedures, and quality assurance program documentation need to all be subject to document control. Document control includes review and approval, distribution to designated recipients (users), and a controlled process for making changes to the

documents. Existing document control programs at a site may provide the necessary controls for documents that are part of the waste certification program.

Training. The certification program needs to identify the training requirements for the various individuals that are involved in the program. At a minimum, the program requires training of the official who certifies the waste packages to the waste acceptance criteria of the facility(ies) to which the waste is being transferred. In addition, individuals will need to be trained to the procedures that control the part of the certification process with which they are involved.

Records. The certification program documentation needs to describe the management of certification records (see guidance for Section II. M.(1)).

Example: At Site Z, the Office of Defense Programs generates much of the high-level waste that is sent to the waste storage tanks which are managed by the high-level waste management organization. Using the above guidance, Defense Programs should work with the receiving facility to define the waste certification program. Through a review of the existing site procedures, site personnel may determine that the waste certification program can operate under the existing site document control program, procurement process, records management program, and training program. The certification program documentation would include identification of these other programs as applying, identify the facilities from which waste would be transferred, designate the officials responsible for waste certification at those facilities, and develop procedures (within the document control program) that ensure compliance with the waste acceptance criteria. Within the existing programs, site personnel would identify the training requirements, records to be maintained and retention times, technical specifications and receipt requirements for obtaining waste packaging materials, and requirement for analytical data. However, the existing site quality assurance program was found to be inadequate and required the generation of new quality assurance documentation to support the Defense Programs Certification Program. Operating within the parameters defined by the high-level waste program, Defense Programs would be able to certify waste for transfer to the high-level waste tank farms.

As noted in the preceding example, existing programs at a site may provide the framework within which elements of the waste certification program can be addressed (e.g., quality assurance, training, document control). The waste acceptance requirements of the facility to which the waste is to be sent may impose additional requirements on what is to be included in the waste certification program. Whether or not the waste acceptance requirements of the facility to which waste is transferred mandate a waste certification program, the organization transferring the waste is responsible for developing and implementing a certification program to provide internal assurance that the waste acceptance requirements will be met.

Implementation. The waste certification program is implemented through the use of documented controls, processes, and procedures. The key document in a waste certification program is the certification statement, or equivalent. The certification statement is the documentation signed by a designated official that certifies that the waste meets the appropriate requirements. Following is a listing of the summary specifications, derived from DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, (EM-WAPS) for the final waste form, that include the elements recommended for consideration in the development of certification statements. While these specifications are specific to the final (vitrified) waste form they should be applied during generation, storage, pretreatment, and treatment activities, as appropriate, to ensure actions are not taken that may jeopardize final waste form compliance with them. (Amplification on the summary and detailed specifications that are included is considered beyond the scope of this Guide. Reference is made to the Waste Compliance Plans and Waste Qualification Reports for the Defense Waste Processing Facility (DWPF) and the West Valley Demonstration Project, both of which provide a detailed description of the methods by which they each comply with the specifications.)

1. Waste Form Specifications

2. Canister Specifications

3. Canistered Waste Form Specifications

4. Quality Assurance Specifications

5. Documentation and Other Requirements

Graded Approach. A graded approach is used in implementing the waste certification program. The above elements are recommended for both intrasite as well as intersite transfers of high-level waste. While it is recognized that there currently are no intersite transfers of liquid high-level waste, there may, at a later date, be transfers of the final waste form between sites to accommodate interim storage. Intersite transfers involve not only certifying that the waste is in compliance with the requirements for the receiving facility itself, but also with Department of Transportation requirements. However, even though the above elements should be considered, the process may be shortened and simplified for on-site transfers where the organizational relationships and knowledge of the waste and waste generating activities may reduce the information that needs to be documented and transferred with each transfer. For on-site transfers, much of the information may already be available to the receiving facility.

> *Example: For on-site transfers, the receiving facility/organization may already have a waste stream profile provided by the generator facility/organization. Because of the existence of the waste stream profile, the certification may be as simple as an individual*

trained to the waste transfer and certification procedures signing a waste transfer request that provides the radionuclide inventory of the waste transfer being transferred and the waste stream identification number.

The waste acceptance requirements of the facility receiving the waste (see DOE M 435.1-1, Section II. J.) may dictate which items must be part of the certification statement. Even if such information is not dictated by the receiving facility, the waste acceptance criteria should be used as a resource for identifying key elements to include on the waste certification statement.

Compliance relative to the development and documentation portion of the certification requirement is demonstrated by a waste certification plan that identifies the organizations involved, assigns responsibilities for implementing the program, and describes or references the quality assurance, training, procurement controls, records management, and procedures to be used by the program. Acceptable performance relative to implementing the program is demonstrated by the appropriate personnel being trained, having and following the procedures that govern their part of the waste certification process, the waste certification plan and procedures being current and controlled in accordance with a document controls program, and records related to certification (e.g., certification statements, training records, procurement records, characterization records, packaging records) being generated and managed in accordance with established site program.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. WSRC, 1994. *DWPF Waste Form Compliance Plan*, WSRC-IM-91-116-0, Westinghouse Savannah River Corporation, Aiken, South Carolina, December 1994.

3. DOE, 1997. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 12, WVDP-185, U.S. Department of Energy, December 1997.

II. M.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability,

and storage of required documentation and specify the records retention period.

Objective:

The objective of this requirement is to ensure the development of waste certification programs that clearly identify the documentation required for certifying waste, specifying which personnel have the authority to make the certification, and establishing a traceable and verifiable record of and basis for certification.

Discussion:

Officials must designate who has the authority to certify that waste meets the waste acceptance requirements of the receiving facility. To avoid having personnel who are not knowledgeable of waste acceptance and transfer requirements authorizing the release of waste, the program needs to identify, by title or name, the officials who are authorized to certify. The officials are qualified by virtue of their position, responsibilities, and training to make this certification. The official(s) have sufficient familiarity with the waste being generated and needs to have been trained relative to the acceptance criteria of the receiving facility (and applicable transportation requirements) to be able to certify in writing that the waste is acceptable for transfer. The official(s) also need to have the authorization from the receiving facility to transfer the waste (see DOE M 435.1-1, Section II. N., Waste Transfer). Implementation of this element should be tailored to specific site needs and situations.

> *Example: On-site transfers of high-level liquid waste from multiple facilities to the high-level waste tank farm may involve multiple personnel (e.g., one for each generator or process) being trained and having the authority to certify waste as meeting the tank farm's waste acceptance requirements. However, for the transfer of waste from the tank farm to an on-site pretreatment or treatment facility, there may be a single designated official at the site who has been trained relative to the acceptance criteria of the pretreatment or treatment facility's waste acceptance criteria that is authorized to certify the waste as ready for transfer.*

The waste certification program needs to specifically identify the documentation that needs to be produced to support the certification that waste meets the waste acceptance criteria of the receiving facility. The required documentation may include the following:

> <u>Waste Stream Profile</u> (or record relating the waste to a previous profile). The waste stream profile is a description of the waste stream, generally identifying the source, physical and chemical description, and upper limits on radionuclides.

Radionuclide Characterization Data. Radionuclide characterization data include the concentration and/or inventory of radionuclides as determined by characterization (see guidance for DOE M 435.1-1, Section II. L., Waste Characterization).

EPA Uniform Hazardous Waste Manifest. The EPA manifest is required by 40 CFR Part 262 for the transfer of a hazardous or mixed waste.

Chain of Custody or Equivalent Documentation, and Packaging Data. (See guidance for Waste Transfer, DOE M 435.1-1, Section II.N).

Radiological Survey Results (or documentation referencing a survey record). Survey results include the determination of the surface contamination of the waste package and the external dose rate (see Section II.L.).

Bill of Lading. A document indicating the contents of a shipment.

Certification Statement. The statement required by DOE M 435.1-1 to document that waste is in compliance with the acceptance criteria of the facility to which the waste is being shipped.

Authorization to Transfer. Documentation indicating that an official from the facility to which the waste is to be shipped has authorized transfer of the waste to the facility.

For the final (vitrified) waste form, most, if not all, of the above recommended elements of the waste certification program should be met by meeting the requirements of the *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* EM-WAPS (DOE/EM-0093). Specifically, compliance with Specification 5.1, “Specification for Waste Acceptance Documentation,” requires the development of production records (5.1.3) and storage and shipping records (5.1.4). Development of these documents should provide the necessary program documentation elements. An example of a production record table of contents for the Defense Waste Processing Facility is included as an attachment to the EM-WAPS. The information that is to be provided within the production record is expected to meet recommended elements of the certification statement.

As noted for other elements of this requirement, the organization developing the certification program uses a graded approach in determining which of these documents are needed. Regardless of the extent of the required documentation, the certification statement can serve as a checklist that all of the waste acceptance criteria have been considered and the waste is in compliance.

In order to ensure that information is available if or when it is needed in the future, the waste certification program needs to identify which records are to be maintained and how they are to be maintained. The certification program documentation may include specific records management requirements or may simply invoke an existing acceptable records management program. Although no minimum record retention times are established in DOE M 435.1-1, certain records need to be maintained indefinitely. Whereas hazardous waste regulations require only a three-year retention period, the DOE geologic repository has specific requirements for disposal of high-level waste and are specified in the EM-WAPS, Specification 5.1.3 and RW-0333P, *U.S. Department of Energy Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program*. Generating, storage, pretreatment, or treatment facility waste management records may not be required beyond the life of the facility or operation, provided pertinent information has been supplied to the facility where the waste will be disposed.

> *Example: Operations personnel at a high-level waste tank farm would maintain records of when they received waste, what the waste was (characterization data provided by the generator), and to whom the waste was eventually transferred. Once the final waste form is produced (via immobilization) and the EM-WAPS- and RW-0333P-required production records and storage and shipping records are developed, the organization responsible for the storage records would not need to retain records on these waste streams. This is because the production records and storage and shipping records are to be maintained as lifetime quality assurance records that transfer with the waste at the time of disposal to the Office of Civilian Radioactive Waste Management.*

To meet the requirement for auditability and retrievability, the method of records storage and retention needs to allow a person to trace shipment or waste package information back to the generator certification data (e.g., characterization data, source data, packaging data). In accordance with the DOE M 435.1-1, Waste Transfer requirements (Section II. N), information on the source and characteristics of the waste are to be transferred along with the waste. However, it is not the intent of this requirement to cause the creation of the certification statement for existing waste that was received without such information (i.e., waste in storage as of the issuance of DOE O 435.1). Such documents should be created only for any subsequent transfers of waste.

Compliance with this requirement is demonstrated by records showing that each waste transfer is certified as having met the waste acceptance criteria of the facility to which it was transferred, that the certification statement is supported by additional records regarding the waste source, characterization, and packaging, and that the waste certification and transfer is in accordance with a documented program.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. DOE, 1995. *Quality Assurance Requirements and Description and Description for the Civilian Radioactive Waste Management Program*, Revision 5, DOE/RW-0333P, U.S. Department of Energy, Washington, D.C., October 2, 1995.

3. WSRC, 1994. *DWPF Waste Form Compliance Plan*, WSRC-IM-91-116-0, Westinghouse Savannah River Corporation, Aiken, South Carolina, December 1994.

4. DOE, 1997. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 12, WVDP-185, U.S. Department of Energy, Washington, D.C., December 1997.

II. M.(2) Certification Before Transfer. High-level waste shall be certified as meeting the waste acceptance requirements before it is transferred to the facility receiving the waste.

Objective:

The objective of this requirement is certify that waste meets the acceptance requirements of the storage, pretreatment, treatment, or disposal facility before it is transferred, to prevent transferring waste that could endanger receiving facility personnel, and to avoid the delay and potential hazards associated with corrective actions taken to remedy non-compliant conditions.

Discussion:

The waste certification requirements above address development, implementation, and content of a waste certification program. The requirement that waste be certified before transfer ensures that the program is effective in preventing the transfer of waste that does not meet the waste acceptance criteria of the facility receiving the waste for storage, treatment, or disposal. In accordance with this requirement, waste is released for transfer to another facility only after there is a certification by an authorized official that the waste acceptance requirements have been met. Ensuring certification occurs prior to allowing the physical transfer of waste prevents potential hazards associated with managing waste rejected by the facility to which it is transferred. Requiring certification before waste is transferred also reduces the likelihood of having to recall a

waste transfer due to a discovery by the certification official, after the waste is transferred, that the waste does not comply with the waste acceptance requirements.

Certification that the waste is ready for transfer and meets the waste acceptance criteria and the applicable transportation requirements, is a control point in the transfer process. The procedures controlling waste transfer do not allow the transfer to occur unless the certification statement has been signed. Once signed, the certification statement becomes part of the record for the transfer of the waste (see Waste Transfer, Section II.N).

Compliance with this requirement is demonstrated by the presence of a certification program approved by the DOE Field Element Manager (or designee), documented approval from the receiving facility to implement the certification program, if needed, procedures which mandate the use of a certification statement, and dated records of waste certification.

Supplemental References: None.

II. M.(3) Maintaining Certification. High-level waste that has been certified as meeting the waste acceptance requirements for transfer to a pretreatment, treatment, storage, or disposal facility shall be managed in a manner that maintains its certification status.

Objective:

The objective of this requirement is to ensure certified waste is managed so as to maintain the validity of the certification status to avoid the unnecessary handling of the waste stream or final waste form packages that would be involved in recertifying waste.

Discussion:

There may be instances where waste must be stored prior to being transferred to the next stage in the waste management process. If waste is certified as meeting the waste acceptance criteria of the receiving facility prior to storage, it needs to be stored and controlled so that the certification remains valid until the waste can be transferred.

> *Example: As of the issuance of this guidance, the siting of the geologic repository for high-level waste disposal had not been decided. However, high-level waste treatment facilities at the Savannah River Site and West Valley Demonstration Project are producing and certifying final waste forms that must be managed in accordance with the requirements of the EM-WAPS. These requirements include, for example, Specifications 1.4.2, "Control of Temperature for Phase Stability" and 5.1.4, "Storage and Shipping*

Records." For the first specification, temperature monitoring of the canister storage areas maintains certification status. For the second specification, both internal and external audits ensure the documentation and permanent records support continued certification status.

Actions necessary to certify a waste that involves the potential of radiation exposure of workers should be deferred, if possible, until there is a reasonable expectation that the waste can be transferred to the receiving facility within the time that the certification is valid. Routine monitoring required for waste in storage may not permit all activities that could result in worker exposure to be deferred.

This requirement is not to be interpreted in a manner that would interfere with a facility performing an acceptable waste management function. Therefore, if a waste is certified as meeting the waste acceptance criteria of a treatment facility, the requirement to maintain the certification of the waste is not intended to prevent the treatment facility from proceeding with the treatment even though such action would seemingly violate the certified status of the waste. The requirement is instead intended to ensure that the waste be stored, transported, and staged at the treatment facility in a manner that will allow personnel to treat the waste. In spite of the protection provided for the waste, sampling prior to treatment may still be a necessary process control step.

Specific requirements for protecting the certification status of a waste are generally negotiated with the receiving facility. Requirements to be considered include protecting the waste, preventing unauthorized introduction of material into the waste, and protecting the data on the waste package. The Waste Transfer requirements (DOE M 435.1-1, Section II. N.) also address protecting waste packages and data to ensure that characterization and packaging data remain accurate and useable by waste managers. Final high-level waste form packages (canisters) need to be protected from the elements in a manner that meets the storage requirements of the EM-WAPS. In addition, it is necessary to be able to relate each waste package to information about the contents of the package. For the final high-level waste form, the EM-WAPS-required production record provides the necessary data. Also required by the EM-WAPS are other container (canister) requirements for identification, labeling, length and diameter (Specifications 2.3 and 2.4).

Compliance with this requirement is demonstrated by site personnel showing that the storage of liquid high-level waste and final waste form packages (canisters) are managed in facilities in a manner that does not negate their certification status. Further, it is possible to trace each package to its certification and the information supporting that certification.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. DOE, 1995. *Quality Assurance Requirements and Description and Description for the Civilian Radioactive Waste Management Program*, Revision 5, DOE/RW-0333P, U.S. Department of Energy, Washington, D.C., October 2, 1995.

3. WSRC, 1994. *DWPF Waste Form Compliance Plan*, WSRC-IM-91-116-0, Westinghouse Savannah River Corporation, Aiken, South Carolina, December 1994.

4. DOE, 1997. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 12, WVDP-185, U.S. Department of Energy, Washington, D.C., December 1997.

II. N. Waste Transfer.

The following requirements are in addition to those listed in Chapter I of this Manual.

(1) Authorization. High-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Objective:

The objective of this requirement is to ensure that transfers of high-level waste are made only with the cognizance and approval of personnel at the facility receiving waste so the preparation can be assured for its safe management.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(7), General Requirements, the radioactive waste generator program includes consideration for the generation planning, characterization, certification, and transfer of high-level waste. During the development of DOE O 435.1 and DOE M 435.1-1, a review of waste management functions indicated that the transfer of waste without the knowledge of personnel at the facility to which it was sent presented a potential hazard. If waste is transferred to a facility without prior authorization, the controls necessary for the proper and safe management of the waste may not be in place. As a consequence, the waste may have to be rejected and returned to the sender. This requirement represents a control to minimize the potential for exposures and releases during the handling and transfer of high-level waste.

Safe transfer of the waste can only be assured if the facility receiving the waste for storage, pretreatment, or treatment has considered the acceptability of the waste versus its safety operating constraints. Personnel at a storage, pretreatment, or treatment facility which authorize the transfer of waste are indicating that they have the capability to receive the waste and manage it in a manner that is protective of its workers, the public, and the environment. Therefore, for purposes of safe life-cycle management it is essential that authorization be received before transfer of high-level waste to a storage, pretreatment, or treatment facility. Meeting this requirement is the responsibility of the organization or individual transferring (sending) the waste.

The transfer of high-level waste represents moving the waste through a pipeline or to another part of a facility through a pipeline. The analysis of the hazards associated with the management of radioactive waste in the development of DOE O 435.1 and DOE M 435.1-1 indicated that the transportation of liquid high-level waste represents a potential risk of containment and/or

confinement failure. In order to minimize this risk, the transfer of high-level waste should be minimized. The following are considered transfers:

(1) Waste is physically moved from one location to another, even if ownership does not change.

(2) Waste is physically moved from one location to another and ownership changes.

(3) Waste is not physically moved, but ownership changes.

The actions and documentation necessary to obtain authorization will depend on the specific storage, pretreatment, or treatment facility to which waste is to be transferred. In some cases, the submittal of a waste stream profile which provides a description of the waste and a range of the waste characteristics, augmented by conversations with the generator, may provide enough information for the storage, pretreatment, or treatment facility staff to be confident that they can safely manage the waste. In other cases, the waste acceptance requirements of the storage, pretreatment, or treatment facility may dictate that an onsite visit and review of the generator's waste certification program be performed. In order to expedite the transfer of waste, staff responsible for sending the waste need to ensure they understand what information and activities need to be completed in order to receive transfer authorization.

Authorization to transfer waste needs to be received in writing and should state the scope of the authorization. The authorization may specify a specific group of transfers or specific number of transfers of a particular waste type. However, it is acceptable for the written authorization to specify a waste stream(s) which the generator can send on a routine basis. Any additional conditions or notification requirements can be included in the written authorization. Whereas it is the responsibility of the storage, pretreatment, or treatment facility receiving the waste to prepare the written authorization, the organization sending the waste must understand which waste has been authorized.

Example: At Site Z, a high-level waste stream is periodically generated and transferred to the high-level waste storage tanks. The waste stream is designated by the number XX-2233. Consistent with site procedures, the generator prepares a waste stream profile which describes the characteristics and projected generation rate of the waste stream and provides it to the waste management organization responsible for operation of the tank farm. The waste management organization reviews the waste stream profile and calls the generator facility representative to clarify the information on the waste stream profile. The waste management organization has previously reviewed the generator's certification program. Based on the certification program and the waste stream profile, the waste management organization prepares a letter authorizing the generator to transfer any waste that meets the XX-2233 profile until further notice. The authorization

letter also states that the generator must provide the waste management organization notice of the volume of the waste that is to be transferred 48 hours before a transfer occurs.

When high-level waste is transferred (moved from one location to another) and the "ownership" of the waste does not change (i.e., the same individual is responsible for both facilities), a separate letter authorizing transfer may not be required. Recognizing that the intent of this requirement is to ensure that the waste is expected and can be safely managed at the facility to which it is being transferred, other documentation can serve as the written authorization.

Example: The manager of the waste management organization is the official responsible for authorizing transfer of waste to either of two separate waste tank storage facilities, Tank Farm C and Tank Farm D. Even though the waste acceptance criteria are the same for the two tank farms, waste is accepted and logged into each facility separately. The manager decides to consolidate all of the waste into one tank at Tank Farm C for more efficient management. The written authorization to transfer is provided by the certification statement indicating that the waste meets Tank Farm C waste acceptance requirements, and the documentation of the new storage location on the waste characterization and packaging data.

Compliance with this requirement is demonstrated by sites having procedures that require a confirmation of authorization before releasing waste for transfer, and records showing that transfers are made in accordance with written authorizations.

Supplemental References: None.

II. N.(2) Data. Waste characterization data and generation, storage, pretreatment, treatment, and transportation information for high-level waste shall be transferred with or traceable to the waste.

Objective:

The objective of this requirement is to establish and maintain information about the characteristics of waste and the waste packaging to ensure that sufficient information to support management of waste in a manner that is protective of workers, the public, and the environment.

Discussion:

The *Radioactive Waste Management Manual*, General Requirements, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the

responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the applicable waste acceptance requirements. Generator requirements address generation planning, waste characterization, waste certification, and waste transfer. The requirement for traceability of data addresses the hazards associated with transferring waste without providing adequate information about the packaging and its content. Establishing and maintaining the identity of the waste, as well as maintaining controls based on the waste's hazards, are vital to its safe transfer. Acquisition of information about the waste is addressed in the guidance on Waste Characterization (DOE M 435.1-1, Section II.L). Certification that waste is ready for transfer (i.e., meets the waste acceptance requirements and transportation requirements) is discussed in the guidance on Waste Certification (DOE M 435.1-1, Section II.M). Maintenance of documentation regarding transfer of waste is discussed later in this section of guidance.

Establishing, maintaining, and communicating accurate information on high-level waste is essential to the safe and proper management of the waste. In the process of developing DOE O 435.1 and DOE M 435.1-1, transfer was identified as the activity in the life-cycle management of waste with the greatest potential for loss of information about waste packages or waste characterization data, and the associated loss of adequate waste management controls to avoid exposure or release of radioactivity. Therefore, when waste is transferred, the waste characterization and packaging data must be properly transferred to the new "owner" (i.e., responsible waste manager) of the waste.

> *Example: An abnormally high-activity slurry of high-level waste was transferred to a treatment (vitrification) facility for solidification. The waste was characterized and the waste characterization information listed on the waste certification statement. Although the waste met the waste acceptance criteria for the treatment facility and an authorization to make the transfer was granted, the characterization information was not transmitted before, or at the time of, the waste transfer. Since recent previous transfers had been lower activity, i.e., normal, special radiological protection measures, required for the high-activity waste at the vitrification facility's sampling station, were not invoked. During the first transfer of waste to the sampling station, local radiation monitors alarmed, signaling the operators that the activity of the waste warranted implementing the special rad protection procedures. Had the characterization information been documented and transferred with the waste, treatment facility personnel would have known it was high-activity waste and would have imposed the proper controls on the waste to protect sampling station personnel.*

Sufficient information about the packaging should be provided to the storage, treatment, or disposal organization to which waste packages are transferred to ensure that the packages are handled safely. Packaging is defined as a receptacle and any other components or materials

necessary for the receptacle to perform its required containment function. The waste package is the packaging plus its contents (i.e., the waste). The information about the packaging that is transferred with the waste should be supported by and traceable to the more detailed packaging procurement information (see guidance on Packaging and Transportation, DOE M 435.1-1, Section II.O)

When waste is initially placed in the packaging, the organization packaging the waste should document and manage information regarding its characteristics (e.g., radioisotopic inventory, total activity, radiation dose, waste form). When the waste package is physically transferred or the "ownership" has changed, the information regarding the waste package must be provided to the organization that acquires responsibility for the waste.

The DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms* (EM-WAPS), requires packaging of the final (vitrified) waste form in a stainless steel canister to perform the necessary containment function. Proper documentation of packaging design and procurement records is necessary to ensure safe handling of a waste package. Specification 5.1.3, "Production Records," of the EM-WAPS provides the content requirements for Production Records that must be met to allow disposal at the geologic repository. The organization that procures the waste packaging is responsible for properly documenting the essential information regarding the procurement. The purchaser should maintain this information to answer future questions about subsequent procurements and address questions concerning the adequacy of the package for its intended purpose. Examples of the content of Production Records for the Defense Waste Processing Facility and the West Valley Demonstration Project are included in the EM-WAPS at Appendix E. Included within the Production Records are the following information on the canisters: canister material specification and compliance information (2.1), canister fabrication and closure methods (2.2), canister length and diameter (2.4), and final (filled) canister weight and overall dimensions (3.11).

Compliance with this requirement is demonstrated by procedures requiring that characterization and packaging data be provided with each transfer and documented records of transfers show that the information is being provided.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. WSRC, 1994. *DWPF Waste Form Compliance Plan*, WSRC-IM-91-116-0, Westinghouse Savannah River Corporation, Aiken, South Carolina, December 1994.

3. WVNS, 1995. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, WVDP-185, Revision 11, West Valley Nuclear Services Company Incorporated, West Valley, New York, February 1995.

4. DOE, 1995. *Hazardous Waste Determination of the DWPF Product*, Revision 0, WSRC-IM-91-116-13, U.S. Department of Energy, February 1995.

II. N.(3) Records and Transfer Reporting. The records and transfer requirements for canistered high-level waste forms shall comply with DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

Objective:

The objective of this requirement is to ensure that the hazardous waste requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* (EM-WAPS), are met in order to support the determination that the final (canistered) waste form is acceptable to the high-level waste geologic repository.

Discussion:

The current EM-WAPS are the technical specifications the waste form producers are required to meet in order to ensure acceptance of their vitrified high-level waste into the Civilian Radioactive Waste Management System. The Office of Environmental Management (EM) and the Office of Civilian Radioactive Waste Management have agreed that the Office of Environmental Management is to provide the final waste form specifications to the waste form producers and that the Office of Environmental Management will ensure that the EM-WAPS is consistent with the technical baselines as defined in DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD). Thus the EM-WAPS governs all elements of the final, canistered, waste form which includes the borosilicate waste glass, the stainless steel canister, and the sealed canistered waste form.

The following background is provided to clarify the roles of the EM-WAPS and the WASRD. As the waste form requirements for immobilized high-level waste developed, the Department and its operating contractors selected borosilicate glass as a reference waste form. Several high-level waste sites subsequently identified a vitrified waste form for their sites, and two high-level waste vitrification facilities are currently operating to produce canisters of borosilicate waste-glass. Recently, several new high-level waste streams have been identified. One such high-level waste

stream is the proposed insertion of small immobilized surplus plutonium containers within a standard high-level waste canister; molten vitrified high-level waste is then poured around these plutonium cans yielding a matrix immobilized waste form. This composite high-level waste stream is considered high-level waste and can be disposed as such. Another proposed high-level waste stream results from immobilizing the waste resulting from reprocessing certain spent nuclear fuels using an electro-metallurgical process. In this case a non-vitrified waste form will result.

In both these cases, a product that adheres to all the existing requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* is not possible. The exact waste form specifications that these two proposed waste forms must meet are unknown at this time; however, they will be incorporated in DOE/RW-0351P, *Waste Acceptance System Requirements Document*. That document is therefore cited for those unique immobilized high-level waste forms that cannot meet the requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS).

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(7), General Requirements, the radioactive waste generator program includes consideration for the generation planning, characterization, certification, and transfer of high-level waste. In order to ensure the final high-level (immobilized) waste form meets the specifications of the EM-WAPS, the characterization and transfer responsibilities should include a determination of whether the waste stream includes hazardous wastes, as defined by EPA's or authorized states' *Resource Conservation Recovery Act* (RCRA) requirements.

Specification 1.5, "Hazardous Waste Specification," of the EM-WAPS, requires that each producer determine and report to the Office of Civilian Radioactive Waste Management the presence, or absence, of any hazardous waste listed in the RCRA requirements contained in the Code of Federal Regulations (CFR), Title 40, Sections 261.30 through 261.33, "Lists of Hazardous Waste," in the waste or in any feed stream proposed for storage or disposal. Furthermore, any RCRA-listed component in the waste shall require the producer to petition EPA and the authorized state(s) to delist the waste as provided under Title 40, Subpart C, "Rulemaking Petitions," Part 260.22. Finally, the producer shall perform the appropriate tests and procedures, as described under Title 40, Subpart C, "Characteristics of Hazardous Waste," Parts 261.20 through 261.24, to determine if the waste that will be received by the Office of Civilian Radioactive Waste Management, for transportation and disposal, exhibits any hazardous characteristics. Any such waste that is shown to have hazardous characteristics shall be treated to remove such characteristics.

A material is hazardous waste if: a) it contains a listed hazardous waste component, or b) it exhibits hazardous characteristics (ignitability, corrosivity, toxicity, reactivity). Thus, a final

(vitrified) waste form would be considered hazardous if it contains a listed hazardous waste or is characteristically hazardous.

To comply with the first part of the EM-WAPS Specification, a review of the practices and procedures at a site, from waste generation through post-treatment storage, should be performed to determine if RCRA-listed hazardous wastes are present or introduced into the high-level waste system. If the conclusion of such a review is negative, i.e., there are no RCRA-listed hazardous components present in the pre-vitrified waste, then a declaration, with adequate supportive documentation, is needed in the producer's Waste Qualification Reports. If, however, the review finds that listed waste components are present, then the Producer must petition the EPA and the authorized state(s) to delist the waste for the final waste form to be acceptable to the disposal repository. Additional information on the delisting process can be found at 40 CFR 260.22, "Petitions to Amend Part 261 to Exclude a Waste Produced at a Particular Facility."

The second part of the EM-WAPS Specification requires that the final (vitrified) waste form not exhibit hazardous characteristics. A review of the final waste form (currently vitrified glass) is expected to conclude that the glass is a stable waste form and therefore is not corrosive, ignitible, or reactive. However, to demonstrate that the final waste form is not characteristic hazardous waste for toxicity, the glass should be subjected to the appropriate tests and procedures as described in the cited regulations. Currently, the appropriate test is the Toxicity Characteristic Leaching Procedure (TCLP) found at 40 CFR 261.24, "Toxicity Characteristic," which is the EPA mandated test for determining whether a waste form retards the release of specific contaminants, i.e., hazardous metals (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) and organics. If the glass passes this test, i.e., it contains concentrations lower than the values presented in the requirements for the specific contaminants, then it is not characteristic hazardous waste.

Further amplification on the EM-WAPS Specification is considered beyond the scope of this Implementation Guide. Refer to the EM-WAPS and the Waste Compliance Plans and Waste Qualification Reports for the Defense Waste Processing Facility and the West Valley Demonstration Project for additional information. Both provide detailed descriptions of the methods by which they each comply with this specification.

Compliance with this requirement is demonstrated by documenting compliance with Specification 1.5 of the EM-WAPS.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. WSRC, 1994. *DWPF Waste Form Compliance Plan*, WSRC-IM-91-116-0, Westinghouse Savannah River Corporation, Aiken, South Carolina, December 1994.

3. WVNS, 1995. *Waste Form Compliance Plan for the West Valley Demonstration Project High-Level Waste Form*, Revision 11, Draft E, WVDP-185, West Valley Nuclear Services Company Incorporated, West Valley, New York, February 1995.

4. DOE, 1995. *Hazardous Waste Determination of the DWPF Product*, Revision 0, WSRC-IM-91-116-13, February 1995.

5. EPA. *Petitions to Amend Part 261 to Exclude a Waste at a Particular Facility* ,40 CFR Part 260 Subpart C, U.S. Environmental Protection Agency, Washington, D.C.

6. EPA. *Characteristics of Hazardous Wastes*, 40 CFR Part 261, Subpart C, 261.20 through 261.24, U.S. Environmental Protection Agency, Washington, D.C.

7. EPA. *Lists of Hazardous Wastes*, 40 CFR Part 261, Subpart D, 261.30 through 261.33, U.S. Environmental Protection Agency, Washington, D.C.

8. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

II. O. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Canistered Waste Form. Immobilized high-level waste shall meet the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified immobilized high-level waste.

Objective:

The objective of this requirement is to ensure that the final high-level waste form satisfies packaging and transportation requirements as specified in DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS), or DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD), for non-vitrified immobilized high-level waste. These documents provide the technical specifications the waste form is required to satisfy in order to ensure acceptance of the vitrified waste form into the Civilian Radioactive Waste Management System.

Discussion:

The packaging and transportation requirement of DOE M 435.1-1 is narrowly focused on producing a canistered waste form for which there is a path forward. To achieve that goal, consideration must be given to the packaging requirements contained in the EM-WAPS or the WASRD, prior to the generation of the final high-level waste form. The EM-WAPS is based on the WASRD, which was developed by the Office of Civilian Radioactive Waste Management (RW) and establishes the specifications that high-level waste must satisfy to be acceptable to the Office of Civilian Radioactive Waste Management. For purposes of DOE O 435.1, “acceptable” is evidenced by documentation that the canistered waste form satisfies the specifications described in the EM-WAPS. Satisfaction of the EM-WAPS is intended to be essentially the same as acceptability for disposal.

The Office of Civilian Radioactive Waste Management is responsible for developing geologic disposal capability for high-level waste and for transporting the high-level waste to the repository. Additional information relevant to the Office of Civilian Radioactive Waste Management’s responsibilities and the interfaces between the Office of Civilian Radioactive Waste Management and the Office of Environmental Management are included in the guidance for Section II.S, Disposal.

The following background is provided to clarify the roles of the EM-WAPS and the WASRD. As the waste form requirements for immobilized high-level waste developed, the Department and its operating contractors selected borosilicate glass as a reference waste form. Several high-level waste sites subsequently identified a vitrified waste form for their sites, and two high-level waste vitrification facilities are currently operating to produce canisters of borosilicate waste-glass. Recently several new high-level waste streams have been identified. One such high-level waste stream is the proposed insertion of small immobilized surplus plutonium containers within a standard high-level waste canister; molten vitrified high-level waste is then poured around these plutonium cans yielding a matrix immobilized waste form. This composite high-level waste stream is considered high-level waste and can be disposed as such (Draft EIS, DOE/EIS-0283-D, *Surplus Plutonium Disposition Draft Environmental Impact Statement*, DOE, 1998). Another proposed high-level waste stream results from immobilizing the waste resulting from reprocessing certain spent nuclear fuels using an electro-metallurgical process. In this case a non-vitrified waste form will result.

In both these cases a product that adheres to all the existing requirements of EM-WAPS is not possible. The exact waste form specifications that these two proposed waste forms must meet are unknown at this time; however, they will be incorporated in WASRD. That document is therefore cited for those unique immobilized high-level waste forms that cannot meet the requirements of EM-WAPS.

The EM-WAPS requirements apply only to the vitrified waste forms that have been qualified by the Office of Civilian Radioactive Waste Management and include waste packaging requirements. Qualification may be sought for additional waste forms at sites that do not currently have high-level waste processing facilities in operation. Transportation of liquid high-level waste is not anticipated and is not addressed by the requirements in the EM-WAPS.

> *Example: Most of the high-level wastes at INEEL are now in the form of a calcine. Production processes and waste stream input for preparation of a final canistered waste form are likely to differ significantly from the processes at Savannah River and at West Valley. Therefore, waste management personnel at INEEL will develop waste acceptance product specifications tailored to their high-level waste stream and consistent with the WASRD.*

The EM-WAPS specifications are divided into three technically oriented categories -- waste form specifications, canister specifications, and canistered waste form specifications -- and two administratively oriented categories -- quality assurance specifications and documentation and other requirements.

<u>Waste Form Specifications</u>. The EM-WAPS includes specifications for several elements relevant to packaging and transportation. Waste form specifications in the EM-WAPS include chemical

composition, radionuclide inventory, product consistency, phase stability, hazardous waste, and safeguards reporting. Descriptions of the tests for establishing compliance with the waste form specifications are to be included in the Waste Form Compliance Plan. The Waste Form Qualification Report contains the results of all of these tests except for the safeguards information. The results are reported on a canister-by-canister basis in the production records.

> Chemical Composition and Radionuclide Inventory: These specifications require projection or reporting of specific chemical, crystalline phase, and radionuclide information and provide that the waste form be a borosilicate glass.
>
> Product Consistency: This requirement provides for consistency (with the benchmark glass described in the environmental assessment on Waste Form Selection for Savannah River Plant High-Level Waste) in the glass composition.
>
> Phase Stability: This specification requires information on the glass transition temperature, a time-temperature-transformation diagram, and temperature control.
>
> Hazardous Waste: This specification requires determination of the presence or absence of any hazardous waste. The results of the determination are to be reported to the Office of Civilian Radioactive Waste Management.
>
> Safeguards: The final waste form specification in the EM-WAPS is for safeguards purposes. Satisfaction of this specification requires reporting of quantities of uranium and plutonium isotopes on a canister-by-canister basis.

Canister Specifications. Canister specifications in the EM-WAPS include materials, fabrication and closure, identification and labeling, and canister length and diameter. Descriptions of the tests for establishing compliance with the canister specifications are to be included in the Waste Form Compliance Plan. The Waste Form Qualification Report generally contains the test results. Data on individual canisters (materials, fabrication, closure, length, diameter, wall thickness) are captured in the production records.

> Materials: The material specification requires that the canister be made of austenitic stainless steel.
>
> Fabrication and Closure: The fabrication and closure specification requires that the closed canister be leak-tight under well-defined vacuum conditions. The Waste Form Qualification Report provides evidence that the fabrication and closure methods can produce a canister that satisfies the leak-tightness criterion.

Identification and Labeling: The identification and labeling specification imposes requirements for the alphanumeric identifiers used, where they are located, and other requirements for readability and durability.

Length and Diameter: The length and diameter specification provides the dimensional ranges for these parameters.

Canistered Waste Form Specifications. Canister specifications in the EM-WAPS include requirements on free liquid, gas content, various kinds of reactivity, organic materials, chemical compatibility, canister fill height, removable contamination, heat generation, maximum dose rates, subcriticality, weight and overall dimensions, drop tests, handling features, and plutonium concentration. Descriptions of the tests or methods for establishing compliance with the canistered waste form specifications are to be included in the Waste Form Compliance Plan. The Waste Form Qualification Report generally contains the test results. Fill height data on individual canisters are captured in the production records. Storage and Shipping Records document, by canister, information on removable contamination tests, heat generation rate, dose rate, and weight.

Free Liquid: The free liquid specification prohibits detectible liquid in the canistered waste form.

Gas Specification: The gas specification includes requirements on allowable gases and their partial pressures inside the canister at closure as well as gases that could be generated after sealing the canisters.

Reactivity: The reactivity of the contents of the canister requires that the generator ensure that there are not detectable amounts in a canister of materials that are explosive, pyrophoric, or combustible.

Organic Materials: The organic materials specification prohibits detectable amounts of organic material in the canistered waste form after closure.

Chemical Compatibility: The chemical compatibility specification addresses interaction between the canister and its contents.

Fill Height Specification: The fill height specification requires that each canister be filled to at least 80 percent of the empty volume of the canister.

Removable Contamination: The removable contamination specification provides limits on allowable radioactive material contamination and guidance on performing wipe tests to evaluate contamination levels.

Heat Generation: The heat generation specification establishes a maximum rate of 1500 watts per canister, at the year of shipment, and requires reporting of expected heat generation rates.

Dose Rate: The specification for maximum surface dose rate provides that the gamma rate not exceed ten thousand rem per hour and that the neutron rate not exceed 10 rem per hour.

Subcriticality: The subcriticality specification establishes the maximum calculated effective multiplication factor and states that criticality shall not be possible unless at least two unlikely, independent changes occur in conditions essential to nuclear criticality safety.

Weight and Dimensions: The specifications for weight and overall dimensions require that the canistered waste form not exceed 2,500 kilograms. This specification also establishes height and diameter limits for the canistered waste form.

Drop Test: The drop test specification requires that the canistered waste form withstand a seven-meter drop onto an essentially unyielding surface.

Handling Features: The handling features specification establishes the standard canistered waste form features that allow for grasping and moving the canistered waste form. The generator describes the grapple in the Waste Form Compliance Plan and provides the designs in the Waste Form Qualification Report.

Plutonium Concentration: The plutonium concentration specification requires that the concentration in the canistered waste form be less than 2500 grams per cubic meter.

Quality Assurance Specifications. Generators of high-level waste are required to establish a quality assurance program to verify that the specifications established in the EM-WAPS are satisfied. The quality assurance program must be consistent with the *Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description*, DOE/RW-0333P, and with the *Office of Civilian Radioactive Waste Management Waste Acceptance System Requirements Document*. Guidance to Sections I.E.(12) and II.G of DOE M 435.1-1 provide additional information on these documents.

Documentation and Other Requirements. The four key records that provide documentation for determining compliance with the EM-WAPS and the results of those determinations are the Waste Form Compliance Plan, the Waste Form Qualification Report, the Production Records, and the Storage and Shipping Records.

Waste Form Compliance Plan: The Waste Form Compliance Plan describes tests, analyses, and process controls for demonstrating compliance with the EM-WAPS as well as commitments to meet the EM-WAPS.

Waste Form Qualification Report: The Waste Form Qualification Report is the record of results of the tests and analyses to demonstrate the producers ability to comply with the EM-WAPS.

Production Records: The Production Records provide descriptions of each canistered waste form.

Storage and Shipping Records: The Storage and Shipping Records provide physical description of the individual canistered waste forms and document any abnormal events that occur during storage.

Compliance with the transportation and packaging requirement of DOE M 435.1-1 can be demonstrated with a waste certification process that documents that the specifications of the EM-WAPS have been met.

Supplemental References:

1. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, April 1999.

2. DOE, 1982. *Waste Form Selection for the Savannah River High-Level Waste Environmental Assessment*, DOE/EA-0179, U.S. Department of Energy, Washington, D.C., 1982.

3. DOE, 1995. *Quality Assurance Requirements and Description*, DOE/RW-0333P, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D.C., October 2, 1995.

4. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

5. Paperiello, 1999. C.J. Paperiello to L.H. Barrett, letter, *U.S. Department of Energy Plans for Disposal of Surplus Weapons Plutonium*, U.S. Nuclear Regulatory Commission, Washington, D.C., January 25, 1999.

6. DOE, 1998. *Surplus Plutonium Disposition Draft Environmental Impact Statement*, DOE/EIS-0283-D, U.S. Department of Energy, Washington, D.C., July 1998.

II. P. Site Evaluation and Facility Design.

The following requirements are in addition to those in Chapter I of this Manual:

(1) Site Evaluation. Proposed locations for high-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new high-level waste facility or expansion of an existing high-level waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, or human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Objective:

The objective of this requirement is to ensure that natural environmental factors, human activities, and geotechnical characteristics of proposed sites are considered in selecting the location and design features of new high-level waste management facilities or significant modifications of existing facilities. In addition, that locations are avoided if facility design cannot compensate for poor site characteristics, environmental conditions, or adverse human activities.

Discussion:

The *Radioactive Waste Management Manual* (DOE M 435.1-1), *General Requirements and Responsibilities,* Section I.1.E, invokes the requirements of DOE O 420.1, *Facility Safety,* and DOE O 430.1A, *Life-Cycle Asset Management,* in site evaluation and facility design. In the development of DOE M 435.1-1, it was determined that specific attention should be given to selection of a waste management facility location with consideration given to the beneficial and detrimental aspects of the site.

Site evaluation includes the identification and characterization of potential sites for new high-level waste management facility or expansion of existing facilities. Selection of sites for DOE facilities is generally constrained to those federal lands owned and managed by DOE. Within DOE reservations, the process of selecting sites has the purpose of identifying the best location with consideration of features which are desirable for a facility. In addition, it is recognized that often a *National Environmental Policy Act* (NEPA) analysis will be conducted prior to the initiation of

the site evaluation process. The results of this process should be considered during the site evaluation process to ensure the bounds of the NEPA analysis are not exceeded. Finally, the site evaluation process produces a set of data and analysis that is often used to establish a facility's authorization basis and Radioactive Waste Management Basis (RWMB). Therefore, data and analysis quality, as well as records management, are important and must be ensured.

In the context of this requirement the terms environmental factors/characteristics (natural and human), geotechnical characteristics, and human activities are used to capture specific site elements that determine its suitability for the proposed facility. These include:

- ecology - the flora and fauna that have evolved and adapted to the other environmental characteristics of the site;
- topography - the physical features of the ground surface at and around the site;
- meteorology - the normal and extreme weather events of the site;
- hydrology - the surface and ground water at the site;
- geology - the sediment and structural features of the earths crust at the site;
- seismology - the earthquake potential of the area;
- volcanology - the volcano potential of the area;
- soil characteristics - characteristics of the soil that affect its load-bearing, water infiltration;
- human activities - proximity of the public and human-induced events both internal and external to the facility;
- emergency services and response - proximity of services and population sheltering; and
- hazards to other facilities - proximity of existing facilities and proposed facility.

Potential regional impact due to construction, operation or decommissioning of the facility and the extent of such regional impacts will be determined on the basis of measurable effects on the population or the environment from the construction, operation, or decommissioning of the facility.

Various requirements and guidance documents exist for compliance with *National Environmental Policy Act* requirements that are relevant for evaluation of a site. These include DOE O 451.1A, *National Environmental Policy Act Compliance Program*, and the “Green Book” (the NEPA Compliance Guide). The “Green Book” includes guidance for performing habitat evaluations. This guide should be consulted in evaluating characteristics of potential sites to assess potential impacts on biological resources including any endangered or threatened species.

Characterization of a site should result in collecting the data necessary to support a decision on acceptability of a site and for use in site-specific design of a facility. The site characterization and selection process will vary from one DOE site to the next because of substantial differences in the environmental/geotechnical characteristics or human activities of the sites. Similarly, the interests of stakeholders which vary from site to site are likely to influence the issues to be addressed in site characterization and selection. The level of characterization should be established using a data quality objective-type process where the type and amount of information to be collected is commensurate with the hazards and the decisions which have to be made based on the data. The resulting site characterization program should include the investigations and studies needed to evaluate site and facility performance.

Natural Phenomena Hazards. The characterization of a site for natural phenomena hazards is to identify the range of normal and extreme natural events that should be taken into account in the siting and design of the facility. The amount of characterization necessary will be influenced by the hazard associated with the facility and release of the radionuclide inventory. Guidance on characterization and consideration of natural phenomena hazard in the design of DOE facilities is contained in the following standards supporting implementation of *Facility Safety* (DOE O 420.1):

- *Natural Phenomena Hazards Characterization Criteria*;
- *Natural Phenomena Hazards Assessment Criteria*;
- *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*;
- *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*; and
- *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities*.

Example: A new immobilized high-level waste storage facility is being considered at Site X. Due to the environmental setting, wind effects, seismic activity and volcanic ash

> *are factors that have to be considered in the design regardless of the location selected at the site. However, due to the local topography, concerns about flooding can be addressed by selecting a location on the site's central plateau. A similar facility is being considered at Site Y. The Site Y evaluation includes the consideration of flooding and high winds in the design regardless of location. However, seismic concerns are minimal because of the region of the country; also flooding impacts can be mitigated by selecting an appropriate area of the site.*

In carrying out characterization activities, field studies should be performed so as to not compromise the integrity of the land to be dedicated to waste management activities. This is particularly relevant to disposal facilities where improper design or installation of core sampling or groundwater sampling wells can lead to a preferential path for the migration of contaminants from a facility. Also, the characterization should be carried out in accordance with the site's quality assurance program, including maintaining records of data collected. Documentation of the results of the site characterization program is not only needed for use in facility design and establishment of facility-specific safety design criteria, but may also provide information necessary for complying with requirements of the NEPA process.

Human Activities. The site of a proposed high-level waste management facility should be evaluated with respect to the effects of the facility on human activities and the effect of human activities on the facility. Effects of the facility location on human activity should include consideration of

- transportation routes;
- present and future population distribution;
- present and proposed land and water uses in the region and the hazards they may pose to the proposed facility; and
- any special characteristics that would influence the consequences of releases of radioactive material during the life cycle of the facility.

The potential impact of the waste management facility construction, operation, and decommissioning should be evaluated, considering current and future land use plans and population distribution. Evaluation and selection of the location for a facility should ensure that there is and will remain a buffer between the facility and the public. Such considerations in site selection provide defense-in-depth by ensuring there is space for corrective actions to be taken if there are unplanned releases and by establishing distance for attenuation of such releases so that impacts are minimized.

Example: Site X is going to construct a facility to treat high-level waste to make it acceptable for off-site disposal. There are no natural environmental characteristics that make any of the proposed locations superior to others. However, one location is in the center of the site and the others are either near the current site boundary or in areas being cleaned up so they can be released from DOE control. Because the criteria for selecting a site include consideration of the proximity to current and future populations, the location near the center of Site X is preferred.

Another aspect of human activities is the affect that they may have on the waste management facility. Locating a facility near other facilities on or near the DOE site may impact the design or performance of the facility. For instance, a tall building may create a wake on its downwind side that would cause the exhaust effluent to be dragged down to ground surface in a short distance with the potential of impacting workers or nearby member of the public. To counter act this effect, the waste management facility would have to extend its stack higher than the wake effect, or an alternative location for the facility should be considered.

The term "adequate protection" is intended to support the protection of the worker, public, and the environment to the extent required by applicable requirements, e.g., 10 CFR Part 835, and DOE Orders, e.g., DOE 5400.5. Therefore, a site should be selected based on the protection it affords in meeting the requirements contained in applicable regulations and DOE Orders through site characteristics and/or facility design features.

Compliance with this requirement is demonstrated by performing an appropriate site evaluation for new facilities or expansions of existing facilities, and by the ensuring that the environmental and geotechnical characteristics of the site which are significant to protection of workers, the public or the environment are accounted for in selection of the site or through facility design.

Supplemental References:

1. DOE, 1997. *Design Consideration Manual*, Draft, U.S. Department of Energy, 1997.

2. DOE, 1992. *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities*, DOE-STD-1024-92, Change 1, U.S. Department of Energy, 1992.

3. DOE, 1993. *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, DOE-STD-1021-93, Change 1, U.S. Department of Energy, 1993.

4. DOE, 1994. *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, DOE-STD-1020-94, Change 1, U.S. Department of Energy, 1994

5. DOE, 1994. *Natural Phenomena Hazards Characterization Criteria*, DOE-STD-1022-94, Change 1, U.S. Department of Energy, 1994.

6. DOE, 1995. *Natural Phenomena Hazards Assessment Criteria*, DOE-STD-1023-95 Change 1, U.S. Department of Energy, 1995.

7. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, U.S. Department of Energy, September 1995.

8. DOE, 1997. DOE O 451.1A, *National Environmental Policy Act Compliance Program*, U.S. Department of Energy, June 1997.

9. DOE, 1998. *National Environmental Policy Act Compliance Guide*, U.S. Department of Energy, Office of NEPA Policy and Assistance, August 1998.

10. NRC. *Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation*, 10 CFR Part 72, U.S. Nuclear Regulatory Commission, Washington, D.C.

11. DOE. *Occupational Radiation Protection*, 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

12. DOE, 1993. *Radiation Protection of the Public and Environment*, DOE 5400.5, Change 2, U.S. Department of Energy, January 1993.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

Objective:

The objective of this requirement is to ensure that a minimum set of high-level waste facility design requirements determined from hazards analyses or policy considerations are applied to high-level waste management facilities.

Discussion:

The general design requirements included at DOE M 435.1-1, Sections II.P.(2)(a) through (j), are included as requirements to ensure adequate protection of the public, workers, and the environment from nuclear hazards. The requirements contained in these sections apply to all high-level waste management facilities, except for: II.P.(2)(b), Confinement; II.P.(2)(e); Consideration of Decontamination and Decommissioning; and II.P.(2)(h), Structural Integrity, which apply to new or modifications to existing high-level waste facilities. Modification is generally considered to be an action that significantly increases the probability of a nuclear accident or requires a change to an operations' authorization basis (Implementation Guide for DOE O 420.1, draft Revision G). Discretion is intended to allow upgrading of existing safety equipment or the installation of minor new improvements without subjecting the process to onerous procedural requirements and thus discouraging improvements. However, modifications to facility design and construction during the design and construction phase shall conform to the design requirements established in this section for new facilities.

For additional design assistance, refer to the DOE Handbook, DOE-HDBK-1132-99, *Design Considerations*. This Handbook includes information and considerations for the design of systems typical to nuclear facilities, design considerations specific to various types of special facilities, and information useful to various design disciplines. The Handbook specifically includes design considerations for confinement systems and radiation protection and effluent monitoring systems as well as good practices and design principles that should be considered in specific design disciplines.

The analysis of the hazards associated with the management of high-level waste in the development of DOE O 435.1 and DOE M 435.1-1 indicated that appropriate general design requirements are essential to ensuring the protection of the public, workers, and the environment. Therefore the intent of these requirements is to have them applied to all high-level waste management facilities, both existing and new. However, it is recognized that in some cases it may not be practical, or possible, to apply these requirements to existing high-level waste facilities or operations. In such cases, an exemption to the requirement may be warranted. These situations are separate from the exceptions noted above. Exemptions to the requirements may be due to conditions such as limited programmatic usage, expected short service life of the operation, or other reasons that make long-term, capital intensive upgrades unreasonable. In this case, non-compliance with the subject requirements requires the use of the exemption process, as provided at DOE M 435.1-1, Section I.1.E. Section I.1.E. provides for the use of an exemption to a requirement provided it is processed in accordance with the requirements of DOE M 251.1-1A, *Directives System Manual.* The guidance to Section I.1.E. provides additional information on the DOE M 251.1-1A exemption process.

Example: At Site Q, it is determined that the requirement in DOE M 435.1-1, Section II. P.2.(d), Ventilation, is not met by an existing high-level waste pretreatment process. The process has been shutdown for an extended period of time but has been maintained in a standby mode pending a decision on whether it is needed for future high-level waste processing/treatment missions. Specifically, the existing process has an air filtration system that provides adequate decontamination factors for the radionuclides of concern but lacks proper fire protection to the filter media. In accordance with DOE M 251.1-1A, Chapter VII, "Exemptions," an Exemption Request is prepared that supports the position that application of the requirement is not justified by any safety and health benefit at this time. If the decision is made to restart the process, the decision to upgrade the fire protection system for the ventilation system will be revisited. The Exemption Request is processed in accordance with the requirements contained in paragraph 4., Exemption Process, in Chapter VII.

The application of these requirements to all existing high-level waste facilities may conflict with the direction or guidance provided by some other DOE Orders that are invoked by the DOE M 435.1-1, General Requirements, Section I.1.E, Requirements of Other Regulations and DOE Directives. In such cases the requirements contained in DOE M 435.1-1 have precedence over requirements contained in other DOE Directives invoked by DOE M 435.1-1.

Example: Section I.1.E.(18), Site-Evaluation and Facility Design, invokes DOE O 420.1, Facility Safety. Guidance to DOE O 420.1 states that the design criteria included in that Order are "applicable to the design and construction of new nonreactor nuclear facilities and for modifications to existing nonreactor nuclear facilities when modifications significantly increase the probability or consequences of a nuclear accident or require a change in the Technical Safety Requirements (TSRs) of a facility. The definition of the term 'significant' is intentionally left to the judgment of the proposing contractor and the approving DOE authority to define 'significant.' In part, this is intended to allow upgrading of existing safety equipment or installation of minor new improvements without subjecting the process to onerous procedural requirements and thus discouraging improvements." Thus, under DOE O 420.1, an existing high-level waste management facility that is to be "in-significantly" modified does not have to meet the design requirements of DOE O 420.1. However, under DOE M 435.1-1, the same high-level waste management facility must meet the design requirements of DOE M 435.1-1, Section II.P.2.(a) through (j), or the requirements that are not to be implemented are subjected to the DOE M 251.1-1A exemption process. The requirements contained in DOE M 435.1-1 have precedence, and should be implemented, in lieu of those contained in DOE O 420.1 (invoked by DOE M 435.1-1, Section I.1.E).

A "backfit" process has been discussed by the Department in the past to address changes that may be required through the imposition of a new DOE safety requirement. Such changes are

particularly problematic for many high-level waste facilities and systems that have been in existence for over 20 years. It is not the purpose of DOE O 435.1 and DOE M 435.1-1 to create such a process for the Department; however an existing or new field-office or Program Secretarial Office backfit analysis and review process may be applied to determine whether implementation of a proposed backfit could be justified on the basis of a substantial safety improvement or on a cost-benefit basis. One example of a candidate process is contained in expired DOE N 5480.5, *Imposition of Proposed Nuclear Safety Requirements*, which expired in 1993 because of an administrative provision. Another candidate process is described Draft DPOM-FS-300, "Treatment of Proposed Backfits," which was developed for the Office of Defense Programs, but not formally adopted. A third candidate process is documented in Westinghouse Savannah River Company, High Level Waste Management Engineering Procedure, ENG. 12, "HLWMD Backfit Analysis Procedure." For development of new backfit processes Nuclear Regulatory Commission requirements in 10 CFR 50.109 and 10 CFR 76.76 should be consulted.

Compliance with this requirement is demonstrated by documentation that supports the implementation of the requirements at Section II.P.2.(a) through (j), or documentation that supports implementation of the "Necessary and Sufficient Closure Process" or "Integrated Safety Management System," or the DOE M 251.1-1A, Exemption Process.

Supplemental References:

1. DOE, 1998. *Directives System* and *Directives System Manual*, DOE O 251.1A and DOE M 251.1-1A, U.S. Department of Energy, January 30, 1998.

2. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, U.S. Department of Energy, September 1995.

3. DOE, 1993. *Defense Programs Operations Manual, "Treatment of Proposed Backfits,"* Draft DPOM-FS-300, Revision 0, U.S. Department of Energy, February 5, 1993.

4. DOE, 1999. *Design Considerations*, DOE-HDBK-1132-99, U.S. Department of Energy, Washington, D.C., April 1999.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(a) Safety (Safety Class and Safety-Significant) Structures, Systems, and Components. Safety structures, systems, and components for high-level waste storage, pretreatment, and treatment facilities shall be designated and designed consistent

with the provisions of DOE O 420.1, *Facility Safety*; DOE 5480.22, *Technical Safety Requirements*; and DOE 5480.23, *Nuclear Safety Analysis Reports*.

Objective:

The objective of this requirement is to ensure the identification and function of safety-class and safety-significant structures, systems, and components for high-level waste management facilities are consistent with the provisions of applicable DOE Orders.

Discussion:

DOE M 435.1-1, Section I.1.E.(8), requires that the management of radioactive waste management facilities, operations, and activities prepare and maintain hazard analysis documentation and that an authorization basis be prepared, as required by DOE O 425.1A, *Startup and Restart of Nuclear Facilities,* DOE 5480.21, *Unreviewed Safety Questions,* DOE 5480.22, *Technical Safety Requirements*, and DOE 5480.23, *Nuclear Safety Analysis Reports.* For high-level waste management facilities implementation of these Orders require an integrated approach to the development of a high-level waste operation's safety analysis, hazard analysis, and accident analysis, all of which contribute to the operation's Authorization Basis. An Authorization Basis defines the aspects of a high-level waste facility's design basis and operational requirements that are relied upon by DOE to authorize operations. Details of this integrated approach are provided in the DOE Standard, DOE-STD-3009-94, as well as the Department's recently issued Guide for an Integrated Safety Management System, DOE G 450.4-1. Following is a summary of this approach; refer to these documents, and the guidance for each, for further details.

The development of a high-level waste management facility Authorization Basis is necessary to assure safe operation of a facility, operation, or activity. A critical element of all high-level waste management facility's Authorization Basis is a facility-specific, or operation-specific Safety Analysis Report. DOE 5480.23 requires the development of a Safety Analysis Report for Hazard Category 1, 2, and 3 operations for the purpose of ensuring a facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Since most high-level waste management facilities or operations are designated Hazard Category 2 or 3 operations, through the process prescribed in the DOE-STD-1027-92, they require the preparation of a Safety Analysis Report. (Note: For those high-level waste management facilities that are designated a hazard category below Hazard Category 3, as defined by DOE-STD-1027-92 (e.g., Radiological Facilities), refer to the DOE-EM Limited Standard, DOE-EM-STD-5502-94, for guidance on safety analysis requirements.) The requirement in Section II.P.(2)(a) does not apply to facilities, operations, or activities that are below Hazard Category 3.

DOE 5480.23, through DOE-STD-1027-92, also requires the preparation of a hazard analysis for Hazard Category 1, 2, and 3 operations, with the purpose of systematically identifying facility hazards and accident potentials through a hazard identification and evaluation process. The importance of a hazard analysis centers on its thoroughness since it requires evaluation of the complete spectrum of hazards and accidents that an operation may be subjected to.

From the hazard analysis, a limited subset of accidents (i.e., design-basis accidents) that bound the envelope of accident conditions and to which the operation could be subjected, are carried forward to the accident analysis. The accident analysis is used to designate safety-class structures, systems, and components by comparing the accident consequences to DOE's (Offsite) Evaluation Guidelines for the public. Information obtained from specific accidents or representative accidents are used to specify function requirements for safety-class structures, systems, and components in the Safety Analysis Report. The safety-class designation of structures, systems, and components are reserved for those structures, systems, and components needed for public protection, and as such carries with it the most stringent requirements (e.g., enhanced inspection, testing and maintenance, and special instrumentation and control systems). With the identification of a high-level waste facility's safety-class structures, systems, and components, Technical Safety Requirements (TSR) can be derived by using the screening criteria provided by DOE 5480.22, *Technical Safety Requirements.* Technical Safety Requirements for safety-class structures, systems, and components are generally restricted to those that are needed to meet the DOE Evaluation Guidelines for public protection. See DOE-STD-3009-94, for a discussion on the DOE Evaluation Guidelines.

> *Example: At Site X, the high-level waste vitrification plant hazard analysis and accident analysis concludes that an explosion of the melter will result in the maximally exposed offsite individual receiving a dose at the site boundary that exceeds the DOE Evaluation Guidelines. To mitigate such a release, the melter cell offgas monitoring system is designated a safety-class structure, system, and component. Development of the Technical Safety Requirements for the facility conclude that a Technical Safety Requirement "Safety Limit" and an accompanying "Limiting Control Setting" is required to prevent this accident from occurring.*

Likewise, safety-significant structures, systems, and components, which are the major contributors to the defense-in-depth philosophy and worker safety, are identified by a hazard analysis. Safety-significant structures, systems, and components are developed by qualitatively evaluating the credible accidents and designating structures, systems, and components that further protect the onsite workers or support defense-in-depth.

> *Example: At Site Y, the high-level waste evaporator hazard analysis and accident analysis concludes that during the design basis earthquake, a number of evaporator support systems could fail (e.g., normal power, emergency power, cooling water,*

instrument air, steam, and ventilation) causing components associated with the evaporator's safe shutdown to fail. Analysis indicates that the DOE Evaluation Guideline for public exposures is not exceeded, however, radiological and chemical exposures to onsite workers could be significant. Therefore a number of structures, systems, and components at the evaporator are designated safety-significant: instrument air, primary ventilation system, and the emergency power system. In addition, a number of Technical Safety Requirements (Limiting Conditions of Operation) are assigned to support worker protection and defense-in-depth. Included are hardware and administrative actions that ensure continued supply of ventilation air to the evaporator, off-gas filtration, air flow monitoring, seismic detection, and backup power supply.

Compliance with this requirement is demonstrated if safety-class and safety-significant structures, systems, and components designations are consistent with the cited DOE Orders and Technical Standards. In addition, the design and maintenance of these designated structures, systems, and components shall be consistent with the hazard analysis, accident analysis, and Safety Analysis Report that supports the facility's Authorization Basis.

Supplemental References:

1. DOE, 1994. *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports,* DOE-STD-3009-94, U.S. Department of Energy, Washington, D.C., July 1994.

2. DOE, 1997. *Integrated Safety Management System Guide*, DOE G 450.4-1, U.S. Department of Energy, Washington, D.C., November 1997.

3. DOE, 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C., December 1992.

4. DOE, 1994. *DOE Limited Standard, Hazard Baseline Documentation*, DOE-EM-STD-5502-94, U.S. Department of Energy, Washington, D.C., August 1994.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(b) Confinement. High-level waste systems and components shall be designed to maintain waste confinement. The following requirements apply to new or modifications to existing high-level waste tank systems, ancillary systems, and components.

1. Secondary confinement systems shall be designed to prevent any migration of wastes or accumulated liquid out of the waste system; shall be capable of detecting, collecting, and retrieving releases into the secondary confinement; and shall be constructed of, or lined with, materials that are compatible with the waste(s) to be placed in the waste system.

Objective:

The objective of these requirements is to ensure that high-level waste is invoked in the high-level waste system process vessels, structures, and ancillary systems and components by emphasizing the importance of secondary confinement and the integrity of system and component connections.

Discussion:

In addition to the facility and general design requirements contained in Chapter I, General Requirements (Section I.1.E), the above requirements for high-level waste confinement shall be met. The term “confinement” is defined in Attachment 2, Definitions, to DOE M 435.1-1, as:

> “The control or retention of radioactive materials within a designated boundary. Primary confinements are process enclosures and other spaces normally containing radioactive material. Secondary confinement surrounds one or more primary confinement systems.”

In broad terms, the purpose of confinement systems is to minimize the spread of radioactive and/or hazardous materials and the release of these materials in facility effluents during normal operations, abnormal operations, and potential accidents. These requirements and much of the following guidance is based on detailed requirements developed by the Environmental Protection Agency in support of hazardous waste confinement in 40 CFR Parts 264 and 265, Subpart J, *Tank Systems*. Most untreated, mobile high-level waste is also a mixed waste that must also meet certain hazardous waste requirements. The 40 CFR Parts 264 and 265 requirements allow implementation of one set of requirements for both the radioactive and chemical hazard. A primary function of process equipment is to provide primary confinement and prevent or mitigate radioactive and/or hazardous material releases to the environment. Process equipment that provides primary confinement includes tanks, piping, pressure vessels, pumps, valves, and glove boxes. Secondary confinement systems are those systems that provide the next level of confinement and may include a second barrier incorporated in process equipment, e.g., double-walled tanks, double-walled piping systems, and glove boxes, as well as ventilation and offgas systems, that further prevent or mitigate uncontrolled releases of radioactive and/or hazardous materials to the environment. The need for redundancy and the degree of redundancy in these

systems should be determined by the safety analysis process and maintenance concerns for both active and passive components.

For a specific high-level waste facility or operation, the number and arrangement of confinement systems or barriers and their required characteristics need to be determined on a case-by-case basis. Factors that need to be considered in confinement system design include type, quantity, form and conditions for dispersing the high-level waste material during normal operations and design basis conditions. Engineering evaluations, trade-offs, and experience should be used to develop practical designs that achieve confinement system objectives. The adequacy of confinement systems to perform effectively the needed functions should be documented and accepted through the facility or operation Safety Analysis Report.

The intent of the requirement at Section II.P.(2)(b)(1) is to impose secondary confinement requirements on high-level waste systems and ancillary components and to ensure that the secondary confinement system shall prevent the outflow of high-level waste to the soil, groundwater, or surface water during the high-level waste system's design life. Design of the secondary confinement system needs to be integrated with the hazard analysis and safety analysis process to ensure that the risks of high-level waste collecting outside the primary confinement are addressed. Integration of this requirement is best assessed by monitoring the volume of waste in the tank and monitoring the surrounding soil, groundwater, and surface water for the inflow of waste.

This requirement also prescribes the provisions for designing and constructing the secondary confinement of a high-level waste system. Detection requirements of the secondary confinement systems for failure of the primary confinement is also provided by Section II.P.(2)(b)(2) and Section II.T, Monitoring Program.

Additional guidance, consistent with the performance-based requirements in DOE M 435.1-1, is recommended to promote effective implementation of the higher level requirements. Additionally, secondary confinement systems need to be:

- Constructed of or lined with materials that are compatible with the waste(s) to be placed in the tank system and have sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrological forces), physical contact with the waste to which it is exposed, climatic conditions, and the stress of daily operation (including stresses from nearby vehicular traffic);

- Placed on a foundation or base capable of providing support to the secondary confinement system, resistance to pressure gradients above and below the system, and capable of preventing failure due to settlement, compression, or uplift;

- Provided with a leak-detection system that is designed so that it will detect the failure of either the primary or secondary confinement structure or the presence of any release of hazardous waste or accumulated liquid in the secondary confinement system in accordance with facility requirements determined from safety analyses or environmental permit restrictions; and

- Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked waste and accumulated precipitation should be removed from the secondary confinement system to meet facility administrative controls or operational requirements determined from safety analyses or environmental permit restrictions.

Secondary confinement for tanks may include devices such as vaults and double-walled tanks. A vault is normally either a steel-lined concrete vessel containing the primary confinement vessel or a concrete vessel properly protected by sealants to protect the concrete from the effects of the waste. Double-walled tanks are normally steel or concrete tanks with two walls. Leakage from the primary wall is retained between the two tank walls until it is detected and can be removed.

In general, vault systems need to be:

- Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

- Designed or operated to prevent infiltration of precipitation into the secondary confinement system unless the collection system has sufficient excess capacity to contain infiltration. Such additional capacity should be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;

- Constructed with chemical-resistant water stops in place at all joints (if any);

- Provided with an impermeable interior coating or lining that is compatible with the stored waste and that will prevent migration of waste into the concrete;

- Provided with a means to protect against the formation of and ignition of vapors within the vault, if the waste being stored or treated is:

    1. ignitable waste; or
    2. reactive waste and may form an ignitable or explosive vapor;

- Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.

Example: At Site Z, a high-level waste separations facility was constructed to remove strontium and cesium from the liquid residue from dissolution of spent fuel. The tanks, pumps, valves, piping, and additional ancillary equipment is enclosed in a concrete vault to provide secondary confinement and to protect workers from radiation. The inside surfaces of the vault were coated with an epoxy resin to prevent absorption of any releases from the primary confinement into the concrete vault. The expansion joints of the vaults are sealed with a flexible silicone sealer to help contain any releases from the primary confinement and to prevent intrusion from the exterior of precipitation, surface water, and groundwater. The waste to be processed is not ignitable or reactive, so provision for controlling such vapors need not be included.

The intent of the guidance in paragraphs (iii), (iv), and (vi) above is to protect secondary confinement systems from the harmful effects of high-level waste and to prevent the migration of groundwater into the secondary confinement system.

Double-walled tanks are to:

- Designed as an integral structure (i.e., an inner tank completely enveloped within an outer shell) so that any release from the inner tank is contained by the outer shell.
- Protected, if constructed of metal, from both corrosion of the primary tank interior and of the external surface of the outer shell; and
- Provided with a built-in continuous leak detection system capable of detecting any releases of high-level waste in the outer shell in accordance with facility requirements determined from safety analyses or environmental permit restrictions.

The intent of this guidance is to design and construct the primary and secondary confinement systems as one integral system and to provide continuous leak detection system capability within the secondary confinement system. Detection of leaked wastes in the secondary confinement system is important to alert operators of a release from the primary vessel and removal is necessary to reduce the potential for contamination and exposure.

High-level wastes or treatment reagents are not be placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail.

Due to the hazardous nature of high-level waste and potential airborne and liquid pathway contamination it poses, the requirements that apply to high-level waste facilities apply also to ancillary equipment. Ancillary equipment is considered to include piping, valves, jumpers, valve pits, and other equipment with which the high-level waste can reasonably be expected to be in contact.

Variances or Exemptions to Secondary Confinement Requirements. Variances or exemptions from the secondary confinement requirements for new non-immobilized high-level waste handling, transfer, and storage facilities may not meet exemption criteria because of the potential hazard and releases/exposures liquid or calcined high-level waste may pose. The high-level waste hazard analysis conducted in support of preparing DOE M 435.1-1 identified numerous pathways for the release of high-level waste with the principle one being loss of, or lack of, secondary confinement. Additionally, the selected scenarios that involved loss of, or lack of, secondary confinement resulted in high hazard consequences. Therefore, an exemption from the secondary confinement requirements for new high-level waste facilities that are involved in the handling, transfer, and storage of non-immobilized high-level waste, i.e., high-level waste that has not yet been immobilized in its final glass or ceramic form that meets the EM-WAPS specifications, is not likely to meet exemption criteria.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(b) Confinement.

2. Tank and piping systems used for high-level waste collection, pretreatment, treatment, and storage shall be welded construction, except where remote configurations or periodic rerouting of high-level waste streams require non-welded construction.

Objective:

The objective of this requirement is to ensure that high-level waste tank and piping systems provide the maximum protection possible to the public and the environment by requiring welded construction except in those cases where remoteness or rerouting of the component/piping requires non-welded construction to support operations.

Discussion:

The intent of the requirement for tank and piping systems to be welded construction whenever feasible is to offer the maximum protection possible to systems containing high-level waste.

However, it is recognized that welded construction is not practical where transferring of high-level waste streams requires frequent rerouting, e.g., jumpers within tank farm diversion boxes or when the remoteness, service life, or maintenance requirements of a component/piping requires the use of jumpers. In such cases non-welded construction of piping systems is considered adequate when use of non-welded connections is supported by the operations' authorization basis or radioactive waste management basis.

Example 1: At Site X, a new storage tank is to be added to the existing high-level waste tank farm. The new tank is to be constructed at a significant distance from the existing tanks using welded piping. However, to support transfers, the connection to the existing tank farm is made at a diversion box that utilizes piping jumpers with non-welded connections.

Example 2: At Site Y, a high-level waste transfer pump is located in a shielded transfer pit that requires periodic removal for maintenance. Piping and instrumentation connections to the pump use jumpers, in lieu of welded connections, to facilitate remote removal.

Supplemental References:

1. EPA. *Tank Systems*, 40 CFR Parts 264 and 265 Subpart J, U.S. Environmental Protection Agency, Washington, D.C.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(c) Lifting Devices. The design of hoisting and rigging devices shall comply with the following specific requirements:

1. Lifting devices that are designated as safety class or safety significant shall be designed to prevent free fall of loads.

2. Loading and unloading systems for lifting devices that are designated as safety class or safety significant shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

Objective:

The objective of this requirement is to ensure that special attention is devoted to the design of hoisting and rigging devices in order to avoid releases that could result from dropping a container of high-level waste and to avoid damage to high-level waste containers and systems (e.g., transfer, pretreatment, treatment) that could occur by dropping equipment, containers, or other objects.

Discussion:

The hazards analysis performed to guide development of DOE M 435.1-1 revealed that lifting and rigging activities pose a high hazard for many high-level waste activities. In particular, physical and chemical treatment of high-level waste in large storage tanks often involves the use of large, heavy equipment such as mixers and pumps. Typically, the access to the tanks is through relatively small risers. Manipulation of loads in restricted spaces with the additional complication of high radiation and reduced visibility due to use of containment huts requires that precautions be taken to guard against dropping loads into and onto containers, transfer equipment (e.g., pipelines, valves), and other systems containing high-level waste.

Lifting devices that are designated as safety class or safety significant are subject to the additional requirements for "design to prevent free fall" and "fail safe interlocks on devices for loading and unloading systems for lifting devices." These requirements also apply when the lifting device is not itself a safety class or safety significant device but it could position loads above safety class or safety significant structures, systems, and components. Safety class structures, systems, and components means structures, systems, and components (SSCs) that are relied upon to protect the safety and health of the offsite public as identified by the safety analysis. Safety significant SSCs means structures which are not designated as safety class SSCs, but whose preventive or mitigative function is a major contributor to defense-in-depth (i.e., prevention of uncontrolled material release) and/or worker safety, as determined from hazard analyses. (These definitions are taken from the guide for DOE O 450.4).

> *Example: An underground tank containing 500,000 gallons of high-level waste is determined to have separated into layers, and one of the layers appears to contain materials that are reacting to form a potentially explosive gaseous product. The decision has been made to mix the contents of the tank to reduce the potential for abrupt release of accumulations of explosive gas. The mixer chosen weighs 2 tons and must be inserted through a three foot diameter riser. Because of the potential for damage to the tank and release of high-level waste, as well as contamination of workers involved in the activity, the lifting device is classified as a safety significant SSC and the special requirements for prevention of free fall of loads and fail safe interlocks for loading and unloading devices must be applied. In this case, the mechanism used to grasp or hook the pump must include an interlock to prevent lifting of the pump unless it is securely*

grasped or hooked. Also, the lifting device (e.g., crane, hoist, fork lift) must include a system to prevent free fall of the pump. The lifting activity described in this example is also subject to the critical lift provisions of DOE-STD-1090-96 as required by the hoisting and rigging operational requirements in Section II.V.(1).

Compliance with this requirement can be demonstrated by the development and implementation of procedures that:

- Identify safety class and safety significant lifting devices and safety class and safety significant structures systems and components that would be adversely impacted by the failure of the lifting device;
- Establish the requirements of II.P.(2)(c) as high-level waste design requirements for the lifting device and the associated loading and unloading system; and
- Assures the design requirements are incorporated in the construction and modification of the lifting devices.

Supplemental References:

1. NRC. *Disposal of High-Level Radioactive Wastes in Geologic Repositories,* 10 CFR Part 60, Subpart E, Technical Criteria, paragraph 60.131(b)(10), U.S. Nuclear Regulatory Commission, Washington, D.C.

2. DOE, 1996. *Hoisting and Rigging*, DOE STD 1090-96, U.S. Department of Energy, Washington, DC, September 1996. (a U.S. Department of Energy standard).

3. DOE, 1997. *Integrated Safety Management System Guide*, DOE G 450.4-1, U.S. Department of Energy, Washington, D.C., November 1997.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(d) Ventilation.

1. Design of high-level waste pretreatment, treatment, and storage facilities shall include ventilation through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the applicable requirements.

Objective:

The objective of this requirement is to ensure that airborne releases of radioactive materials will at all times be maintained within limits specified in applicable DOE Orders and regulations and requirements of other relevant Federal and State agencies.

Discussion:

Ventilation, filtration, and off-gas systems need to be designed to ensure that the releases of airborne radioactive particulate material during normal and off-normal conditions conform to:

- the limits specified in 10 CFR Part 835, *Occupational Radiation Protection*, for workers and for members of the public in controlled areas;

- the limits established in other applicable DOE Orders such as DOE 5400.5, *Radiation Protection of the Public and the Environment*, and

- generally applicable standards for releases of radioactive material to the environment that have been promulgated by the Environmental Protection Agency, including those for the *Clean Air Act*, 40 CFR Part 61.

The limits for release cited in DOE 5400.5, *Radiation Protection of the Public and the Environment*, and in the *Clean Air Act* requirements, 40 CFR Part 61, are for the DOE site (i.e., all the activities of the Department at that site), not for individual facilities. Therefore, the operational limits for any individual facility should be established based on the potential impacts from all facilities on the site. Consistent with Departmental practices, and an underlying principle in development of the Radioactive Waste Management Manual, airborne releases should be kept as low as reasonably achievable.

Attention to fire protection for filtration on these ventilation systems is important because of the potential presence of flammable and explosive gases that led to the requirement for ventilation. Guidance for fire protection of filtration systems in ventilation plenums for nuclear facilities is provided in *Fire Protection Design Criteria*, DOE-STD-1066-97. Typical requirements address materials of construction, location of filters, fire ratings of protective walls, and internal detectors for fire and high heat.

To preclude the ventilation system itself from becoming a source of ignition for these gases, the ventilation systems need to employ spark-proof technology.

> *Example: Spark-proof fan motors, spark-proof dampers and actuating mechanisms and spark-proof fan/fan-grill combinations are used in the ventilation system for Tank 400 at*

Site Z because of the presence of flammable gases that could burn if an ignition source were present.

This requirement specifies that the design of ventilation systems include appropriate filtration so the emissions from the ventilation system do not exceed established limits. This subrequirement is to be implemented using the graded approach. This requirement is intended to ensure that high-level waste management facilities have adequate filtration, not to dictate that each facility must have a particular type of air filtration. Therefore, the safety analysis or assessment for each facility should provide the basis for determining the level of filtration required.

Example: A new facility is to be built at Site Z for pretreatment of liquid high-level waste prior to transferring the waste to an existing vitrification facility. The pretreatment process equipment will be housed in a new building that protects it from the elements and provides confinement for any radioactive liquid or air particulates that may leak from the process equipment. While the portions of the building occupied by workers will be shielded from the process equipment, ventilation will also be required to mitigate any release of airborne radioactive material. The design of the facility must provide for ventilation and appropriate filtration of the exhaust from the system.

Compliance with the ventilation requirements can be demonstrated by:

- incorporating necessary ventilation systems (as indicated by safety analyses or assessments) in the design of high-level waste management equipment and facilities, and

- providing filtration capability for each ventilation system, as appropriate, to meet regulatory requirements for emissions of radioactive materials under normal and off-normal conditions.

Supplemental References:

1. DOE. *Occupational Radiation Protection*, 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

2. EPA. *National Standards for Hazardous Air Pollutants*, 40 CFR Part 61, U.S. Environmental Protection Agency, Washington, D.C.

3. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

4. DOE, 1997. *Fire Protection Design Criteria*, DOE-STD-1066-97, U.S. Department of Energy, Washington, D.C., March 1997.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(d) Ventilation.

2. When conditions exist for generating gases in flammable and explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Objective:

The objective of this requirement is to keep concentrations of flammable and explosive gases below the lower flammability limits. However, in those instances where the concentrations of such gases are expected to approach or exceed the lower flammability limit, the objective is to prevent detonation or deflagration by an alternate means. These means could include oxygen/oxidant control or employing designs which prevent ignition (i.e., spark-proof technologies).

Discussion:

Ventilation systems that are required for equipment and facilities that generate and accumulate quantities of flammable and/or explosive gases in concentrations that would pose a risk of fire and/or explosion need to be capable of moving a sufficient volume of gases to limit concentrations of flammable and/or explosive gas to safe levels at all times.

Example: Tank 400 at Site Z generates flammable organic gases. The tank was constructed and filled with high-level waste in the 1980s. This tank must be equipped with a ventilation system, and the volume of air circulated through the headspace must be sufficient to maintain concentrations below the lower flammability limit for the organics present. The ventilation system must include filtration for removing radioactive particulates that may be in the ventilation exhaust so release limits are not exceeded.

Attention to fire protection for filtration on these ventilation systems is important because of the potential presence of flammable and explosive gases that led to the requirement for ventilation. Guidance for fire protection of filtration systems in ventilation plenums for nuclear facilities is provided in *Fire Protection Design Criteria,* DOE-STD-1066-97. Typical requirements address materials of construction, location of filters, fire ratings of protective walls, and internal detectors for fire and high heat.

The hazard analysis supporting revision of the DOE requirements for management of high-level waste identified the potential for generation, accumulation, and ignition of flammable and explosive gases in high-level waste storage tank headspace as one of the highest risk scenarios. The analysis indicated that such scenarios could result in uncontrolled releases of radioactive material to the environment and exposure of workers and the public to radiation from the releases.

When conditions exist for generating gases in flammable and explosive conditions, designs of high-level waste facilities shall include active ventilation systems with the capability to remove sufficient quantities of gases to preclude the accumulation of flammable and explosive gases in concentrations that pose a safety hazard. However, it may not be practical to keep concentrations below the lower flammability or explosivity limits 100% of the time with ventilation systems. There may be infrequent period where “puff” releases of gases will result in concentrations that approach or exceed the lower flammability or explosivity limits for a brief interval of time. In addition, some processes may routinely result in relatively large releases of such gases. In such cases, facility designs should include alternate features to preclude deflagration or detonation. This could be accomplished through the use of spark-proof fan motors, actuating mechanisms, and fan/grill combinations. Other features, such as the insertion of a sufficient flow of an inert gases into the headspace, may also provide a practical means to dilute the concentrations of these gases or the available oxygen/oxidants, and to thereby preclude deflagration and detonation.

> *Example: Tank 400 at Site Z generates flammable organic gases. The tank was constructed and filled with high-level waste in the 1980s. This tank has been equipped with a ventilation system, circulated with the capability to circulate through the headspace a volume of air sufficient to maintain concentrations below the lower flammability limit for the organics present for 98% of the time. Since the concentrations of flammable gases are above the lower flammability limit for the remaining 2% of the time, the ventilation system design also includes spark proof technology. The ventilation system includes filtration for removing radioactive particulates that may be in the ventilation exhaust so release limits are not exceeded.*

> *Example: An existing tank at site X is generating flammable gases following the receipt of waste from another tank. The tank design does not include an active ventilation system. Without mitigative actions, concentrations of flammable gases will increase to levels approaching the lower flammability limit. Calculations have demonstrated the*

feasibility of introducing nitrogen into the tank head space in sufficient volume to displace the oxygen and maintain the concentrations well below the lower flammability limit. This approach has been selected as the preferred option in view of the cost for installing an active ventilation system to provide the same level of safety.

Compliance with the ventilation requirements can be demonstrated by:

- identifying new and existing equipment and facilities that require ventilation systems, or other features to preclude or mitigate the hazards posed by the accumulation of flammable and explosive gases in concentrations above the lower flammability limit or the lower explosivity limits of such gases,

- incorporating ventilation systems, or other features, (as indicated by the safety analyses or assessments) in the design of such high-level waste management equipment and facilities, and,

- providing filtration capability for each high-level waste facility ventilation system as appropriate, to meet regulatory requirements for emissions of radioactive materials under normal and off-normal conditions.

Supplemental References:

1. DOE. *Occupational Radiation Protection*, 10 CFR Part 835, U.S. Department of Energy, Washington, DC.

2. EPA. *National Standards for Hazardous Air Pollutants*, 40 CFR Part 61, U.S. Environmental Protection Agency, Washington, D.C.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(e) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing high-level waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Objective:

The objective of this requirement is to ensure the incorporation of the concept of life-cycle waste management into the design and construction of radioactive waste management facilities to minimize the amount of radioactive waste that must be managed in the future, and to reduce the number of facilities that must be dismantled rather than used for another purpose.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the concept of life-cycle management of waste was identified as a key theme that would promote safety and provide a long-term benefit in reducing hazards associated with radioactive waste management. This requirement was developed to extend the life-cycle management of waste concept to the design of facilities used for the management of radioactive waste. The goals of applying this concept at the design stage are to minimize the future generation of waste and to promote the planning for subsequent beneficial use or decommissioning of a facility at the end of its original mission. Decontamination and decommissioning activities are becoming a significant part of the life-cycle costs for high-level waste facilities. This requirement also addresses this situation by promoting proactive consideration of design features that facilitate decontamination and dismantlement activities that will lead to a beneficial use or decommissioning.

New high-level waste facilities are defined as those whose design basis is not approved. (The term design basis is defined in the definitions attachment to the Manual). Thus, if a high-level waste facility's design basis is defined, the requirements of this section are applicable. Similarly, if a significant modification to an existing facility is to be made, this requirement applies. Application of these requirements to existing facilities should be considered and applied on a case-by-case basis. To support this decision, an analysis should be conducted comparing the expected benefits of the application of these requirements to the costs of implementing such measures. These costs should include programmatic impacts current cost and schedule impacts, as well as potential impacts such as additional worker exposure due to radiation and chemical hazards, and future costs.

Design to Facilitate Decontamination. Decontamination is defined in Attachment 1 to DOE O 430.1A, *Life-Cycle Asset Management*, as "the removal or reduction of residual radioactive and hazardous materials by mechanical, chemical, or other techniques to achieve a stated objective or end condition." In conjunction with DOE O 430.1A, DOE M 435.1-1 requires that high-level waste facilities incorporate measures to reduce areas of contamination, or to simplify decontamination of areas that may become contaminated with radioactive or hazardous materials to facilitate either decommissioning or reuse of the facility. Following are design features that should be considered:

- Service piping, conduits, and ductwork should be kept to a minimum in areas that could be potentially contaminated, and their design, if included in such areas, should be arranged to facilitate decontamination.

- Cracks, crevices, and joints should be filled and finished smooth to prevent accumulation of contaminated material.

- Walls, ceilings and floors in areas vulnerable to contamination should be finished with washable or strippable coverings.

- Metal liners, e.g., stainless steel cell lining, should be used in areas that have the potential to become highly contaminated with high-level waste materials.

- Contaminated or potentially contaminated piping systems should have provisions for flushing and/or cleaning.

- Accessible, removable covers for inspection and cleanouts should be provided.

- Construction materials that reduce the amount of radioactive materials requiring disposal and that are easily decontaminated should be selected.

Design to Support Decommissioning. Decommissioning, also defined in DOE O 430.1A, is "actions taken at the end of the life of a facility to retire it from service with adequate regard for the health and safety of the public and workers and protection of the environment." Design features that should be considered to support decommissioning or a reuse of the facility include:

- Use of modular radiation shielding, in lieu of or in addition to, monolithic shielding walls.

- Use of modular, separable confinements to preclude contamination of fixed portions of the structure.

- Designs that facilitate cut-up, dismantlement, removal, and packaging of contaminated equipment, such as glove boxes, air filtration equipment, large tanks and vessels, and ductwork, from the facility.

- Use of localized liquid transfer systems that avoid long runs of buried, contaminated piping. Special provisions should be included in the design to ensure the integrity of joints in buried pipelines.

- Piping systems that carry contaminated or potentially contaminated liquid should be free draining by gravity.

- Location of exhaust filtration components of ventilation systems should be at or near individual enclosures to minimize long runs of internally contaminated ductwork.

- Equipment, including effluent decontamination equipment, should preclude, to the extent practical, the accumulation of radioactive or other hazardous materials in relatively inaccessible areas, including turns in piping and ductwork.

- Provisions for suitable clearances, where practical, to accommodate remote handling and safety surveillance equipment required for future decontamination and decommissioning.

- Use of lifting devices on large tanks and equipment.

Decommissioning and Reuse Planning. Due to the high life-cycle costs of high-level waste facilities, the second part of the requirement is intended to promote post-mission planning of high-level waste facilities by requiring the identification of possible decommissioning methods, or reuses, of high-level waste facilities, as early as possible. To meet this requirement, high-level waste facility designs, or significant modification efforts, should include analysis to determine the best decommissioning methods, using currently available technologies, and factor the results of this analysis into the facility's design. Likewise, if a reuse of the facility is envisioned, any features that can support this reuse mission should be considered in the design effort.

At the time of the preparation of this guidance, the "Decommissioning Implementation Guide," Draft G 430.1-4, was in preparation to incorporate deactivation and decommissioning requirements currently contained in DOE 5820.2A, Chapter V. Refer to this Guide, and DOE O 430.1A, *Life-Cycle Asset Management*, for further information on deactivation and decommissioning activities. Also, refer to DOE-STD-1120-98, referenced below, on the integration of safety and health requirements into facility disposition activities.

Compliance with this requirement can be demonstrated by the existence of design documentation that indicates decontamination was considered during the design of new high-level waste facilities or significant modifications to high-level waste facilities. Additionally, documentation should demonstrate that post-mission planning was considered, as early as possible in the life of a facility, to assist in the identification of possible decommissioning methods or facility reuse.

Supplemental References:

1. DOE, 1998. *Life-Cycle Asset Management,* DOE O 430.1A, U.S. Department of Energy, October 14, 1998.

2. DOE, 1997. *Decommissioning Implementation Guide*, Draft G 430.1-4, U.S. Department of Energy, October 1, 1997.

3. DOE, 1997. *Integration of Safety and Health into Facility Disposition Activities*, DOE-STD-1120-98, U.S. Department of Energy, Washington, DC, Draft for DOE Complex Wide Review 9/26/97, September 26, 1997.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(f) Maintenance Exposure Reduction. Remote maintenance features and other appropriate techniques to maintain as low as reasonably achievable (ALARA) personnel exposures shall be incorporated into each high-level waste facility.

Objective:

The objective of this requirement is to incorporate engineered features into the high-level waste facilities to minimize total personnel radiation exposures at high-level waste facilities in accordance with ALARA principles.

Discussion:

Those structures, systems, and components for which operation, maintenance, and required inspections may involve occupational exposure must be designed, fabricated, located, shielded, controlled, and tested so as to control external and internal radiation exposures to personnel. Features may be employed individually or in combination to achieve this objective. Some features include the following:

- preventing the accumulation of radioactive material in those systems requiring access (e.g., minimizing bends and piping low points);
- decontaminating those systems to which access is required;
- controlling access to areas of potential contamination or high radiation; measuring and controlling contamination of areas requiring access;
- minimizing the time required to perform work in the vicinity of radioactive components;

- shielding personnel from radiation exposures; and

- providing remote maintenance features.

Existing DOE Orders address many of the concerns relevant to maintenance exposure reduction. The policy for DOE 4330.4B, Maintenance Management Program, includes the requirement that "…DOE property be maintained in a manner which promotes … worker health… while meeting the programmatic mission." The guidance for this order includes the development of goals and objectives such as "…minimize radiological exposure…" consistent with the DOE requirements for occupational radiation protection.

The principal DOE requirements for occupational radiation protection are found in 10 CFR Part 835, *Occupational Radiation Protection*, and include requirements for maintaining doses as low as reasonably achievable (ALARA). Section 835.101 specifically states that DOE activities shall be conducted in compliance with a radiation protection program that includes formal plans and measures for applying the ALARA process to occupational exposures. ALARA also includes consideration of economic as well as technical factors. As noted in DOE M 435.1-1, Section I.1.E.(13), the requirements of 10 CFR Part 835 apply to radioactive waste management facilities, operations, and activities which include maintenance activities.

> *Example: In a high-level waste processing facility, a component decontamination cell and contact-handled maintenance facility are provided. The decontamination cell incorporates remote decontamination capabilities to reduce contamination levels so that contact maintenance can be performed in reduced radiation fields. The contact-handled maintenance facility is located adjacent to the decontamination cell and incorporates features such as enhanced lighting and temporary shielding to facilitate maintenance.*

> *Example: In a high-level waste vitrification facility, manipulators and remotely operated work arms are sized to perform certain maintenance functions in addition to limited operational tasks. Specific maintenance functions such a tool could perform include change of melter components not accessible by in-cell cranes.*

Compliance with this requirement can be demonstrated by having and implementing a Maintenance Management Program that includes due emphasis on radiation protection. The radiation protection requirements must not only maintain exposures at or below prescribed limits, but also must incorporate ALARA principles.

Supplemental References:

1. DOE. *Occupational Radiation Protection*, 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

2. DOE, 1994. *Maintenance Management Program,* DOE 4330.4B, U.S. Department of Energy, Washington, D.C., February 10, 1994.

3. DOE, 1998. *Worker Protection Management for DOE Federal and Contractor Employees,* DOE O 440.1A, U.S. Department of Energy, Washington, D.C., March 27, 1998.

4. DOE, 1998. *Occupational Exposure Assessment,* DOE G 440.1-3, U.S. Department of Energy, Washington, D.C., March 30, 1998.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(g) Facilities for the Receipt and Retrieval of High-Level Waste.

1. Designs for storage facilities shall incorporate features to facilitate retrieval capability.

2. High-level waste receipt and retrieval systems shall be designed to complement the existing storage facilities for the safe storage and transfer of high-level waste.

Objective:

The objective of this requirement is to ensure that the interfaces for input to and transfer from high-level waste storage facilities are designed to facilitate subsequent removal of the waste, and that they are fully compatible with the high-level waste to be stored, including necessary packaging and transfer operations, and with structural and other limitations of storage facilities.

Discussion:

Facilities for the receipt and retrieval of high-level waste must be designed to allow safe handling, storage, and retrieval of the wastes. Therefore, before new facilities are constructed and employed to store high-level waste, strategies for retrieval of that waste need to be identified and the essential features of those strategies for retrieval of that waste need to be incorporated into the design of the facilities. Design of existing facilities need to be reviewed to identify essential additional features that could be engineered into the facility to provide for acceptable handling and retrieval.

Example: At Site Z, a new tank farm is being designed for storage of high-level waste from reprocessing of deteriorating spent fuel. The reprocessing is intended to remove isotopes that can be used in power reactors, but the separations process is not highly efficient, so significant quantities of special nuclear material will remain in the high-level waste to be vitrified and disposed of with the fission products. Because of the higher than normal concentrations of special nuclear material, special efforts will be made to design the tanks so most of the liquid high-level wastes can be removed from the tanks. Design features include:

- *configuration of tank bottoms to slope toward the low point of tanks to promote removal of most of the waste;*

- *installation of a residuals pump-out line at the low point of each tank;*

- *elimination of internal structural members in the tanks that could interfere with waste removal and clean-out activities for closure; and*

- *incorporation of adequate risers to accommodate anticipated in-tank activities such as mining, pumping, and wash-down of the tank walls.*

In the interest of identifying the structural needs and other requirements that can be incorporated in the design of new facilities, t is important to anticipate the types of activities that may be performed for retrieval of high-level waste. For existing facilities whose structural integrity limitations would not support the loads for an integral retrieval capability, additional structural support would be provided to eliminate or minimize imposed loads on the tank structure.

Example: The strategy for retrieval of liquid waste from a storage tank involves the use of a robotic arm whose weight must be born by the tank structure. The associated loads need to be included in the structural design requirements for the tank, as well as provisions for access. The structural integrity program would also use these loads in assessing the structural integrity of the tank over its life, to assure the tank's integrity can be maintained during retrieval.

The retrieval of canistered waste for shipment to another storage facility or to a disposal facility will require transferring the waste into a shipping cask certified by the Nuclear Regulatory Commission under 10 CFR Part 71. Additional requirements of the Department of Transportation (49 CFR Part 193, Subpart I) and the DOE Orders, DOE O 460.1A and DOE O 460.2, may also affect the design of the receipt and retrieval features.

Implementation of this requirement must be coordinated with several other related requirements of this Manual. DOE M 435.1-1, Section II. J. specifies that Waste Acceptance Requirements be

developed for storage facilities, and the receiving features of storage facilities must be designed to support any evaluation and acceptance activities necessary to ensure compliance with the Waste Acceptance Requirements. Finally, the receipt and retrieval features must be designed to be compatible with the general requirements for waste management including Worker Protection (Section I.1.E.(21)), Radiation Protection (Section I.1.E.(13)) including maintaining exposures as low as reasonably achievable, and Safeguards and Security (Section I.1.E.(16)).

Compliance with this requirement for new facilities can be demonstrated by the existence of design documentation of the receipt and retrieval features of high-level waste storage facilities to provide for necessary evaluation and acceptance activities, and demonstrating that retrieval operations can be performed under conditions likely to prevail at the time of removal. Compliance with this requirement for existing facilities can be demonstrated by evaluating the receipt and retrieval features of storage facilities and the existence of design documentation for modifications to systems as required to allow retrieval operations to be safely and effectively performed under conditions likely to prevail at the time of removal of the waste

Supplemental References:

1. NRC. *Packaging and Transportation of Radioactive Material*, 10 CFR Part 71, U.S. Nuclear Regulatory Commission, Washington, D.C.

2. USDOT. *Shippers-General Requirements for Shipments and Packaging-Radioactive Materials*, 49 CFR Part 173, Subpart I, U.S. Department of Transportation, Washington, D.C.

3. DOE, 1996. *Packaging and Transportation Safety*, DOE O 460.1A, U.S. Department of Energy, Washington, D.C., October 2, 1996.

4. DOE, 1995. *Departmental Materials Transportation and Packaging Management*, DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(h) Structural Integrity. Designs for new tanks shall contribute to the confinement requirement at Section II.P.(2)(b) of this Manual by:

1. Incorporating features to avoid critical degradation modes at the proposed site where practicable, or minimize degradation rates for the critical modes; and

2. Incorporating features to facilitate execution of the Structural Integrity Program required by Section II.Q.(2) of this Manual.

Objective:

The objective of this requirement is to incorporate engineering features into the design of new tanks that will allow for longer service life and to facilitate implementing the Structural Integrity requirement at Section II.Q.(2) after the new tanks are placed in service.

Discussion:

For any new tanks that may be constructed to store high-level waste, the service life is to be specified. A primary determinant of service life is the structural integrity (leak-tightness and structural stiffness) of the tank. Confidence that the design service life of new tanks will be realized can be attained by selection of materials and design features that will avoid critical degradation modes or minimize their degradation rates. The critical modes and rates of interest are those that result from the chemistry of the waste to be stored in the tank, the chemistry of its in-situ environment, and loads that are anticipated to be imposed during its lifetime.

BNL-UC-406, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks* identifies guidelines for establishing a structural integrity program for high-level waste storage tanks. It includes both design and operational features. For tanks constructed without access for inspection, the uncertainty associated with assessment of structural integrity is greater because material degradation and remaining thickness must be inferred from indirect data such as derived corrosion rates. However, new tanks can be designed to provide access for robotic instruments to travel between the primary and secondary containers to directly assess the degradation experienced and the material thickness remaining. Access to conduct other tests (e.g. coupon tests) can also be provided in new tanks to obtain other critical data so as to minimize personnel exposures.

> *Example: Based on information provided through the structural integrity program at DOE M 435.1-1, Section II.Q.(2), the remaining service life of five existing tanks at Site XX cannot meet operational requirements. Therefore, five new tanks are to be designed and constructed to store high-level waste. The planned service life for the new tanks, with a range of uncertainty, has been established as a design requirement. Based on characterization of the existing waste to be transferred to the new tanks, and*

characterization of the site geology, the corrosion modes and rates have been established for alternative materials, Site XX has developed a strategy for retrieval of the waste from the tanks using a robotic arm. Loads that will be experienced by the tank structure from normal soil loads, loads from anticipated ground motion, loads from retrieval and decommissioning activities, and loads for operational and maintenance activities have been estimated and established as design requirements. The capability for access by robotic devices to assess structural degradation and remaining thickness has also been established as a design requirement as has the capability to monitor critical structural loads with instrumentation during the service life of the tanks has also been established as a design requirement.

The actions necessary to comply with this requirement are complementary to those identified in the guidance for the Structural Integrity requirement at Section II.Q.(2)., except that the actions are undertaken prior to selection of the materials and the design of the structure. These actions include:

1. Establishing the design load requirement based on loads anticipated during the service life of the tank. These loads include: normal soil load; loads from anticipated ground motion; thermal loads; loads from retrieval and decommissioning activities; and, loads related to maintenance and operational activities.

2. Establishing design requirements for acceptable corrosion modes and rates based on the chemistry of the waste that will be stored in the tanks and the in-situ chemistry of the site and the supporting structure.

3. Establishing design requirements to implement the structural integrity program at paragraph II.Q.(2), including access for instrumentation to assess degradation and remaining material thickness

4. Establishing other design requirements which would significantly increase confidence that the design service life will be achieved (e.g., access for coupon tests; cathodic protection).

Supplemental References:

1. BNL, 1997. *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, BNL-UC-406, Brookhaven National Laboratory, Upton, NY, January 1997.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(i) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of high-level waste treatment, storage, pretreatment, and treatment facilities to provide volume inventory data and to prevent spills, leaks and overflows from tanks or confinement systems.

Objective:

The objective of this requirement is to include engineering controls in the design of high-level waste pretreatment, treatment and storage facilities to minimize the likelihood of loss of confinement during normal and abnormal operations. Additionally, the requirement is to ensure the incorporation of engineering controls that alert operations personnel of an impending and actual loss of confinement.

Discussion:

During the development of the DOE O 435.1 and DOE M 435.1-1, a hazards analysis and a requirements analysis concluded that the loss of confinement due to a spill, leak or overflow at a high-level waste treatment or storage facility could pose a significant risk to both workers and the environment. That analysis resulted in the inclusion of this requirement to be applied to all high-level waste treatment and storage facilities. In the context of this requirement, pretreatment is a subset of treatment and affected facilities include process vessels, tanks and bins that serve as a level of confinement for high-level waste in the liquid, slurry, or solid (e.g., calcine) state. Storage facilities include underground high-level liquid waste storage tanks as well as storage bins for calcined material.

This requirement is invoked to support prompt detection and prevention of conditions which could lead to release of radioactive material from high-level waste pretreatment, treatment, and storage facilities. This is also closely related to the design requirement for monitoring systems. However, this requirement addresses implementation of controls that <u>prevent</u> the loss of confinement whereas the monitoring design requirement is intended to address <u>detection</u> of loss of containment.

For clarification, engineering controls in this requirement are considered to be those systems or design characteristics that are provided to prevent or mitigate the loss of confinement from high-level waste storage facilities and which provide volume inventory data. Examples of engineering controls include flowmeters, level-sensing devices, liquid and solid level alarms, anti-siphon devices overflow prevention features, and any other instrumentation and controls that maintain sufficient freeboard within the storage unit.

Loss of confinement at a high-level waste pretreatment, treatment or storage facility can result from overflows, spills, leaks and siphoning of waste from the storage unit. Incorporation of design measures at these facilities to prevent such loss of confinement is necessary, but their presence alone is not considered sufficient to meet this requirement. Engineering controls must also be subject to periodic inspection and maintenance to ensure proper operation. In spite of rigid maintenance and surveillance, such equipment can fail over its expected service life. Therefore, to fully meet this requirement, mitigative measures to reduce the loss of confinement are necessary. These mitigative measures should be implemented in conjunction with the required measures of confinement, as specified by DOE M 435.1-1, Section II.P.(2)(b), Confinement, of this guidance.

> *Example 1: At Site X High-Level Waste Tank Farm, an engineering control on a waste tank includes a waste feed line shut-off valve, which is activated by a tank level-sensing device, to prevent overflow of waste from the tank. For defense-in-depth, a double-contained overflow line is attached to the tank to channel any overfill to a spare waste tank at the tank farm.*

> *Example 2: A facility is being designed to separate high-level liquid from precipitated solids as the mixture is withdrawn from a storage tank. The separations process is a continuous operation, with the liquid being transferred to a storage tank. To avoid loss of containment, an interlock is included in the design which prevents feed from entering the separations process and liquid from being discharged unless the supernatant receiving tank is below ninety-five percent full.*

The graded approach should be used for determining the appropriate level of engineering controls to incorporate into the design of high-level waste management facilities. As indicated in the preceding examples, sensing devices, alarms, and spill or overflow prevention features are most appropriate in facilities storing liquids or with continuous, automatic processes. Other instances involving bulk or solid high-level waste may need to invoke these controls, as well as a simple shutoff switch which could prevent overfilling.

It is recognized that incorporation of engineering controls to meet this requirement may be directed by the facility-specific safety analysis for the storage unit or group of storage units. Such safety analysis may dictate that some of the engineering controls be designed as safety-class or safety-significant systems, structures or components (SSC) to ensure they survive the design-basis accidents. Use of the safety analysis process prescribed by DOE 5480.23, “Nuclear Safety Analysis Reports,” to identify the necessary engineering controls to meet this requirement for both new, and upgrades to existing, high-level waste storage facilities is encouraged.

Compliance with this requirement is demonstrated by the incorporation of engineering controls that provide timely information to facility operations personnel regarding the volumes of high-

level waste being stored, automatic shut-off, anti-siphoning devices, and automatic sensing devices, and mitigative measures to minimize the spread of high-level waste in the event of loss of confinement.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, DOE O 420.1, Revision G (Draft), Facility Safety, U.S. Department of Energy, Washington, D.C., September 1995.

II. P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(j) Volume Monitoring Systems. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of high-level waste storage, pretreatment, and treatment facilities to provide rapid detection of failed confinement and/or other abnormal conditions.

Objective:

The objective of this requirement is to mandate design and installation of equipment in high-level waste management facilities that is capable of identifying failures in containing high-level waste and other conditions that could result in exposure of the public, workers, or releases to the environment.

Discussion:

This requirement is invoked to address a group of high hazards was identified by the hazards analysis performed in support of DOE O 435.1 and DOE M 435.1-1 associated with the failure to promptly detect a release of high-level waste that could impact personnel, the public, or the environment. This particular requirement addresses the design of monitoring systems so that unexpected changes in quantity indications can be promptly checked to determine if they are a reflection of failure in high-level waste confinement facilities/systems and so that high-level waste transfers can be monitored to avoid overfilling. Monitoring for detecting releases that may be too small to be detected quickly, via volume changes, is addressed in DOE M 435.1-1 Section II.T, Monitoring.

The hazards analysis performed to guide development of DOE O 435.1 and DOE M 435.1-1 revealed that releases can result from failure of confinement or from failure to stop transfer of high-level waste when the receiving vessel (e.g., tank or bin) is full. The requirement discussed

here is generally directed toward prompt detection of acute releases (releases that can be readily detectable) that become apparent over a time frame of hours or days. In contrast, the requirements for environmental monitoring (see Section II.T) for compliance with release limits is directed toward detection of releases that generally evolve slowly and may be detected by low threshold environmental monitoring devices weeks, months, or longer after the release begins.

> *Example: A large diameter storage tank for liquid high-level waste includes a mechanical level indicator that is read and recorded daily. The level indicator remained stable for six months following the last waste addition to the tank. The level indicator readings then began to show a downward trend that totaled two inches over a two week period. There could be causes for the level change other than leakage (see following additional discussion), but the level indicator change would alert operators of a potential problem that requires further investigation.*

Experience in the management of high-level waste has led to identification of various events for the release of high-level waste. Some of those factors include the generally corrosive (acidic or basic) chemical composition of liquid high-level waste, the use of vessel materials such as mild steel that are not highly resistant to corrosion and other chemical attack, the abrasive physical form of calcined high-level waste, and the absence of secondary confinement. The consequences of release of high-level waste, coupled with the factors threatening confinement, led to development of the requirement for monitoring. Other requirements of this chapter address Confinement (Section II.P.(2)(b)), Structural Integrity of storage tanks (Section II.P.(2)(h)), Structural Integrity Program (Section II.Q.(2)), and Instrumentation and Control Systems for high-level waste volume inventory (Section II.P.(2)(i)). The confinement requirement focuses on design of waste systems and components to ensure confinement and requires application of a number of specific design considerations. The Structural Integrity requirement focuses on assessment of the condition of confinement barriers and processes that promote anticipation of potential confinement weakness or failure based on known deterioration processes. The Instrumentation and Control requirement focuses on <u>prevention</u> of releases in contrast to this requirement, which emphasizes <u>detection</u> of releases.

Storage facility surface level is a relatively straightforward parameter to monitor. In general, the surface level in a vessel is an appropriate indicator of high-level waste volume. However, operations and mechanisms that could change the volume in a vessel must be considered to factor out explainable level changes.

> *Example 1: An unexpected chemical reaction generates gas that is trapped within the waste matrix or under a semipermeable layer of waste that retards percolation of the gas to the surface of the waste. This mechanism maintained the apparent surface level of high-level waste in a vessel even as liquid was leaking out.*

Example 2: Operating personnel at a high-level waste storage facility calculate the evaporation loss expected from a tank based on an assumed radionuclide inventory. The actual radionuclide inventory is much smaller than that assumed, so the actual heat generation rate is much smaller than that assumed. Overestimation of the waste volume change due to evaporation resulted in failure to detect leakage that was incorrectly assumed to be evaporative loss.

Gas generation and evaporation, as well as intentional additions to and removals from the vessels must be accurately accounted for if the waste level (or volume) is to be used to monitor for leakage. The monitoring capability should be coupled with instrumentation and control systems, such as automatic shutoffs and bypasses with alarms, that will alert operators that action is needed to prevent or mitigate a release.

For transfer systems, approaches such as continuous flow measurements and comparisons of total volume input to total volume output can be used to monitor the integrity of the transfer system. The containment integrity of waste transfer systems can also be monitored for radiation levels in excess of those expected from residual waste in the transfer system.

Example: A pneumatic transfer system for calcined high-level waste is enclosed in a concrete tunnel that provides significant shielding for an adjacent work area. Routine surveys along the outside of the tunnel revealed higher than normal residual activity when calcine was not being transferred. The surveys also showed progressively higher activity after each transfer of calcine. Examination inside the tunnel with a remotely operated camera revealed an accumulation of calcine fines below an elbow where abrasion from the calcine had apparently eroded a hole in the transfer line.

A highly reliable means of monitoring for releases is the use of secondary confinement, which is then checked for the presence of high-level waste. This monitoring approach should be applied to essentially any high-level waste management systems including pretreatment, treatment, storage, and transfer (see Section II.P.(2)(b)). It also offers the benefit of providing defense-in-depth to avoid the release of high-level waste.

Example: A high-level waste transfer line from a storage tank farm to a vitrification plant includes a secondary confinement barrier. The transfer line is constructed with sufficient pitch to cause any leakage into the outer line to flow back to the storage tank. A conductivity cell, with associated monitor, is included in the outer line to alert operators of a primary to secondary barrier leak, as a mitigative measure.

What constitutes rapid detection of failed confinement or provides indications of abnormal conditions needs to be established for each facility, operation, or activity. Monitoring system design requirements and engineering controls to address catastrophic failures will be established

through the conduct of safety analyses. The failures and conditions being addressed by this requirement are not catastrophic, but could result in releases of radioactivity, or doses to workers or the public, in excess of established limits, if the leak was allowed to continue over a period of hours or days or individuals were not removed. Similarly if the failure results in releases of radioactivity to an air or liquid effluent stream, detection needs to occur rapidly enough to prevent environmental releases from exceeding annual limits.

A graded approach should be applied to design and operational implementation of this requirement for monitoring to detect acute releases promptly. For example, it may not be necessary to provide continuous monitoring of waste levels in high-level waste storage tanks that have had the pumpable liquids removed, to the extent possible, or in bins of stored calcined high-level waste the waste is not especially mobile. Occasional level verification with a non-permanent detection system for such cases is considered suitable and meets the intent of this requirement. On the other hand, highly mobile liquid waste in a single-walled, mild steel tank would probably require continuous monitoring coupled with alarms and transfer equipment.

Compliance with this requirement is demonstrated by the existence of design documents for high-level waste systems that include the capability to monitor waste volumes and detect volume changes in a time frame that will allow implementation of corrective measures to limit public and worker doses and releases to allowable levels.

Supplemental References:

1. EPA. *Containment and Detection of Releases,* 40 CFR 264.193 for Hazardous Waste Tank Systems, U.S. Environmental Protection Agency, Washington, D.C.

2. EPA. *General Operating Requirements*, 40 CFR 264.194 for Hazardous Waste Tank Systems, U.S. Environmental Protection Agency, Washington, D.C.

II. Q. **<u>Storage</u>.**

The following requirements are in addition to those in Chapter I of this Manual and also apply to facilities intended for management of high-level waste awaiting pretreatment, treatment or disposal, unless stated otherwise.

(1) Operation of Confinement Systems.

(a) Confinement systems shall be operated and maintained so as to preserve the design basis.

(b) Secondary confinement systems, where provided, shall be operated to prevent any migration of wastes or accumulated liquid out of the waste confinement systems.

Objective:

The objective of this requirement is to ensure that containment systems, both primary and secondary, are: (a) maintained to preserve the design capabilities of the systems to prevent the release of hazardous materials to the environment; and (b) operated so as to maximize the effectiveness of the design to contain wastes and accumulated liquids.

Discussion:

The establishment of appropriate operational procedures and diligence in executing the procedures are essential to maximize the effectiveness of the design capabilities of the waste containment system. The procedures need to be based on the operational assumptions that formed the basis for the system design.

Example: At Site Orange, the secondary containment system does not have instrumentation to detect liquids in the secondary system. Instead, provisions were included in the design to manually check for liquids. The design of the primary container does not assume that liquids will be present in the secondary system. Additionally, the presence of liquids in the secondary containment system will induce an unanticipated increase in the corrosion rate of the primary system that will reduce its service life. Operational procedures require daily checks for accumulated liquids in the secondary containment, and systems are provided and maintained to remove accumulated liquids promptly.

The stress of daily operational activities can impose degradation modes and increase the rate of degradation of confinement systems beyond those included in the design basis. It is important to

identify the operational and maintenance assumptions that formed the basis for the system design. These factors normally include assumptions regarding the frequency and severity of loads imposed by naturally-induced and human-induced events. Naturally-induced events include pressure gradients (including static head and external hydrological forces), the physical contact with the waste, and climatic events. Human-induced events include stresses from nearby vehicular traffic, and operational events including sampling, installation and removal of pumps, and other operational activities that impose loads. If the stresses due to these factors exceed the stresses for which the system was designed, the service life can be substantially reduced which could result in unanticipated loss of confinement. As discussed in the guidance II.Q.(2), Structural Integrity Program, many of the single containment systems are already beyond the service life for which they were designed, and efforts are required to extend the service life of most tanks even further into the future. For this reason, as well as the consequences of containment failure, new high-level waste is not be placed into single confinement systems. New high-level waste imposes a greater heat and corrosive load, which is inimical to efforts to extend the service life of the oldest tanks.

> *Example: At Site Red, a mis-routing during transfer of waste has created a safety issue regarding criticality of the high-level waste in tank XYZ by the introduction of additional fissile material. A decision has been made to install pumps to re-suspend the fissile material. Because of the low viscosity of the waste, the pumps required for this unanticipated operation are much heavier than those assumed in the design of the tanks. In addition, the crane to install the pumps is much larger and heavier. The integrated operations and maintenance procedures at the site identify the design basis loads for the tanks. The maintenance organization has determined that the additional loads of the pump and crane are greater than the design basis loads for the tank confinement systems in the tank farm. Therefore, additional structures will be required to support the loads.*

Other operational and maintenance requirements of DOE M 435.1-1, e.g., Section II.Q.(2), Structural Integrity Program, Section II.J, Waste Acceptance, Section II.L, Waste Characterization; and Section II.M, Waste Certification, also directly relate to the successful operation of confinement systems to preclude migration of waste.

Compliance with this requirement is demonstrated by developing, documenting and implementing a program that integrates the operational and maintenance requirements of DOE M 435.1-1, (the above citations) with the design basis assumptions, implementing operational procedures that maximize the effectiveness of the system design, and by continually assessing and modifying the stresses of daily operational and maintenance activities to be as low as practical, and no greater than the stresses assumed in the design for the containment systems.

Supplemental References: None.

II. Q.(2) Structural Integrity Program.

(a) Leak-Tight Tanks In-Service. A structural integrity program shall be developed for each high-level waste storage tank site to verify the structural integrity and service life of each tank to meet operational requirements for storage capacity. The program shall be capable of:

1. Verifying the current leak-tightness and structural strength of each tank in service;

2. Identifying corrosion, fatigue and other critical degradation modes;

3. Adjusting the chemistry of tank waste, calibrating cathodic protection systems, wherever employed, and implementing other necessary corrosion protective measures;

4. Providing credible projections as to when structural integrity of each tank can no longer be assured; and

5. Identifying the additional controls necessary to maintain an acceptable operating envelope.

(b) In-Service Tanks that Have Leaked or Are Suspect. For each high-level waste storage tank in-service that is known to have leaked, or is suspect, a modified structural integrity program shall be developed and implemented to identify the safe operational envelope. The modified program shall be capable of:

1. Verifying the structural strength of each tank in-service which has leaked or is suspect;

2. Identifying corrosion, fatigue and other critical degradation modes;

3. Adjusting the chemistry of tank waste, calibrating cathodic protection systems, wherever employed, and

implementing other necessary corrosion protection measures;

4. **Determining which of the tanks that have leaked or are suspect may remain in service by identifying an acceptable safe operating envelope;**

5. **Providing credible projections as to when the acceptable safe operational envelope can no longer be assured; and**

6. **Identifying the additional controls necessary to maintain the acceptable safe operational envelope.**

When physical activities, as part of a structural integrity program, pose additional vulnerabilities, alternative measures shall be implemented to provide an acceptable storage operational envelope.

(c) Other Storage Components. The structural integrity of other storage components shall be verified to assure leak tightness and structural strength.

Objective:

The objectives of this requirement are to: (1) identify an acceptable safe operational envelope (where feasible) for tanks that are known, or suspected, to leak and where it is necessary to keep such tanks in-service for the interim; (2) provide an estimate of the remaining service life for each tank; (3) identify the frequency for monitoring in-tank waste chemistry; (4) extend the service life (leak-tightness and structural strength) of individual tanks to meet the operational requirements for storage capacity where such extensions are feasible; and (5) verify the structural integrity of transfer piping and other storage components prior to transfer of high-level waste.

Discussion:

In addition to the facility and general design requirements contained in DOE M 435.1-1, Section I.1.E., Requirements of Other Regulations and DOE Directives, high-level waste storage tanks, transfer piping and other storage components, shall be subject to a structural integrity program. During the development of DOE O 435.1 and DOE M 435.1-1, a hazards analysis and a requirements analysis concluded that there is a need for this requirement to preclude an uncontrolled release of high-level waste from storage systems due to loss of structural integrity. Although the analysis that prompted this requirement involved high-level waste “storage

systems" that are likely to contain large quantities of liquid high-level waste for extended periods of time during which corrosion modes and rates could lead to loss of structural integrity, i.e., high-level waste underground storage tanks, high-level waste sites are encouraged to apply these requirements to all storage systems (e.g, process storage vessels, solid (calcined) high-level waste storage bins).

Meeting operational requirements for storage. Changes in DOE programs now require that high-level waste storage tanks remain in-service for a significantly longer time than ordinally planned. The Department has over two hundred and forty high-level waste storage tanks. These tanks have already exceeded their design service life, and many more tanks will exceed their original design service life before waste is removed from the tanks. If the structural integrity program is to meet its requirement to "verify the structural integrity and service life for each tank to met operational requirements for storage capacity" [Section II.Q.(2)(a)], the service life of the tanks must be extended beyond that for which they were designed. In the near term, predictive models will be required to estimate the remaining service life of specific tanks to determine whether operational requirements for waste storage can be met. The remaining service life extends to that point in time beyond which structural integrity (leak tightness and structural strength) cannot be assured. This estimate will be revised periodically with each reassessment of structural integrity. The purpose of the estimate is to provide management sufficient time to pursue alternatives for storage of the waste.

Guidelines for establishing a structural integrity program. BNL-UC-406, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks,* (referred to subsequently as "Guidelines") provides an acceptable process for establishing a structural integrity program. This set of Guidelines was finalized in January 1997 to promote the structural integrity of high-level waste storage tanks and transfer lines at facilities of the Department. In summary, the document lays out the essential elements of a structural integrity program. The procedures contained in the Guidelines provide an acceptable methodology to assess the structural integrity of existing tanks and to estimate the end of service life.

The primary elements of a structural integrity program are described in the Guidelines and include addressing possible aging degradation mechanisms for both steel and concrete components of tanks. In addition, the Guidelines identify an evaluation process to screen out non-significant aging mechanisms and contain the details for developing and maintaining such a program. Guidance Section II.P.(2)(h), Storage Tank Structural Integrity, incorporates recommendations from BNL-UC-406 on design information for underground high-level waste storage tanks. The following is a summary of some of the more salient points contained in BNL-UC-406 for operational aspects of a structural integrity program.

A structural integrity program is to be developed for each high-level waste tank farm site according to its specific needs. Although these programs are expected to be different from site

to site according to the composition and nature of the wastes, intended use of the tanks, and specific structural features, there are several basic elements and considerations that are included in the program to ensure a systematic assessment of the tank's structural integrity. The structural integrity program is to be developed such that the steps required for verification of structural integrity can be performed. This requires collection of adequate data and their evaluation. The worst combination of material properties data and loadings during the service life of the tank system need to be considered in the structural analysis.

An assessment of the current material properties in the high-level waste tanks allows a verification of their current structural integrity. However, in order to demonstrate that at the end of the service life of a tank, structural integrity will be maintained, projection of the component degradation may be required. Alternatively, if the maximum service life of a tank is to be estimated, a prediction model needs to be developed as part of the structural integrity program. In either case, a demonstration of structural integrity for future operation requires periodic inspection and maintenance programs necessary components in an effective structural integrity program. Ultimately, if the integrity of a tank cannot be demonstrated, the program needs to provide adequate warning for management actions, such as retrieval of the waste.

The elements of a structural integrity program need to be defined and implemented in a logical sequence to achieve the above goals. The basic concern for integrity of high-level waste tanks is the degradation of structural materials. Therefore the first step of a structural integrity program is to identify any aging mechanisms that could cause material degradation. The next step is to quantify the degradation and determine its effect on performance of the two desired functions, leak-tightness and structural adequacy. Program features of the leak detection system and non-destructive examination will verify the leak tightness. A structural analysis program based on end-of-life material properties data will verify structural adequacy. If both analyses are successful, no further action is required. If not, additional steps should be considered such as preventive maintenance, and management options (e.g., retrieval). More specifically the major program elements are:

- <u>Identification of Aging Mechanisms:</u> the aging mechanisms that may cause degradation of the materials are identified considering tank-specific conditions, such as thermal loads, pH level, material types and chemical attack.

- <u>Quantification of the Degree of Degradation</u>: for each aging mechanism identified as part of the above process, the potential degradation of structural and material properties are quantified.

- <u>Evaluation of the Effect of Degradation on Tank Integrity:</u> determine the effect of the degradation on the intended functions of the tanks, i.e., leak tightness and structural adequacy

- Verification of Leak Tightness: data from a non-destructive examination are studied to estimate the potential for leakage, including inspections by robotic instruments in the annular space between the primary and secondary confinement barriers, where practicable.

- Verification of Structural Adequacy: since a reduction of material properties or significant geometric change can affect the ability of a tank structure to withstand imposed loads, all loads (hydrostatic, soil pressure, thermal, earthquake and other accidental loads including appropriate combinations of these) are considered in a structural analysis. Loads that are generated by the waste contents (e.g., thermal) need to be routinely monitored. Based on the severity of these loads, a schedule is established for monitoring (see Section II.T).

- Management Options: in addition to preventive maintenance and repair programs other options may need to be evaluated, e.g., removal of the supernate or retrieval of the tank's entire contents. Such actions will require decisions by the responsible waste management organization to ensure the decision is consistent with other elements of the program.

A systematic consideration of all the elements delineated in BNL-UC-406 is expected to result in a successful structural integrity program. The basic elements and considerations of the program contained in the BNL document is applicable to all high-level waste underground storage tanks. However, it is recognized that differences in how the data are accumulated, the degradations modes experienced, the frequency with which the structural integrity program must be repeated, and whether or not predictions of the end of service life will be required, may differ for certain tank farms or individual tanks; however, a documented technical basis needs to be available to support the structural integrity program at each site.

Scope. The scope of this requirement is limited to high-level waste tanks and does not apply to tank supporting systems that are covered by other requirements within DOE M 435.1-1. For example, the requirement does not apply to the functional integrity of the high-level waste tank ventilation system (see requirement at Section II.P.(2)(d). Likewise it does not apply to the monitoring and leak detection systems/equipment that provide identification of failed confinement, nor does this requirement apply to monitoring and leak detection systems/equipment that provide identification of abnormal conditions at high-level waste tanks and transfer lines (Section II.P.(2)(i)).

Modified structural integrity program for leaking tanks. Although some high-level waste storage tanks cannot meet the leak-tightness criteria of the structural integrity requirement, i.e., they have leaked in the past, or are suspected of leaking now, application of a modified structural integrity program remains important for such tanks that must continue in-service either to store

high-level waste for the interim, or for contingency use. For tanks that are known to have leaked in the past, leak now, or are suspected of leaking (single containment or double containment), the requirement to verify leak tightness and structural strength is to confirm that the tanks do have sufficient structural strength and that the tanks do, or do not leak. Tanks that are known to have leaked in the past, and those whose leak-tightness cannot be verified, will be treated as leaking tanks and are subject to the requirements of the modified structural integrity program. Where storage requirements, including the requirement for contingency storage, necessitate the use of leaking tanks for some interim period, the modified structural integrity program for leaking tanks is required to be capable of determining an acceptable safe operating envelope in order to continue use of the tank for storage. The acceptable safe operating envelope is that portion of a structurally adequate tank for which leak-tightness can be verified. An acceptable operational envelope for continued storage could consider the location of the leak sites and the viscosity of the waste to be stored.

The modified structural integrity program is required to be capable of projecting how long the acceptable safe operating envelope can be sustained. The Guidelines provide detailed guidance on how to determine the remaining thickness of the tank wall, identify the degradation modes and rates and make projections of remaining service life. However, use of tanks that have leaked, and tanks for which structural integrity cannot be verified, is to be discontinued for storage, including contingency storage, as soon as capacity in a tank with no known or suspected leak sites becomes available. Verification of leak-tightness and making credible projections as to when the acceptable safe operating envelope can no longer be assured (Section II.Q.(2)(b)(5)) for leaking, or suspect leaking, single-shell tanks at some of the sites is not possible due to their configuration, waste levels, or the risks posed in trying to do so. In such cases, as illustrated in the examples below, management should identify the options, and, in those cases that waste must remain for some period of time, add the necessary controls, e.g., periodic pumping to remove as much of the pumpable liquids as possible, to provide an acceptable storage operational envelope. Under such conditions the requirements in Section II.Q.(2) are considered met.

The modified structural integrity program is also required to be capable of identifying additional controls that may be required to maintain an acceptable safe operating envelope. To be effective, these controls must address the operational and natural threats to safe storage. These threats include the following:

- Overfilling above the safe operational envelope;
- Permitting waste to be accepted which intensifies the critical corrosion modes;
- Internal Loads
    - High temperature and/or temperature cycling

    - High pressure and/or pressure cycling

- External loads
    - Unequalized soil and hydrologic loads as a result of reducing the volume of waste in the tank
    - Maintenance activities and installation and operation of retrieval equipment

- Inflow of groundwater through leak sites; and

- High viscosity liquid waste.

Example 1: At Site X, leak sites for two of the high-level waste storage tanks have been identified at elevations in the top half of each tank. Because of limited retrieval capability and other storage capacity, waste in only one of the tanks has been substantially retrieved. This tank has been designated as a contingency storage tank to accept waste up to an administratively controlled level, well below the elevation of the leak site. Waste in the other tank has only been partially retrieved to an administratively controlled level well below the elevation of the leak sites.

Example 2: At Site H, Tank DEF is known to leak, but the number of leak sites, and their exact locations, cannot be ascertained with a high degree of confidence. Retrieval capability to remove all of the waste does not exist, nor does capacity exist to store all of the waste in other tanks. A decision has been made to remove as much of the pumpable liquid as possible to minimize the consequences of any potential leak. Retrieval capability and contingency capacity are available to support this option. Periodic pumping will continue so as to remove any additional liquids that may become available (interstitial liquids or inflow of groundwater). These actions, together with the very low viscosity of the remaining waste, will help to minimize any further leakage to the environment and its consequences. These actions constitute an acceptable safe operational envelope, with controls, for continued use of the tank for storage where operational constraints preclude the removal of all of the waste.

<u>Corrosion control</u>. BNL-UC-406 also recommends measures to minimize corrosion, including adjustments to waste chemistry, and verification of corrosion rates following such adjustments. The following guidance, based on the primary features of the corrosion control program, are recommended. Refer to the referenced documents for additional details.

1) <u>Ascertain the current in-situ chemical constituents</u>. The chemical constituents of the waste may vary with depth in the tank as the waste settles out into relatively homogeneous zones. The levels at which the most critical corrosion mode(s) and

rate(s) are present are identified, monitored, and controlled. The critical corrosion zones are established to ensure leak-tightness and tank structural integrity. Once the critical zone(s) have been established, repeated actions to identify them should not be required unless the layers in the tank become disturbed.

A schedule for tank sampling is established that is consistent with the critical corrosion mode and rate and with the programmatic requirement to maintain tank integrity, as measured by leak-tightness and structural stability.

> *Example: At Site Z DOE is currently scheduled to complete treatment (solidification) of the high-level (tank) waste in the year 2025. This assumes that no new storage tanks will be built. These programmatic factors mean that some of the site's storage tanks must maintain their structural integrity through the year 2025. These requirements should be considered in establishing the frequency of tank sampling.*

If the projected lifetime of the tanks is very short and the material properties of the tanks have not degraded, then the sampling schedule can be relaxed. However, if the operational requirement for the tank to provide safe storage is relatively long, the corrosion rates are estimated to be high, and the material properties of the tank have degraded, then an aggressive sampling schedule would be necessary.

2) Identify the corrosion modes and assess their rates. Based on the current chemical constituents of the contained high-level waste, expected additional waste receipts, and the material properties of the tank, the corrosion modes and rates are assessed to determine the critical mode(s) and rate(s) that threaten tank leak-tightness and structural stability. Examples of corrosion modes that may be applicable are general corrosion, pitting, and cracking.

3) Add chemicals to mitigate corrosion. After identifying the critical corrosion modes for ensuring leak-tightness and structural stability, the chemistry of the waste are adjusted to mitigate corrosion. Projections for mitigation effectiveness consider the method by which the chemicals are introduced into the storage tank system and the time required for the treatment chemicals to reach the critical zones.

> *Example: Insertion of liquid corrosion-mitigating chemicals through tank inlet piping or tank risers and subsequently distributed by operations of mixing pumps may deliver them directly into the critical*

zones immediately. However, dry chemicals applied to the liquid surface of the wastes stored in the tank, without mixing, may have a long transport time to reach critical zones, or may not reach the zones without some agitation. Such an approach would require evaluation.

4) Validate the corrosion modes and rates in the tank as a result of the adjusted chemical constituents of the waste. In step # 3 above, chemicals were added to the waste to mitigate corrosion rates to a lower target level. In this step, tests are undertaken to determine if the lower targeted corrosion rate was actually achieved through the adjustment to waste chemistry. Projections of corrosion modes and rates based on adjusted tank waste chemistry are validated with tests involving specimens of the tank material at the critical corrosion zone(s). This can be accomplished in-situ or in controlled laboratory tests.

Example: Projections of corrosion modes and rates at Site X High-Level Waste Tank #1001 were validated by subjecting material coupons of the same material as the tank wall to simulated waste and the added corrosion-mitigating chemicals. Based on the results of the validation and the corrosion rates, a frequency for monitoring tank chemistry for corrosion should be established.

Similarly, active cathodic protection systems, where used, need to be calibrated and the impressed currents, if applicable, adjusted to minimize corrosion rates as part of the structural integrity program. The frequency for such calibrations and adjustments is to be established and justified with a technical basis. In addition, DOE Handbooks, such as DOE-STD-HDBK-1015 and -1017, provide information on both the corrosion theory and corrosion material sciences.

The structural integrity of in-service transfer piping needs to be assessed before each transfer of high-level waste. This assessment can be accomplished by pressure testing the pipelines with water or gas.

Compliance with this requirement for leak-tight tanks in service is demonstrated by implementing a structural integrity program for each tank site that should be consistent with the guidelines contained in this guidance and BNL-UC-406, as tailored for the conditions at each high-level waste storage tank site; or as modified by this guidance for leaking tanks.

Supplemental References:

1. BNL, 1997. *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, BNL-UC-406, Brookhaven National Laboratory, Upton, NY, January 1997.

2. DOE, 1992. *DOE Fundamentals Handbook, Chemistry*, DOE-HDBK-1015, Module 2: "Corrosion," U.S. Department of Energy, Washington, D.C., June 1992.

3. DOE, 1993. *DOE Fundamentals Handbook, Material Science,* DOE-HDBK-1017, Module 2: "Properties of Metals," U.S. Department of Energy, Washington, D.C., January 1993.

II. Q.(3) Canistered Waste Form Storage. Canisters of immobilized high-level waste awaiting shipment to a repository shall be:

(a) Stored in a suitable facility;

(b) Segregated and clearly identified to avoid commingling with low-level, mixed low-level, or transuranic wastes; and

(c) Monitored to ensure that storage conditions are consistent with DOE/EM–0093, *Waste Acceptance Product Specifications for Vitrified High-level Waste Forms,* or DOE/RW-0351, *Waste Acceptance System Requirements Document,* for non-vitrified immobilized high-level waste. Facilities and operating procedures for storage of vitrified high-level waste shall maintain the integrity of the canistered waste form.

Objective:

The objective of this requirement is to ensure that immobilized (vitrified) high-level waste is stored and monitored in a manner that meets DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS), or DOE/RW-0351, *Waste Acceptance System Requirements Document* (WASRD). Meeting the requirements of the EM-WAPS or the WASRD reflects the best current understanding of the waste acceptance criteria to support the geologic repository's safety case. Because the Nuclear Regulatory Commission will make the final determination of the adequacy of the acceptance criteria in conjunction with issuing the repository license amendment to emplace, these criteria are not final and changes to them may occur as the licensing process progresses.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1 storage of immobilized (vitrified) high-level waste was reviewed for the potential risk to the public, workers and the environment. Because of its stability, storage of the final waste form is considered to pose a low risk.

However, it is critical, for the acceptance of the waste at the geologic repository (disposal site) that the waste has been stored and monitored in a manner consistent with the EM-WAPS and/or the WASRD. Meeting the requirements of these documents is essential because they contain the technical specifications that current waste form producers are required to meet before acceptance of their vitrified high-level waste, or non-vitrified high-level waste, into the Civilian Radioactive Waste Management System. A similar requirement for high-level waste treatment operations is included at DOE M 435.1-1, Section II.R, Treatment.

Since the objective of each of the three subrequirements (a through c) is to ensure to the greatest extent possible at this time that the waste is acceptable to the repository, each will be discussed in terms of the critical EM-WAPS or the WASRD specifications. These specifications are considered critical because they are considered important to storage operations; however, there may be other requirements that pertain to storage operations. Refer to the EM-WAPS and the WASRD for full details on each of the specifications and how they may impact storage operations. Enveloping all three of the subrequirements for vitrified high-level waste forms is the EM-WAPS Specification 4, Quality Assurance Specification and WASRD, Section 3.9, Quality Assurance. These specifications require waste producers to establish a quality assurance program that is consistent with the *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program* (DOE/RW-0333P) requirements. These requirements apply to storage as well as production operations. The following discussion focuses on the specifications for vitrified high-level waste, as defined in the EM-WAPS. However, similar specifications are expected to be developed in the WASRD in the near future and a discussion on these specifications will be added to this guidance at that time.

Subrequirement (a) is intended to ensure that immobilized high-level waste is stored in a facility that meets the requirements of the EM-WAPS. The EM-WAPS specifications that are considered critical to meeting this subrequirement are Specification 1.4.2, Control of Temperature for Phase Stability and Specification 3.7, Specification for Removable Radioactive Contamination on External Surfaces. The first specification is to certify that after initial cool-down the waste form temperature has not exceeded 400^o centigrade. The second specification prescribes the level of acceptable surface contamination on a canister at the time of shipment of beta- and gamma-emitting radionuclides and alpha-emitting radionuclides. Both of these specifications may require storage facility engineering controls (e.g., active ventilation systems) to ensure that the centerline temperature limit and the surface contamination limits are not exceeded.

Subrequirement (b) is intended to ensure that the immobilized high-level waste is clearly identified to avoid commingling it with other waste types and to reduce the potential for contaminating other wastes with high-level waste potentially requiring such waste to be sent to the high-level waste repository. The EM-WAPS specification that meets this subrequirement is

Specification 2.3, Identification and Labeling Specification, which prescribes the identifying label that is to be attached to each canister and the size and location of the label.

Subrequirement (c) is intended to ensure that all remaining specifications of the EM-WAPS are met to ensure the waste is acceptable to the waste repository. The EM-WAPS specification that is considered critical to meeting this subrequirement is Specification 5, Documentation and Other Requirements. This administrative specification, among other requirements, prescribes the contents of the Production Records and the Storage and Shipping Records. The Production Records identify the physical attributes of each canister of final waste form and the Storage and Shipping Records describe any abnormal events, such as thermal excursions, which have occurred during the storage of the canister.

Compliance with this requirement is demonstrated by documenting that the immobilized high-level waste is stored and monitored in compliance with the EM-WAPS or WASRD specifications, as applicable.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

2. DOE, 1995. *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program*, Revision 5, DOE/RW-0333P, U.S. Department of Energy, Washington D.C., October 1995.

3. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

II. R. Treatment.

Treatment shall be designed and implemented in a manner that will ultimately comply with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

Objective:

The objective of this requirement is to ensure that high-level waste treatment (and pretreatment) activities are designed and implemented in a manner that does not jeopardize the final waste form's ability to meet DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS), or DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD), for non-vitrified immobilized high-level waste. Meeting the requirements of the EM-WAPS or the WASRD ensures that the waste will be acceptable for disposal in a geologic repository managed by the Office of the Civilian Radioactive Waste Management.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, treatment of waste was identified as an activity that presented potential risks to the public, workers, and the environment. It was determined that requirements to address the weaknesses and conditions that could lead to potential adverse impacts already existed in external requirements (e.g., *Clean Air Act* or RCRA) or other DOE requirements and directives (e.g.,10 CFR Part 835, *Occupational Radiation Protection* or DOE O 360.1, *Training*). Consequently, DOE M 435.1-1, *General Requirements and Responsibilities*, Section I.2.F.(14), assigns the Field Element Manager an umbrella, performance-oriented responsibility for ensuring that waste treatment is protective of the public, workers, and the environment. This requirement focuses instead on the treatment actions necessary to make waste acceptable for subsequent waste management steps, e.g., disposal in a geologic repository.

This requirement was established to ensure that no pretreatment or treatment activities are undertaken that may jeopardize the final (vitrified and non-vitrified) waste forms ability to meet the specifications contained in the EM-WAPS or the WASRD. Meeting this requirement is essential since the EM-WAPS is the technical specifications that current high-level waste form producers are required to meet to ensure acceptance of their vitrified high-level waste into the Civilian Radioactive Waste Management System. Likewise, meeting the requirements of the WASRD is essential for non-vitrified high-level waste. Thus, it is critical that actions taken up to waste disposal, predominately pretreatment and treatment activities, do not compromise the

ability of the waste form to meet these specifications. A similar requirement for high-level waste storage operations is included at DOE M 435.1-1, Section II.Q., Storage.

Refer to the EM-WAPS for vitrified waste forms for full details on each of the specifications and how they may be impacted by specific pretreatment or treatment operations. The following examples are offered to display how an action within a pretreatment or treatment facility could jeopardize the final waste forms ability to meet the EM-WAPS.

> *Example 1: At Site X, a change to expedite the production of canisters in the vitrification process is being proposed that may allow organic contaminants to enter the canister between the time of glass pouring and canister closure. However, Specification 3.4 of the EM-WAPS requires that the producer ensure that the canistered waste form does not contain detectable amounts of organic materials. Thus, prior to approval of such a change to the vitrification process, an evaluation needs to be conducted to determine the likelihood of such organic contamination. If organic contamination is possible the proposed change should not be allowed because it could violate the EM-WAPS specification and jeopardize the acceptance of the waste form.*

> *Example 2: At Site Y vitrification (treatment) facility, an order of empty canisters is received that are slightly out of tolerance with the canister diameter specification (63.0 cm versus the specification of 61.0 +1.5 cm, -1.0 cm). Due to vitrification schedule concerns, it is proposed by the plant operations management that the canisters be accepted and used. Such acceptance violates EM-WAPS Specification 2.4.2 and should not be allowed.*

Compliance with this requirement is demonstrated by programs and procedures being documented and used that ensure that high-level waste product specifications for disposal at a geologic repository are met, and final waste form acceptance documentation (production records and storage and shipping records) that certify the requirements of the EM-WAPS or the WASRD have been satisfactorily met.

Supplemental References:

1. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, DC, December 16, 1996.

2. DOE, 1999. *Waste Acceptance System Requirements Document,* Revision 3, DOE/RW-0351P, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, April 1999.

II. S. Disposal.

Disposal of high-level waste must be performed in accordance with the provisions of the *Atomic Energy Act of 1954,* as amended, the *Nuclear Waste Policy Act of 1982,* as amended, or any other applicable statutes.

Objective:

The objective of this requirement is to ensure that high-level waste management activities, from generation through post-treatment storage, do not jeopardize the Department's ability to meet the provisions of the *Atomic Energy Act of 1954*, as amended, the *Nuclear Waste Policy Act of 1982*, as amended, and other applicable statutes for high-level waste disposal.

Discussion:

The safety and hazard analysis for management of radioactive waste, conducted to develop the essential requirements for DOE O 435.1 and DOE M 435.1-1, indicated that disposal is the most critical activity requiring controls because disposal is intended to be the last function conducted on the waste, yet the potential hazards from radioactive waste will continue far into the future. Although the disposal of high-level waste at a geologic repository may be regulated by the Nuclear Regulatory Commission (NRC) and the requirements of DOE O 435.1 and DOE M 435.1-1 do not apply to the repository, except as required by DOE O 435.1, Section 4.d., this requirement is necessary to ensure that DOE's high-level waste management activities support any applicable disposal requirements at a repository.

As discussed in the guidance for Section I.2.F.(15), Disposal, the Field Element Manager is responsible for ensuring that radioactive waste is disposed in a manner that protects the public, workers, and the environment. For high-level waste this requirement means that DOE's actions taken during generation, pre-treatment, treatment, and post-treatment storage must not jeopardize the final waste form's ability to meet the provisions of the *Nuclear Waste Policy Act of 1982*, as amended. This is accomplished through compliance with the requirements of the DOE Office of Environmental Management's Waste Acceptance Product Specifications (EM-WAPS). The following is a brief description of the programs and documents that ensure the EM-WAPS meets the provisions of the *Nuclear Waste Policy Act of 1982*, as amended. Also included is a brief description of the responsibilities and interfaces between the DOE Office of Environmental Management and the DOE Office of Civilian Radioactive Waste Management.

Nuclear Waste Policy Act of 1982, as amended. From the *Energy Reorganization Act of 1974*, the NRC was granted licensing and regulatory authority for the receipt, storage, and disposal of high-level radioactive wastes at a geologic repository. From this authority and the *Nuclear Waste Policy Act of 1982*, as amended, the NRC promulgated 10 CFR Part 60, "Disposal of

High-Level Radioactive Wastes in Geologic Repositories," which prescribes the "rules governing the licensing of DOE to receive and possess source, special nuclear, and byproduct material at a geologic repository operations area sited, constructed, or operated in accordance with the *Nuclear Waste Policy Act of 1982*."

In addition, the *Nuclear Waste Policy Act of 1982*, as amended, recognized the Federal responsibility for managing the disposal of spent nuclear fuel and high-level waste as defined in the *Nuclear Waste Policy Act of 1982*, as amended. The Office of Civilian Radioactive Waste Management, established under the *Nuclear Waste Policy Act of 1982*, as amended, developed the DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD) that describes the functions to be performed and the technical requirements for a "Waste Acceptance System" for accepting spent nuclear fuel and high-level radioactive waste into the Civilian Radioactive Waste Management System. The WASRD, which is subject to the requirements of the Office of Civilian Radioactive Waste Management DOE/RW-0333P, *Quality Assurance Requirements and Description Document*, establishes the requirements for acceptance of high-level waste into the geologic repository. The waste acceptance requirements contained in the WASRD are derived from a number of documents including statutes, regulations, and DOE directives; the primary requirements are contained in 10 CFR Part 60. The EM-WAPS is derived from the WASRD, and serves as the basis for the high-level waste producer's Waste Acceptance programs.

The EM-WAPS outline the technical specifications waste form producers are required to meet in order to ensure acceptance of their vitrified high-level waste into the Office of Civilian Radioactive Waste Management system. The Office of Environmental Management has the responsibility for providing product specifications to the waste form producers. The Office of Environmental Management also ensures that the EM-WAPS are in concert with the Office of Civilian Radioactive Waste Management WASRD. Compliance by the vitrified waste form producers with the current EM-WAPS ensures that the disposal provisions of the *Nuclear Waste Policy Act of 1982*, as amended, will be met. The specifications from the current EM-WAPS are not duplicated here; refer to the current EM-WAPS for additional information on each specification.

Atomic Energy Act of 1954, as amended. It is recognized that onsite disposal of high-level waste may be possible under the provisions of the *Atomic Energy Act of 1954*, as amended. However, the safety and hazards analysis conducted to support DOE O 435.1 and DOE M 435.1-1 did not evaluate disposal activities for high-level waste at a DOE site. Therefore, DOE O 435.1 and DOE M 435.1-1 do not include safety and administrative requirements for such activities. Further, DOE plans that high-level waste be treated to meet specifications for acceptance for disposal at a repository under the *Nuclear Waste Policy Act of 1982*, as amended. Onsite disposal of high-level waste is not consistent with these plans.

Interfaces Between the Office of Environmental Management and Office of Civilian Radioactive Waste Management . Responsibilities of, and interfaces between, the Office of Environmental Management and Office of Civilian Radioactive Waste Management for the management of high-level waste are defined in the Memorandum of Agreement between the Office of Environmental Management and Office of Civilian Radioactive Waste Management (*Memorandum of Agreement for Acceptance of Department of Energy Spent Nuclear Fuel and High-Level Radioactive Waste*), dated January 1999. Guidance on these requirements is provided here to assist in determining the boundaries of responsibilities for these two organizations.

The Memorandum of Agreement (MOA) responds to the requirements of the *Nuclear Waste Policy Act of 1982*, as amended, that Federal agencies requiring disposal services for spent nuclear fuel and/or high-level waste be accommodated by a suitable interagency agreement reflecting the terms and conditions set forth in the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste as provided in the *Nuclear Waste Policy Act of 1982*, as amended. Through the MOA, the Office of Environmental Management and Office of Civilian Radioactive Waste Management seek to achieve safe and timely disposal of DOE spent nuclear fuel and high level waste by identifying data needs, interface descriptions, and acceptance criteria and developing compliance procedures needed to support both the geologic repository license application to the NRC and the transportation system necessary to transfer DOE spent nuclear fuel and high-level waste to an Office of Civilian Radioactive Waste Management facility.

The following are the highlights of the MOA that support the management of high-level waste. These are provided to support the use of DOE O 435.1 and DOE M 435.1-1. Refer to the MOA for additional details. The MOA is available on the Internet at *http://www.rw.doe.gov/pages/resource/facts/moafin3r1.pdf*.

A. Data Needs

Any changes to the Waste Form Compliance Plan, Waste Form Qualification Report, Production Records and Storage and Shipping Records, which presently meet the Office of Civilian Radioactive Waste Management data needs, shall be coordinated between the Office of Civilian Radioactive Waste Management and Office of Environmental Management.

B. Design, Certification and Fabrication of Transportation and Storage Systems for DOE High-level waste

The Office of Environmental Management shall design, fabricate and store high-level waste pour canisters. The Office of Civilian Radioactive Waste Management shall be

responsible for the design, NRC certification and fabrication of the transportation cask system.

C. <u>Transportation and Loading Operations</u>

The Office of Environmental Management shall be responsible for the Office of Environmental Management site infrastructure and shall provide all preparation, assembly, and inspections for loading high-level waste pour canisters into transportation casks and for the transportation of high-level waste to the Office of Civilian Radioactive Waste Management. For the loading of high-level waste pour canisters into the transportation casks, the Office of Civilian Radioactive Waste Management shall provide written procedures and training for cask handling and loading and information and parts necessary for cask maintenance. For the handling of high-level waste at an Office of Civilian Radioactive Waste Management facility, the Office of Environmental Management shall provide similar records to the Office of Civilian Radioactive Waste Management. The Office of Civilian Radioactive Waste Management shall be responsible for routine cask maintenance, while incidental maintenance is the responsibility of whichever organization possesses the cask.

D. <u>Conformance and Safeguards Verification of High-level waste</u>

The Office of Civilian Radioactive Waste Management shall perform conformance verification of all high-level waste delivered to the Office of Civilian Radioactive Waste Management and shall agree to accept the high-level waste that meets the acceptance criteria for disposal when the Office of Civilian Radioactive Waste Management has completed safeguards verification and determined that the material is properly loaded, packaged, marked, labeled and ready for transportation. The Office of Civilian Radioactive Waste Management reserves the right to refuse to accept improperly described high-level waste. If the Office of Civilian Radioactive Waste Management has already accepted improperly described high-level waste, the Office of Environmental Management must provide the Office of Civilian Radioactive Waste Management with a proper designation within 30 days. Temporary storage of improperly described high-level waste will be at the facility where the material resides at the time the improper designation is discovered.

E. <u>Acceptance of High-level Waste</u>

The Office of Civilian Radioactive Waste Management shall accept high-level waste at the Office of Environmental Management site after successful conformance and safeguards verification and shall be solely responsible for control of all material upon acceptance.

F. NRC Licensing for Storage and Disposal

The Office of Civilian Radioactive Waste Management shall have the lead responsibility in repository and storage facility (if needed) pre-licensing and licensing interactions with the NRC. The Office of Environmental Management shall support the Office of Civilian Radioactive Waste Management in these interactions.

G. Training

The Office of Environmental Management and Office of Civilian Radioactive Waste Management shall each be responsible for providing or acquiring training specific to their various responsibilities as described in the MOA.

H. Quality Assurance

The Office of Environmental Management and Office of Civilian Radioactive Waste Management shall abide by requirements of the Office of Civilian Radioactive Waste Management's *Quality Assurance Requirements and Description* (DOE/RW-0333P) and the Quality Assurance MOAs between the Office of Environmental Management and Office of Civilian Radioactive Waste Management. For high-level waste, this is the MOA between the Office of Waste Management and Office of Civilian Radioactive Waste Management for *Coordination of Quality Assurance Activities Associated with High-Level Waste and Spent Nuclear Fuel* (Appendix E to the MOA). Specific activities subject to Quality Assurance controls are defined in *Quality Assurance Requirements and Description*.

Compliance with this requirement is demonstrated by the preparation and acceptance of the waste acceptance documentation required by the EM-WAPS. This includes the Waste Form Compliance Plan, the Waste Form Qualification Report, Production Records, and Storage and Shipping Records. The contents of these documents are specified throughout the EM-WAPS.

Supplemental References:

1. *Nuclear Waste Policy Act of 1982,* as amended, Public Law 97-425, Section 2.(12), January 7, 1983.

2. *Atomic Energy Act of 1954*, as amended, August 30, 1954.

3. DOE, 1999. *Waste Acceptance System Requirements Document*, Revision 3, DOE/RW-0351P, U.S. Department of Energy, Washington, D.C., April 1999.

4. DOE, 1995. *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program*, DOE/RW-0333P, U.S. Department of Energy, Washington, D.C., October 2, 1995.

5. DOE, 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (EM-WAPS)*, Revision 2, DOE/EM-0093, U.S. Department of Energy, Washington, D.C., December 16, 1996.

6. DOE, 1999. Assistant Secretary for Environmental Management (EM) to the Director Office of Civilian Radioactive Waste Management (RW), memorandum, *Memorandum of Agreement for Acceptance of Department of Energy Spent Nuclear Fuel and High-Level Radioactive Waste*, Revision 1, U.S. Department of Energy, January, 1999. Available on the Internet at *http://www.rw.doe.gov/pages/resource/facts/moafin3r1.pdf*

7. EPA, 1985. "Final Rule; 40 CFR 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

II. T. Monitoring.

High-level waste pretreatment, treatment, storage, and transportation facilities shall be monitored for chemical, physical, radiological, structural, and other changes that could indicate failure of systems confinement, integrity, or safety, and which could lead to abnormal events or accidents. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, flammable or explosive mixtures of gases, level and/or waste volume, and significant waste chemistry parameters for non-immobilized high-level waste. Facility monitoring programs shall also include physical inspections to verify that control systems have not failed.

Objective:

The objectives of this requirement are to: specify minimum parameters for which data will be routinely collected and analyzed; ensure by physical inspection that instrumentation, controls, automatic monitoring systems, and automatic shut-off systems have not failed; sample the chemical characteristics (appropriate parameters and monitoring frequencies) of the waste necessary to support the requirements of the structural integrity program; and promptly evaluate the results of the inspections and sample analyses.

Discussion:

This monitoring requirement is intended to alert facility operators to releases and the potential for releases of radioactivity in effluents and to the generation of explosive and flammable gases from operations. During the development of DOE O 435.1 and DOE M 435.1-1, monitoring at radioactive waste management facilities was identified as an effective way to mitigate numerous weaknesses and conditions associated with all phases of the life-cycle of waste management. An analysis of existing departmental requirements for environmental monitoring in DOE 5400.1 and DOE 5400.5 found that they were applicable to all radioactive waste types and all radioactive waste management facilities. Many of the individual conditions that were evaluated in the safety and hazards analysis and that warranted monitoring are already monitored due to the implementation of the requirements in DOE 5400.1 and DOE 5400.5. Consequently, DOE M 435.1-1 Section I.1.E.(7), Environmental Monitoring, requires that these two DOE Orders be implemented for environmental monitoring of radioactive waste management facilities.

While the environmental monitoring mandated by DOE 5400.1 and DOE 5400.5 is adequate to detect after-the-fact releases of high-level waste to the environment, additional requirements are necessary to improve the detection of conditions that could provide warning of impending releases that could increase worker exposure and/or impact the environment. Some of the

requirements contained in the *Nuclear Safety Analysis Reports* Order (DOE 5480.23), related DOE standards (DOE-STD-3009-93, DOE-STD-1027-92, DOE-EM-STD-5502-04), and the *Facility Safety* Order (DOE 420.1), provide information on the hazard categorization of facilities and the safety analyses to be performed. Through the conduct of safety analyses for high-level waste management facilities (e.g., storage, pretreatment, treatment, and transportation), facility personnel identify the quantity and form of radioactive material to be handled at the facility, the operations for managing the waste, and the associated hazards of this source term under the proposed operational scenario. The safety analysis establishes a basis for defining the acceptable operational envelope for the facility and provides the basis for identifying technical safety requirements if needed. The technical safety requirements may include requirements for monitoring; however, facility personnel need to also review the safety analysis to determine if it indicates other monitoring that would be prudent.

An effective monitoring program is dependent on the frequency and the rigor of the monitoring operations, and the effectiveness of the systems and devices in detecting changes and abnormal conditions. Therefore, facility managers must take these factors into consideration when designing the monitoring program to ensure that the high-level waste systems are being operated according to design.

The specified parameters to be monitored are selected based on their significance for anticipating and identifying undesirable conditions and the availability of a means for monitoring them. In addition, parameters to be monitored include those to ensure the protection of public health, the environment, and workers due to releases of radioactivity in ventilation exhausts and liquid effluent streams, and from unsafe concentrations of flammable and/or explosive gases in the waste. The accuracy and precision of measurement required is dictated by the expected variations in the parameters and the level of accuracy and precision needed to identify problems. The monitoring frequency for specific parameters is likewise determined based on the possible time variation of the parameter and the response time required to take mitigating action. For facilities that release radioactive effluents, frequent monitoring or continuous monitoring may need to be considered.

> *Example 1: A high-level waste treatment facility includes a holding tank that contains liquid high-level waste that can be held for months prior to processing. The tank is equipped with an induced draft ventilation system. The tank must include monitoring capability for temperature, radioactivity in the ventilation system, waste level and/or volume, and significant chemical parameters. Where the contents of the waste generate flammable or explosive mixtures of gases, monitoring capability must also be provided to detect the concentrations of such gases. The other minimum parameter (pressure) need not be monitored because the tank is ventilated, not closed.*

Example 2: A high-level waste treatment facility has an interim storage tank that contains liquid high-level waste. The minimum parameters specified in the monitoring requirement in DOE M 435.1-1 are monitored. The facility manager has identified additional parameters to be monitored and established a monitoring schedule based on the hazards identified in the Safety Analysis Report.

High-level waste management facilities are required to apply the monitoring requirement for the specified parameters using a graded approach. As previously noted, the methods used and the frequencies of monitoring are commensurate with the significance of changes in the parameters.

The monitoring of waste level and/or volume is required to address a high hazard that was identified by the hazards analysis performed in support of this Order and Manual -- the failure to promptly detect a release of high-level waste that could impact workers, the public, or the environment. The monitoring of these parameters addresses the operation of monitoring systems to detect vessel or transfer equipment failure that is of sufficient magnitude to cause a detectable volume change as well as to alert operators that a vessel (e.g., tank or bin) is approaching capacity so that overfilling can be avoided. This requirement is focused on operations, and is closely related to the requirement in Section II.P.(2)(j) which requires engineered monitoring systems.

There are a number of complicating factors that must be considered to meet the level/volume aspect of the monitoring requirement. Some of these factors could lead to failure to detect leaks and/or to over-react to changes in surface level indicators. These factors include the following:

(1) Irregular shaped crusts can form on the surface of the waste during storage, which could render automatic surface level detection devices unreliable for promptly detecting actual changes in the volume of the waste in a storage tank. The irregular crust could lead to false indications of increase, decrease, or no change in surface level and tank volume.

(2) High-level waste storage tanks with a very high thermal load will cause evaporation resulting in a decrease in tank surface level and volume. The decrease in tank volume must be correlated with the calculated rate of evaporation before a judgement can be made regarding whether the tank is leaking.

(3) Chemical conditions in the waste tank can result in gases generated within the waste becoming trapped within the waste matrix, leading to indications of false increases in the surface level.

(4) For underground storage tanks, an increase in the surface level can also result from an inflow of groundwater through leak-sites above the level of the waste, indicating a loss of structural integrity.

(5) Intentional additions to and removals from the storage vessels must also be considered in evaluating the monitoring results.

Example 1: An unexpected chemical reaction generates gas that is trapped within the waste matrix. The resulting rise in surface level precluded the detection of a leak in the tank by monitoring surface level only.

Example 2: Operating personnel at a high-level waste storage facility calculated the evaporative loss expected from a tank based on an assumed radionuclide inventory. The actual radionuclide inventory was much smaller than that assumed, so the actual heat generation rate was much smaller than that assumed. Overestimation of the change in waste volume due to evaporation resulted in failure to detect leakage that was incorrectly assumed to be evaporative loss.

The monitoring of waste chemistry parameters needs to be able to detect significant changes important to corrosion, and to the generation of explosive and/or flammable gases. The frequency of monitoring should satisfy the requirements identified by the structural integrity program in Section II.Q.(2), but the frequency of monitoring may need to be even greater if required to monitor the formation of gases.

Monitoring of waste chemistry parameters needs to:

(1) detect changes in the waste chemistry that cause changes in the rates of the critical corrosion modes previously identified;

(2) determine if new critical corrosion modes have been established;

(3) determine when adjustments to waste chemistry are required to maintain the predicted corrosion rates established by the structural integrity program [II.Q.(2)]; and

(4) monitor the formation and accumulation of any gases within the waste.

Other design related requirements of this chapter include Confinement in Section II.P.(2)(b) and Instrumentation and Control in Section II.P.(2)(i).

A graded approach is applied to operational implementation of this requirement for monitoring to detect releases promptly. The full suite of parameters to be monitored as well as the methods for monitoring them are tailored to the specific facility and vessel. For example, it may not be necessary to provide continuous monitoring of waste levels and waste parameters in bins of stored calcined high-level waste, since corrosion is not usually a problem.

Compliance with this requirement is demonstrated by: the identification of, and justification for, the parameters to be monitored and the frequency with which they will be monitored including coordination with the structural integrity program to identify important waste chemistry parameters and appropriate monitoring frequency; development and implementation of procedures and training to insure that disciplined and effective monitoring is sustained; and prompt evaluation of monitoring data by qualified personnel and prompt reporting of findings to management.

Supplemental References:

1. DOE, 1994. *DOE Limited Standard: Hazard Baseline Documentation*, DOE-EM-STD-5502-04, U.S. Department of Energy, Washington, D.C., August, 1994.

2. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

3. DOE. *DOE Fundamentals Handbook, Material Science*, Corrosion, DOE-HDBK-1017.

4. BNL, 1997. *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, Brookhaven National Laboratory, BNL-UC-406, January 1997.

5. DOE, 1986. *Nuclear Safety Analysis and Review System*, DOE 5481.1B (canceled), U.S. Department of Energy, Washington, D.C., September 23, 1986.

6. DOE, 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C., December 1992.

7. DOE, 1993. *SAR Preparation Guide*, DOE-STD-3009-93, U.S. Department of Energy, Washington, D.C., 1993.

8. DOE, 1995. *Facility Safety*, DOE O 420.1, U.S. Department of Energy, Washington, D.C., October 13, 1995.

II. U. <u>Closure</u>. The following requirements for closure of deactivated high-level waste facilities and sites are in addition to those in Chapter I of this Manual.

(1) Decommissioning. Deactivated high-level waste facilities/sites shall meet the decommissioning requirements of DOE O 430.1A, *Life-Cycle Asset Management* and the requirements of DOE 5400.5, *Radiation Protection of the Public and the Environment*, for release; or

(2) CERCLA Process. Deactivated high-level waste facilities/sites shall be closed in accordance with the CERCLA process as described in Section I.2.F.(5); or

(3) Closure. Deactivated high-level waste facilities/sites shall be closed in accordance with an approved closure plan, as specified below. Residual radioactive waste present in facilities to be closed shall satisfy the waste incidental to reprocessing requirements of this Chapter.

(a) Facility/Site Closure Plans. A closure plan shall be developed for each deactivated high-level waste facility/site being closed that defines the approach and plans by which closure of each facility within the site is to be accomplished. This plan shall be completed and approved prior to the initiation of physical closure activities, and updated periodically to reflect current analysis and status of individual facility closure actions. The plan shall include, at a minimum, the following elements:

1. Identification of the closure standards/performance objectives to be applied from Chapter III or IV, as appropriate;

2. A strategy for allocating waste disposal facility performance objectives from the closure standards identified in the closure plan among the facilities/units to be closed at the site;

3. An assessment of the projected performance of each unit to be closed relative to the performance objectives allocated to each unit under the closure plan;

4. An assessment of the projected composite performance of all units to be closed at the site relative to the performance objectives and closure standards identified in the closure plan; and

5. Any other relevant closure controls including a monitoring plan, institutional controls, and land use limitations to be maintained in the closure activity.

Objective:

The objective of this requirement is to ensure that closure of deactivated high-level waste facilities follows one of three acceptable closure processes. The first requirement allows deactivated high-level waste management facilities that can meet the decommissioning requirements of DOE O 430.1A to be released for restricted or unrestricted use. The second part allows deactivated high-level waste facilities to be closed using the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) process to demonstrate compliance with DOE Orders and other requirements under the *Atomic Energy Act of 1954*, as amended. The final part defines the requirements that shall be met for all other deactivated high-level waste facilities that are to be closed.

Discussion:

In support of the requirements in Section II.U, there are a number of requirements in Chapter I of DOE M 435.1-1 that address closure and need to be considered with this section. These include Section I.2.E.(2), Site Closure Plans, which defines the roles and responsibilities of the Deputy Assistant Secretaries for Waste Management and/or Environmental Restoration and Section I.2.F.(8), Closure Plans, which defines the same for the Field Element Manager. Guidance for each of these sections describes the roles and responsibilities for developing, reviewing, approving, and implementing the closure documents required by this section. Additionally, Section I.2.F.(5), Environmental Restoration, Decommissioning, and Other Cleanup Waste, defines the roles and responsibilities for managing and disposing of radioactive waste resulting from environmental restoration activities and will likely include decommissioning activities. These activities may overlap with the closure requirements of this section and therefore need to be reviewed for applicability.

To understand the scope of the requirements in Section II.U, the following definitions are provided. Chapter I of DOE M 435.1-1 defines closure as:

> "Deactivation and stabilization of a radioactive waste facility intended for long-term confinement of waste."

DOE O 430.1A, *Life-Cycle Asset Management*, defines deactivation as:

> "Process of placing a facility in a stable and known condition including the removal of hazardous and radioactive materials to ensure adequate protection of the worker, public

health and safety, and the environment thereby limiting the long-term cost of surveillance and maintenance. Actions include the removal of fuel, draining and/or de-energizing nonessential systems, removal of stored radioactive and hazardous materials, and related actions. Deactivation does not include all decontamination necessary for the dismantlement and demolition phase of decommissioning, e.g., removal of contamination remaining in the fixed structures and equipment after deactivation."

The scope of the closure requirements in Section II.U includes those activities necessary to complete the life cycle of former (deactivated) high-level waste facilities, or a group of facilities (herein named a site), by stabilizing residual hazardous and radioactive materials in a manner that ensures adequate protection of the worker, public health and safety, and the environment to limit long-term management of the facility. Activities that may be included are deactivation (as defined above), as well as post-deactivation activities, such as decontamination and decommissioning activities, both of which support placing a facility in a final state that requires the minimal amount of long-term management. The closure of deactivated high-level waste facilities is considered an activity that may be driven by DOE Orders, external regulations, local agreements, or both and therefore requires flexibility in meeting the objectives stated above. For this reason, the requirements in Section II.U provide three alternative paths to accomplishing closure: (1) meeting the decommissioning requirements of DOE O 430.1A and the release requirements and guidelines contained in DOE 5400.5; (2) following the CERCLA process to meet DOE requirements; or (3) meeting the requirements of a DOE-approved facility/site-specific closure plan. Following a brief discussion on the waste incidental to reprocessing determination process, each of these paths are discussed.

<u>Waste Incidental to Reprocessing</u>. Material remaining in a deactivated high-level waste management facility that meets the requirements in Section II.B for the Citation or Evaluation processes can be included in the closure process, as discussed in this guidance, and managed as either low-level waste or transuranic waste. If it does not meet the criteria for determining that the waste is incidental to reprocessing, then the residual waste must be managed as high-level waste.

As discussed in the guidance for Section II.A, Definition of High-Level Waste, DOE plans to dispose of high-level waste in a geologic repository consistent with the *Nuclear Waste Policy Act of 1982*, as amended. This plan was outlined in Secretary Hodel's letter to President Reagan (DOE, 2/6/85), in which the Secretary recommended that "the Department proceed with plans and actions to dispose of defense waste in a commercial repository." President Reagan's finding, in accordance with Section 8 of the *Nuclear Waste Policy Act of 1982*, as amended (Presidential memo, 4/30/85), found no basis to do otherwise and the Department has since implemented plans to dispose high-level waste in a geologic repository consistent with the *Nuclear Waste Policy Act of 1982*, as amended. Thus, any residual radioactive material remaining in deactivated high-level waste management facilities must meet the waste incidental to reprocessing evaluation

process requirements for a high-level waste closure activity to continue under these requirements.

Decommissioning. Section II.U.(1), Decommissioning, provides the opportunity to close deactivated high-level waste facilities/sites by meeting the Department's public dose limits for residual radioactive material which allows restricted or unrestricted release of the property. The draft guide on decommissioning, Draft G 430.1-4, *Decommissioning Implementation Guide,* and Chapter IV of DOE 5400.5, *Radiation Protection of the Public and the Environment,* discuss the requirements/guidance on meeting these public dose limits. The draft DOE G 430.1-4 provides the framework and guidance for implementing DOE O 430.1A and DOE P 450.4, *Safety Management System Policy*, during decommissioning activities conducted as part of facility disposition. Draft DOE G 430.1-4 also addresses the implementation of the *Policy on Decommissioning of DOE Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), dated May 22, 1995 (commonly known as the Decommissioning Policy). Chapter IV, *Residual Radioactive Material*, of DOE 5400.5, defines the radiological protection requirements and guidelines for cleanup of residual radioactive material that are applicable to allow the free release of deactivated high-level waste facilities for use without radiological restrictions.

While it is believed the number of former high-level waste facilities or sites that can meet this criteria will be small, the requirement is provided to allow closure through meeting the prescribed dose limits and surface contamination guidelines, where possible. In order to make such a determination, release criteria should be developed on the basis of the guidelines found in Chapter IV of DOE 5400.5. Chapter IV of DOE 5400.5 includes additional information on the development of site-specific release criteria and guidelines. DOE policy requires residual radioactivity to be reduced in accordance with ALARA principles before a site is released. The principles of ALARA are discussed in both DOE 5400.5 and the guidance to DOE M 435.1-1, Section I.2.F.(12).

The roles and responsibilities of the Field Element Manager, the Program Office, and the Office of Environment, Safety, and Health that are to be met for this closure path are contained in DOE 5400.5 and DOE O 430.1A.

CERCLA Process. Section II.U.(2), CERCLA Process, allows deactivated high-level waste facilities/sites to be closed using the CERCLA process to demonstrate compliance with the *Atomic Energy Act* requirements in the DOE Orders. Information on use of the CERCLA process can be found in numerous documents published by the Environmental Protection Agency (EPA) and DOE. Some of these documents are included in the listing of supplemental references at the end of this guidance section. Additionally, guidance to DOE M 435.1-1, Section I.2.F.(5), provides information on the use of the CERCLA process for planning and managing onsite disposal of low-level waste resulting from environmental activities, which includes

decommissioning and facility closure. (As noted in the guidance to Section I.2.F.(5), the requirement in Section I.2.F.(5) replaces the January 1997 guidance for complying with DOE 5820.2A and the May 1996 policy for demonstrating compliance with DOE 5820.2A for CERCLA or cleanup activities).

DOE high-level waste sites may follow the CERCLA process either because they are listed on the National Priorities List (NPL) or because the regulatory structure established in cleanup strategies (e.g., negotiated agreements) is based on CERCLA authority and procedures. As discussed in the guidance to Section I.2.F.(5), the CERCLA process may be used to demonstrate compliance with the requirements of DOE O 435.1 and DOE M 435.1-1 with regard to the safe management and onsite disposal of waste generated by environmental restoration activities.

Application of the CERCLA process to the closure of deactivated high-level waste management facilities involves the following:

- <u>Remedial Investigation (RI)</u> is a process undertaken to determine the nature and extent of the problem. The RI emphasizes data collection and site characterization and is generally performed concurrently and in an interactive manner with the feasibility study.

- <u>Feasibility Study (FS)</u> is undertaken to develop and evaluate options for remedial action. The FS emphasizes data analysis, using data gathered during the RI, and defines the objectives of the response action, to develop remedial alternatives and to undertake an initial screening and detailed analysis of the alternatives.

- <u>Record of Decision</u> documents the final selection of the cleanup option. This ROD also satisfies relevant NEPA requirements.

- <u>Remedial Design</u> is the technical analysis and procedures which follow the selection of the remedy and results in detailed plans and specifications for implementation.

- <u>Remedial Action</u> involves the actual construction or implementation of the cleanup.

As part of the Remedial Design, the applicable or relevant and appropriate requirements (ARARs) must be selected. The guidance for Section I.2.F.(5) provides additional information on the selection of ARARs and the applicability of DOE O 435.1 and DOE M 435.1-1 . This guidance also provides additional instructions on the applicability and demonstration of compliance with the performance objectives for a waste disposal facility in Section IV.P.(1) of DOE M 435.1-1.

The roles and responsibilities of the Field Element Manager and the Deputy Assistant Secretaries for Waste Management and Environmental Restoration for this closure path can be found in Sections I.2.F.(8) and I.2.E.(2), respectively.

Closure. Section II.U.(3), Closure, provides the third path for the closure of deactivated high-level waste facilities. This process includes the preparation of a closure plan that contains the elements defined in Sections II.U.(3)(a)(1) through (5). Each of these elements, as well as the expectations for a closure plan, are discussed below. The roles and responsibilities of the Field Element Manager, defined in Section I.2.F.(8), Closure Plans, and the Deputy Assistant Secretaries for Waste Management and Environmental Restoration, defined in Section I.2.E.(2), Site Closure Plans, are critical to the implementation of the closure process and need to be closely coordinated with the requirements in Section II.U.(3) to ensure the closure process meets its objectives.

Facility/Site Closure Plans. For each deactivated high-level waste facility or site, a closure plan must be developed. The general purpose of closure plans is to define the approach that will be taken for ensuring the long-term protection of the public and the environment from the closure of deactivated high-level waste facilities containing residual low-level or transuranic wastes. Included as part of this approach are the purpose and objectives of the closure action and general discussion of how the specific closure action fits within other past, and planned, closure actions. The closure plan should also address the three phases that a facility closure may experience. These are: (1) operational or interim closure; (2) final facility closure; and (3) institutional closure.

Operational, or interim closure, includes those activities that are conducted to stabilize a deactivated high-level waste facility, but do not include the final actions necessary to support minimal, long-term maintenance. Final closure activities include those activities that complete the physical activities necessary for the closure of the facility/site but do not include long-term institutional control activities. Institutional control closure follows final closure and includes the actions and measure necessary to ensure long-term stability of the site such as monitoring and land use limitations.

> *Example: Closure of a group of deactivated high-level waste tanks at Site K is planned and defined in a Closure Plan. Included is a schedule and list of activities that defines the activities planned for each phase of the closure. First is Interim Closure which will involve all the activities necessary, following bulk waste removal, to stabilize the tanks and their contents including filling them and the connecting piping with grout, to avoid subsidence. Stabilization also allows tank surveillance and maintenance activities to be reduced. The Final Closure phase is planned to be a CERCLA closure action that includes all the tanks and other facilities within the area of this group of tanks and includes the application of a cap, ground cover, and the installation of monitoring*

stations and permanent markers. The Institutional Closure phase is planned to last up to 100 years after the Final Closure phase and will include monitoring, land use limitations, and any necessary corrective actions, e.g., additional erosion protection, to ensure protection of the public and the environment.

The closure plan needs to address all activities to be performed during and following deactivation of a facility, including decommissioning, with emphasis on those activities required to minimize the need for long-term maintenance and maximize the stability of the closed facility. As with the closure of low-level waste disposal facilities, a period of active institutional control of 100 years is normally assumed during which access is controlled, and monitoring, and custodial maintenance is performed. However, longer periods of institutional control may be assumed when justification is provided in documented plans which describe long-term site land use or site remediation.

Closure plans need to include the conceptual/preliminary designs and approaches to be taken for each step in the closure process and should be coordinated with the monitoring plan (see discussion below) for the closure facility or site. The closure plan provides the details for accomplishing the closure requirements included in the design. The plan needs to be specific to the facility or site closure action, the characteristics of the site, and the residual wastes in the deactivated facility. The plan should provide a discussion of applicable DOE, Federal, State, and local closure requirements. A discussion of each activity to be performed during each phase of the closure process, and the relationship between the activities to achieve the desired result of minimum maintenance and long-term stability are to be provided. The methods for accomplishing each of the closure activities are to be provided for each phase of the closure, including those methods to be employed to minimize infiltration of water into the closed site and the final landscape. As part of this discussion, the plan needs to explain how contaminant migration will be controlled in the near-term and the long-term. A description of the cover designs for the closed units and their intended performance is included. Features of the plan which address the minimization of erosion by wind and water are also described, along with features to prevent intrusion into the closed unit by plants and animals.

The closure plan includes a summary description of how the activities to be performed will place the facility into a configuration which will allow the performance objectives identified (see requirement in Section II.U.(3)(a)(3)) to be met in both the short-term and the long-term. The schedule for completing facility closure accompanies this presentation. The schedule is to show each phase of closure and the preparation and approval of related documents and permits, such as the final assessment of projected performance, projected composite performance of all units to be closed at the site, safety analysis report, RCRA permit, or State approvals.

Example: The closure plan for Facility X provides a crosswalk summary of the elements of the facility closure to and the performance objectives for the closure of the facility.

The relationship between each feature included in the closure plan and the corresponding purpose of the feature with respect to the short-term and long-term performance of the facility is explained. How the various elements of the closure plan support minimizing the potential for the transport of contamination is provided. The closure plan includes the schedule for the facility closure that includes milestones and the steps for completing each step with dates of completion. The closure plan also lists, as part of the schedule, all needed permits and documents as part of the closure. Milestones are established for the completion of all documents and permits. The schedule includes allowances for review and approval of all documents and permits.

The closure plan also addresses corrective actions to be taken at each stage of the closure process. For example, it includes the elements of an inspection program, the inspection methods to be used, and the criteria to be used for initiating corrective actions. Specific corrective actions should be included for the occurrence of subsidence or the indication of contaminant migration. Other corrective actions to address potential issues such as uncontrolled facility or site access, natural phenomena, failure of monitoring equipment, ponding of water or excessive infiltration, erosion, or the presence of undesirable flora or fauna should also be included. The relationship between corrective actions to ensure compliance with the performance objectives and the monitoring program need to be clearly identified.

As required by Section II.U.(3)(a), each deactivated high-level waste facility or site, as defined in this guidance, shall have a plan that is complete and approved, as specified by the requirements in Sections I.2.F.(8) and I.2.E.(2), prior to physical closure activities. This requirement is intended to reduce the risk of committing a significant amount of resources to a closure action before the closure plan has been reviewed and approved by the appropriate levels of management. As explained in the guidance to these two sections closure plans are expected to be two-tier documents, i.e., their development and review/approval are expected to be conducted in two phases. This multi-phase process is considered necessary because it is recognized that much of the data needed to fulfill all the requirements in Section II.U.(3)(a) are not available initially, but become available as engineering data and/or other documents/permits are developed. However, Headquarters' review and approval is primarily focused on the first tier plans from which subsequent plans are developed.

The first tier plan, which is to be approved by the Deputy Assistant Secretaries for Waste Management and/or Environmental Restoration (Section I.2.E.(2)), is intended to define and bound the parameters of a closure action(s). This level of closure plan should include, at a minimum, the following topics:

- closure methodology;
- schedules and assumptions;
- site or individual closure standards/performance objectives;

- allocation of closure standard/performance objective budgets to individual facilities/sites;
- assessment (preliminary) of the projected performance of each unit to be closed relative to the allocated performance objectives;
- assessment (preliminary) of the projected composite performance of all units to be closed at the site;
- alternatives (if any);
- waste characterization data;
- closure controls plans; and
- stakeholder concerns.

While it is recognized that the availability of some of the above information may be limited and therefore, preliminary, it is necessary to ensure that a credible, bounding review can be conducted by DOE Headquarters.

The second tier of the closure plan, which is to be approved by the Field Element Manager, or designee, should provide the detailed information related to a specific unit or facility closure action that is bounded by the analyses contained in the first tier plan. The lower tier closure documentation should demonstrate that the performance objectives identified in the upper tier documentation can be met and maintained. As explained in the guidance to Sections I.2.E.(2) and I.2.F.(8), the first tier closure documentation should be approved by the Deputy Assistant Secretaries for Waste Management and/or Environmental Restoration before remedial action activities commence. However, design and field survey work can proceed prior to approval of a closure plan, particularly in the case where the data are needed to support elements required in the closure plan. Additionally, once the DOE Headquarters review/approval is gained on the first tier documentation and an authorization to proceed is issued, additional DOE Headquarters approvals are not required <u>provided</u> the bounding conditions defined in the approved first tier plan are not exceeded.

> *Example: Site ZZ plans to close a cluster of deactivated high-level waste tanks and an evaporator facility as a single closure unit. While detailed information concerning the closure actions is not available because of the lack of engineering analysis and RCRA permit discussions with the State, the Site prepares a first tier Interim Closure Plan that bounds the expected closure conditions. This plan includes a closure methodology, schedules and assumptions, identification of the closure site performance objectives (as required by Section II.U.3.(a)1.), preliminary waste characterization data, a strategy for apportioning the site performance objectives to each of the facilities within the site, preliminary closure controls, and current stakeholder concerns. This Interim Closure Plan for the site is submitted to the DOE Office of Environmental Management for review and approval. Approval and authorization to proceed is gained and the Site proceeds with the development of individual closure plans, development of assessments*

> *of the projected performance of each tank, and an assessment of the projected composite performance of all the units within the closure unit. Further review and approval by the DOE Office of Environmental Management is not required since the analysis and assessments prepared as part of the second tier closure plan are bounded by the DOE Office of Environmental Management-approved plan.*

Once approved, closure plans are to be updated periodically, to reflect revised analysis and the status of individual facility closure actions that are part of a site closure. The closure plan is a living document that is updated through the operational life of the closure activities with specific information about the contents and actions of interim closures and other information necessary (e.g., monitoring locations) to support final closure. As discussed below, it is imperative that the relationship between the analysis conducted in the assessment of the projected performance of each unit (Section II.U.(3)(a)(3)) and the assessment of the projected composite performance of all units (Section II.U.(3)(a)(4)) be kept in mind as the closure activities commence. Any information that is incorporated into a closure plan or any changes made to the closure activities of a facility that impacts the analysis in either of these assessments should be incorporated into them as soon as possible so that the extent of their impact on the closure can be known and any required changes can be made effective as soon as possible.

Following is a brief discussion of each of the closure plan elements identified in Section II.U.(3)(a)(1) through (5).

1. <u>Identification of closure standards/performance objectives to be applied from Chapter III or IV, as appropriate</u>;

As discussed in the guidance to Section II.B., Waste Incidental to Reprocessing, residual waste in deactivated high-level waste facilities that remains as part of the facility's closure may be managed as either low-level waste or transuranic waste. Following is a discussion on identifying the appropriate radiological closure standards/performance objectives for each case.

<u>Low-level waste</u>. For deactivated high-level waste facilities or sites that are closed as low-level waste sites, the disposal facility performance objectives in DOE M 435.1-1, Section IV.P.(1) should be met. As discussed in guidance Section IV.P.(1), these performance objectives provide criteria to be used in a disposal facility performance assessment that define the desired level of protection of the public and the environment from disposed low-level waste. The analyses in the performance assessment demonstrates there is a reasonable expectation that, when actually measured, compliance with actual protection requirements will be easily achieved. A discussion on the performance objectives can be found in Section IV.P.(1).

<u>Transuranic waste</u>. For deactivated high-level waste facilities or sites that are closed as transuranic waste sites, the applicable performance objectives/requirements are contained in 40

CFR Part 191, *Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste*, as identified in the guidance to DOE M 435.1-1, Section III.P, Disposal. Within this regulation, Subpart B, Environmental Standards for Disposal, contains the applicable requirements at 40 CFR 191.13, Containment Requirements; 191.14, Assurance Requirements; 191.15, Individual Protection Requirements; 191.16, Ground Water Protection Requirements; and 191.17, Alternative Provisions for Disposal. The discussion contained in guidance to Section III.P provides additional information on the applicability of 40 CFR Part 191 to the disposal of transuranic waste at a non-Waste Isolation Pilot Plant (WIPP) site. As acknowledged in the guidance to Section III.P, DOE needs to develop 40 CFR Part 191 compliance criteria for the disposal of transuranic waste at sites, other than WIPP.

The term transuranic waste as used in the above discussion is consistent with the definition provided in DOE M 435.1-1, Section III.A, Definition of Transuranic Waste. Therefore, residual waste remaining in a deactivated high-level waste facility must meet the definition in Section III.A in order for it to be closed as a transuranic waste disposal site. If, for example, the waste meets one of the three exceptions included at Section III.A, it is not considered transuranic waste under the closure requirements.

In addition to the radiological standards discussed above, there may be nonradiological air, groundwater and surface-water standards that are applicable to the closure action. Identification of such standards includes needs to be included during the development of a closure plan, and included in the plan. These standards may include state and local, as well as other Federal standards such as inorganic contaminant standards, contained in the *Safe Drinking Water Act* (40 CFR 141.62). To identify these standards, it is recommended that a performance standards evaluation process, similar to the CERCLA criteria for the identification of ARARs, be considered.

2. <u>A strategy for allocating waste disposal facility performance objectives from the closure standards identified in the closure plan among the facilities/units to be closed at the site</u>;

Included in the closure plan is the strategy/method for apportioning the performance objectives/closure standards identified in Section II.U.(3)(a)(1) to each of the facilities/units to be closed at the site. This strategy defines how facility or unit-specific performance objectives are, or will be, established based upon the overall site performance objectives. The strategy or methodology provides reasonable assurance that the overall performance objectives will not be exceeded by either the summation of the individual facility closure actions or by future closure activities. Additionally, the method recognizes that constituents of concern (radionuclides or chemicals) from various facilities or areas may impact compliance points at different times due to varying closure scenarios and geological conditions.

The performance standards for the closure of a deactivated high-level waste facility are concentration or dose limits for specific radiological or chemical constituents released to the environment. These standards apply to various environmental media, at different points of compliance, at various periods during or after closure.

> *Example: Site Z conducted a preliminary evaluation of the environmental pathways and receptors for a deactivated high-level waste group (site) of tanks and determined that groundwater was the limiting pathway for radionuclides and chemicals of concern to impact receptors. Therefore, the strategy of apportioning performance objectives for the closure of the site, and to be included in the closure plan, was applied to the groundwater pathway only. This method involved the definition of a groundwater transport segments (GTS), identification of high-level waste tank systems and other non-tank sources in the GTS, apportionment of each source based on its contribution to total impacts, and the development of adjusted and tank-specific performance objectives.*

3. An assessment of the projected performance of each unit to be closed relative to the performance objectives allocated to each unit under the closure plan;

With the allocation of overall performance objectives or closure standards to individual facilities, an assessment of the projected performance of each facility or unit compared to these objectives needs to be prepared. As discussed above, the residual material in a deactivated high-level waste facility may be managed as either low-level waste or transuranic waste. Following is a discussion on preparing an assessment of projected performance for each of these waste types.

Low-level waste. For deactivated high-level waste facilities or sites that are to be closed as low-level waste sites, the requirements for a radiological performance assessment for low-level waste disposal sites, in Section IV.P.(2) of DOE M 435.1-1, are to be met. As discussed in the guidance to this section, the objectives of a performance assessment are to ensure that all aspects of low-level waste disposal are evaluated in an assessment to provide reasonable assurance that the performance objectives will be met. All of the elements of a low-level waste performance assessment provided in the requirement in Section IV.P.(2) are considered appropriate for this type of a deactivated high-level waste closure activity. The applicable review and approval requirements for the closure plan, which includes an assessment of performance, are included in Section I.2.E.(2). A complete discussion on the preparation of a low-level waste disposal facility performance assessment can be found in the guidance to Section IV.P.(2).

Transuranic waste. Deactivated high-level waste facilities or sites that are to be managed as transuranic waste disposal sites must demonstrate compliance with 40 CFR Part 191. Details on the criteria for reviewing and approving 40 CFR Part 191 performance assessments are included in the guidance to Section III.P.

4. <u>An assessment of the projected composite performance of all units to be closed at the site relative to the performance objectives and closure standards identified in the closure plan</u>;

With assessments of the projected performance of each facility or unit completed relative to the performance objectives allocated to each unit (Section II.U.(3)(a)(3)), an assessment of the projected composite performance of all the applicable units to be closed needs to be prepared. The objective of such an assessment is to ensure that the potential dose to hypothetical members of the public from the cumulative residual radioactive material that is likely to remain on a DOE site is reasonably expected to not exceed the dose limits for protection of the public.

Low-level waste or transuranic waste disposal is not the only DOE activity that will leave residual radioactive material on a DOE site when operations have ceased. Environmental activities will be conducted to mitigate releases from former operations such as disposal of liquid radioactive waste to soil columns, but will not generally result in the removal of all of the radioactive material. Also facilities currently operating that involve the use of or handling of radioactive material or radioactive waste will eventually be closed and their closure may leave some residual radioactive material.

The assessment of the projected composite performance of all units/facilities to be closed at a site that are relevant to the performance objectives/closure standards identified in a closure plan, is considered a reasonably conservative assessment of the cumulative impacts from all the current and planned closure facilities/units. The composite analysis provides a suggestion of what could conceivably happen if DOE did not act to protect public health and safety and provides information that DOE can use for planning. For example, the results of the composite analysis can assist DOE in identifying those sources that most significantly contribute to the total projected dose and decide on priorities for remediation, or decide on closure alternatives for active or inactive closure sites. Hazard implications for some sources may be so low that little needs to be done beyond land control, minor maintenance, and monitoring.

The requirements and guidance to DOE M 435.1-1, Section IV.P.(3), Composite Analysis, provide additional information on the development of an assessment of composite performance.

Example: At Site X , deactivated high-level waste tanks and other high-level waste contaminated facilities will be closed at various time over a period of decades. For each closure action, in single facilities or groupings of facilities, the site identifies the potential impacts from all sources that can contribute to the specific closure action by identifying the limiting exposure pathways for the contamination to move. This is accomplished by defining a groundwater transport segment (GTS) for the facility to be closed and identifying and quantifying sources within the GTS. These sources include the facilities or sites being closed, past contamination sites and closures, and future closure sites that are known at the time. For this example these sites/sources include

closed seepage basins, a closed low-level waste disposal site, and a number of spill sites that are not expected to be remediated.

In addition, the assessment of the projected performance of all units to be closed relative to the closure plan needs to be reviewed and updated as appropriate to keep the analysis current. Such updates should be performed to ensure the assumptions and parameters are appropriate to maintain the validity and effectiveness of the controls that are applied to the closure site. The guidance for DOE M 435.1-1, Section IV.P.(4), Performance Assessment and Composite Analysis Maintenance, provides additional information on maintaining the composite analysis.

5. Any other relevant closure controls including a monitoring plan, institutional controls, and land use limitations to be maintained in the closure activity.

The final required element of a closure plan is to include those closure controls that are needed to ensure that the primary health and environmental protection requirements needed are put in place. These controls are to include, at a minimum, a monitoring plan, institutional controls, and limits of land use. Each of these is discussed below.

Monitoring Plan. The closure plan addresses the post closure activities to be undertaken to ensure health and environment protection requirements are met. One of the elements that is considered key is the development and implementation of a monitoring plan. Such a plan needs to identify the monitoring activities that are to be conducted after the closure is completed. This plan includes a location map of the monitoring wells or monitoring points that are considered necessary, the data that are to be collected, and actions that will be taken in response to the results of the monitoring activities. Also, the monitoring plan defines the inspection program and the inspection methods to be used, and describes the criteria to be used for initiating corrective actions. Specific corrective actions need to be included for the occurrence of subsidence or the indication of contaminant migration. Other corrective actions to address potential issues, such as uncontrolled site access, natural phenomena, failure of monitoring equipment, ponding of water or excessive infiltration, erosion, or the presence of undesirable flora or fauna, need to be included. The relationship between corrective actions and the monitoring program needs to be clearly identified.

Example: At Site Z, a closure plan for the closure of a group of deactivated high-level waste tanks includes: a map of the monitoring wells to be maintained over the institutional control period after closure; sampling frequencies, sampling methods, monitoring parameters, and methods of analysis for each monitoring well; the data management methods, data analysis methods, data reporting and remedial action plan associated with the monitoring wells for the closed site; and an inspection program that provides criteria for inspecting and initiating corrective actions for the group of closed tanks.

Institutional Controls and Land Use Limitations. The intent of this requirement is to ensure that institutional control will continue at the closed site until it can be released and that local land use records appropriately record the use of the land as a closed radioactive waste facility/site. These actions provide additional protection against misuse of the land in the future and the possibility of an inadvertent intrusion.

Documentation of institutional control and land use assumptions for a closed facility or site that is to be managed as a low-level waste disposal site should meet the requirements of DOE M 435.1-1, Section IV.Q.(2), paragraphs (c) and (d) and follow the corresponding guidance. Similarly, closed facilities or sites that are to be managed as a transuranic waste disposal site are to meet similar requirements. As with a low-level waste disposal site, the closure plan should identify the necessary activities to be performed to ensure protection of public health and the environment.

Compliance with these requirements is demonstrated by successful closure and supporting documentation, e.g., decommissioning documentation, CERCLA documentation, or closure plan, which provides a reasonable expectation that the proposed closure conditions will achieve stability of the closed facility/site, reduce the need for active maintenance, and be protective of worker and public health and the environment.

Supplemental References:

1. DOE, 1998. *Life-Cycle Asset Management*, DOE O 430.1A, U.S. Department of Energy, October 14, 1998.

2. DOE, 1997. *Decommissioning Implementation Guide*, Draft DOE G 430.1-4, U.S. Department of Energy, October 1, 1997.

3. DOE, 1996. *Industrial Wastewater Closure Plan for F- and H-Area High-Level Waste Tank Systems*, Savannah River Site, ESH-CGP-96-0375, Revision 1, U.S. Department of Energy, July 10, 1996.

4. DOE, 1997. *Industrial Wastewater Closure Module for the High-Level Waste Tank 20 System*, Savannah River Site, ESH-CGP-97-0003, Revision 1, U.S. Department of Energy, January 8, 1997.

5. DOE, 1997. *Guidance for Complying with DOE Order 5820.2A, "Radioactive Waste Management," for Onsite Management and Disposal of Low-Level Waste Resulting from Environmental Restoration Activities*, U.S. Department of Energy, Washington, D.C., January 9, 1997. (Superseded by Guidance to DOE M 435.1-1, Section I.2.F.(5))

6. DOE, 1996. *Policy for Demonstrating Compliance with DOE Order 5820.2A for Onsite Management and Disposal of Environmental Restoration Low-Level Wastes Under the Comprehensive Environmental Response, Compensation, and Liability Act*, U.S. Department of Energy, May 31, 1996. (Superseded by Guidance to DOE M 435.1-1, Section I.2.F.(5))

7. DOE, 1995. *Decommissioning Resource Manual*, DOE/EM-0246, U.S. Department of Energy, Office of Environmental Management, August 1995.

8. Sullivan, 1998. M.A. Sullivan, DOE, to J.T. Greeves, USNRC, letter, *Natural Resources Defense Council Petition to Exercise Licensing Authority over Savannah River Site High-Level Waste Tanks*, U.S. Department of Energy, Washington, D.C., September 30, 1998.

9. DOE, 1985. *An Evaluation of Commercial Repository Capacity for the Disposal of Defense High-Level Waste,* DOE/DP/0020/1, U.S. Department of Energy, Washington, D.C., June 1985.

10. DOE, 1985. Secretary Hodel to President Reagan, memorandum, *Use of Commercial Repository for Disposal of Defense High-Level Nuclear Waste*, U.S. Department of Energy, Washington, D.C., February 6, 1985.

11. DOE, 1985. President Reagan to Secretary Herrington, memorandum, *Disposal of Defense Waste in a Commercial Repository*, Washington, D.C., April 30, 1985.

II. V. <u>Specific Operations</u>.

Specific requirements are provided for the operation of lifting devices and facilities for receipt and retrieval of high-level waste.

(1) Operation of Lifting Devices. Hoisting and rigging activities shall be conducted in accordance with the guidance provided in the DOE Standard "Hoisting and Rigging" (DOE-STD-1090-96).

Objective:

The objective of this requirement is to ensure avoiding releases of high-level waste that could result from dropping equipment, containers, or other objects that could damage high-level waste containers and systems (e. g., transfer, pretreatment, treatment) during hoisting and lifting operations.

Discussion:

The hazards analysis performed to guide development of DOE M 435.1-1 revealed that lifting and rigging activities pose a high hazard for many high-level waste activities. In particular, physical and chemical treatment of high-level waste in large storage tanks often involves the use of large, heavy equipment such as mixers and dehydrators. Typically the access to the tanks is through relatively small risers. Manipulation of loads in restricted spaces with the additional complication of high radiation and reduced visibility due to the potential presence of confinement huts, requires that precautions be taken to guard against dropping loads into and onto containers, transfer equipment (e.g., pipelines, valves) and other systems containing high-level waste.

The existing DOE standard for hoisting and rigging, DOE-STD-1090-96, includes a section on critical lift determinations (Sections 2.1) which is especially applicable to high-level waste activities. The critical lift designation applies if collision, upset, or dropping could result in:

- Unacceptable risk of personnel injury or significant adverse health impact (onsite or offsite);

- Significant release of radioactive or other hazardous material or other undesirable conditions;

- Undetectable damage that would jeopardize future operations or the safety of a facility; or

- Damage that would result in unacceptable delay to schedule or other significant program impact such as loss of vital data.

A lift needs to also be designated as critical if the load requires exceptional care in handling because of size, weight, close-tolerance installation, high susceptibility to damage, or other unusual factors.

Example: Transfers of liquid high-level waste among tanks is typically performed using underground piping systems with pumps and valves located in below-grade transfer boxes over which large shielding blocks are emplaced. Access to the pumps and valves requires lifting the shielding blocks. The potential for personnel injury, release of radioactive material, and delay in schedule or other significant program impact [including loss of transfer capability as required by DOE M 435.1-1, Section II.H.(2)] if a shielding block were dropped, renders lifts of these blocks subject to the critical lift provisions of DOE-STD-1090-96.

Requirements that apply to critical lifts appear in Section 2.2 of DOE-STD-1090-96. Included are appointment of a person in charge; preparation of a pre-job plan or procedure; use of experienced, trained, and qualified lift equipment operators; use of designated, qualified lift operations signalers; review of the plan or procedure and rigging sketches prior to the lift; and conduct of a pre-lift meeting to review and ask questions about the plan or procedure. The plan or procedure is to include identification of the items to be moved and key characteristics, such as size and weight, identification of the operating equipment to be used, and rigging sketches.

Compliance with this requirement for lifting devices can be demonstrated by existence of formal procedures for prior review of lifting activities to determine when the critical lift provisions of DOE-STD-1090-96 are to be applied. The procedures should also identify those lifting devices that are classified as safety-class or safety-significant. Procedures, programs, or other processes are to be in place to ensure the implementation of these requirements when necessary.

Supplemental References:

1. DOE, 1996. *Hoisting and Rigging*, DOE STD 1090-96, U.S. Department of Energy, Washington, D.C., September 1996 (a U.S. Department of Energy standard).

2. DOE, 1997. *Safety Management System Guide*, DOE G 450.4-1, U.S. Department of Energy, Washington, DC, November 1997.

II. V.(2) Operation of Facilities for Receipt and Retrieval of High-Level Waste. High-level waste receipt and retrieval systems shall be

operated and maintained consistent with high-level waste system features incorporated in the facilities. Strategies for retrieval of waste shall be analyzed to ensure that structural and radiological impacts are consistent with the facility design basis.

Objective:

The objectives of this requirement are to ensure the proper retrieval strategy will be employed for retrieval of high-level waste and to preserve the operability of design features for the safe receipt and retrieval of waste.

Discussion:

The threat to losing the design capabilities and safety features of systems for the receipt and retrieval of waste is very real given the long time period between design and installation of some of these system components and the time when they will be used. An aggressive program is necessary to continually ascertain the operability of system components and extend the service-life of systems and components to meet operational requirements. Operability of the system and components are threatened by budgetary and operational decisions. The assignment of insufficient priority to maintain the operability of components and safety features, the use of a retrieval strategy that is different from the design basis, and operation of systems by personnel who are inexperienced or untrained are challenges that must be addressed. Therefore, the essential components of systems for receipt and retrieval of waste, and their performance requirements, should be identified, maintained and, wherever practicable, used during normal operations. Similarly, wherever practical, procedures that will be used during receipt and retrieval should be incorporated into normal operations. Such an approach is necessary to derive confidence in the receipt and retrieval capabilities by demonstrating the operability of the equipment and the competence of the operating personnel.

Maintaining the viability of the facilities for receipt and retrieval of waste which were designed into the systems over the intervening time period between construction of the systems and that point in time when they will be used requires an understanding of the degradation modes and retrieval strategies that will be employed in the future and actions that must be employed to preserve safe operability.

This requirement is applicable to storage of high-level waste in the various stages of processing as well as to the canistered waste form. Liquid high-level waste presents special problems of retrieval, such as maintaining adequate knowledge of the content of the waste when it may be a mixture received from many sources, and ensuring that most of the liquid can be removed from the storage vessel for processing or for closure. Stored vitrified waste in metal canisters must also be monitored during storage to ensure the canisters can be retrieved and moved.

Implementation of this requirement must be coordinated with several other related requirements of this Manual. DOE M 435.1-1, Section II.P.(2)(g) requires that the design of the systems be based on the strategy selected for retrieval. Knowledge of that strategy is required to formulate and implement an operations and maintenance program. Sections II.P.(2)(h) and II.Q.(1) outline requirements for structural integrity. Finally, the receipt and retrieval features were designed to be compatible with the general requirements for waste management including Worker Protection (Section I.1.E.(21)), Radiation Protection (Section I.1.E.(13)) including maintaining exposures as low as reasonably achievable, and Safeguards and Security (Section I.1.E.(16)). If strategies other than the design basis strategy is planned for retrieval, an understanding of the impact of using a different strategy on structural integrity and on radiation protection is imperative.

> *Example: Tank farm "C" at site XYZ was designed and constructed based on a retrieval strategy involving the use of a robotic arm whose weight must be born by the tank structure. The associated loads were included in the structural design requirements for the tank as well as provisions for access. An integrated operations and maintenance plan has been developed and implemented for the receipt and retrieval systems. The integrated plan is focused on maintaining equipment and personnel operability to execute the design basis retrieval strategy. The integrated plan documents the structural and operational features included in the design to support the retrieval strategy. The plan includes the structural integrity program requirements outlined in DOE M 435.1-1 at II.Q.(1), the waste acceptance requirements of Section II.L, the waste certification requirements of II.M, and the radiation protection requirements of I.1.E, as they relate to preserving the design basis operability of the retrieval systems. Procedures for routine operations and maintenance, including transfer of waste, have been developed to be consistent with procedures to execute the planned retrieval strategy and are employed wherever practical*

Compliance with this requirement can be demonstrated by developing and implementing an integrated operations and maintenance program that includes the requirements of other relevant sections of DOE M 435.1-1.

Supplemental References:

1. NRC. *Packaging and Transportation of Radioactive Material,* 10 CFR Part 71, U.S. Nuclear Regulatory Commission, Washington, D.C.

2. USDOT. *Shippers-General Requirements for Shipments and Packaging-Radioactive Materials,* 49 CFR Part 173, Subpart I., U.S. Department of Transportation, Washington, D.C.

3. DOE, 1996. *Packaging and Transportation Safety,* DOE O 460.1A, U.S. Department of Energy, Washington, D.C., October 2, 1996.

4. DOE, 1995. *Departmental Materials Transportation and Packaging Management,* DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

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IMPLEMENTATION GUIDE
for use with DOE M 435.1-1

Chapter III

Transuranic Waste Requirements

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III. A. Definition of Transuranic Waste.

Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) 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 the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or

(3) Waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Objective:

The objective of this requirement is to provide the criteria for determining if a waste is to be managed in accordance with DOE M 435.1-1, Chapter III, *Transuranic Waste Requirements*. Additionally, it is necessary to determine if a waste meets the definition of transuranic waste to enable the Department of Energy to comply with provisions in the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended.

Discussion:

Basis. This definition of transuranic waste is the definition used in the *Waste Isolation Pilot Plant* (WIPP) *Land Withdrawal Act of 1992*, as amended. This definition is functionally equivalent to that in 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*. The *WIPP Land Withdrawal Act of 1992*, as amended, defines transuranic waste and limits disposal at WIPP to transuranic waste resulting from atomic energy defense activities which meets this definition.

Interpretation and Application. In order to ensure consistent application, various terms used in the definition need to be clarified. First, the limit above which a waste is determined to be transuranic waste is based on an activity of 100 nanocuries (nCi) (3700 becquerels (Bq)) per gram of waste. The activity to be counted in making this determination is only that from the isotopes that would qualify a waste as transuranic waste as described in the following paragraphs. In other words, one would not include the activity from short-lived fission products (i.e., non-alpha emitters with half-lives less than 20 years) in calculating the concentration. The mass over which

the activity is divided in making the waste determination is the waste matrix. This includes the waste material itself as well as any stabilization media that must be added to meet waste acceptance criteria for mobility, physical form, structural stability or free liquids. The mass of added shielding, the container, or any rigid liners is not included in the calculation.

The term transuranic means those elements with an atomic number greater than that of uranium (i.e., atomic number >92). Therefore, uranium wastes do not qualify as transuranic waste by virtue of their uranium concentration.

The transuranic radionuclides that are to be considered in making a transuranic waste determination must decay by emission of alpha particles and also must have a half-life greater than 20 years. Consistent with this portion of the definition, there are radionuclides with atomic numbers greater than 92 that would not cause a waste to be called transuranic waste.

> *Example: A waste is contaminated with americium-242 which predominantly decays by emission of a beta particle and has a 16-hour half-life. Even though americium-242 has an atomic number greater than 92, it cannot be considered in determining the waste type because it is not an alpha emitter and does not have a 20-year half life.*

Given the definition provided in the public law and its application pursuant to DOE M 435.1-1, the determination of transuranic waste should be made at the time of waste certification, that is, each time the waste is transferred to another person or facility (see guidance for DOE M 435.1-1, Section III.J).

> *Example 1: A waste is contaminated with curium-244 which is an alpha-emitter and has an atomic number greater than 92. Over a period of about 200 years, a sufficient inventory of curium-244 will decay to greater than 100 nCi/g of plutonium-240, an alpha emitter with a 6,750-year half-life. Regardless of the decay product, the curium-244 content of the waste is not relevant to the determination of whether the waste is transuranic because the curium has an 18.11-year half-life and the determination is made at the time the waste is certified as meeting a facility's waste acceptance criteria. However, even if the waste is determined to be a low-level waste, the method of disposal must be commensurate with the long-term hazard associated with the plutonium-240 decay product.*

> *Example 2: A waste is generated and placed in bags within 55-gallon drums. The waste has been characterized and certified as transuranic waste in accordance with the waste acceptance criteria of the facility receiving the waste. This same waste, if required to undergo solidification to enable shipment and disposal, could be re-certified after treatment by the treating facility as low-level waste, in the event that radioassay found*

that the solidification process reduced the concentration of relevant radioisotopes to less than 100 nCi (3700 Bq) per gram of waste matrix.

In the previous example, the waste form would be altered by the addition of solidifying agents that would be considered in the radioassay. In either of the two cases in the previous example, the determination would not consider the waste container or its rigid liner. Even if a waste container fails and has to be overpacked, the mass of the failed container does not need to be included in the transuranic waste determination.

Example: A 55-gallon drum is damaged, has leaked, and requires overpacking. The concentration determination would include the weights of the original waste matrix and interior bags, but not the weight of the failed drum.

It is also conceivable that a low-level waste could become sufficiently concentrated that it becomes a transuranic waste.

Example: A waste with a relatively high concentration of transuranic radionuclides (but less than 100 nCi (3700 Bq) per gram) is transferred to a treatment facility as low-level waste. The thermal treatment of the waste reduces the mass of the waste matrix enough that the resulting transuranic concentration exceeds 100 nCi (3700 Bq) per gram. If no additional treatment (e.g., stabilization) were necessary, the resulting waste would be categorized as transuranic waste.

Determining whether waste exceeds the 100 nCi/g (3700 Bq/g) shall be in accordance with the requirements and guidance issued by the Carlsbad Area Office in the *Transuranic Waste Characterization Quality Assurance Program Plan, Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, and/or other controlling documents. Waste which does not exceed the 100 nCi/g limit is to be managed in accordance with the low-level waste requirements of DOE M 435.1-1.

Dilution of a transuranic waste stream to reclassify the waste as low-level waste (i.e., reducing the concentration to less than or equal to 100 nCi (3700 Bq) per gram) is not permitted by the Department. While it is recognized that in the course of stabilizing a waste stream some changes in waste concentration may occur, actions to dilute a waste stream below the concentration limits for transuranic waste are prohibited. It is also recognized that actions taken to process a waste stream for safety or technological reasons that are justified, may result in the waste being reclassified after processing as low-level waste.

Example: Due to the moisture content of a transuranic waste sludge, the waste does not meet the WIPP WAC. The site evaluates several treatment options taking into consideration factors such as worker exposure, waste minimization, cost and complexity

of the treatment process and disposal facility waste acceptance requirements. The treatment process selected involves adding grout to the transuranic waste sludge to eliminate free liquids resulting in a solidified waste form that contains transuranic radionuclides in concentrations less than 100 nCi (3700 Bq) per gram and meets the waste acceptance criteria for a low-level waste disposal facility.

There are three exceptions to the definition of transuranic waste: the high-level waste exception; the degree of isolation exception; and the NRC-approved disposal exception.

<u>High-Level Waste Exception</u>. The definition of transuranic waste includes exceptions for some wastes that would otherwise be considered transuranic waste. The first exception to the definition of transuranic waste is waste that meets the definition of high-level waste (see Definition of High-Level Waste guidance). Because high-level waste is generated by reprocessing spent nuclear fuel, much high-level waste contains concentrations of greater than 100 nCi (3700 Bq) per gram alpha-emitting radionuclides with half-lives greater than 20 years. Separate requirements apply to management of high-level waste, both within and external to DOE. This exception serves to distinguish high-level waste, as defined in DOE M 435.1-1, Chapter II, from transuranic waste.

Example: Waste in underground storage tanks at the Hanford Site contains long-lived, alpha-emitting plutonium and neptunium isotopes in excess of 100 nCi (3700 Bq) per gram. However, the waste is not categorized as transuranic waste because it is highly radioactive waste from reprocessing spent nuclear fuel; i.e., it is high-level waste.

<u>Degree of Isolation Exception</u>. The second exception to the definition of transuranic waste is waste that is determined to not need the degree of isolation that is provided by implementation of the disposal requirements of 40 CFR Part 191. This allows the Secretary of Energy to make a determination to remove these wastes from the transuranic waste definition based on an evaluation of a proposed disposal concept. Such a determination would have to be submitted to and concurred with by the EPA Administrator.

Example: A site is contemplating on-site disposal of a small quantity of a unique waste contaminated with greater than 100 nCi (3700 Bq) per gram of transuranic alpha-emitters with greater than 20-year half-lives. Site personnel submit a rationale for applying standards other than those for transuranic waste disposal, a conceptual disposal design, and a preliminary radiological impacts analysis to the cognizant Headquarters Program Office. The Program Office confers with the Offices of Environmental Management and Environment, Safety, and Health on the proposal. The Headquarters staff agrees with the site's approach, so the Office of Environment, Safety, and Health arranges a meeting with the Environmental Protection Agency. The meeting results in an agreement on the analyses that need to be conducted and the radiological performance measures that apply. Site personnel conduct the analyses, which project

that the performance measures will be met. The analyses are reviewed by Headquarters staff, then by EPA staff. Following resolution of any concerns, the Secretary of Energy determines, and the EPA Administrator concurs, that the waste does not need to be considered transuranic waste, but can be disposed of as low-level waste.

NRC-Approved Disposal Exception. Under the current regulatory regime, this exception does not affect DOE's management of defense transuranic waste that is to be disposed of at WIPP. This exception gives the Nuclear Regulatory Commissioning (NRC) the latitude to not apply the disposal standards of 40 CFR Part 191 to waste which meets the concentration limits of transuranic waste if the waste is disposed of in an NRC-licensed facility. Waste generated by commercial activities could have concentrations of radionuclides that would result in categorization as transuranic waste. As long as the waste is not high-level waste, it could be accepted as Greater-than-Class-C low-level waste per the waste classification system in 10 CFR 61.55. In accordance with the *Low-Level Radioactive Waste Policy Act*, as amended, the Department is responsible for disposal of Greater-than-Class-C waste; however, disposal of Greater-than-Class C waste generated by an NRC licensee is to be in a facility licensed by the NRC.

The NRC issued a final rule requiring the disposal of Greater-than-Class C low-level radioactive waste in a geologic repository, unless disposal has been approved elsewhere (54 FR 22578, codified at 10 CFR Part 61). The rulemaking clarified that only the requirements governing disposal of high-level radioactive waste in geologic repositories (10 CFR Part 60) would be relevant to disposal of Greater-than-Class C waste in a geologic repository. Although the NRC has indicated that the disposal of Greater-than-Class C waste in near-surface disposal facilities is generally not acceptable, the requirements of 10 CFR Part 61 would be applicable to the disposal of commercially generated (NRC licensed) Greater-than-Class C waste in "intermediate" disposal facilities. The exception to the definition allows NRC to authorize such waste to be disposed without necessarily invoking the additional requirements of 40 CFR Part 191.

Supplemental References:

1. Cowan, 1996. Stephen P. Cowan to Distribution, memorandum, *Implementation Guidance Concerning "Atomic Energy Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, U.S. Department of Energy, October 17, 1996.

2. NRC. *Disposal of High-Level Radioactive Wastes in Geologic Repositories*, 10 CFR Part 60, U.S. Nuclear Regulatory Commission, Washington, D.C.

3. NRC. *Licensing Requirements for Land Disposal of Radioactive Waste*, 10 CFR Part 61. U.S. Nuclear Regulatory Commission, Washington, D.C.

4. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended, October 30, 1992.

5. *Low-Level Radioactive Waste Policy Amendments Act of 1985*, as amended, January 15, 1986.

6. CAO, 1998. *U.S. Department of Energy, Transuranic Waste Characterization Quality Assurance Program Plan,* Revision 1, CAO-94-1010, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1998.

7. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

8. NRC, 1989. "Final rule, 10 CFR Part 61, Disposal of Radioactive Waste," *Federal Register*, Vol. 54, No. 100, U.S. Nuclear Regulatory Commission, Washington, D.C., May 25, 1989.

9. EPA, 1985. "Final rule, 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

III. B. Management of Specific Wastes.

The following provide for management of specific wastes as transuranic waste in accordance with the requirements in this Chapter:

(1) Mixed Transuranic Waste. Transuranic waste determined to contain both a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, and a radioactive component subject to the *Atomic Energy Act of 1954*, as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. Transuranic waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(3) Pre-1970 Transuranic Waste. Transuranic waste disposed of prior to implementation of the 1970 Atomic Energy Commission Immediate Action Directive regarding retrievable storage of transuranic waste is not subject to the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to ensure that DOE transuranic waste is managed in accordance with the applicable requirements of external regulations, specifically those of the *Resource Conservation and Recovery Act* and the *Toxic Substances Control Act*, that address non-radiological hazards, in addition to being managed in accordance with the requirements of DOE O 435.1 and the *Radioactive Waste Management Manual*, DOE M 435.1-1.

Discussion:

The *Radioactive Waste Management Manual*, DOE M 435.1-1, contains requirements for managing the radioactive character of transuranic waste. Through the safety and hazards analysis process used in developing the Manual, non-radiological hazards associated with managing certain wastes were identified. During development of the requirements necessary to control the identified hazards, it was concluded that sufficient external regulations, promulgated pursuant to *Resource Conservation and Recovery Act* (RCRA) and *Toxic Substances Control Act* (TSCA), exist for controlling the non-radiological hazard.

In managing transuranic waste which are subject to RCRA and TSCA requirements, personnel should be aware of the requirements for storage and disposal of the waste. The ability to dispose of RCRA and TSCA waste that has a radioactive component is limited. The expectation is that certain mixed wastes can be disposed of at WIPP without treatment (refer to the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*). Currently, no disposal facilities are available for TSCA-regulated transuranic wastes. Therefore, to the extent practical, waste generators should avoid generating mixed or TSCA-regulated transuranic waste, and generators and waste managers should avoid actions (e.g., commingling wastes with different regulatory requirements) that result in transuranic waste with no path to disposal (see guidance for DOE M 435.1-1, Section I.2.F.(19)).

> *Example: According to the Waste Acceptance Criteria for the Waste Isolation Pilot Plant, PCBs in concentrations greater than 50 ppm cannot be accepted for disposal. Therefore, in performing work involving PCBs (e.g., activities creating waste or waste management such as packaging) care should be taken to avoid commingling PCB contaminated materials with transuranic or mixed transuranic waste. Commingling the wastes could potentially result in a larger volume of waste with no path to disposal. Careful control and segregation of the PCB-contaminated material would result in a relatively small volume of waste that cannot be disposed of and the rest of the waste being eligible for disposal at WIPP*.

<u>RCRA and State Hazardous Waste Regulations</u>. *Resource Conservation and Recovery Act* required the Environmental Protection Agency to promulgate regulations for management of hazardous waste. The Act also provides for states to promulgate and implement hazardous waste regulatory programs that are at least as protective as the Federal program. The hazardous waste requirements that personnel must follow in managing (i.e., generating, transporting, treating, storing or disposing) mixed transuranic waste and in closing affected facilities are primarily in 40 CFR Parts 260 through 270, or authorized state regulations. A variety of guidance manuals and information relevant to the management of the hazardous component of mixed transuranic waste has been prepared both by the state regulatory agencies and the Environmental Protection Agency (see, for example, *U.S. Environmental Protection Agency, Catalog of Hazardous and Solid Waste Publications, EPA530-B-96-007, September, 1996)*. These guidance documents should be consulted when developing management programs for mixed transuranic waste.

Hazardous waste regulations promulgated by States with RCRA authority may be more restrictive than the Federal regulations. The more restrictive requirements may include more waste than the Federal requirements or may impose another state's definition of hazardous waste when waste is received from that state. Waste management personnel therefore need to be aware of the requirements of the regulations in their own state as well as the implications of the regulations in states to which they intend to transfer waste.

Example 1: In a state that invokes requirements equivalent to the EPA hazardous waste regulations, waste oil that meets the radiological criteria for being transuranic waste would not be managed as mixed waste. However, if the oil was to be shipped to another state in which the state-passed regulations had expanded the definition of hazardous waste to include waste oil, the waste would have to be packaged, manifested, transported and stored as a mixed waste.

Example 2: If the direction of waste transfer in the above example were reversed, a different situation could arise. The waste would be declared a mixed waste in the state of origin because the state regulations had a broader definition of hazardous waste. The state to which it was to be shipped did not specifically regulate waste oil as a hazardous waste. However, it may be that the state regulations require that waste be considered to be categorized as it was in the state of origin. Then the waste would still be considered mixed waste even after it was shipped to the state that did not explicitly regulate waste oils.

The RCRA requirements prohibit storage of hazardous (including mixed) waste restricted from land disposal except for purposes of accumulating sufficient quantities to facilitate recovery, treatment, or disposal. Capabilities and capacities to treat DOE mixed waste to the land disposal restriction treatment standards do not exist. Congress addressed this issue in 1992 with passage of the *Federal Facility Compliance Act of 1992* (FFCA). The FFCA required the Department to prepare site-specific treatment plans to address treatment of mixed waste to meet the land disposal restrictions at each facility at which DOE generates or stores mixed waste. To meet the requirement, site-specific treatment plans were developed, and through agreements or consent orders, commitments to schedules to treat or otherwise meet the land disposal restrictions were made. In accordance with the *WIPP Land Withdrawal Act of 1992*, as amended, transuranic mixed waste that is to be disposed at the Waste Isolation Pilot Plant (WIPP) is exempt from having to comply with the treatment standards and is not subject to the land disposal restrictions of 40 CFR Part 268. Therefore, management of most of the transuranic waste addressed in the agreements or consent orders is predicated on the assumption that mixed transuranic waste will be disposed at WIPP without treatment. Waste that is not eligible for disposal at WIPP, i.e., waste that cannot meet the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, must comply with RCRA treatment and disposal requirements, the *Federal Facility Compliance Act of 1992*, and consent orders and agreements with the States or EPA. This highlights the importance of avoiding actions in generating or managing waste that result in a waste not being acceptable for disposal at WIPP. Personnel should consult the site-specific treatment plans and agreements or consent orders as part of the life-cycle planning performed in accordance with Waste Generation Planning (DOE M 435.1-1, Section III.H).

PCB, Asbestos, and Other TSCA Wastes. Transuranic wastes contaminated with PCBs do not meet the definition of mixed waste, however, the situation is similar to RCRA in that there are

external requirements promulgated under the authority of the *Toxic Substances Control Act* that need to be complied with in addition to the requirements of DOE O 435.1 and DOE M 435.1-1. Waste managers responsible for managing PCB-containing products should consult the EPA requirements at 40 CFR Part 761. The regulations impose requirements for the destruction, storage awaiting destruction, and disposal of PCBs. Unlike mixed wastes, there are no provisions to accommodate PCBs (exceeding 50 ppm) at WIPP. If transuranic waste contaminated with PCBs cannot be treated to reduce the PCB concentration to less than 50 ppm, then it is one of the wastes that currently has no path to disposal (see General Requirements, Section I.2.F.(19)). Waste managers responsible for managing materials containing asbestos should consult the EPA requirements at 40 CFR Part 61, Subpart M. These regulations impose requirements for the removal of asbestos during demolition and renovation and disposal of asbestos-containing waste. This regulation includes cross-references to several other regulations governing management of asbestos that may also apply. Planning for management of transuranic wastes that include a component which is regulated under TSCA is addressed in the Complex-Wide Transuranic Waste Management Program and the appropriate Site-Wide Waste Management Programs (see DOE M 435.1-1, Sections I.2.B.(1) and I.2.F.(1)).

The DOE M 435.1-1 requirements imposed on the radioactive component of RCRA or TSCA waste should not create a duplication of management activities that can be satisfied by compliance with a RCRA or TSCA requirement. Also, documentation required by RCRA or TSCA requirements which provides the same or similar information as required by DOE M 435.1-1 can be used to satisfy the DOE M 435.1-1 requirement.

> *Example: Mixed transuranic waste is being sent from one site to another for storage. The Uniform Hazardous Waste Manifest is prepared as required by 40 CFR Part 262. It is determined that the manifest satisfies the need to document the transfer of ownership of the waste, the transfer date, and physical location of the waste. If the waste acceptance requirements of the facility receiving the waste allow it, the manifest may also provide the necessary information on the chemical and physical characteristics of the waste.*

Compliance with these requirements is demonstrated if RCRA, state-hazardous, and TSCA-regulated radioactive wastes are being managed in compliance with applicable requirements and agreements or in accordance with a consent order, and consistent with the Transuranic Waste Requirements of DOE M 435.1-1.

<u>Pre-1970 Transuranic Waste</u>. A definition for transuranic waste was first put into operational use by the Department's predecessor in 1970. At that time, the decision was made to store waste exceeding the transuranic waste limit. Waste disposed of prior to implementation of the 1970 Atomic Energy Commission Immediate Action Directive regarding retrievable storage of transuranic waste is not subject to the requirements of the *Radioactive Waste Management*

Manual. This interpretation is consistent with the decision of the Environmental Protection Agency as documented in the preamble to 40 CFR Part 191 (50 FR 38066). The Agency stated that the disposal standards do not apply to transuranic waste that already has been disposed of because the selection of disposal system site, design, and operational techniques are no longer available options. Therefore, "the Agency believes it appropriate that these disposal standards only apply to disposal occurring after the standards have been promulgated." Transuranic waste consists of waste generated by DOE activities that has been placed in retrievable storage since 1970, and waste that will continue to be generated as a result of plutonium stabilization and management activities, environmental restoration (including remediation of some sites where transuranic waste was previously buried), decontamination and decommissioning, waste management, and testing and research. Transuranic waste that was disposed of prior to 1970, retrieved as part of environmental restoration activities, may be managed in accordance with the requirements of the *Radioactive Waste Management Manual.*

Supplemental References:

1. EPA. 40 CFR Parts 260-270, U.S. Environmental Protection Agency, Washington, D.C.

2. EPA. *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*, 40 CFR Part 761, U.S. Environmental Protection Agency, Washington, DC.

3. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

4. EPA, 1996. *U.S. Environmental Protection Agency Catalog of Hazardous and Solid Waste Publications,* EPA530-B-96-007, U.S. Environmental Protection Agency, Washington, D.C., September 1996.

5. *Federal Facility Compliance Act of 1992,* as amended, October 6, 1992.

6. *Resource Conservation and Recovery Act of 1976*, as amended, October 21, 1986.

7. *Toxic Substances Control Act*, as amended, October 11, 1976.

8. EPA, 1973. *National Emission Standards for Hazardous Air Pollutants – National Emission Standard for Asbestos,* 40 CFR Part 61, Subpart M, U.S. Environmental Protection Agency, Washington, D.C., April 6, 1973.

9. AEC, 1970. *Policy Statement Regarding Solid Waste Burial*, Immediate Action Directive, IAD No. 0511-21, U.S. Atomic Energy Commission, Washington, D.C., March 20, 1970.

III. C. <u>Complex-Wide Transuranic Waste Management Program</u>.

A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure the development, documentation, and implementation of a complex-wide transuranic waste management program. The complex-wide program and plan establishes the framework within which individual site programs operate.

Discussion:

The Department's management of transuranic waste occurs at over 15 sites that generate and store waste, as well as at the Waste Isolation Pilot Plant which is to serve as the central repository for most of the waste. A complex-wide program and plan establish the overall mission for the Department's management of transuranic waste and to provide a framework within which the individual site programs operate. The *Radioactive Waste Management Manual*, DOE M 435.1-1, Section I.2.B assigns the Assistant Secretary for Environmental Management the responsibility for developing and maintaining complex-wide, waste-type programs. The *Manual*, DOE M 435.1-1, Section I.2.D also assigns the Deputy Assistant Secretary for Waste Management the responsibility for developing and implementing complex-wide, waste-type program plans. The Complex-Wide Transuranic Waste Management Program and Plan are to be developed following the guidance provided for DOE M 435.1-1, Sections I.2.B and I.2.D.

Compliance with this requirement is demonstrated by the presence of a Complex-Wide Transuranic Waste Management Program which includes the appropriate interfaces, technical information, data inputs, and other elements described in Chapter I of this Manual.

Supplemental References:

1. CAO, 1997. *The National TRU Waste Management Plan*, Revision 1, DOE/NTP-96-1204, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1997.

III. D. Radioactive Waste Management Basis.

Transuranic waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, disposal authorization statement, waste acceptance requirements, and monitoring plan.

Objective:

The objective of this requirement is to ensure that the hazards associated with transuranic waste management facilities, operations, and activities have been identified, their potential impacts analyzed, and appropriate controls documented, implemented, and maintained for the protection of workers, the public, and the environment.

Discussion:

As described in the guidance for DOE M 435.1-1, Section I.2.F.(2), the Manual requires the radioactive waste management basis to provide for development and documentation of controls to ensure the safe and efficient management of radioactive waste. Requiring an approved radioactive waste management basis for the initiation of new, or continuation of existing, radioactive waste management activities should prevent the operation of facilities without the appropriate controls. The required elements of the radioactive waste management basis vary with the type of waste management operation or facility and the types of hazards associated with the facility. The term "controls," used here and elsewhere in the discussion of a radioactive waste management basis, refers to processes, procedures, equipment, instruments, and other items intended to curb the likelihood of, or consequences from, a problem that could arise from managing radioactive waste. Controls include such things as placards, alarms, tools, shielding, training, checklists, duplication of critical steps, redundant monitoring, analysis, sampling and testing, etc. The items required for a radioactive waste management basis listed above for the four types of transuranic waste management facilities, operations, and activities is not a complete list of those items which should

be included in a radioactive waste management basis. Several processes, procedures, and documents that are required by other directives and requirements provide for radioactive waste management controls that should be considered part of the radioactive waste management basis. The guidance on DOE M 435.1-1, Section I.2.F.(2) discusses this aspect of the radioactive waste management basis in detail.

> *Example: Site X has a transuranic waste storage facility in which they store waste to be shipped to the Waste Isolation Pilot Plant. The Field Element Manager is responsible for ensuring that it operates in accordance with an approved radioactive waste management basis. The DOE staff reviews the waste acceptance requirements, the storage facility's waste certification program, plus the facility-specific procedures implementing the site's radiological control program, health and safety plan, training program, quality assurance program, and record-keeping plan. Based on the staff's review, they report to the Field Element Manager that an adequate radioactive waste management basis has been developed and recommend approval.*

Also, as discussed in the Section I.2.F.(2) guidance, if a transuranic waste management facility already operates under an approved Authorization Basis, it may not need any additional controls to demonstrate that it has a radioactive waste management basis. In this case, the Authorization Basis documentation is reviewed and evaluated to determine whether it sufficiently covers the requirements needed for a radioactive waste management basis. The Field Element Manager has the responsibility to ensure the transuranic waste management facilities under his or her authority have a radioactive waste management basis.

> *Example: Site personnel are developing the radioactive waste management basis for the Site Q Transuranic Waste Management Facility which provides non-destructive characterization, selected treatment and repackaging, and storage capabilities for transuranic waste. The site personnel identify the following documents and programs which include descriptions of the controls for safely managing waste at the facility:*
>
> - *Radiological Control Program*
> - *Site Health and Safety Plan*
> - *Safety Analysis Report (SAR)*
> - *Operational Safety Requirements/Technical Safety Requirements*
> - *Basis for Interim Operations*
> - *Technical Standards*
> - *Unreviewed Safety Questions Evaluation*
> - *DOE Safety Evaluation Report*
> - *Listing of documents that are to be Configuration Managed but are not Authorization Basis Documents (including the waste acceptance criteria and certification program documents).*

Following an analysis of the information contained in the above documents, the staff concludes that the complete set of operational requirements relied on by the site to ensure that the public, workers, and the environment are protected from hazards associated with management of transuranic waste at the facility are in place. A statement is prepared that documents that the radioactive waste management basis is covered by the Authorization Basis for the facility.

For a facility that generates transuranic waste, the radioactive waste management basis is to include the program for certifying that waste meets the waste acceptance requirements of the facility(ies) to which the waste will be sent. The waste certification program is reviewed against the applicable requirements of DOE M 435.1-1 and approved in accordance with the Radioactive Waste Generator Requirements (DOE M 435.1-1, Section I.2.F.(7)) before becoming part of the radioactive waste management basis. As discussed in guidance on DOE M 435.1-1, Section I.2.F.(2), several other processes and procedures contribute to a complete radioactive waste management basis at a generating facility.

Example: A small laboratory facility at Site R generates transuranic waste. The radioactive waste management basis for the facility is established through review and approval of the laboratory's waste certification procedure, and a review confirming the adequacy of the following: the Radiological Control Program, the Health and Safety Plan, the Training Program, and the site waste transfer procedure. This is documented in a radioactive waste management basis statement for the laboratory.

Facilities that store or treat transuranic waste are to have approved waste acceptance requirements (see DOE M 435.1-1, Section III.G) prior to the issuance of a radioactive waste management basis. The waste acceptance requirements will usually suffice as documentation of the radiological, physical, and chemical limitations on waste that can be safely received at the facility, provided they are developed correctly with consideration of the hazards of the waste to be managed, and are kept up to date. Controls on the radiological, physical and chemical limitations need to include considerations of the potential effects of radiolysis.

A facility that stores or treats waste is generally expected to have a waste certification program. Waste from these facilities will have to be certified as meeting the waste acceptance requirements of the facility to which it will be transferred and the facilities have the potential for generating radioactive waste (e.g., secondary processing streams from treatment, monitoring and sampling, radioactive release cleanup). Consequently, storage and treatment facilities should also have an approved waste certification program as part of their radioactive waste management basis. An exception to the need for a waste certification program can be justified based on there being no known path to disposal for the waste or based on the expectation that a long time will elapse

(e.g., more than a year) before the certification program has been reviewed and accepted by the receiving facility.

Example: A transuranic waste storage facility is used for storing defense transuranic waste that will be shipped to the Waste Isolation Pilot Plant and non-defense transuranic waste. According to the schedule for receipt of waste at WIPP, shipments from the site will not occur for six years. The certification program for the defense waste is not scheduled to be reviewed by WIPP for two years. Because there is no disposal facility to which the non-defense waste can be sent, it is not possible for the storage facility to develop a certification program for that waste (i.e., there are no waste acceptance requirements for a disposal facility to which waste can be certified). The Field Element Manager should proceed with ensuring the development of and approving a radioactive waste management basis for the facility even though fully authorized certification programs do not exist. In this case, an interim certification program for the defense waste may be included as part of the radioactive waste management basis (interim because it has not been reviewed by WIPP personnel). The radioactive waste management basis would be updated after the certification program is reviewed and accepted by WIPP personnel.

The radioactive waste management basis for transuranic waste disposal facilities is to be based on documented controls similar to those discussed for treatment or storage facilities, but with additional limitations based on the performance assessment required by 40 CFR Part 191 and any conditions associated with authorizing operation of the facility (e.g, the conditions of compliance certification resulting from the Environmental Protection Agency review of DOE's compliance certification application per 40 CFR Part 194) and by the disposal authorization statement issued following approval of the performance assessment. In addition, the radioactive waste management basis should include the development and implementation of a monitoring program designed to evaluate performance of the facility (see guidance for DOE M 435.1-1, Section III.Q).

The results of the 40 CFR Part 191 performance assessment and the safety analyses required by DOE 5480.23 provide the basis on which the quantities and concentrations of radionuclides that can be accepted for disposal will be identified and documented in the waste acceptance requirements. The responsibility for the radioactive waste management basis for transuranic waste disposal facilities resides with the Field Element Manager. However, a review may be required by another organization before the issuance and documentation of the radioactive waste management basis. In the case of the Waste Isolation Pilot Plant, the review was performed by the Environmental Protection Agency and was documented in a compliance certification. If another transuranic waste disposal facility is constructed, a performance assessment will need to be prepared. Review of the performance assessment will be in accordance with either external

requirements (if regulations similar to those for WIPP certification are promulgated) or a process imposed by the Department.

Staff responsible for establishing a disposal facility radioactive waste management basis should combine the results of the review of the performance assessment (and compliance certification application if applicable) with their own findings on the waste acceptance requirements and monitoring plans as the basis for documenting the radioactive waste management basis for the disposal facility. Guidance for DOE M 435.1-1 Sections III.G (waste acceptance requirements) and III.Q (monitoring) provides details on what information needs to be addressed to meet the requirements and serve as part of the radioactive waste management basis.

For transuranic waste disposal facilities other than WIPP, a disposal authorization statement is to be issued by Headquarters following the review and approval of the performance assessment as required by DOE M 435.1-1, Section I.2.E.(1). The Waste Isolation Pilot Plant met the requirement for a disposal authorization statement when the Secretary of Energy provided notification to Congress that the Department of Energy would open WIPP for disposal operations pursuant to section 7(b)(3) of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended. In the notification, the Secretary determined that the Waste Isolation Pilot Plant was in compliance with all requirements of section 9(a)(1) of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended.

<u>Contents of a Disposal Authorization Statement</u>. The disposal authorization statement will clearly indicate the transuranic waste disposal facility and design that is being authorized to operate. The statement will refer to the performance assessment reviewed as the basis for the authorization and state the primary features of the disposal facility important for understanding the authorization of operations of the facility. Conditions and limitations for operations of the facility are clearly indicated in the disposal authorization statement. These include quantities, limitations, references, or codification of assumptions contained in the performance assessment. The conditions include any limitations or allowances required based on independent analysis of the disposal configuration and conditions being examined in the evaluations. The conditions also include any other limitations, responsibilities, or commitments that were needed to resolve issues during the review of the performance assessment or which will serve to answer questions that need to be resolved during the first years of operation of the disposal facility.

As part of the radioactive waste management basis, site personnel should implement a system or process for tracking the waste inventory at a storage, treatment, or disposal facility. Tracking the waste inventory is a means of ensuring that radionuclide limits established in accordance with a safety analysis or performance assessment will not be exceeded. In addition, a system or process for accurately tracking waste received at a facility can facilitate providing information to the complex-wide management data system (see guidance Section I.2.D.(2)).

Compliance with this requirement is demonstrated if, the radioactive waste management basis is documented and signed by the Field Element manager or a designee (see DOE M 435.1-1, Section I.1.A, Delegation of Authority) for each transuranic waste management facility, operation, or activity. Using a graded approach, it may be possible to include multiple activities under a single radioactive waste management basis, but it should be possible to objectively identify which activities are covered. Further, the radioactive waste management basis includes or references the controls that are established on a facility-specific basis to address the unique waste management requirements and circumstances for each facility, operation, and/or activity.

> *Example: A storage facility that stores mixed and non-mixed transuranic waste has approved waste acceptance requirements and a waste certification program that enables transuranic waste to be shipped to the Waste Isolation Pilot Plant for disposal. The mixed transuranic waste is to remain in storage pending WIPP receiving a RCRA Part B permit. The radioactive waste management basis statement references the waste certification process and the waste acceptance requirement documentation, which in turn invoke the waste acceptance requirements of WIPP. In addition to citing site-wide programs and plans (radiological control, health and safety, training, etc.) the radioactive waste management basis statement also cites the RCRA permit issued for storage of mixed transuranic waste and the facility operating procedure for segregating mixed and non-mixed waste within the facility.*

Supplemental References:

1. EPA. *Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*, 40 CFR Part 191, U.S. Environmental Protection Agency, Washington D.C.

2. EPA. *Criteria for the Certification or Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*, 40 CFR Part 194, U.S. Environmental Protection Agency, Washington, D.C.

3. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

III. E. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving liquid transuranic waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated transuranic waste contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of liquid waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to ensure the impacts on the public, workers, or environment are mitigated in the event that a leak develops in a tank storing transuranic waste or in a facility processing transuranic waste. The mitigation is provided by ensuring spare waste storage capacity is a required part of a site's emergency management program. To meet this objective, there needs to be both capacity to handle the largest volume of any single storage tank or liquid waste in process, and the capability to transfer the waste.

Discussion:

This requirement shall be implemented through and included in site emergency management programs that are required by DOE O 151.1, *Comprehensive Emergency Management System.* The directive DOE O 151.1 is referenced in DOE M 435.1-1, Chapter I and considered necessary for the safe management of radioactive waste. The Comprehensive Emergency Management System requires the development of a complex-wide system for preparing for and managing emergencies. At the site level, personnel are to establish an Operational Emergency Base Program that provides the framework for responding to events involving, among other subjects, health and safety, and the environment. The program requires a qualitative hazards survey to identify the emergency conditions, describe the potential impacts, and summarize the planning and preparedness requirements that apply.

During the development of the requirements of DOE M 435.1-1, *Radioactive Waste Management Manual*, a waste management hazard and safety analysis identified the loss of containment of a storage tank or waste processing facility containing radioactive liquids as a hazard requiring mitigation. In addition to requiring facility designs to maintain waste confinement (see DOE M 435.1, Section III.M.(2)), the ability to respond to leaks or other off-normal conditions if they occur was also considered necessary. Consequently, the requirements to have adequate spare capacity and the ability to transfer waste to the spare capacity were established.

Operating procedures are developed and utilized for transfer of liquid transuranic waste to contingency storage. The procedures should address maximum operational capacities and limits for components of the operational system (e.g., spare storage capacity available in tanks). The procedures should define and address all possible emergency transfer scenarios needed to comply with this requirement.

Contingency Storage. Contingency storage is to be provided for both stored liquid transuranic waste and for liquid transuranic waste treatment facilities. In the case of storage tanks, adequate volumetric capacity must be available to receive the largest volume of waste stored in any single tank. In the case of a treatment facility, adequate volumetric capacity must be available to allow all in-process liquids in the facility to be moved into storage in the event of emergency or off-normal conditions.

A number of factors are considered in maintaining spare capacity. First, the requirement includes a provision that the spare capacity has “adequate capabilities.” Therefore, the spare capacity must have the necessary features and functionality as dictated by the design and safety analysis for the facility and wastes of concern. Features to be taken into account include appropriate materials of construction, shielding, ventilation and filtration, heat dissipation, liquid level monitoring, and mixing. Similarly, if the waste that may need to be transferred is regulated by some external regulation (e.g., RCRA), the tank(s) that would be used for spare capacity should be properly permitted.

The requirement specifies that the contingency storage provided is to meet the requirements of DOE O 435.1 and DOE M 435.1-1. Of prime interest is the ability of contingency storage and associated facilities to meet the requirements for confinement in Facility Design, DOE M 435.1-1, Section III.M.(2). Additionally, compliance with the requirements for instrumentation and control systems, ventilation, and monitoring systems is very important for tanks or facilities that will be used for contingency storage. Meeting these requirements, in combination, ensures that the use of existing tanks or other facilities for contingency storage minimizes the potential impacts of off-normal or emergency situations involving liquid transuranic waste.

Spare capacity may be provided by a single tank or by the combined available volume in multiple tanks. In cases where radiation fields are sufficiently low, spare capacity could be provided by

portable tanks, tankers (i.e,. railroad cars), or tank trucks. Due to the potential for airborne radioactive material, impoundments or bermed areas open to the air should not be used for spare storage capacity unless a safety analysis shows that the risk to workers and the public is low.

> *Example: Liquid radioactive waste is stored in six underground storage tanks with a design capacity of 250,000 gallons each. The waste in the all tanks has the same chemical and radiological characteristics. One tank contains 200,000 gallons and each of the others contain about 100,000 gallons. Capabilities exist to retrieve waste and transfer it among the six tanks. This system meets the requirement because the largest volume of 200,000 gallons can be distributed between any two of the other tanks.*

Transfer Equipment. The ability to perform the transfer is just as important as having the capacity. Equipment necessary to transfer each tank or treatment facility volume of liquid transuranic waste in the event of a leak or other off-normal condition is to be identified and documented.

> *Example: Liquid radioactive waste is stored in six underground tanks with the volumes and characteristics described in the previous example. Although there are transfer lines to any of the tanks from a central diversion box, the tanks were constructed without the capability to retrieve the waste. This situation does not comply with the requirement. Although there is adequate capacity, the ability to transfer the waste does not exist.*

In addition, equipment necessary to transfer the contents of each tank is tested and inspected as part of a routine maintenance program (see DOE M 435.1-1, I.1.E.(9)). Special attention should be given to including in the maintenance program equipment and transfer lines that are not routinely used in managing liquid wastes. Inspection and testing includes the following minimum items:

- leak testing of pipelines;

- ensuring the availability of any jumpers necessary for completing waste transfer;

- confirming that instrument panels, control panels, valves, pumps and any necessary ventilation equipment is supplied with the necessary electrical power, air (for pneumatically-controlled items), steam, and water; and

- performing functional tests of instruments, controls, valves, pumps, and ventilation equipment.

The capability to perform an emergency transfer of liquid transuranic waste is to be maintained at all times. Therefore, every shift must include or have immediate access to qualified individuals

and the equipment necessary to perform transfers in a timely manner, unless analysis of the hazards associated with the leaking waste demonstrates that immediate transfer is unnecessary.

> *Example: A large shielding block is in place over a jumper pit that needs to be accessed during an emergency transfer of liquid waste. The block can only be moved by a crane. Therefore, implementation of this requirement entails making sure that the crane is always operationally available (in a matter of hours rather than days) and every shift has a individual qualified to operate the crane and remove the block.*

Spare capacity may be shared by different waste types, however mixing radioactive wastes of different types should be evaluated and is generally not acceptable.

> *Example 1: A tank farm contains both high activity liquid low-level waste and liquid transuranic waste in separate tanks. A spare empty tank is maintained and available for emergency transfers of either waste.*

> *Example 2: A tank farm contains both high-level waste and liquid transuranic waste in separate tanks. If the spare capacity were provided by excess capacity in tanks that contain high-level waste, use of the capacity for transuranic waste would be undesirable. Transferring transuranic waste into a tank containing high-level waste, would result in a mixture that would no longer be eligible for disposal at the Waste Isolation Pilot Plant which, by law, cannot dispose of high-level waste. Therefore, waste managers should identify different spare capacity to accommodate the two different waste* types.

Compliance with these requirements is demonstrated by having adequate spare capacity and transfer equipment exists for emergency transfers of all liquid transuranic waste. In addition, the capability to perform emergency transfers is demonstrated by having waste transfer routings identified, operational procedures to direct transfers, staff trained to the procedures, and records showing that the spare capacity and transfer capability are kept in operating condition.

Supplemental References:

1. DOE, 1995. *Comprehensive Emergency Management System*, DOE O 151.1, U.S. Department of Energy, Washington, D.C., September 25, 1995.

III. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

Objective:

The objective of this requirement is to ensure that actions will be taken to preclude, minimize, or mitigate hazards whenever a situation arises at a transuranic waste management facility that could threaten worker or public safety, or the environment.

Discussions:

The *Radioactive Waste Management Manual*, DOE M 435.1-1, Section I.2.G, states that all personnel have a responsibility to identify conditions that require corrective actions to achieve compliance with the Order and Manual requirements or to address health and safety conditions that pose an imminent or possible danger. That responsibility is to ensure that conditions that pose an imminent or potential danger to the environment, or to the health and safety of workers or the public are identified and corrected. If necessary, activities are to be curtailed or shutdown to ensure that the public, workers, and the environment are protected until corrective actions are implemented to mitigate the identified hazard.

Corrective actions are activities which, when implemented, will address and correct noncompliant or hazardous conditions. Corrective actions can include improvements to documentation (e.g., procedures, plans, authorization basis documents), training and qualification programs or procedures, physical and process design changes, changes to operating conditions, or a combination of these activities.

Corrective Action System. A corrective action system exists for addressing noncompliant or hazardous conditions for transuranic waste management facilities, operations, and activities. The system for addressing corrective actions may be an integral portion of the site's quality assurance program. Corrective actions in response to quality assurance program assessments are addressed in the *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance*. The corrective action system provides for documenting noncompliant or hazardous conditions, identifying the organizations or individuals responsible for developing and implementing corrective action plans, providing corrective action status, and tracking progress through final implementation of the actions. The corrective action system is instituted as a fundamental part of the systematic

evaluation of radioactive waste activities that is implemented by the Site-Wide Radioactive Waste Management Program (see guidance for DOE M 435.1-1, Section I.2.F.(1)).
A problem requiring corrective action could range from a minor deviation from a procedure that has minimal safety or public health implications, to a situation that poses an immediate threat to health and safety from an uncontrolled release of large quantities of radioactive material. For situations where a problem could pose an immediate risk to a worker, member of the public, or damage to the environment, immediate shutdown of the process or facility may be appropriate as the first step in addressing the problem (see guidance for DOE M 435.1-1, Section III.F.(2).

> *Example: An employee performing a routine container inspection in a storage facility notices that there are drums in an area designated for "WIPP-ready packages" that do not have a tamper indicating device on the container closure. The worker records his observation in the inspection log and notifies the building manager. The manager directs that a corrective action plan be prepared. The plan includes an evaluation of the conditions that resulted in the package being improperly controlled and recommends changes in procedures and training to the new procedures to prevent any recurrences. A notice is sent to staff responsible for receiving and handling waste containers and to generator organizations reiterating the requirement for tamper indicating devices. In addition, a follow-up review is schedule for 60 days after the plan is approved.*

If a facility or activity can be allowed to operate while a noncompliant or hazardous condition exists, the allowance and any associated limitations must be defined as part of the facility's or activity's radioactive waste management basis, identified as a configuration controlled item in a configuration management plan or included in a revision or modification to an operating procedure or similar controlled documentation. The corrective action system should provide for preventing the use of systems or facilities (e.g., through lockout), or procedures (through cancellation) in cases where it is determined that use of the system, facility, or procedure impacts safety.

> *Example: In the above example, the facility manager imposes a 2 week moratorium on receiving additional transuranic waste at the facility or certifying transuranic waste as meeting the Waste Acceptance Criteria for the Waste Isolation Pilot Plant. The manager expects that during the two week time period, the underlying problem can be identified and interim measures implemented to prevent a recurrence until the corrective action plan is fully implemented.*

Compliance with this requirement is demonstrated if a corrective action system exists which addresses noncompliant or hazardous situations associated with transuranic waste management and in a systematic fashion, and allows identification of problems by all personnel.

Supplemental References:

1. DOE, 1996. *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance,* DOE G 414.1-1, U.S. Department of Energy, Washington D.C., August 1996.

III. F.(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Objective:

The objective of this requirement is to limit the operation of waste management activities and facilities as necessary to avoid creation of near- or long-term safety or environmental hazards.

Discussion:

The *Radioactive Waste Management Manual,* DOE M 435.1-1, requires that a radioactive waste management basis be established for each transuranic waste management facility, operation, or activity. The radioactive waste management basis documents the conclusion that the potential hazards from management of radioactive waste have been sufficiently evaluated and that adequate controls are in place to provide assurance that the public, workers, and the environment are being protected. Field Element Managers are responsible for ensuring a radioactive waste management basis is developed, reviewed, approved, and maintained for each DOE radioactive waste management facility, operation, or activity (DOE M 435.1-1, Section I.2.F.(2)). The guidance for that requirement should be consulted for additional details on the development, review, and approval of a radioactive waste management basis. Also, additional discussion concerning the radioactive waste management basis for transuranic waste generator, treatment, storage, and disposal facilities is discussed under guidance for DOE M 435.1-1, Section III.D.

As part of his/her responsibilities for maintaining the radioactive waste management basis for transuranic waste management facilities, operations, and activities under his/her authority, the Field Element Manager evaluates the compliance of the facilities, operations, and activities with the constraints and controls documented in the radioactive waste management basis by ensuring that routine assessments are conducted. If the Field Element Manager determines, either through routine assessment or by virtue of an occurrence or off normal event, that an operation, activity, or facility is not operating in compliance with an approved radioactive waste management basis, it must be curtailed or shut down. The action taken is commensurate with the hazards associated with the noncompliance and with the continued operation of the facility.

This requirement is to be implemented in a graded manner. Actions to be taken are based on assessments of adherence to radioactive waste management bases, and can range from shutdown of an operation or facility to placing limits or constraints on what activities can be performed or how the activities are to be performed. Shutdown of a facility involves stopping all operations in the facility except surveillance or monitoring activities necessary to maintain the facility in a safe standby condition. Shutdown is considered appropriate when there is either a potential imminent threat to safety or environmental protection, or a blatant failure to establish or comply with a radioactive waste management basis.

Alternatively, there may be cases where a facility, operation, or activity assessment determines that the radioactive waste management basis is no longer current or has been violated, but there is no imminent threat to public, worker, or environmental protection. In such a case, the Field Element Manager may decide that shutdown of the facility is not necessary. It may be sufficient to impose certain limits until the radioactive waste management basis is made current. The limits imposed may prohibit the generation, receipt, or processing of certain waste streams, or may involve constraints on the processes that may be performed.

The action taken in response to the failure to establish a radioactive waste management basis is to be clearly documented in a formal communication (e.g., letter, memorandum). Such communication needs to identify the reason for the shutdown or curtailment, and identify what is necessary to initiate restart. Generally, development of a corrective action that is implemented through the corrective action system discussed in the preceding section would be appropriate for responding to a shutdown or curtailment of activities.

In concert with Core Requirement #6 of the Integrated Safety Management System, “Feedback and Improvement,” the Field Element Manager should use the audits and assessments to identify opportunities for improvement in the implementation of an activity or facility’s radioactive waste management basis. Identified improvement actions should be shared with like organizations and tracked by management to determine whether they are yielding the anticipated improvements. Communicating the results of assessment upward in the DOE and contractor organization will allow the findings to reach the management level with the authority necessary to effect improvements.

Compliance with this requirement is demonstrated by documented evidence of systematic, routine reviews to determine whether waste management activities and facilities under are operating in accordance with an approved radioactive waste management basis. In addition, the documentation should show that limitations (which may include shutdown) have been placed on activities and operations that do not have or are operating outside the conditions of an approved radioactive waste management basis.

Supplemental References:

1. DOE, 1996. *Safety Management System Policy*, DOE P 450.4, U.S. Department of Energy, Washington, D.C. October 15, 1996.

2. DOE, 1997. *Line Environment, Safety and Health Oversight*, DOE P 450.5, U.S. Department of Energy, Washington, D.C., June 26, 1997.

3. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE P 411.1, U.S. Department of Energy, Washington, D.C., January 1, 1997.

4. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

III. G. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all transuranic waste storage, treatment, or disposal facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal;

(c) Restrictions or prohibitions on waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance;

(d) Requirement to identify transuranic waste as defense or non-defense, and limitations on acceptance; and

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

Objective:

The objectives of the waste acceptance requirements are to ensure that transuranic waste which is received at a facility contains only the radionuclides that the facility can safely manage, and only in concentrations and/or total activities which are compatible with the work to be undertaken in the facility; ensure that transuranic waste which is to be received at a facility is in a form or package that will maintain its integrity and retain acceptable configuration under the conditions that are expected to be encountered during the management steps the waste will undergo; ensure that no transuranic waste received at a facility contains materials that will compromise the safety or integrity of the facility under the expected operating conditions; and ensure that formal procedures exist and a decision process is clear concerning the granting of exceptions to waste acceptance requirements.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(6), the waste acceptance requirements establish the conditions for waste that facilities can safely receive. Therefore, the acceptance requirements for a transuranic waste storage, treatment, or disposal facility include all requirements that transuranic waste must meet to be acceptable for receipt, and for the subsequent storage, treatment, or disposal, as appropriate.

In conducting the analyses for development of the DOE M 435.1-1 requirements, minimum acceptance requirements that must be specified in the waste acceptance documentation for storage, treatment, and disposal facilities in order for transuranic waste to be safely handled were identified. Guidance on subrequirement (a) is provided below under <u>Radionuclide Content or Concentration</u>. Guidance on subrequirements (b) and (c) is provided under <u>Waste Form and Package Criteria and Prohibitions</u>. Guidance on subrequirement (d) is provided under <u>Defense/Non-Defense Waste</u>. Guidance on subrequirement (e) is provided under <u>Exceptions</u>.

<u>Development of Waste Acceptance Requirements</u>. A facility receiving waste for storage, treatment, or disposal is required to document the waste acceptance requirements for the facility. These requirements have their foundation in facility design capabilities such as volume, handling weight, allowable contents, and radiological limits (i.e., criticality, radiation, contamination). Other requirements may include any number of regulations promulgated by the EPA, NRC, DOT, the host state, and DOE itself. The designer and operator of the facility receiving waste are likely to be most knowledgeable and understanding of the requirements and limitations of the facility and, therefore, are in the best position to establish the waste acceptance requirements or criteria that must be met for waste sent to the facility.

Although there are exceptions, most transuranic waste in the Department is to be disposed at WIPP. The exceptions include waste that cannot meet the waste acceptance criteria of WIPP or are otherwise ineligible (e.g., non-defense waste). Personnel responsible for transuranic waste storage or treatment facilities which manage waste destined for WIPP need to consider the WIPP waste acceptance criteria in developing acceptance criteria for their facilities.

A transuranic waste management facility at a site may have its own specific stand-alone waste acceptance requirements. Or a site may have general waste acceptance requirements applicable to all transuranic waste management facilities at the site, with separate facilities adding facility-specific acceptance requirements to the site waste acceptance requirements as necessary. This practice may be particularly effective at sites with many facilities which manage small quantities of waste with multiple locations for staging, storage, and/or central management of waste. At such facilities, most of the process and procedural waste acceptance requirements could be in one document applicable to the whole site, which would be supplemented with specific technical requirements for acceptance at each of the separate management locations. If activities across

various facilities are similar, they could share the same supplemental waste acceptance requirements documents. Likewise, if several activities are carried out at locations that are close to one another, or are managed by the same entity, then one supplemental technical document may be prepared to cover those activities.

The waste acceptance requirements and documentation for a facility receiving waste for storage, treatment, or disposal is prepared using a graded approach commensurate with the hazards associated with the management of the waste in the facility and the complexity of the activities to be conducted in the facility. The waste acceptance requirements for a facility which receives large quantities of transuranic waste from many generators, or with highly variable contents, or both, may need to address many hazards and consequently be more detailed. By contrast, a storage facility which will only pass-through properly packaged waste directly to a disposal facility without any additional processing or packaging may only need a minimal set of requirements. Perhaps only a few administrative requirements would be necessary for proper receipt of waste at such a storage facility, along with assurance that waste received at the storage facility meets the disposal facility technical waste acceptance requirements.

> *Example 1: The Waste Isolation Pilot Plant is to receive defense transuranic waste generated by many different processes and from many different sites. In addition, the transportation of contact-handled transuranic waste to WIPP is to be in TRUPACT II containers. The requirements for acceptance of waste at WIPP are extensive and require a high degree of rigor. The waste acceptance requirements are addressed in a number of interrelated documents. These documents include the Waste Acceptance Criteria for the Waste Isolation Pilot Plant, the Generator Site Certification Guide, the Quality Assurance Program Description, and the Transuranic Waste Characterization Quality Assurance Program Plan.*

> *Example 2: At a DOE site, several facilities are used for storage of transuranic waste. A single waste acceptance requirements document which contains the necessary administrative requirements for all of the storage facilities is prepared as an umbrella document at the site. For each storage facility, a supplemental technical procedure which contains the technical criteria specific to the facility (e.g., inventory limits based on safety evaluations) and which invokes the umbrella document for the administrative processes and forms is prepared. This combination of documents provides the necessary waste acceptance criteria for waste to be received at the facilities.*

Legislation, regulations, performance assessments, safety analysis reports, technical safety requirements, criticality analyses, and other appropriate safety or authorization basis documents are to be used to establish the waste acceptance criteria for facilities receiving transuranic waste for storage, treatment, or disposal. These documents and analyses provide the basis for radioactivity (concentration and inventory) limits, waste categories (e.g., contact-handled or

remote-handled), waste form and/or packaging stability requirements, allowable chemical content, allowable free liquid content, and any other necessary waste package or form requirements to ensure that the facilities' design, performance, and operating bases are not compromised.

Radionuclide Content or Concentration. Radiological limits for storage, treatment, and disposal facilities may be derived from a number of technical as well as administrative sources. In developing radionuclide limits, personnel need to consider legislative and/or regulatory limitations, the disposal facility performance assessment, safety analysis reports, and criticality analyses. In addition to establishing general radiological limits (e.g., a contact dose rate), these sources identify specific radionuclides whose concentration or total activity must be limited in the waste acceptance criteria in order to remain within the bounds for safe and legal facility operation.

The operating definition of transuranic waste is taken from Federal legislation (see guidance for DOE M 435.1-1, Section III.A). The definition is significant to transuranic waste management because the designated disposal facility for defense transuranic waste, WIPP can only accept waste that meets that definition. Storage and treatment facilities need to include appropriate waste acceptance requirements that require identification of transuranic waste to facilitate its eventual transfer for WIPP disposal.

The results of a long-term performance assessment analysis may provide information on critical radionuclides that are most important to the long-term performance of the disposal facility. The waste acceptance criteria for the disposal facility are to translate the results of the performance assessment analyses into limits on the receipt of waste at the facility or on the operation of the facility.

> *Example: The performance assessment of WIPP is based on an assumed final inventory of transuranic and other radionuclides. Although the performance assessment indicated that facility performance was not sensitive to radionuclide inventory, in the Compliance Certification Application WIPP committed to tracking the cumulative inventory of radionuclides of interest. Therefore, the waste acceptance criteria require sites to report the inventory or concentration of these radionuclides of interest.*

Although performance assessments are not required for storage or treatment facilities, personnel developing waste acceptance criteria for these types of facilities should consider the radiological limits of WIPP. In most cases, transuranic waste will eventually be transferred to WIPP for disposal, so WIPP waste acceptance criteria should be factored into the waste acceptance requirements of the storage or treatment facility to ensure a situation is not created in which the waste does not have a path to disposal.

> *Example: A transuranic storage facility accepts a high dose rate transuranic waste from a generator. Due to the dose rate, the waste is managed and stored as remote-handled*

waste. However, when placed into storage, the waste does not meet the WIPP waste acceptance criteria, thus creating a future management issue. As an alternative, the waste acceptance criteria could be revised to not allow acceptance of transuranic waste that does not meet the WIPP waste acceptance criteria. The generator would be compelled to work with the waste management organizations to determine how to manage or process the waste at the source in order to meet the disposal criteria of available facilities (transuranic and/or low-level waste).

The safety analysis report or safety evaluation prepared for a transuranic waste management facility may identify specific radionuclides that warrant specific attention from a worker safety standpoint, and may require special handling if received and managed at the facility.

Example: A storage facility that manages mixed transuranic waste is subject to RCRA Part B permit requirements for routine inspection of the waste. An analysis of worker radiation exposure associated with inspection of the storage configuration indicates that several radionuclides need to be controlled below certain concentrations to maintain doses to workers as low as reasonably achievable. The waste acceptance requirements for the facility reflect the allowable concentrations from the safety analyses as maxima for waste that can be accepted for storage in the facility.

Any criticality analyses conducted in accordance with the criticality safety program in conformance with DOE M 435.1-1, Section I.1.E.(4) may also result in limitations on acceptance of fissile radionuclides. These limitations need to be included in the waste acceptance requirements, as appropriate. Similarly, for transuranic waste, the *TRUPACT II Safety Analysis Report for Packaging* establishes limits on the amount of fissile material that is allowed to be transported in the TRUPACT II. These limits need to be considered in the development of waste acceptance criteria to avoid the need to repackage waste to transfer it to the next step in the waste management process. These limits are reflected in the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant.*

Waste Form and Package Criteria and Prohibitions. Generally, waste acceptance requirements specify that wastes received at the facility are in a physically/chemically stable form. As used in this requirement, stability refers to the physical and chemical properties of waste that are necessary for it to be handled safely at a facility and to undergo the management steps normally performed at that facility. Such stability is dependent on the waste management steps to be performed with the waste (e.g., treat, store) and the time to complete the management step (e.g., time until treatment or length of expected storage period). Therefore, waste acceptance requirements must specify the physical and chemical stability that correspond to the specific operations and activities of a particular facility. Waste acceptance requirements for a transuranic waste treatment facility need to specify the physical and chemical precautions and conditions under which untreated waste can be received at the facility so that facility safety and effective

operations will not be compromised. Any physical or chemical stabilization of waste prior to transfer to a facility receiving waste for storage, treatment, or disposal needs to be done according to a systematic process that may include consideration of bench-scale testing and verification that the process is producing satisfactory results.

> *Example: A facility that is in the process of cleaning out transuranic radionuclide-contaminated glove boxes determines that operational efficiencies will be realized in the form of fewer drums, less storage space, and fewer transuranic waste shipments if they compact the cleanout waste into 55-gallon drums. The organization responsible for operating the compactor establish a set of waste acceptance criteria for waste that can be received from the cleanout activities. The criteria, based on expected ability to fit 25 boxes in a drum, specify: waste must be packages in 1 cubic foot cardboard boxes; no more than 5% of the volume of a box can be incompressible waste; the long axis of incompressible waste must be oriented in a horizontal plane; boxes must be free of removable external contamination; the dose rate from any box must be less than 10 mrem/hr; there must be less than 8 plutonium-239 fissile-gram equivalents per box; there must be less than 3 plutonium-239 equivalent curies per box; waste must be less than 50 ppm polychlorinated biphenyls, and the waste must be characterized for RCRA constituents. Based on these criteria, the compactor facility can provide 55-gallon drums that meet the on-site storage facility's requirements, and subsequently, the WIPP requirements.*

The waste acceptance requirements are to specify waste streams, classes, or categories of waste requiring application of specific physical, chemical, or structural stabilization methods, as determined by the results of safety analyses or long-term performance assessments. Acceptable waste forms, containers, and packages are specified by the waste acceptance requirements. The waste acceptance requirements need to list any specific packages and containers pre-approved as acceptable for the transuranic waste management facilities, as well as acceptable overpacks. The waste acceptance requirements need to identify any of the following specific technical requirements that must be included to ensure that waste received at any storage, treatment, or disposal facility is consistent with the operating basis of the facility:

- the acceptable limits for waste package external surface dose rate for both contact and remote handled packages;
- the acceptable limits for waste package surface contamination;
- the allowable heat generation rates;
- the acceptable limits for free liquid content, specified on a per package basis;

- the acceptable limits for maximum void space, specified on a per package basis;

- the necessary labeling and marking, including information about bar coding or other tracking system used at the facility receiving the waste and the application of the system by generators;

- any specific radionuclides or chemical or hazardous materials that are prohibited from acceptance at the facility. This may include pyrophoric materials, explosives, or materials that might cause violent reactions during storage, treatment, or disposal;

- any specific requirements associated with acceptance of mixed transuranic waste, including any additional restrictions or limitations on the waste or specifications for handling mixed waste containers;

- any specific requirements associated with acceptance of special transuranic waste needing out-of-the ordinary attention for receipt, handling, storage, treatment, or disposal, (e.g., sealed sources), including any additional restrictions or limitations on the waste or specifications for handling the waste containers;

- any package protection requirements needed for transport and receipt to provide needed physical protection of the packages to prevent breaching and so that the certified status of the waste is preserved; and

- the necessary shipping arrangements for transport to the facility receiving waste, including any electronic data bases or scheduling system used.

Example 1: Waste acceptance criteria for the Waste Isolation Pilot Plant have been developed based on applicable requirements, e.g., statutory requirements, other environmental compliance requirements, operational and safety analysis requirements, and transportation requirements. Development of waste acceptance requirements based on these sources ensures that waste received at WIPP complies with applicable regulations and can be safely managed at the site. The requirements include technical requirements addressing container properties, physical properties, nuclear properties, chemical properties, and gas generation; and administrative requirements for data that need to be provided with waste shipments.

Example 2: A transuranic waste containing spent solvents regulated by RCRA is transferred from a storage facility to a treatment facility for treatment. The treatment facility personnel must establish the limits, if any, on the concentration of solvents for which the treatment process was designed and qualified, and limitations or prohibitions

on other materials that may adversely affect the processing. The waste treatment process is to produce a treated waste product that (1) has been reduced in transuranic contaminant concentrations such that it may be disposed of as mixed low-level waste or (2) is acceptable for disposal at the WIPP as mixed transuranic waste. In either case, the final treated waste form must also meet the disposal facility waste acceptance criteria. In order to ensure that the treatment process product will meet applicable requirements, the treatment facility must document the limitations in the waste acceptance criteria that the organization supplying the waste must meet. By doing so, the treatment facility can safely process the waste, treat it successfully, and produce a product that can be disposed of.

Defense/Non-Defense Waste. The *WIPP Land Withdrawal Act of 1992*, as amended, limits the waste that can be accepted for disposal at WIPP to transuranic waste generated by atomic energy defense activities. In order to ensure compliance with the statutory constraint, and to facilitate identification of waste that can be disposed of at WIPP, all transuranic waste acceptance criteria must include a requirement for waste to be identified as defense or non-defense. At a minimum, the waste acceptance criteria should require identification of waste as defense or non-defense to be part of the certification program (see Waste Certification guidance for DOE M 435.1-1, Section III.J) and be included in the documentation used to transfer responsibility to personnel at the facility receiving the waste for storage, treatment, or disposal. The requirement applies to all transuranic waste and to all waste management facilities to ensure that the defense or non-defense identity of waste is not lost during waste generation and subsequent processing operations.

Example: The waste acceptance criteria for a transuranic waste storage facility has a waste transfer form that is to be used for each transfer of waste to the facility. The form, which the waste acceptance criteria requires to be used to document the certification that waste meets the waste acceptance criteria, includes identification of the waste as defense or non-defense as a mandatory piece of data. In addition, the waste acceptance criteria require that waste packages be marked to indicate the waste as being defense or non-defense. The waste acceptance criteria identifies three acceptable means of marking waste packages, color of the package, labeling, or through bar coding.

The Departmental interpretation is that the term "atomic energy defense activities" used in the *WIPP Land Withdrawal Act of 1992*, as amended, has the same meaning as the same term used in the *Nuclear Waste Policy Act of 1982*, as amended.

The term "atomic energy defense activities" permits WIPP to dispose of defense transuranic waste resulting from all of the noncivilian activities and programs of DOE, including weapons production, naval reactors, defense research and development, associated defense environmental restoration and waste management and other defense-

related activities, as defined more specifically in the *Nuclear Waste Policy Act*, from which the term was borrowed. (Nordhaus, 1996)

As the *Nuclear Waste Policy Act of 1982*, as amended, states, the term "atomic energy defense activity" means any activity of the Secretary [of Energy] performed in whole or in part in carrying out any of the following functions:

(a) naval reactors development;
(b) weapons activities, including defense inertial confinement fusion;
(c) verification and control technology;
(d) defense nuclear materials production;
(e) defense nuclear waste and materials by-product management;
(f) defense nuclear materials security and safeguards and security investigations; and
(g) defense research and development.

This definition of atomic energy defense activity does not include transuranic waste generated from DOE's civilian atomic energy activities.

<u>Exceptions</u>. Waste acceptance requirements are established to ensure that facilities can safely manage waste received for storage, treatment, or disposal. Thus, exceptions or deviations to waste acceptance criteria cannot be routine and must be carefully reviewed and documented. The procedures for granting exceptions need to clearly state the entire process for requesting an exception, describe acceptable bases for granting exceptions, and identify any additional information that is needed to supplement the documentation normally provided for waste transfers. The approval process needs to be clearly spelled out including identification of the officials who have the authority to approve the exception.

Example: The waste acceptance requirements for a transuranic waste storage facility establishes a per package limit on fissile material. The limit was developed based on criticality and safety analyses which assumed all of the packages in the facility could potentially contain the specified amount of fissile material. A generator has a waste package that slightly exceeds the limit. The waste acceptance requirements specify the that the generator needs to identify the criterion for which an exception is being requested and provide relevant information about the waste package or waste stream for which an exception is being sought. It further identifies to whom the request for an exception is to be submitted. At the storage facility, there are documented procedures indicating the process to be followed for evaluating the exception request and identifying the facility manager as the approval authority. In this case, an analysis is performed indicating that because of the small inventory of fissile material in the facility, an exception can be granted. Documentation supporting this decision includes notification to the generator that the exception is granted, copies of the analyses performed to

support the decision, and additional controls on waste that can be accepted in the facility during the time the particular waste remains in storage (i.e., limits may have to be placed on the per package content of other waste or on the total number of packages that the facility could accept).

Compliance with these requirements is demonstrated if waste acceptance requirements are documented, contain clear and precise criteria specifying the radionuclide limits in the form of contents or concentrations that can be accepted, the limitations and prohibitions on waste forms and packages that can be received, and the limits, prohibitions, or instructions concerning any other technical information so that the waste is compatible with the safety basis of the facility, and which will result in acceptable waste at subsequent steps in managing the transuranic waste. Waste acceptance requirements are to also contain a clear description of the process and bases for obtaining an exception or deviation to the acceptance criteria for transuranic waste to be received at the facility.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, August 1997.

2. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

3. CAO, 1996. *Quality Assurance Program Document*, Revision 1, CAO-94-1012, U.S. Department of Energy, Carlsbad Area Office, Carlsbad NM, 1996.

4. CAO, 1998. *U.S. Department of Energy, Transuranic Waste Characterization Quality Assurance Program Plan,* Revision 1, CAO-94-1010, U.S. Department of Energy, Carlsbad Area Office, Carlsbad NM, December 18, 1998.

5. CAO, 1998. *TRUPACT-II Operating and Maintenance Instructions,* Revision 1, DOE/WIPP-93-1001, U.S. Department of Energy, Carlsbad Area Office, Carlsbad NM, May 1998.

6. Nordhaus, 1996. Robert R. Nordhaus, to Al Alm, memorandum, *Interpretation of the Term "Atomic Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, U.S. Department of Energy, Washington, D.C., September 9, 1996.

III. G.(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Objective:

The objective of this requirement is to establish a process by which personnel at a facility receiving transuranic waste for storage, treatment, or disposal determine that the waste being transferred is acceptable in accordance with the waste acceptance requirements, and for that process to specifically address management of waste that does not conform with all of the requirements when it is received at the facility.

Discussion:

This requirement makes it the responsibility of officials at a facility to which waste is transferred to confirm that waste is in compliance with the established waste acceptance requirements and also provides a mechanism by which the officials confirm that waste can be accepted and safely managed at the facility.

Evaluation and Acceptance. The methodology for implementing the evaluation and acceptance of transuranic waste needs to be flexible and defined on a facility-specific basis. The complete process and procedures, including the responsibilities of generating facilities, need to be clearly documented so that both the generator and the facility receiving the waste understand the process that will be used. As with implementation of other parts of DOE M 435.1-1, this requirement is implemented using the graded approach. Facilities receiving transuranic from many generators and/or offsite generators may need to implement more detailed waste evaluation and acceptance processes than a facility receiving waste from a small number of onsite generators.

The evaluation and confirmation process consists of one or more of the following approaches, and is designed to demonstrate that the waste presented meets the waste acceptance requirements of the facility receiving waste for storage, treatment, or disposal:

- Testing, sampling, and analysis of the contents of a representative sample of waste packages as they are received at the facility;

- Testing and analysis of a number of samples taken at the generator facility;

- Detailed review of sampling and analysis data generated by the sending facility or an independent laboratory employed by the generating facility;

- Audit, review, or surveillance of the sender's waste characterization activities and processes and waste certification programs.

Testing, sampling, and analysis of the contents of a representative sample of waste packages upon receipt is complicated by the fact that additional risk is posed if a technique such as opening of drums and obtaining grab samples is used. Therefore, consideration needs to be given to implementing non-destructive examination technologies if receipt sampling and analysis is the preferred approach. Likewise, analysis of samples taken at the generator's site may involve additional risk, and also may be expensive to implement. If this method is employed, samples which are representative, either statistically or correlated with generator profiles, need to be obtained for analysis to validate this method as accurate. This sampling would include packages from the generators sending the largest volume of waste to the facility or packages containing the critical radionuclides as identified in the waste acceptance requirements.

Example: The waste acceptance process for a storage facility that receives waste from multiple generators involves assay to confirm the waste is transuranic, and sample collection and analysis to confirm its RCRA status. The process calls for assaying and sampling one waste package of every 100 from established waste streams and one of every 10 for new waste streams or for waste streams from generators who have a history of poor compliance with the waste acceptance criteria.

The use of a detailed review of the sampling and analysis data gathered by others would include an evaluation of the methodologies used for collecting the sample, maintaining the integrity of the sample and data (e.g., through a chain of custody), and performing the radioanalyses. As above, the samples collected would need to be representative of the waste, either statistically or with a bias towards large generators or generators of significant radionuclides (i.e., those that are most limiting for the storage, treatment, or disposal facility).

The use of assessments (audits, reviews, or surveillances) to verify compliance of the waste generators' certification programs with acceptance requirements would need to be conducted on a regular schedule commensurate with the frequency of waste generation and shipments. The documentation of the verification process would include organization and authorities; frequency of assessments; methods to be employed; the information that will be documented as a result; and the qualifications of personnel.

Example: At the Waste Isolation Pilot Plant, there are no plans for sampling waste packages upon receipt. Instead, WIPP has instituted a program in which generator site waste certification programs are reviewed to determine whether they will produce waste packages meeting the waste acceptance criteria. A Generator Site Certification Guide describes what is entailed in obtaining an approved site certification program. Once a site has developed its program, representatives from WIPP evaluate it, and if determined

to be acceptable, approve it. After a site's certification program has been approved, WIPP personnel rely on the combination of site certification that waste packages comply with the site's approved program and their own review of transfer documentation and processes to assure that waste meets the waste acceptance criteria. Site certification programs are re-evaluated annually to confirm that they are still adequate.

Non-Conforming Waste. Facilities receiving waste for storage, treatment, or disposal must have a documented process to be used in the event a non-conforming waste is received. A non-conforming waste is a waste container or shipment which is certified by the generator as meeting the waste acceptance requirements of the receiving facility, but which is found to be in violation of the acceptance criteria during the facility's waste receipt and inspection process. Facility procedures need to address how non-conforming waste will be segregated from acceptable waste, the process for notifying the sender of the non-conformance, and the acceptable methods for dispositioning the non-conforming waste. The process includes prior notice to the sender of the actions to be taken by the facility receiving the waste and the sender's obligations, particularly regarding the cost of the actions, to support the disposition of the non-conforming waste.

Example: A transuranic waste storage facility's waste acceptance procedures require that non-conforming waste be segregated from conforming waste and isolated by a rope barrier pending resolution of the non-conformance. The procedures further require notification of the generator of the non-conformance and a resolution to be negotiated with the generator. The process requires consideration of risk and cost in determining the proper resolution.

Compliance with these requirements is demonstrated if there is a procedure or process for evaluating and accepting incoming waste which ensures the acceptance criteria of the facility receiving the waste are met by one or a combination of: (1) testing, sampling, and analysis of representative samples of incoming waste upon receipt; (2) testing, sampling, and analysis of samples of waste taken at the generator facility; (3) evaluation of testing, sampling, and analysis of data provided by the generator; or (4) audits, reviews, or surveillances of generator waste certification programs and characterization activities. Additionally, acceptable waste acceptance requirements for a storage, treatment, or disposal facility will have documented procedures and actions to be taken if a waste that does not conform to the waste acceptance criteria is received at the facility.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, August 1997.

2. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. H. Waste Generation Planning.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all transuranic waste streams.

Objective:

The objective of this requirement is to provide for the disposal of all transuranic waste that is generated in the future by ensuring that prior to generating a new transuranic waste stream, the specific waste management facilities necessary for safe management of the waste from the time it is generated up to and including its disposal are identified; plans are developed for resolving issues that prevent disposal, and for safe, long-term storage for transuranic waste with no path to disposal; and sites are discouraged from generating transuranic waste that does not have an identified path to disposal.

Discussion:

The Department intends on disposing of stored and future defense transuranic waste (the majority of DOE transuranic waste) that meets waste acceptance requirements at WIPP. The subject requirement is based on a recognition that protection of the public, workers, and the environment is best assured if transuranic waste is generated with cognizance of its final disposition and of the waste management facilities that are needed until the waste is disposed. In developing DOE O 435.1 and DOE M 435.1-1, the safety and hazards analysis identified long-term storage of waste, and potential loss of characterization data from generators and the subsequent need for recharacterization as weaknesses to be mitigated. Therefore, as part of the generator planning requirements in DOE M 435.1-1, Section I.2.F.(7), specific requirements are identified for planning the management of waste prior to its generation, and for approval to generate transuranic waste streams with no identified path to disposal.

Life cycle planning for all transuranic waste. Planning prior to generating transuranic waste is primarily intended to address newly-generated waste streams. Life-cycle planning for waste that has been generated and continues to be generated is documented through the Site-Wide Waste Management Program required in DOE M 435.1-1, Section I.2.F.(1). The following discussion describes the types of life cycle planning need. The information needed is influenced by the fact that, on the implementation date of the Order, the transuranic waste will be in one of three stages of its life-cycle: (1) waste generated in the past (in storage); (2) waste being generated at present; and (3) wastes not yet generated (future wastes); and will either have an identified path to disposal, or will not.

Therefore, from a waste generation planning perspective, there are six different "states" of transuranic waste, depending on when the waste was or is generated and whether it has or will have a path to disposal. The following paragraphs explain the recommended life cycle information for these different transuranic wastes.

Transuranic Waste With a Path to Disposal

Generated currently - The life-cycle information for currently generated transuranic waste with an identified path to disposal includes a description of the management steps for the waste as discussed in guidance for the Site-Wide Radioactive Waste Management Program.

Generated in the future (from a new process) - The life-cycle information for transuranic waste with an identified path to disposal that is generated from a new process includes a description of the management steps for the waste as discussed in guidance for the Site-Wide Radioactive Waste Management Program.

Generated in the past (in storage) - In addition to the basic information on management steps, life cycle information for transuranic waste with a path to disposal that is in storage (due to budget constraints, delays due to regulatory matters or management decisions, or for other reasons) includes a schedule for achieving disposal. For transuranic waste in earthen-covered storage, the retrieval plan required by the storage requirements (DOE M 435.1-1, Section III.N) can be used to meet this requirement provided it has a schedule.

Transuranic Waste Without a Path to Disposal

Generated in the past (in storage) - The life-cycle information for transuranic waste in storage as of the issuance of DOE O 435.1 for which there is not an identified path to disposal includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues.

Generated in the future (from a new process) - The life-cycle information for transuranic waste without an identified path to disposal which is generated from a new process includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues. This information will be assembled in the course of getting the generation of the waste approved in accordance with the process required in DOE M 435.1-1, Section I.2.F.(19), and is also discussed in the next section of this guidance.

Generated currently - The life-cycle information for transuranic waste without an identified path to disposal includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues. The intent of the requirement is not to ensure that these waste streams receive approval for generation in accordance with General Requirement I.2.F.(19). However, the life-cycle planning information needs to address the continued generation of this waste. The life-cycle planning information for continuing to generate a no path forward waste needs to include consideration of the necessity to generate the waste, an understanding of what prevents disposal of the waste, the needed capacity and capabilities for continued storage of the waste, and the plans for future disposal of the waste. Discussions would also be included on any alternatives to the process that generates the no path forward waste that have been considered.

Providing the life cycle information discussed above for waste streams already being generated is relatively straightforward. For most transuranic wastes, the information already exists and has been utilized for other documents such as the Programmatic Environmental Impact Statement and the Baseline Disposition Maps. To the extent that existing documentation includes the specified information, they may be used to meet the life cycle planning requirement.

Example: A transuranic waste generating facility operating at Site A continues to operate with no alterations. The facility generates the same transuranic waste streams it has been generating for years, and none of them are waste streams without a path to disposal. The life-cycle information about transuranic waste generated at this facility is included in the current waste inventories and capacities section of the Site A Radioactive Waste Management Plan, and no technical or programmatic issues are included in the Plan concerning these waste streams.

Waste generator planning prior to generation. Planning, prior to generating transuranic waste (subrequirement H.(1)), is intended to address transuranic waste streams that do not already exist. Transuranic waste streams that are first generated after issuance of the Order are subject to this requirement. Waste generator planning is a component of the waste generator program required in I.2.F.(7) of the General Requirements Chapter of DOE M 435.1-1. Waste generator planning activities need to be integrated in the generator program with waste characterization, certification, and transfer activities.

Example: A previously operating high-level waste treatment facility has been shut down for eighteen months and is to be restarted. Based on past experience, it is known that contamination control activities in the building will result in the generation of a transuranic waste stream. As part of the generation planning in support of the restart, plant personnel must evaluate the life-cycle of all of the waste streams (high-level,

transuranic and low-level) that will come from the facility. For the transuranic waste, personnel confirm that there is a facility that can accept the waste for storage and that because the waste is from a defense-related activity, it is eligible for disposal at the Waste Isolation Pilot Plant. Based on the WIPP waste acceptance criteria and communications with WIPP personnel, the determination is made that the waste will meet the waste acceptance criteria and that adequate capacity will be available. From the perspective of transuranic waste life-cycle planning there are no issues associated with the restart.

Generator planning addresses the life-cycle of the waste to disposal, including all interim steps of waste management. This can be accomplished by preparing a waste stream profile and reviewing it with the facility(ies) that will manage the waste. The waste stream profile format used needs to be consistent with the needs of the storage, treatment, and/or disposal facilities that will be involved in managing the waste stream. An example of a waste stream profile form is included as Figure III.H.1 at the end of this section of guidance. The waste generator confirms with each storage, treatment, and disposal facility that will be used, that based on the current knowledge of the waste stream characteristics, and planned facility capacity, the waste stream can be managed by the facility. It is therefore conceivable that a generator may have to interface with multiple facilities (e.g., a storage and/or treatment facility in addition to the disposal facility) to ensure that the waste can be managed.

Example: In the previous example, the treatment facility confirmed with the storage facility that based on the expected generation rate of the transuranic waste and the expected commencement of shipments of waste to WIPP that there was sufficient storage capacity to handle the transuranic waste stream.

The determination of whether a transuranic waste stream has an identified path to disposal is based on the availability and capacity of existing or planned facilities and operations. A planned facility is considered to be available if it has been authorized (e.g., a line item in a Congressional appropriation or equivalent approval for design and construction). A facility is not considered available if it is not authorized to accept or manage a particular waste type or concentration. If a planned facility is designated in the planning information, then the planning information also needs to address the schedule for when the facility will be operational, and the management steps that will be taken for waste designated for that facility until it becomes operational.

For purposes of planning for disposal of a transuranic waste stream, a facility or capabilities that are part of a program or strategic plan, but have not been authorized are not considered available. If a planned or available facility is canceled, the generator site needs to revise the planning for the life-cycle of the transuranic waste, an alternate path to disposal needs to be identified and documented, or approval to generate the transuranic waste needs to be obtained from the cognizant Field Element Manager as required by DOE M 435.1-1, Section I.2.F.(19).

The generator is responsible for ensuring that transuranic waste is not generated unless the life-cycle management, including disposal of the waste, has been considered. However, as discussed below, it is not the objective of this requirement to prohibit, under all conditions, the generation of transuranic waste that does not have an identified path to disposal. In meeting the DOE O 435.1 planning requirements, it is appropriate for waste management organizations to provide assistance to the generator in determining the waste management path, particularly in cases where the waste management organization may utilize offsite treatment, storage, or disposal facilities.

Compliance with this planning requirement is demonstrated by the individual sites establishing a process for evaluating the life-cycle of low-level waste prior to its generation, including the identification of low-level wastes with no path to disposal and appropriate records justifying the newly generated low-level waste stream(s), and site personnel possessing planning information showing the location(s) where low-level waste will be stored, treated, and/or disposed along with a confirmation that the personnel managing the facilities agree that the low-level waste may be managed at those facilities.

Supplemental References:

1. DOE, 1998. *Accelerating Cleanup: Paths to Closure*, DOE/EM-0362, U.S. Department of Energy, Washington, D.C., June 1998.

III. H.(2) Waste With No Identified Path to Disposal. Transuranic waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Objective:

The objective of this requirement is to ensure that prior to generation of a new transuranic waste streams with no path to disposal, the need to generate the waste is carefully considered and plans

for safe long-term storage and for resolving issues that prevent disposal of the wastes are developed.

Discussion:

There are instances where programmatic needs may necessitate the generation of transuranic waste without an identified path to disposal. In these instances, the Field Element Manager must ensure development of a process for identifying generation of transuranic waste with no path to disposal and approving the conditions under which such transuranic waste can be generated (DOE M 435.1-1, Section 1.2.F.(19)). The process of identifying waste with no path to disposal and establishing conditions for its generation is intended to raise to the attention of DOE management that a long-term commitment is being made with the generation of such a waste, including prolonged storage of this waste and resolving those issues that prevent the waste from being disposed.

> *Example: Through generation planning it is determined that an Office of Science project will generate a small volume of non-defense transuranic waste. The generator contacts the waste management organization and learns that because the waste is non-defense it is not eligible for WIPP disposal. Working together, generator and waste management personnel determine there is no way to avoid creating the waste if the project proceeds, however, the waste management organization does have long-term storage capacity available. The Field Element Manager determines that due to the importance of the project, and based on plans that the Department is pursuing to resolve disposal of non-defense transuranic waste that generating the transuranic waste is acceptable.*

The minimum conditions for generating a waste without an identified path to disposal are identified in this requirement. They include various evaluations and considerations that involve both the waste generating and waste management organizations. The decision to proceed with the activity generating the wastes is made considering the factors discussed below.

<u>Programmatic need to generate the waste</u>. There must be a clear identification of the programmatic mission being served that results in the generation of transuranic waste with no identified path to disposal. Alternate means of accomplishing the mission without generating the waste should be discussed. These could include use of alternative materials to achieve the mission, use of different processes, or substitution of chemicals other than the ones originally to be used.

<u>Characteristics and issues preventing the disposal of the waste</u>. The reasons that the transuranic waste cannot be disposed of must be identified. These may be technical or programmatic reasons. For example, if a waste needs to be treated in order to meet a disposal facility waste acceptance criteria and an appropriate treatment facility is not available, the lack of treatment would be

identified as the reason the waste does not have a path to disposal. Identifying the characteristics and issues preventing disposal is necessary to support the development of plans for achieving disposal.

Safe storage of the waste until disposal can be achieved. Since the waste cannot be disposed of pending the resolution of programmatic or technical issues, facilities must be available for safe storage. In order to evaluate the ability to provide for the storage of the waste, there needs to be an estimate of the amount of the waste that will be generated, as well as an estimate of the time necessary to keep the waste in storage. Identification of the requirements for safe storage and acceptable storage facilities is a prerequisite to generating the waste so that unique or risky aspects that may make long-term storage problematic can be identified. In addition, treatment necessary to comply with RCRA, if applicable, should be identified.

Activities and plans for achieving final disposal of the waste. The decision to generate waste with no identified path to disposal must be based on a plan to eventually achieve disposal. The plan to achieve disposal of the waste needs to identify the activities being pursued to resolve issues preventing disposal and a schedule for their resolution. The activities described may be fairly detailed if the problems are technical and involve only one waste stream at a site. In other cases involving programmatic issues, or which involve several waste streams at several sites, the activities and schedules to resolve issues may be less certain because they are dependent on other internal or external organizations. For example, resolution of the issue of disposal of non-defense transuranic waste may require action external to DOE (e.g., legislation). Sites should defer to the complex-wide plans for addressing disposal of non-defense transuranic waste in lieu of developing individual plans and schedules.

> *Example 1: Approval is given to generate transuranic waste with no path to disposal. The waste is not acceptable for disposal at WIPP because it is reactive (EPA hazardous waste code D003). The approval to generate the waste is based on the generator providing plans to develop the treatment capabilities necessary to make the waste acceptable for WIPP disposal. These plans should be detailed, identifying the schedule for conducting the studies, tests, and engineering, as well as regulatory activities, necessary to allow the waste to be treated.*
>
> *Example 2: A non-defense transuranic waste which is otherwise acceptable for WIPP disposal may require a programmatic decision by DOE Headquarters and legislative action to resolve disposal issues. The site plan for addressing this issue should identify the data collection and options analyses to be performed by the site and address how they fit with the actions being taken by the Complex-Wide Transuranic Waste Management Program (see DOE M 435.1-1, Section III.C).*

If the assumptions for the planned management of the waste are adversely impacted (e.g., as a result of testing, design, funding profile, DOE policy) they should be updated. Minor updates to the assumptions and changes to the planned management of the waste would not be a basis for re-evaluating the generation of the waste as long as the overall plan remains essentially unchanged. However, major changes to the plan (e.g., changes in decisions for developing a treatment facility or disposal facility to handle the waste) must result in a re-evaluation of the acceptability of continuing to generate the transuranic waste. All changes in plans for resolving issues preventing disposal should be forwarded to the Headquarters Office of Waste Management so their impact on the Complex-Wide Transuranic Waste Management Program can reflected in the program plan (see DOE M 435.1-1, Section I.2.D.(1)).

Compliance with requirement is demonstrated by the waste generation organization having documentation concerning the decision to generate a transuranic waste stream that does not have an identified path to disposal. This documentation needs to include the cognizant Field Element Manager or designee approval to generate the waste, an explanation of the need for the process that generates the transuranic waste, a discussion of the reason it cannot be disposed of, the proposed management plan for the waste, and an up-to-date schedule of activities being pursued to resolve constraints to the disposal of the subject waste. Consistent with the use of a graded approach for applying DOE M 435.1-1 requirements, the schedule and plans for disposing of non-defense waste can defer to the complex-wide resolution of the issue.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* DOE/WIPP-069, Revision 5, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

WASTE STREAM PROFILE FORM **Page 1 of 3**

Waste Stream Profile Number: __________________ Generator site name: __________________
Technical contact: ___________________________ Generator site EPA ID : ______
Technical contact phone number: __________________
Did your facility generate this waste? Yes No
If no, provide the name and EPA ID of the original generator:
____

<u>Waste Stream Information</u>
ID: ___________________________ Summary Category: _____________________
Waste Stream Name : ___________________________________
Description from the TWBIR (if available): _____________________________________
Defense TRU Waste?: Yes No CH-TRU or RH-TRU?: CH RH
Concentration of PCBs: ____
Number of SWBs ________ Number of Drums_________ Number of Canisters ___
Data package numbers supporting this waste stream characterization: ____________________
List applicable EPA Hazardous Waste Numbers: __________________________________

List the concentrations of VOCs listed in Table 4-2: ___________________________
List average isotope ratios: ____
List the weight fraction of CRP: ____

<u>Acceptable Knowledge Information</u>
For the following, enter supporting documentation used (i.e., references and dates)
<u>Required Program Information</u>

- Map of site: ____
- Facility mission description: ____
- Description of operations that generate waste: __________________________________
- Waste identification/categorization schemes: __________________________________
- Types and quantities of waste generated: ____________________________________
- Correlation of waste streams generated from the same building and process, as appropriate: ____
- Waste certification procedures: ____

Figure III.H.1. Example Transuranic Waste Stream Profile Form

WASTE STREAM PROFILE FORM **Page 2 of 3**

Required Waste Stream Information

- Area(s) and building(s) from which the waste stream was generated: ________________
- Waste stream volume and time period of generation: __________________________
- Waste generating process description for each building: ________________________
- Process flow diagrams: ____
- Material inputs or other information identifying chemical/radionuclide content and physical waste form: ____
- Which Defense Activity generated the waste: (check one)
    - Weapons activities including defense inertial confinement fusion
    - Naval Reactors development
    - Verification and control technology
    - Defense research and development
    - Defense nuclear waste and material by products management
    - Defense nuclear materials production
    - Defense nuclear waste and materials security and safeguards and security investigations

Supplemental Documentation

- Process design documents: ____
- Standard operating procedures: _______________________________________
- Safety Analysis Reports: ____
- Waste packaging logs: ____
- Test plans/research project reports: ____________________________________
- Site data bases: ____
- Information from site personnel: ______________________________________
- Standard industry documents: ____
- Previous analytical data: ____
- Material safety data sheets: ____
- Sampling and analysis data from comparable/surrogate Waste: ____________________
- Laboratory notebooks: ____

Figure III.H.1. Example Transuranic Waste Stream Profile Form (cont.)

WASTE STREAM PROFILE FORM **Page 3 of 3**

Sampling and Analysis Information [1]

For the following, when applicable, enter procedure title(s), number(s) and date(s).

- Radiography: ____
- Visual Examination: ____
- Headspace Gas Analysis

  VOCs: ____

Homogeneous Solids/Soils/Gravel Sample Analysis

Metals: ____
PCBs: ____
VOCs: ____
Nonhalogenated VOCs: ____
Semi-VOCs: ____
Other (specify): ____

Waste Stream Profile Form certification:

I hereby certify that I have reviewed the information in this Waste Stream Profile Form and it is complete and accurate to the best of my knowledge. I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

________________________ ________________________ __________
Signature of site project manager Printed name and title Date

Note: (1) If radiography, visual examination, headspace gas analysis, and/or homogeneous solids/soils/gravel sample analysis were used to determine EPA Hazardous Waste Codes attach signed summary reports documenting this determination.

Figure III.H.1. Example Transuranic Waste Stream Profile Form (cont.)

III. I. Waste Characterization.

> **Transuranic waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.**

Objective:

The objective of this requirement is to ensure that sufficient knowledge of transuranic waste's characteristics (e.g., chemical, physical, radiological) is available to protect workers handling the waste and to support effective decision-making for its management. This information is to be maintained from generation, through storage and treatment in sufficient detail to ensure that the requirements of subsequent treatment and storage facilities, transportation regulations, and the disposal requirements for transuranic waste will be met.

Discussion:

The *Radioactive Waste Management Manual* assigns the Field Element Manager the responsibility of ensuring development, approval, and implementation of a program that addresses the responsibilities of waste generators, including waste characterization (DOE M 435.1-1, Section I.2.F.(7)). The characterization data acquired during generation, storage, and after treatment of transuranic waste need to be reliable and in sufficient detail to ensure subsequent management can be conducted safely and to meet the waste acceptance requirements of all subsequent receiving facilities. Accurate characterization of transuranic waste is essential to: 1) waste planning by generators, as required by DOE M 435.1-1, Section III.H; 2) waste certification by generators and other senders of waste, as required by DOE M 435.1-1, Section III.J; 3) waste transfers by generators and other senders of waste, as required by DOE M 435.1 Section III.K; and; 4) waste evaluation and acceptance by receivers of waste, as required by DOE M 435.1-1, Section III.G.

In conducting the analyses for development of the DOE M 435.1-1, characterization was identified as necessary to ensuring the safe management of waste from generation through disposal. Waste characterization is defined (DOE M 435.1-1, Definitions) as:

> "The identification of waste composition and properties, such as by review of acceptable knowledge (which includes process knowledge), or by nondestructive examination, nondestructive assay, or sampling and analysis, to comply with applicable storage, treatment, handling, transportation, and disposal requirements."

Accurate waste characterization is necessary so that the waste and waste containers are compatible and worker handling of waste containers can be performed safely. All information necessary for personnel to safely handle a container of transuranic waste needs to be known at all times during the life-cycle of the waste.

Waste characterization is a tool for gathering information that supports defensible decisions regarding safety, process, environmental and compliance matters in the management of transuranic waste. The significance of the waste management decision will guide the graded application of this requirement, as well as the more detailed characterization requirements addressed in subsequent sections of this guidance. These subsequent sections address application of a data quality objectives process to guide characterization (Section III.I.(1)) and minimum characterization requirements (Section III.I.(2)).

Use of Direct and Indirect Methods. Waste managers are to characterize transuranic waste using an appropriate combination of direct and indirect methods. The appropriate method for characterizing waste depends on the parameter being measured, the hazards associated with acquiring the information, and the amount and quality of the data needed as determined through a data quality objectives or similar process.

Direct methods of characterizing waste can be used to established certain physical and chemical attributes as well as radiological characteristics. The most common direct methods for characterizing the chemical and/or radiological characteristics are sampling and laboratory analyses and certain nondestructive evaluation techniques (e.g., real-time radiography). Direct characterization methods are conducted in accordance with the quality assurance program and plan governing the site and laboratory facilities.

Indirect methods of characterization use non-destructive examination techniques and acceptable knowledge to replace, supplement, and/or initially provide data that might otherwise be collected by direct, intrusive characterization of the waste. In the safety and hazard analysis performed in support of development of DOE M 435.1-1, the use of indirect methods was identified as an appropriate means of characterizing waste and at the same time complying with the as low as reasonably achievable (ALARA) principle for keeping radiation exposures to a minimum. An additional benefit of characterizing transuranic waste by the use of indirect methods is the avoidance of the generation of waste associated with sample materials, and laboratory equipment and expendables.

In order for indirect methods of transuranic waste characterization to serve their purpose of providing information necessary for the safe management of waste, the data need to be sufficiently accurate. The level of accuracy is determined through application of data quality objectives, or comparable process. Consistent with the data quality objectives, correlations demonstrating that data provided by indirect methods are representative of the actual waste may need to be

supported through the application of direct methods. The methodology could employ a number of techniques, some of which involve some direct sampling and analysis of the waste stream. The following guidance paragraphs discuss different indirect methods.

Similar to the EPA and NRC guidance on characterizing mixed waste, DOE endorses the use of indirect methods such as the use of “acceptable” or “waste knowledge” for characterizing physical, chemical, RCRA-regulated, and radioactive components of waste. The term “acceptable knowledge” (or “waste knowledge”) includes process knowledge; records of analyses performed prior to the effective date of a requirement; or a combination of process knowledge and previous records, supplemented with chemical analyses (NRC/EPA, 1997). Process knowledge refers to detailed information on processes that generate waste subject to this requirement or information on processes similar to those which generated the waste being characterized.

Acceptable knowledge characterization of transuranic waste is based on an understanding of the materials and processes used to generate the waste, or analytical data obtained from the process or waste stream or both. Acceptable knowledge also includes information regarding the source of the waste stream, the physical form and materials comprising the waste, the chemical constituents of the waste, and the nature of the radioactivity present. Acceptable knowledge may be used to describe transuranic waste if the source information is consistent, defensible, and auditable.

While the development of a process for identifying and documenting transuranic waste acceptable knowledge is not dictated by this requirement, the following guidance provides an overview of elements of an acceptable process for assembling acceptable knowledge documentation:

- Acceptable knowledge is compiled in an auditable record.

- Correlations within waste streams in terms of time of generation, waste generating processes, analytical data, and site-specific facilities are clearly described.

- A reference list of applicable documents, databases, quality control protocols, and other sources of information that support the acceptable knowledge information is prepared.

- Procedures which outline the methodology that is to be used to identify and assemble auditable acceptable knowledge records, including the origin of the documentation, how the assembled information was or will be used, and any limitations associated with the information.

Characterization data gained through acceptable knowledge must be within the acceptable range of certainty and precision identified by the data quality objectives or similar process. Additionally, the effects of time-dependent processes must either be negligible or predictable. If acceptable

knowledge is supported by the collection, analysis, and comparison of statistically valid samples with the acceptable knowledge records, periodicity of sampling and analysis should correlate with the nature of any changes in the process creating the waste or with changes that are being documented in characterization data.

Non-destructive examination and assay techniques use methods such as passive-active neutron assay, high resolution gamma ray spectroscopy, and thermal neutron capture to non-destructively collect data relating to the radionuclide constituents in the waste. Acceptable performance of assay techniques is determined through measurement of known standards and comparison to established quality assurance objectives of the applicable characterization program. A process, similar to the one discussed above regarding acceptable knowledge, needs to be established and documented in site procedures that outline the exact nature of the acceptable use of non-destructive examination techniques for providing characterization information on waste.

Another indirect method of providing radionuclide characterization data is through the use of a known relationship, or scaling factors, between a measured radionuclide or a dose rate and the radionuclide(s) of interest. As discussed above for acceptable knowledge and non-destructive examination techniques, use of scaling factors must be correlated with actual data.

The use of scaling factors is generally established by an initial characterization that provides a statistical basis for use of the scaling factors. As with any indirect method, the characterization program needs to include confirmatory measurements. The frequency of the confirmatory measurements is to be based on the consistency of the process generating the waste. Additionally, the history of previous confirmatory measurements may also influence the frequency of future confirmatory measurements with results that are very consistent providing justification for less frequent confirmatory measurements.

> *Example: A waste stream from an actinide processing building is sampled and analyzed and determined to be composed of three primary nuclides: Pu-239, Am-241, and Pu-238. The samples are found to contain the three radionuclides in essentially the same ratio. The process is known to be uniform and is therefore expected to generate similar concentrations in the waste stream as the facility is operated. Therefore, the contents of future waste containers are routinely characterized based on a gamma energy analysis which detects gamma radiation from the Am-241 and Pu-238. The characterization program requires the collection and full analysis of samples once a month to confirm that the ratio of the three radionuclides falls within an acceptable range (based on application of the data quality objectives process).*

Characterization Documentation. The requirement states that characterization data shall be documented in sufficient detail to enable the waste acceptance requirements of the receiving

facility to be met. The following elements are considered essential to this process for acquiring and controlling characterization data:

Organization(s) and Responsibilities - Identification of the organizations involved and responsible for characterization of transuranic waste.

Quality Assurance - Characterization data need to be subjected to a quality assurance program and the program that applies needs to be identified and documented.

Procedures - The process for obtaining waste characterization data is formalized in procedures which describe to the user the steps that are to be followed and the administrative process for ensuring the data are of the quality needed. Topics that need to be proceduralized include the processes for sampling, packaging, transportation, laboratory analysis, and data control.

Procurement/Purchasing Controls - The procurement and/or purchasing of items or services that are significant to characterizing transuranic waste are controlled and documented. Such procurement includes the purchase of sampling equipment and sample transport containers, as well as services such as laboratory analyses (onsite or offsite). As dictated by the type of procurement, the documentation needs to include (or reference) the technical specifications for the item/service being procured, identification of quality assurance requirements including any required inspections, specifications of documentation requirements (e.g., certification of compliance or conformance, laboratory analytical results), and a statement ensuring access to the provider’s facilities as necessary to perform audits and inspections. The characterization data need to be traceable through the provider’s process of generating them and verifying their accuracy.

Document/Data Change Control - Records that contain characterization data, whether they have been generated through sampling and analysis, nondestructive assay, or acceptable knowledge, need to be controlled. In addition, the waste characterization procedures and quality assurance program documentation are subject to document control. Document and data control need to include review, approval, and distribution to designated recipients (users), and a controlled process for making revisions to documents or data. Existing document and data control programs at a site may be adequate to provide the necessary controls for documents related to transuranic waste characterization data, but will need to be reviewed to ensure the objectives of DOE M 435.1-1 requirements are met.

Training - Characterization data are generated and managed only by personnel that are properly trained to recognize the significance of the data. Generally, training of laboratory personnel will be adequate to support transuranic waste characterization, but needs to be

reviewed versus the goals of the characterization. Other staff managing and using characterization data need to understand what is to be done with the data (i.e., what decisions are to be made) once data are collected.

Records - Waste characterization records include those that are necessary to meet the waste acceptance requirements of receiving facilities, and as specified by the waste certification program DOE M 435.1-1, Section III.J.

As noted above, existing programs at a site may provide the framework within which the elements of waste characterization can be addressed (e.g., quality assurance, training, document control).

The waste acceptance requirements of a facility to which the waste is sent also may impose additional requirements on what is to be included in the waste characterization data. The waste acceptance requirements for the receiving facility include specific quality assurance, administrative, or documentation requirements so that waste characterization data are acceptable to the facility.

Example: A site is preparing to transfer waste to WIPP for disposal. The waste characterization program at the site normally generates data on the physical, chemical, and radiological characteristics of the waste. However, additional requirements have been established for the characterization of transuranic waste in order to transfer it to the WIPP for disposal. In addition to what is normally thought of as characterization data (chemical and radiological), the waste acceptance criteria require, among other information, the waste packages to be characterized in terms of their thermal power and decay heat.

Compliance with this requirement is demonstrated by a program for documenting and the existence of records that document the process for acquiring and verifying the validity of transuranic waste characterization data acquired through the use of direct or indirect methods.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* DOE/WIPP-069, Revision 5, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

2. EPA, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

3. NRC/EPA, 1997. "Joint NRC/EPA Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste," *Federal Register*, Vol. 62, No. 224, U.S.

Environmental Protection Agency and U.S. Nuclear Regulatory Commission, November 20, 1997.

III. I.(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Objective:

The objective of this requirement is to invoke a process for determining the type, quantity, and quality of characterization data needed to support the safe management of transuranic waste so as to ensure that needed data are acquired, the data meet the objectives they are being collected for, and resources are not wasted on unnecessary, incomplete or unusable data collection efforts.

Discussion:

The type, quantity, and quality of characterization data obtained for the safe management of transuranic waste need to be consistent with the purpose for which the characterization information will be used. The uses of transuranic waste characterization data include complying with storage, treatment, and disposal facilities' waste acceptance requirements; determining radiation shielding and other protective measures; evaluating compliance with processing requirements; and meeting legislative or regulatory commitments. This requirement is included in DOE M 435.1 to ensure that the appropriate characterization data to support the safe management of transuranic waste are generated. The requirement is intended to promote a structured process for the collection and use of transuranic waste characterization data and to avoid the collection of data that is neither necessary nor defensible.

Input from various waste management organizations and interested groups is necessary to establish a clear understanding of the characterization data needs and the level of data quality that is acceptable for making transuranic waste management decisions. The current requirement invokes the use of a structured process for determining the type, quantity, and quality of characterization data needed. Such a process, called a data quality objectives process, has been developed by the Environmental Protection Agency and is documented in *Guidance for the Data Quality Objectives Process*. Application of the EPA process and use of the guidance for the use of the data quality objectives process is an acceptable method of meeting this requirement. However, use of other comparable processes that employ a structured approach to yield similar results is also acceptable.

The objectives of applying a structured process such as the data quality objectives process are to:

- manage and control the risks of making incorrect decisions;
- determine the data required to support making specific decisions;
- determine the type and quality of required data;
- allow stakeholders, decision makers, data users, and relevant technical experts to participate in planning and assessment;
- determine the quantity, location, and type of samples required;
- quantify the uncertainty in data through development of statistical sampling plans; and
- reduce overall costs by identifying resource-efficient sample collection and analytical methods by optimizing the sample and analysis plans.

The data quality objective process is a strategic planning approach based on the scientific method that is used to prepare for a data collection activity. The value of using this process to develop transuranic waste characterization parameters is that it reduces radiation exposure and saves resources by making characterization data collection operations more resource-effective; enables characterization data users and others to participate in characterization data planning; and provides a structured method for defining characterization data performance requirements, i.e., quality.

To foster the development and implementation of an effective data quality objectives or similar process, individuals are assigned responsibility for specific activities for each application of the process. Key activities of the process include:

- preparing the data quality objectives documentation;
- identifying stakeholders;
- identifying technical experts;
- ensuring opportunities for input and coordinating stakeholder and technical experts into the data quality objective process;
- reviewing and commenting on the developed data quality objectives; and

- approving the data quality objectives documents.

A more detailed description of the assignment of specific responsibilities for implementing a data quality objectives or similar process is presented in the Hanford "Data Quality Objectives Procedure" (see reference 2).

The data quality objectives process consists of seven steps. The output from each step influences the choices that will be made later in the process. Even though the data quality objectives process is depicted as a linear sequence of steps, in practice it is iterative; the outputs from one step may lead to a reconsideration of prior steps. This iteration is encouraged since it will ultimately lead to a more efficient data collection design. During the first six steps of the process, a team of process-cognizant personnel develop decision performance criteria (i.e., data quality objectives) that will be used to develop the data collection design.

The final step of the process involves developing the data collection design based on the data quality objectives developed in the first six steps. The first six steps need to be completed before the team attempts to develop the data collection design because the design is dependent on a clear understanding of the first six steps taken as a whole.

Following is a listing and brief description of each of the seven steps. This is followed by an example of how the data quality objectives process can be applied to transuranic waste characterization.

1. State the Problem – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

2. Identify the Decision – Identify what questions the study will attempt to resolve, and what actions may result.

3. Identify the Inputs to the Decision – Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

4. Define the Study Boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.

5. Develop a Decision Rule – Define the statistical parameter of interest, specify the action level, and integrate the previous data quality objective outputs into a single statement that describes the logical basis for choosing among alternative actions.

6. <u>Specify Tolerable Limits on Decision Errors</u> – Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

7. <u>Optimize the Design</u> – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all data quality objectives.

Example: In order to comply with current legislation, the Waste Isolation Pilot Plant has established a waste acceptance criterion that transuranic waste must exceed 100 nCi (3700 Bq) of alpha-emitting transuranic nuclides per gram of waste. At the CST Site waste management personnel worked with the WIPP staff, site laboratory personnel, and members of the local citizens advisory board to address the transuranic waste determination issue. The question is formulated as, what are the analytical criteria waste must meet in order to be categorized as transuranic waste? The answer to this question makes a significant difference in cost and in the amount of waste that will be shipped to WIPP, and conversely, the amount of waste that will be designated as low-level waste and disposed of near surface. From the perspective of worker protection, it was recognized that a non-intrusive analysis technique was preferred. The CST Site personnel anticipated that most of the waste would be around 200 nCi/g (7400 Bq/g) so they opted for a two-tiered characterization approach which employs a fast, inexpensive protocol to make an initial screening of waste and a slower, more expensive protocol to characterize waste that fails the initial screening. The data quality objective is:

> *Waste containers will be categorized as transuranic waste if the results of the non-destructive analysis exceed the minimum detectable concentration for a particular assay system and protocol, and the results exceed 100 nCi/g. Waste containers will be initially analyzed using a system and protocol that has a minimum detectable concentration of 150 nCi/g. If the result does not exceed 150 nCi/g, the waste container will be analyzed using a system and protocol with a minimum detectable concentration of no more than 50 nCi/g.*

Applying this data quality objective, a waste container is assayed as having 175 nCi/g using the first system (150 nCi/g minimum detectable concentration) and categorized as transuranic waste. Another waste container assayed as having 125 nCi/g using the first system. Even though the assay exceeds 100 nCi/g, the categorization would be indeterminate because the assayed value is less than the minimum detectable concentration. An assay of the container using the second system (50 nCi/g minimum detectable concentration) yields a result of 110 nCi/g. Based on the second measurement the waste is categorized as transuranic.

The above description of the use of the data quality objectives process, and the example, are provided as an introduction to the process. A more detailed description of the process can be found in the referenced EPA guide. The data quality objectives process is most useful during the planning stages of identifying transuranic waste characterization and uncertainty parameters, i.e., before the data are needed and collected. The value of the process is diminished significantly if the characterization data have already been collected because there is a tendency to make the questions that need to be answered fit the available data. The application of the data quality objectives process is applied in a graded manner, i.e., the depth of detail and the magnitude of the resources expended in implementing the process should be commensurate with the relative importance of the characterization data in terms of the decisions to be made and protection of the public, workers and the environment.

The intent of this requirement is not that waste streams with characterization processes already in place and accepted by storage, treatment, and disposal facilities be recharacterized using the Data Quality Objectives Process, or a comparable process, or that the characterization processes be revised using the Data Quality Objectives Process, or a comparable process. The intent is that, as new waste streams are identified and generated, the Data Quality Objectives Process, or a comparable process, be used for identifying characterization parameters and acceptable uncertainty in characterization data. If the characterization parameters of an existing waste stream characterization process are to be significantly modified, then the Data Quality Objectives Process, or a comparable process, should be used.

Compliance with this requirement is demonstrated by the documented use of a data quality objectives or a comparable process for determining the type, quantity, and quality of characterization data needed to safely manage transuranic waste.

Supplemental References:

1. EPA, 1994. *Guidance for the Data Quality Objectives Process,* EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

2. WHC, 1996. *Data Quality Objectives Procedure*, WHC-IP-1216, Revision 1, Westinghouse Hanford Company, January 31, 1996, (included as Appendix A in draft Manual HNF-SD-WM-PROC-021, Revision 0, Lockheed Martin Hanford Corporation, January 2, 1997).

III. I.(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any stabilization or absorbent media;

(c) Weight of the container and contents;

(d) Identities, activities, and concentrations of major radionuclides;

(e) Characterization date;

(f) Generating source;

(g) Packaging date; and

(h) Any other information which may be needed to prepare and maintain the disposal facility performance assessment or demonstrate compliance with applicable performance objectives.

Objective:

The objective of this requirement is to establish minimum transuranic waste data that have been determined to be necessary for safe and effective management during the life cycle of the waste.

Discussion:

In the process of developing DOE O 435.1 and DOE M 435.1-1, the safety and hazard analysis indicated that certain characterization data were critical because several consequences could be avoided or minimized if certain basic information was accurately known about transuranic waste. This requirement identifies those critical characterization data points that must be known for safe handling and proper management. The sections below provide guidance on each of these specific characteristics.

Physical and Chemical Characteristics. Physical characteristics support handling and packaging activities. Parameters include a description of the material, its density, consistency, and appearance. Chemical characteristics impact handling, storage, containment, and can impact treatment processes. These characteristics determine the compatibility of the waste with other waste and the waste container, as well as its compatibility with proposed treatment processes. Parameters include pH, reactivity, chemical compounds present, and the presence of hazardous

and/or toxic constituents. Physical and chemical characteristics can be determined directly by visual examination and/or sampling and analysis. Physical characteristics can be determined directly, indirectly by use of acceptable knowledge and/or by non-destructive examination techniques such as computer tomography or real-time radiography. Chemical characteristics can also be determined by use of acceptable knowledge.

Volume and Weight. Volume and weight information is necessary for proper control of storage and disposal facility capacities as well as proper payload control for transportation and handling systems. Typical parameters include:

- container volume, measured as the external volume of the waste container which represents the volume that will be occupied in a storage or disposal facility (e.g., 55 gallon drum or 120 cu ft (for a 4 x 5 x 6 box));

- actual waste volume, including stabilization media;

- container weight; i.e., the total weight of the container and all of its contents (waste, shielding, stabilization media) that would have to be handled;

- identification of the stabilization medium, if used; and

- waste container utilization factor, measured as the percentage of the packaging volume that is filled with waste, including stabilization media. This parameter does not require an individual calculation be made of stabilization or absorbent media volume, but that those media be included in the total waste volume calculation.

These characteristics are generally determined by acceptable knowledge (e.g., container size, stabilization medium) or by measurement (e.g., weight).

Radionuclide Data. Radionuclide information allows for proper control of thermal loads for storage and disposal facilities, determination of personnel safety procedures, control of total activity limits for transportation, storage, and disposal, and also determination of the waste type. Parameters which constitute radionuclide information may include the following:

- total activity in the container, in curies;

- identity and activity per unit mass of the major radionuclides. For purposes of this guidance, major radionuclides are those which affect the determination that a waste is transuranic waste and any others determined to be of importance to the receiving facility (e.g., by safety analysis, performance assessment, etc.);

- radiation dose levels at the surface of the container; and

- container external surface contamination levels.

These characteristics can be determined directly by smear survey or radiochemical analysis of the waste, or indirectly by waste package non-destructive assay, radiation survey, and/or by documentation of nuclear materials accountability information or individual assays performed on components contained in the container.

Date and Generating Source. Date and generating source information helps to determine the validity of currently held documentation on the waste, which, in turn, will determine the need for additional sampling or analysis. Parameters include characterization date, packaging date, DOE site, building location of the process which generated the waste, and the generating process, if available.

Performance Assessment and Compliance Data. Additional data about waste that are important to performance or evaluating performance of the disposal facility, or to complying with laws, applicable regulations, or authorizing conditions (e.g., of a permit) may also need to be collected. The specific data needed will, by necessity, be identified by the disposal facility operator. Parameters which need to be included with waste characterization data may be identified by the analysts developing the disposal facility performance assessment, specified through conditions imposed on the site through the review and approval of the performance assessment, or derived from internal regulatory compliance evaluations. Examples of the types of data that may be needed are the presence and amounts of chelating agents which can enhance the transport of radionuclides from the disposal facility, or the presence and concentrations of specific chemicals which are not acceptable above specific limits (e.g., reporting polychlorinated biphenyls concentrations versus a limit of 50 ppm).

All of these data may not be required for a particular phase in the management of the waste's life cycle. The specific data needed will be determined by the waste acceptance criteria of a particular receiving facility.

> *Example: Experimental work in a laboratory generates a liquid transuranic waste stream that is transferred via a pipeline to a central storage tank. Although the minimum characterization requirements include "weight of the container and contents," this is not relevant to this waste stream and the characterization data in the waste acceptance requirements for the central storage tank do not include packaging weight.*

Compliance with this requirement is demonstrated by the existence of a program or procedures for determining and records that document characterization of transuranic waste consistent with the minimum characterization data requirements.

Supplemental References: None.

III. J. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving transuranic waste for storage, treatment, or disposal are met.

Objective:

The objective of this requirement is to ensure that waste transferred to a facility for storage, treatment, or disposal meets the receiving facility's waste acceptance requirements, to reduce the likelihood that transferred wastes contain unacceptable materials or characteristics, and to avoid hazards that would occur from the transportation and handling of waste packages which do not meet acceptance requirements. Certification also ensures that the storage, treatment, or disposal facilities receiving the waste operate within limits established through safety analyses and/or performance assessments.

Discussion:

The *Radioactive Waste Management Manual*, General Requirements, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the waste acceptance requirements of the facility to which it is transferred. The generator requirements address generation planning, waste characterization, waste certification, and waste transfer. As discussed in this guidance, a certification program is to be established by generators of radioactive waste to provide a mechanism for confirming that waste is in compliance with the waste acceptance criteria of the facility to which the waste is being transferred. The certification program is required by any organization or facility that transfers waste to another facility.

Example: The Transuranic Waste Storage Facility has transuranic waste that it has received for storage over the last 10 years. Facility personnel plan to continue to receive transuranic waste and store it until it can be transferred to WIPP. The organization responsible for the storage facility must have a certification program through which facility personnel confirm the waste meets the acceptance criteria for WIPP . Since the storage facility does not change the characteristics of the waste package, the facility waste acceptance requirement should ensure that the waste they receive is acceptable for WIPP disposal. In this particular example, the certification program would have to be in accordance with the Generator Site Certification Guide (CAO, 1997).

The certification program is part of the waste generator program that is approved by the Field Element Manager or designee. The certification program requires that an authorized official confirms compliance with the waste acceptance requirements of the facility to which waste is being transferred. Additional guidance correlated to the specific waste certification requirements of the Transuranic Waste Requirements Chapter is provided below.

Program Development and Documentation. The waste certification program should consist of a documented, structured process that works in concert with the DOE M 435.1 requirements for waste acceptance (Section III.G) and waste transfer (Section III.K) to control the transfer of waste to a storage, treatment, or disposal facility. Development of the waste certification program involves defining and documenting controls for those items and activities that affect certifying that a waste and its packaging meets the waste acceptance criteria of the receiving facility. The documentation should include the following:

Organizations and Responsibilities - Certification program documentation needs to identify the organizations and officials involved in the certification process and the responsibilities of each. Officials who are authorized to certify waste are identified in the documentation.

Quality Assurance - The certification program is subject to quality assurance. The quality assurance controls that apply to waste certification activities needs to be identified and documented. The use of an existing quality assurance program under which the certification activities will be performed is acceptable and appropriate.

Procedures - The process for certifying waste is formalized in procedures. The procedures need to describe to the user the steps that are to be followed and the administrative process for ensuring waste containers are certified. The procedures require a signed statement certifying waste meets the appropriate criteria. The procedures also document the steps necessary for complying with the applicable transportation requirements (e.g., requirements from a safety analysis report for packaging and/or from Title 49, Code of Federal Regulations).

Procurement/Purchasing Controls - The procurement and/or purchase of items or services that are significant to certifying that waste meets the waste acceptance criteria of a receiving facility need to be documented. Such procurement may include the purchase of materials such as waste containers or laboratory services (onsite or offsite). As dictated by the type of procurement, the documentation should include (or reference) the technical specifications for the item/service being procured; identification of quality assurance requirements including any required testing or inspections; specification of documentation to be provided on delivery (e.g., fabrication inspection and/or test records; a certificate of compliance or conformance, laboratory analytical results); and a statement ensuring access

to the provider's facilities as necessary to perform audits and inspections. The certification program ensures that the procurement documentation is reviewed and approved by an official with knowledge of the need, intent, and requirements for the procurement. The program also provides for documented verification commensurate with the relative importance and complexity of the items or services being procured.

Document Control - The principal documents that constitute the certification program needs to be subject to document control. Program documentation will identify which documents are to be controlled. The waste certification program description, waste certification procedures, and quality assurance program documentation need to all be subject to document control. Document control includes review and approval, distribution to designated recipients (users), and a controlled process for making changes to the documents. Existing document control programs at a site may provide the necessary controls for documents that are part of the waste certification program.

Training - The certification program needs to identify the training requirements for the various individuals who are involved in the program. At a minimum, the program will require training of the official who certifies that the waste meets the waste acceptance criteria of the facility(ies) to which it is being transferred. In addition, individuals will need to be trained in the procedures that control the part of the certification process with which they are involved.

Records - The certification program documentation needs to describe the management of certification records (see guidance for subparagraph (1) of this Waste Certification requirement).

> *Example: A site generates a small amount of transuranic waste that is sent to a central facility managed by a waste management organization. The generating organization works with the receiving facility to define the waste certification program for the site. Through a review of the existing site procedures, site personnel determine that the waste certification program can operate under the existing site quality assurance program, document control program, procurement process, and records management program. However, they determine that the site training program does not adequately address the certification process. Consequently, the waste managers work with the training department to develop a training module that explains the purpose and process of waste certification. The certification program documentation would identify these other programs as applicable, specify the facilities from which waste would be transferred, designate the officials responsible for waste certification at those facilities and their training requirements, and develop procedures (within the document control program) that ensure compliance with the waste acceptance criteria. Within the*

existing programs, site personnel would identify the records to be maintained and retention times, technical specifications and receipt requirements for obtaining waste packaging materials, and requirements for analytical data. Operating within the parameters defined by the program, the waste generators would be able to certify waste for transfer to the onsite receiving facility.

As noted in the preceding example, existing programs at a site may provide the framework within which elements of the waste certification program can be addressed (e.g., quality assurance, training, document control). The waste acceptance requirements of the facility to which the waste is to be sent may impose additional requirements on what is to be included in the waste certification program. Whether the waste acceptance requirements of the facility to which waste is transferred mandate a waste certification program (e.g., a commercial facility), the organization transferring the waste is responsible for developing and implementing a certification program to provide internal assurance that the waste acceptance requirements will be met.

Implementation. The waste certification program is implemented through the use of the documented controls, processes, and procedures. The key document in a waste certification program is the certification statement or equivalent. The certification statement is the documentation signed by a designated official that certifies that the waste meets the appropriate requirements. The list below, derived from the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, is a generic listing of the topics that are recommended for consideration in development of certification statements.

1. Container and Physical Properties

   - container type or description
   - labeling/markings
   - weight
   - vents
   - liquids

2. Nuclear/Radiological Properties

   - fissile content
   - transuranic activity
   - other radioactivity
   - dose rate
   - surface contamination
   - thermal power

3. Chemical Properties

- mixed waste
- polychlorinated biphenyls
- other hazardous constituents
- pyrophorics
- explosives
- corrosives
- compressed gases
- volatile organic compounds

4. Packaging/Shipping Data

- packaging
- shipping information

Graded Approach. A graded approach is used in implementing the waste certification program. The above list is recommended for the intersite transfer of transuranic waste. Intersite transfers involve certifying that the waste is in compliance with the requirements for the receiving facility itself, and also in compliance with Department of Transportation requirements. However, even though the above list should be considered, it may be shortened and simplified for onsite transfers where the organizational relationships and knowledge of waste and waste generating activities may reduce the information that needs to be documented and transferred with each individual waste container or shipment. For onsite transfers, much of the information may already be available to the receiving facility. Onsite transportation of waste should be certified as meeting Department of Transportation requirements or site-specific requirements for transportation.

> *Example: For onsite transfers the receiving facility/organization may already have a waste stream profile provided by the generator facility/organization. Because of the existence of the waste stream profile, the certification may be as simple as an individual trained to the waste packaging and certification procedures signing a waste pick-up request that provides the radionuclide inventory of the waste packages being transferred and the waste stream identification number.*

The waste acceptance requirements of the facility receiving the waste (see DOE M 435.1-1, Section III.G) may dictate additional items which must be part of the certification statement. Even if such information is not dictated by the receiving facility, the waste acceptance criteria should be used to identify key elements to include on the waste certification statement.

Compliance with the development and documentation portion of the certification requirement is demonstrated by a waste certification plan that identifies the organizations involved, assigns

responsibilities for implementing the program, and describes or references the quality assurance, training, procurement controls, records management, and procedures to be used by the program. Acceptable performance for implementing the program is demonstrated when the appropriate personnel are trained, and have and follow the procedures that govern their part of the waste certification process. Acceptable performance also requires that the waste certification plan and procedures are current and controlled in accordance with a document control program, and records related to certification (e.g., certification statements, training records, procurement records, characterization records, container records) are generated and managed in accordance with the established site program.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1997.

2. DOT. *Shippers-General Requirements for Shipments and Packagings*, 49 CFR Part 173, U.S. Department of Transportation, Washington, D.C.

3. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

Objective:

The objective of this requirement is to ensure waste certification programs are developed that clearly identify the documentation required for certifying waste, specify personnel with the authority to make the certification, and provide a traceable and verifiable record of and basis for certification.

Discussion:

Officials who have the authority to certify that waste meets the waste acceptance requirements of the receiving facility must be designated by a cognizant manager. To avoid having personnel who are not knowledgeable of waste acceptance and transfer requirements authorizing the release of waste, the program needs to identify, by title or name, the officials who are authorized to certify. The official(s) are qualified by virtue of position, responsibilities, and training to make this certification. The official(s) have sufficient familiarity with the waste being generated and have been trained relative to the acceptance criteria of the facility receiving the waste for storage, treatment or disposal (and applicable transportation requirements) to be able to certify in writing that the waste is acceptable for transfer. The official(s) need to also have authorization from the facility receiving the waste to transfer the waste (see DOE M 435.1-1, Section III.K). Implementation of this element should be tailored to specific site needs and situations.

> *Example: Onsite transfers from multiple laboratories or processes to a central waste management facility may involve training multiple personnel (e.g., one for each laboratory or process) who have the authority to certify waste as meeting the onsite waste acceptance requirements. However, for the transfer of waste from the central waste management facility to an offsite facility, there may be a designated official at the site who has been trained relative to the acceptance criteria of the offsite storage, treatment, or disposal facility waste acceptance criteria and transportation requirements that is authorized to certify the waste as ready for shipment.*

The waste certification program needs to specifically identify the documentation to be produced to support the certification that waste meets the waste acceptance criteria of the receiving facility. The required documentation may include the following:

<u>Waste Stream Profile</u> (or record relating the waste to a previous profile). The waste stream profile is a description of the waste stream, generally identifying the source, physical and chemical description, and upper limits on radionuclides.

<u>Radionuclide Characterization Data</u>. Radionuclide characterization data include the concentration and/or inventory of radionuclides as determined by characterization (see guidance for DOE M 435.1-1, Section III.I, Waste Characterization).

<u>EPA Uniform Hazardous Waste Manifest</u>. The EPA manifest is required by 40 CFR Part 262 for the transfer of a hazardous or mixed waste.

<u>Waste Container Data and Integrity Maintenance Documentation</u>. Container data include information about the container dimensions, other physical attributes, and

procurement information. Integrity documentation includes the records of ownership and transfer of waste containers and data. (See guidance for Waste Transfer, DOE M 435.1-1, Section III.K).

Radiological Survey Results (or documentation referencing a survey record). Survey results include the determination of the surface contamination of the waste container and the external dose rate.

Bill of Lading. A document indicating the contents of a shipment.

Real-Time Radiography Results. The results of radiography performed to detect unallowed material in the waste package (e.g., liquids, compressed gas cylinders).

Certification Statement. The statement required by DOE M 435.1-1 to document that waste is in compliance with the acceptance criteria of the facility to which the waste is being transferred.

Authorization to Transfer. Documentation indicating that an official from the facility to which the waste is to be transferred has authorized transfer of the waste to the facility.

As noted for other elements of this requirement, the organization developing the certification program uses a graded approach in determining which of these documents are needed. Regardless of the extent of the required documentation, the certification statement can serve as a checklist that all of the waste acceptance criteria have been considered and the waste is in compliance. An example of a certification statement for waste to be shipped to WIPP is provided at the end of this section of guidance (Figure III.J.1).

In order to ensure that information is available if or when it is needed in the future, the waste certification program should identify which records are to be maintained and how they are to be maintained. The certification program documentation may include specific records management requirements, or may simply invoke an existing acceptable records management program. Although no minimum record retention times are established in DOE M 435.1-1, certain records may need to be maintained indefinitely. Whereas hazardous waste regulations require only a three-year retention period, DOE disposal facilities should plan on maintaining pertinent records at least through the operations, closure, and post-closure monitoring periods, and consider making them part of any local land use records. The pertinent records would be those which identify physical, chemical, and radiological characteristics of the waste and the certification of that information. Generating, storage, or treatment facility waste management records may not be required beyond the life of the facility or operation, provided pertinent information has been supplied to the facility where the waste will be disposed.

Example: Personnel at a storage facility maintain records describing when they received waste, what the waste was (characterization and container data provided by the generator), and to whom the waste was eventually transferred. Once the waste is disposed of and the waste characterization and container information is in the possession of the organization responsible for the disposal facility, the organization responsible for the storage facility disposes of its records.

To meet the requirement for auditability and retrievability, the method of records storage and retention needs to allow a person to trace shipment or waste container information back to the generator certification data (e.g., characterization data, source data, container data). In accordance with the DOE M 435.1-1, Section III.K Transfer Requirements, information on the source and characteristics of the waste are to be transferred when waste is transferred. It is not the intent of this requirement that a certification statement be generated for existing waste that was received without such information (i.e., waste in storage as of the issuance of DOE O 435.1). However, such documents must be created for any subsequent transfers of waste.

Example: A site should be able to provide the characterization, container, and certification information for any waste container within a storage, treatment, or disposal facility if that waste container is transferred after issuance of DOE O 435.1.

Compliance with this requirement is demonstrated by a program or procedure for record keeping and records showing that each container of waste is certified as having met the waste acceptance criteria of the facility to which it was transferred and the certification statement is supported by additional records regarding the waste source, characterization, and container.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. J.(2) Certification Before Transfer. Transuranic waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Objective:

The objective of this requirement is to ensure that waste meets the acceptance requirements of the storage, treatment, or disposal facility before it is transferred to prevent transferring waste that

could endanger receiving facility personnel, and to avoid the delay and potential hazards associated with corrective actions taken to remedy non-compliant conditions.

Discussion:

The waste certification requirements above address development, implementation, and content of a waste certification program. The requirement that waste be certified before transfer ensures that the program is effective in preventing the transfer of waste that does not meet the waste acceptance criteria of the facility receiving the waste for storage, treatment, or disposal. In accordance with this requirement, waste should be released for transfer to another facility only after there is a certification by an authorized official that the waste acceptance requirements have been met. Ensuring certification occurs prior to allowing the physical transfer of waste prevents potential hazards associated with managing waste rejected by the facility to which it is transferred. Requiring certification before waste is transferred also reduces the likelihood of having to recall a waste shipment due to a discovery by the certification official, after the waste is in transit, that the waste does not comply with the waste acceptance requirements. Guidance on DOE M 435.1-1, Section III.K discusses what constitutes a transfer, and can be consulted to determine when this requirement needs to be met.

Certification that the waste is ready for transfer and meets the waste acceptance criteria and the applicable transportation requirements, is a control point in the transfer process. The procedures controlling waste transfer should not allow the transfer to occur unless the certification statement has been signed. Once signed, the certification statement becomes part of the record for the transfer of the waste (see Waste Transfer, Section III.K). An example of a certification statement for shipment of contact-handled waste to WIPP is included as Figure III.J.1. As can be seen from examination of the certification statement in Figure III.J.1, the signature on the certification statement is confirming that the waste has been characterized for physical, chemical, and radiological characteristics, properly packaged, and necessary container markings and shipping data have been prepared.

> *Example: Central Waste Management Facility personnel are responsible for receiving waste, providing interim storage, and making transfers to an offsite transuranic waste storage facility. In order for the workers at the Central Waste Management Facility to place a waste container on a truck for transfer, the operating procedures for the facility require that they have a signed certification statement that correlates to the container(s) (either bar coded or numbered). Once a waste container is loaded, a copy of the certification statement is included in the waste transfer papers and another is included in the Central Waste Management Facility files.*

Compliance with this requirement is demonstrated by the presence of a certification program which includes procedures requiring a signed certification statement prior to the release of waste for transfer, and by dated records showing that waste was certified before being transferred.

Supplemental References: None.

III. J.(3) Maintaining Certification. Transuranic waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Objective:

The objective of this requirement is to ensure that certified waste is managed to maintain the certification status and avoid the unnecessary handling of waste containers that would be necessary for recertifying waste.

Discussion:

There may be instances where waste must be stored before being transferred to the next stage in the waste management process. If waste is certified as meeting the waste acceptance criteria of the receiving facility prior to, or during storage, it needs to be stored and controlled so that the certification remains valid until the waste can be transferred. For instance, many DOE sites will send transuranic waste to WIPP for disposal. If a facility certifies waste in accordance with a program authorized by the Carlsbad Area Office, the waste needs to be stored under conditions and with controls to protect it from physical damage, and to prevent tampering (i.e., placement of unallowed materials into the container) so it can be transferred for disposal without re-certification.

Example: A facility generates transuranic waste which is sent to an onsite storage facility. An inventory of everything put into the waste container is maintained while the container is being filled. Once filled, the container is closed and a numbered tamper-indicating device is put on the container closing band. The facility's authorized waste certification official confirms that the waste has been properly characterized and meets the storage facility's waste acceptance criteria. When the authorized waste certification official fills out the waste certification statement, the number of the tamper-indicating device is also entered on the form. Facility procedures require closed, certified waste packages to be staged in an indoor area adjacent to the loading dock. Thus, at the time of transfer, the generating and receiving facility personnel are assured that the certification is valid because environmental conditions have not affected the

package (it has not been exposed to precipitation, freezing, or extreme heat/sunlight) and because the tamper indicating device indicates that the container has not be opened since it was certified.

Also, certifying officials need to be aware of any limitations on the amount of time a waste can be stored without invalidating the certification. Actions necessary to certify a waste that involve potential radiation exposure of workers are deferred, if possible, until there is a reasonable expectation that the waste can be transferred to the receiving facility within the time that the certification is valid. Routine monitoring required for waste in storage may not allow all activities that could result in worker exposure to be deferred.

This requirement is not to be interpreted in a manner that interferes with a facility performing a normal acceptable waste management function. Therefore, if a waste is certified as meeting the waste acceptance criteria of a treatment facility, the requirement to maintain the certification of the waste is not intended to prevent the treatment facility from treating the waste. Even though, treating the waste will not "maintain" the certification, the purpose of the certification is to ensure the waste can be safely accepted for treatment. Maintenance of the certification status is intended to cause the waste to be stored, transported, and staged at the treatment facility in a manner that will allow personnel to treat the waste without concern that it no longer meets the acceptance criteria. In addition, despite the protection provided for the waste, sampling prior to treatment may still be a necessary process control step.

Specific requirements for protecting the certification status of a container of waste are generally negotiated with the receiving facility. Requirements to be considered include protecting the waste container, preventing unauthorized introduction of material into the waste, and protecting the data about the waste container. The Waste Transfer requirements (DOE M 435.1-1, Section III.K) also address protecting waste containers and data to ensure that characterization and packaging data remain accurate and useable by waste managers. Waste containers need to be provided with sufficient protection from the elements (e.g., precipitation, wind, flooding, excessive heat) such that the character of the waste and container, and therefore the certification are not altered. Containers of waste also need to be stored in a manner that prevents modifying their contents (e.g, under lock and key or with a tamper indicating device) and in a location where the container will not be damaged (away from equipment high traffic areas where there is the possibility of damage). In addition, it is necessary to be able to relate each container of waste to information about the contents of the container. Container markings must be protected from defacement or removal, and records regarding container identification and contents must be safely stored.

Example: Department personnel have learned from experience that below-ground storage does not provide the type of protection that could be relied on to protect the certification status of the waste. Although the below-ground environment maintains waste packages within a reasonable temperature range, it also subjects them to

environmental conditions that can be detrimental to packaging and marking. Condensation collecting under plastic has been shown to lead to rust of waste containers making markings illegible and the container no longer suitable for performing its containment function.

Compliance with this requirement is demonstrated by the existence of a program or procedure reflecting this requirement and site personnel able to show that the storage of containers of waste is in a facility or manner where the containers are not damaged by normal weather events, and cannot be accessed by unauthorized personnel. Further, each container can be traced to its certification and the information supporting that certification.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1997.

2. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

CH-TRU WASTE CERTIFICATION STATEMENT

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Container ID Number: ________________________

CRITERIA	LIMITS	INITIALS
Container Description	• DOT Type A 55-gallon drums or solid waste boxes (SWBs)	
Container/Assembly Weight	• 1000 lbs/55-gallon drum • 4000 lbs/SWB • TRUPACT-II weight limits	
Removable Surface Contamination	• 20 dpm/100 cm^2 alpha • 200 dpm/100 cm^2 beta-gamma [(4)]	
Container Marking	• Bar code • Shipping category [(1)]	
Filter Vents	• Payload containers vented	
Liquids	• No liquid wastes • < 2 liters total residual liquid per 55-gallon drum • < 8 liters per SWB • < 1 in. (2.5 cm) in the bottom of any container	
Pu-239 FGE	• < 200 g/55-gallon drum • < 325 g/SWB • < TRUPACT-II limits	
Pu-239 Equivalent Activity	<u>Untreated Waste</u> • 80 PE-Ci/55-gallon drum • 130 PE-Ci/SWB • 1800 PE-Ci/55-gallon. Drum overpacked in SWB or TDOP <u>Solidified/Vitrified Waste</u> • 1800 PE-Ci/55-gallon drum	
Contract Dose Rate	• 200 mrem/hr	
Thermal Power	• Reported if > 0.1 watts/ft^3 • < 40 watts per TRUPACT-II	
TRU Alpha Activity	• > 100 nCi/g of waste matrix	
Pyrophoric Materials	• < 1% Radionuclide pyrophorics • No non-radionuclide pyrophorics	
Mixed Waste	• Characterization per QAPP • Limited to EPA waste codes listed in WAC	
Chemical Compatibility	• Chemicals allowed by the CH-TRAMPAC	

Figure III.J.1. Example Waste Certification Statement

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CRITERIA	LIMITS	INITIALS
Hazardous Constituents	• Target analytes and TICs reported per QAPP	
Explosives, Corrosives and Compressed Gasses	• None present	
PCBs Concentration	• < 50 ppm	
Decay Heat(1)	• Wattages listed in CH-TRUCON	
Flammable VOCs	• 500 ppm in container headspace	
VOC Concentration	• Limits shown in WAC Table 3.5.3.3	
Aspiration(1)	• Times shown in CH-TRUCON tables	
Shipping Category(1)	• Content codes listed in CH-TRUCON • One category per TRUPACT-II	
Confinement Layers(1)	• Liner punctured/vented • Number of layers known • Bags closed by approved methods • Sealed containers > 4 liters prohibited (except for waste material Type II.2)	
Acceptance Data	• Auditable package of data with signed Certification Statement on file • WWIS data transmitted	
RCRA Data	• Waste Stream Profile Form • Uniform Hazardous Waste Manifest(2) • Land Disposal Restriction notification(2)	
Shipping Data	• TRUPACT-II Payload Container Transportation Certification Documents • Bill of lading(3)	

NOTES: (1) Applies to TRUPACT-II payload control only
(2) Applies to mixed wastes only
(3) A Uniform Hazardous Waste Manifest may be substituted
(4) May be 1000 dpm/100 cm^2 for certain isotopes

I hereby certify that I have reviewed the data for this waste container and that it is complete and accurate to the best of my knowledge. I have determined that it meets the requirements stated in the current revision of the WIPP Waste Acceptance Criteria. I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

_______________________________ ________ ________
Waste Certification Official Signature Date Initials

Figure III.J.1. Example Waste Certification Statement (cont.)

III. K. Waste Transfer.

A documented process shall be established and implemented for transferring responsibility for management of transuranic waste and for ensuring availability of relevant data. The following requirements are in addition to those in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure that the responsibility for transuranic waste containers is established, maintained, properly transferred, and adequately documented so that ownership, and therefore responsibility for safe management, of waste is clear. This responsibility includes maintaining the waste characterization information, the container information, and information about the treatment, storage, transportation and disposal status of containers of waste. This responsibility also includes an assurance that the container of waste has not been altered in a manner that affects its certification status or the ability of the waste to be properly managed.

Discussion:

As discussed in Section I.2.F.(7) of the guidance for DOE M 435.1-1 Chapter I, the radioactive waste generator program includes consideration of the generation planning, characterization, certification, and transfer of transuranic waste. In the generator's program, initial responsibility is assigned for containers of transuranic waste and a documented process for transferring the responsibility is established.

In the development of DOE O 435.1 and DOE M 435.1-1, maintaining the integrity of waste containers was identified as necessary for the proper control and safe management of transuranic waste. Similarly, maintaining information about containers of transuranic waste (characterization and container data) was recognized as vital to making and executing safe management decisions. In order to ensure that it is clear who has the responsibility for protecting the integrity of each container of transuranic waste and associated waste and container data, there needs to be one person who is identified as being responsible for the waste at any time. Confusion over who is responsible for specific waste containers is avoided by documenting the transfer of responsibility.

This requirement is similar to the concept of "chain of custody" used in sample management. As with samples, transuranic waste containers may be the responsibility of many different organizations during their management life cycle. At any point during the life cycle management of the waste, the identity of the individual responsible for each container of waste needs to be explicit. By clearly identifying the "owner" of each container of waste, there is no question regarding who is responsible for protecting the waste container and the waste characterization and

container data, and for moving the waste to the next phase of waste management (i.e., storage, treatment, or disposal).

Maintaining Waste Container and Data Integrity. The individual responsible for a container of waste is responsible for maintaining and protecting both the integrity of the container of waste and the data about the container of waste. Protecting the integrity of the waste container is the same as protecting the certification status of a waste container as discussed in the Waste Certification guidance. Essentially it involves managing the container of waste so that it is not damaged or does not degrade because of the conditions under which it is managed.

Maintaining the data about the container of waste involves ensuring receipt or traceability, or developing (as discussed below) information necessary to support subsequent waste management activities, or clearly documenting and ensuring that the information is stored and updated so that full and accurate information is available to the next individual to whom the waste is transferred.

Transferring Responsibility. The transfer of responsibility for containers of waste and the associated waste and container data is to be done in accordance with procedures at each of the facilities involved. The facility from which the waste is transferred, typically establishes (for newly-generated waste) or possesses (for stored wastes) a record or data package about the waste and its container. The facility operating procedures should require the development of an ownership log sheet similar to a “chain-of-custody” log. This log becomes part of the data package that is transferred with the container of waste. Upon transfer, the facility transferring the waste is responsible for ensuring personnel at the facility to which the waste is being transferred have assumed responsibility for the waste. A signed and dated copy of the ownership log sheet can serve this purpose. All subsequent transfers, e.g., from storage or treatment facilities, are to be in accordance with procedures requiring the transfer of the data package and documentation of the transfer of responsibility for the waste.

Procedures at the storage, treatment, or disposal facility should require the receipt of certain information about any waste which is received. To ensure that they have sufficient information to safely manage the waste and to transfer the waste to a subsequent waste management facility (if appropriate), it is important for storage, treatment, and disposal facility personnel to ensure they are provided information about the containers of waste for which they become responsible. The receiving facility requires the following documented information be available for all waste they expect to receive:

- Responsible individual. The name, title, affiliation, and phone number of each person who has held responsibility for the waste, starting with the generator. This listing can serve as the ownership log with each person signing the log upon accepting responsibility for the waste.

- <u>Transfer dates</u>. The date the transfer was accepted by each new "owner" of the waste.

- <u>Waste container information</u>. Information about the container (see guidance for III.K.(2) in this section).

- <u>Characterization information</u>. Information about the waste. See guidance on Waste Characterization.

- <u>Physical location</u>. The site and name (e.g., unique identifier such as a building number) of each location where the waste was managed.

- <u>Previous transportation</u>. Dates of transportation and names of carriers.

- <u>Certification status</u>. A signed certification statement or equivalent (see guidance on Waste Certification). Only the certification statement for the facility to which the waste is being transferred must be part of the waste package data. Previous certification statements may be included if they serve the purpose of documenting other data that should be part of the data package (e.g.,container or characterization data).

- <u>The planned disposition of the waste</u>. Expected storage, treatment, and disposal. See guidance on Generation Planning and Site-Wide Radioactive Waste Management Program.

For each transfer of waste, beginning with the generator, the receiver of the waste is responsible for obtaining the proper information from the sender of the waste. The receiver is responsible for ensuring receipt or availability of complete and accurate information concerning containers of waste. The information needs to be reviewed prior to actual transfer and is a condition of acceptance by the receiver.

> *Example: A treatment facility receives transuranic waste for processing. Upon signing for receipt of the waste, the facility manager becomes the individual responsible for the waste. Facility procedures require that a copy of the data received from the generator be kept in a file cabinet which is accessible only to one individual on each shift. As the containers of waste are processed in the facility, information is recorded in a log and the data package is updated to reflect the change in status of the waste. Upon completion of the processing, the treated waste is packaged in new waste containers and a certification statement is generated indicating that the treated waste meets the waste acceptance criteria for the storage facility to which it will be shipped. Before the waste is transferred, the treatment facility personnel provide a complete set of data to the storage*

facility personnel. The data package reflects the new container numbers for the treated waste, but includes the data on the original containers received at the treatment facility. The treatment facility also keeps a duplicate copy of the data package which includes a copy of a waste log indicating transfer of ownership to the storage facility.

The responsibility for ownership of the waste can be different than that for waste certification. The individual responsible for the waste does not necessarily have to be the same individual that certifies the waste is ready to be transferred (see guidance on Waste Certification). As indicated above, the certification status is one piece of information that is transferred with the waste.

Compliance with this requirement is demonstrated if facilities have procedures for the receipt of waste and the transfer of waste, as appropriate, which address the acquisition of waste and container data and the transfer of ownership, respectively. Further evidence of acceptable performance is facility records showing that data on the waste containers are available and accurate, and that documented transfer of responsibility occurs.

Supplemental References:

1. EPA 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, 3rd Edition, U.S. Environmental Protection Agency, Washington D.C., June 1997.

III. K.(1) Authorization. Transuranic waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Objective:

The objective of this requirement is to ensure that shipments or transfers of transuranic waste are made only with the cognizance and approval of personnel at the facility receiving waste so that preparations can be assured for its safe management.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(7), the radioactive waste generator program includes consideration of the generation planning, characterization, certification, and transfer of transuranic waste. During the development of DOE O 435.1 and DOE M 435.1-1, a review of waste management functions indicated that the receipt of waste without personnel at the facility receiving the waste having knowledge of what was sent presented a potential hazard. If waste is transferred to a facility without prior authorization, the controls

necessary for the proper and safe management of the waste may not be in place. As a consequence, the waste may be rejected and returned to the sender. This requirement represents a control to minimize the potential for exposures and releases during the handling and transfer of transuranic waste.

Safe transfer of the waste can only be assured if the facility receiving the waste for storage, treatment, or disposal has considered the acceptability of the waste versus its safety operating constraints. Personnel at a storage, treatment, or disposal facility who authorize the transfer of waste are indicating that they have the capability to receive the waste and manage it in a manner that is protective of workers, the public, and the environment. Therefore an essential component to safe life-cycle management is that authorization be received before transfer of transuranic waste to a storage, treatment, or disposal facility. Meeting this requirement is the responsibility of the organization or individual transferring (sending) the waste. The following are considered transfers:

(1) Waste is physically moved from one location to another, even if ownership does not change.

(2) Waste is physically moved from one location to another and ownership changes.

(3) Waste is not physically moved, but ownership changes.

The actions and documentation necessary to obtain authorization will depend on the specific storage, treatment, or disposal facility to which waste is to be transferred. In some cases, the submittal of a waste stream profile which provides a description of the waste and a range of the waste characteristics, augmented by conversations with the generator, may provide enough information for the storage, treatment, or disposal facility staff to be confident that they can safely manage the waste. In other cases, the waste acceptance requirements of the storage, treatment, or disposal facility may dictate that an onsite visit and review of the generator's waste certification program be performed. In order to expedite the transfer of waste, staff responsible for sending the waste need to ensure they understand what information and activities need to be completed in order to receive transfer authorization.

Authorization to transfer waste is received in writing and states the scope of the authorization. The authorization may specify a specific group of waste packages or specific number of shipments of a particular waste type. However, it is acceptable for the written authorization to specify a waste stream(s) which the generator can send on a routine basis. Any additional conditions or notification requirements can be included in the written authorization. Whereas it is the responsibility of the storage, treatment, or disposal facility to prepare the written authorization, the organization sending the waste must not transfer waste until they have authorization and understand which waste is included in the authorization.

Example 1: An activity at Site X results in the routine generation of transuranic waste in the form of contaminated personnel protective equipment, swipes, plastic sheeting, and paper waste. The waste stream is designated by the number X-2156. Consistent with site procedures, the generator prepares a waste stream profile which describes the characteristics, packaging, and projected generation rate of the waste stream and provides it to the waste management organization. The waste management organization reviews the waste stream profile and calls the generator facility representative to clarify the information on the waste stream profile. The waste management organization has previously reviewed the generator's certification program. Based on the certification program and the waste stream profile, the waste management organization prepares a letter authorizing the generator to transfer any waste that meets the X-2156 profile until further notice. The authorization letter also states that the generator must provide the waste management organization notice of the number of waste containers to be transferred 48 hours before a transfer occurs.

Example 2: A site plans to ship transuranic waste to WIPP for disposal. A Generator Site Certification Guide (DOE/CAO-95-2119) has been prepared to aid individual sites in their preparation to become authorized certifiers of waste destined for WIPP. Generator sites are authorized by WIPP to certify waste for transfer following an audit confirming satisfactory implementation of certification requirements. The authorization is typically good for one year, at which time the transferring facility must be re-authorized through an audit. Once the generator's certification program has been audited and found to be acceptable, day-to-day authorization of waste transfers is accomplished by review and approval of data packages describing planned waste transfers.

When transuranic waste is transferred (moved from one location to another), but the ownership of the waste does not change (i.e., the same individual is responsible for both facilities), a separate authorization may not be required. Recognizing that the intent of this requirement is to ensure that the waste is expected and can be safely managed at the facility to which it is being transferred, other documentation can serve as the written authorization.

Example: The manager of the waste management organization is the official responsible for authorizing transfer of waste to either of two separate storage facilities, Building A and Building B. Even though the waste acceptance criteria are the same for the two facilities, waste is accepted and logged into each facility separately. The manager decides to consolidate all of the waste into Building A for more efficient management. The authorization to transfer is provided by the certification statement indicating that the waste meets the Building A waste acceptance requirements, and the documentation of the new storage location on the waste characterization and container data.

Compliance with this requirement is demonstrated by sites having procedures that require a confirmation of authorization before releasing waste for transfer, and records showing that transfers are made in accordance with written authorizations.

Supplemental References:

1. DOE/CAO, 1995. *Generator Site Certification Guide*, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, 1995.

III. K.(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for transuranic waste shall be transferred with or be traceable to the waste.

Objective:

The objective of this requirement is to ensure establishment and maintenance of information about the characteristics of waste and the waste containers to ensure that sufficient information to support management of waste in a manner that is protective of workers, the public, and the environment is always available.

Discussion:

The *Radioactive Waste Management Manual*, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the applicable waste acceptance requirements. Generator requirements address generation planning, waste characterization, waste certification, and waste transfer. The requirement for traceability of data addresses the hazards associated with transferring waste without providing or maintaining adequate information about the container and its content. Establishing and maintaining the identity of the waste, as well as maintaining controls based on the waste's hazards, are necessary for its safe transfer and subsequent management. Acquisition of information about the waste is addressed in the guidance on Waste Characterization (DOE M 435.1-1, Section III.I). Certification that waste is ready for transfer (i.e., meets the waste acceptance requirements and transportation requirements) is discussed in the guidance on Waste Certification (DOE M 435.1-1, Section III.J). Maintenance of documentation regarding transfer of waste is discussed later in this section of guidance.

In the process of developing DOE O 435.1 and DOE M 435.1-1, transfer was identified as the activity in the life-cycle management of waste with the greatest potential for loss of information about containers of waste, and the associated loss of adequate waste management controls needed to avoid exposure or release of radioactivity. Therefore, when waste is transferred, the waste characterization and container data must be transferred or available to the new “owner” (i.e., responsible waste manager) of the waste.

> *Example: A liquid transuranic waste is being transferred to a treatment facility for solidification. The waste was characterized and the waste characterization information listed on the waste certification statement. Although the waste met the waste acceptance criteria for the treatment facility and an authorization to make the transfer was granted, the characterization information was not transmitted before or in conjunction with the waste transfer. Due to storage limitations at the treatment facility, the drums of waste were placed in an unheated staging area. After a three days of below freezing weather, it was noted that the drums were bulging and split. Had the characterization information been documented and transferred with the waste, treatment facility personnel would have known it was an aqueous waste and would have imposed controls on the waste to protect it from freezing conditions.*

Sufficient information about the container in which waste is packaged needs to be provided to the storage, treatment, or disposal organization to which waste is transferred to ensure that the containers are handled safely.

The information about the container is supported by and traceable to the more detailed container procurement information. The organization that procures the container is responsible for properly documenting the essential information regarding the procurement. The information needs to be maintained so questions about adequacy of the container for its originally intended or alternate uses can be assessed and to answer questions about subsequent procurements. Information documented concerning the procurement of waste containers includes:

- Purpose of the container;
- Container performance requirements;
- Purchase specifications; and
- Manufacturer certifications verifying performance to purchase.

The information concerning the purpose of the container should include the designed service life, the environments for which the container was designed and is compatible with, and other information necessary to allow proper use of the container. The procurement information

includes vendor information, product specifications, lot or serial number information, and other procurement information necessary to document the container purchased.

The detailed procurement data about containers can be, but does not have to be, transferred at the time waste is transferred. An acceptable practice for the organization transferring the waste would be to maintain the records for as long as they are retrievable and can be correlated to the waste containers.

The type of container information that should be provided upon transfer of containers of waste will depend on the type of waste and subsequent waste management steps. Typically, the information includes the following:

- container size and type - generally this would be the container that is providing the primary containment of the waste (e.g., DOT 7A 55-gallon drum, standard waste box, or DOT 7A 80-gallon overpack);

- container enhancements - additional items that have been added to the primary container to facilitate container performance (e.g., shielding, liners, plastic bags, absorbents);

- lifting limitations - allowable and/or unallowable lifting points and methods; and

- load limitations - based on the physical characteristics, the maximum number of containers or weight that can be placed on top of the waste container.

When waste is initially placed in the container, the organization packaging the waste is to document and manage the information regarding its characteristics (e.g., radioisotopic inventory, total activity, radiation dose, waste form). When the container of waste is physically transferred or the ownership has changed, the information regarding the waste and container must be provided or made available to the organization that acquires responsibility for the waste. A transfer is considered to have occurred if the waste is physically moved from one location to another or if there is a change in responsibility for the waste.

The following waste container characterization data are typically provided with the transfer of transuranic waste:

- physical and chemical description of waste (use of item description code or waste stream identifier, if applicable);

- radiological inventory (see guidance on Waste Characterization);

- gross weight;
- volume percent utilized;
- fissile gram equivalent;
- fixed and removable surface contamination (alpha and beta/gamma);
- surface dose rate;
- seal number;
- TRUCON Code;
- thermal power; and
- shipping category.

Example: Building 2000 is undergoing a facility cleanout that involves the decontamination of building surfaces and the removal of excess processing equipment. The organization responsible for the facility identifies two types of waste containers to be used, 55-gallon drums for small items, personnel-protective clothing, and contamination control waste, and standard waste boxes for larger pieces of equipment. The job is managed such that one operator is responsible for logging each piece of waste put into the containers. Upon filling a waste drum or box, the container is closed, and a tamper-indicating device is installed. Radiological Services personnel perform radiological surveys of each container of waste and record the data. The authorized waste certification official uses the data recorded on the waste log and survey sheets, supplemented with radiological characterization data, weight data, and other information to fill out a waste certification checklist. The checklist requires identification of waste container data as discussed above. In accordance with site procedures, the checklist is a piece of required paperwork that is to be provided to the storage, treatment, or storage facility to which the waste is transferred.

This requirement needs to be implemented with consideration given to documentation requirements imposed by other internal programs or external organizations such as the Environmental Protection Agency or Department of Transportation. These other documentation requirements, such as an EPA Uniform Hazardous Waste Manifest or a transportation bill of lading, may include much of the waste container information that is provided to the storage, treatment or disposal facility to which waste is transferred. Therefore, to the extent these other documents have the appropriate information, they may be used to meet the requirement to convey

information about the waste being transferred to a subsequent waste management facility. If documentation prepared to meet requirements of other programs or organizations is used, it may need to be supplemented to provide any additional data on waste characterization and packaging addressed in this guidance.

> *Example: Transuranic mixed waste is being sent from one site to another for storage. Since the waste is regulated under RCRA, a Uniform Hazardous Waste Manifest is prepared as required by 40 CFR Part 262. The manifest includes information about the physical and chemical characteristics of the waste, the container type, and container weight. The site has developed a 'Radiological and Supplemental Characteristics Data Sheet' to provide additional information about the containers of mixed waste. The data sheet provides additional information about the radiological inventory, surface dose rate, surface contamination, fissile material content, number of the tamper-indicating device installed on the waste containers, load limitations, and handling limitations. Between the two documents the storage facility is provided enough information so they can safely manage the waste.*

Compliance with this requirement is demonstrated if there are procedures requiring that characterization and container data be provided and maintained for each waste transfer and documented records of transfers show that the information is being provided.

Supplemental References:

1. EPA. *Standards Applicable to Generators of Hazardous Waste,* 40 CFR Part 262, U.S. Environmental Protection Agency, Washington, D.C.

III. L. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging.

(a) Transuranic waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste is removed from the container.

(b) Vents or other mechanisms to prevent pressurization of containers or generation of flammable or explosive concentrations of gases shall be installed on containers of newly-generated waste at the time the waste is packaged. Containers of currently stored waste shall meet this requirement as soon as practical unless analyses demonstrate that the waste can otherwise be managed safely.

(c) When transuranic waste is packaged, defense waste shall be packaged separately from non-defense waste, if feasible.

(d) Containers of transuranic waste shall be marked such that their contents can be identified.

Objective:

The objective of these requirements is to ensure that when waste is packaged, the container selected is adequate to contain the waste and limit radiation exposure for the entire time the waste is in storage, to reduce future exposure by segregating defense and non-defense wastes, and to ensure that the container can be correlated to necessary information on its contents. The first subrequirement is to ensure the selection of a container for waste based on the life cycle of the waste so that there will not be unnecessary repackaging of waste. The second sub-requirement is to prevent the build-up of pressure or concentrations of gases that could cause a loss of waste confinement. The third subrequirement is to ensure the segregation of defense waste that can be accepted for disposal at WIPP from other waste in order to facilitate compliance with the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992,* as amended. The last subrequirement is to ensure that it is possible to identify the contents of the container of waste during storage and when the waste is removed from storage for treatment or disposal without having to open the container.

Discussion:

The need for packaging requirements specific to waste management evolved from the development of DOE O 435.1, and past experience in transuranic waste transportation. The safety and hazards analysis conducted in support of the Order and Manual development identified loss of confinement of a waste container as a potential hazard affecting worker safety and releases to the environment. In addition, the inability to associate a container with data on the contents was identified as a situation that would result in unnecessary worker exposure due to the need to re-characterize the waste. Mitigation of each of these concerns can be achieved through proper packaging and compliance with the requirements of this section. The safety analysis supporting use of the TRUPACT II for transportation of transuranic waste has identified the build up of explosive gases as a potential problem.

An analysis of existing requirements affecting the packaging of waste identified the Department of Transportation (DOT) regulations and the DOE Orders, DOE O 460.1A and DOE O 460.2, as sources of packaging requirements (see DOE M 435.1-1, Section I.D.(12)). Generally, the DOT requirements apply to offsite shipments. *Packaging and Transportation Safety* (DOE O 460.1A) invokes the DOT requirements, or documented requirements providing equivalent safety, for onsite shipments. These regulations require the use of DOT Type A or Type B packaging (depending on radionuclide content) for DOE waste shipments. The DOE O 460.1A also establishes the means and approval authority for qualifying packaging as Type A or Type B. *Departmental Materials Transportation and Packaging Management* (DOE O 460.2) includes DOE policies and requirements that supplement the DOT regulations. Requirements from DOE O 460.2 relevant to waste packaging include the inspection of waste shipments upon receipt, provision of data to the Department's Packaging Management Plan, and performance of routine assessments of transportation and packaging operations.

While the DOT regulations and DOE packaging and transportation requirements were considered adequate for shipping waste, they were not considered sufficient to address the other transuranic waste management concerns associated with long-term storage or with selecting and packaging waste based on the entire waste management life cycle.

The life-cycle management of transuranic waste has historically involved the packaging of transuranic waste followed by a protracted storage period while awaiting disposal. Selection of a container (i.e., a receptacle and any other components or materials necessary for the receptacle to perform its required containment function) needs to account for all waste management steps expected prior to and including disposal. Therefore, the container needs to meet the requirements for transportation, storage, and eventual disposal (to the extent the disposal requirements are known). Alternatively, if waste treatment is required, the container needs to be adequate to contain the waste during storage and allow the waste to be transferred to the treatment facility where it may be removed from the container prior to treatment. Subsequent to treatment,

packaging of the treated residues is based on meeting all of the requirements of the remaining waste management steps. Selection of a container that fulfills the needs of all subsequent waste management actions ensures waste confinement and eliminates the need to repackage the waste, thus avoiding potential exposure to workers.

> *Example: The Waste Acceptance Criteria for the Waste Isolation Pilot Plant (DOE/WIPP-069) identifies the container, packaging, and transportation requirements that must be met before transuranic waste may be shipped to and disposed in WIPP. The requirements are derived from several sources which include: the WIPP Safety Analysis Report, the TRUPACT-II Safety Analysis Report for Packaging, the RH-TRU 72-B Cask Safety Analysis Report for Packaging, and the WIPP Land Withdrawal Act of 1992, as amended. Containers that meet the WIPP Waste Acceptance Criteria and the acceptance criteria for storage would be acceptable since the waste would likely not require repackaging for any of the expected waste management steps.*

<u>Containment and Protection</u>. Transuranic waste must be adequately contained, and the container protected from conditions that could cause container degradation. Inadequate containers or container degradation could lead to failure and result in the spread of contaminated materials, worker exposure, or the non-acceptance by a receiving facility. When selecting transuranic waste containers, consideration must be given to the conditions to which the container will be subjected. If waste is to be stored outside for an extended period and subjected to the natural environment, the container must be made of materials that have been demonstrated to maintain integrity during these conditions.

> *Example: Contaminated soil and debris were packaged in wooden boxes or carbon steel 55-gallon drums which were stored in earthen berms for many years. The boxes and drums degraded to the point that they no longer served as containment and were literally falling apart. Due to the selection of inadequate containers (for the storage conditions and duration), the waste had to be repackaged prior to transfer and the used wooden boxes and drums also managed as transuranic waste.*

Transuranic waste must not be incompatible with the container in which it is placed. The physical, chemical, and radiological attributes of the waste need to be considered when selecting a container. Container integrity must not be jeopardized due to the size, shape, or weight of objects contained in the waste. Containers need to be compatible with any unusual chemical characteristics, water content, and pH of the waste. If absorbent or other materials are used to bind liquids contained in the waste, the resultant waste matrix must not be capable of spontaneous combustion, decomposition, explosion, liquid desorption, or otherwise have the ability to affect the integrity of the containers in any way (see Storage guidance III.N).

Shielding may also be required to provide protection to workers who handle the waste containers or who are responsible for monitoring waste in storage. The necessity for shielding should be

considered at the time of packaging so that the shielding can be integrated into the waste container before waste is present if internal shielding is acceptable to the storage, treatment, or disposal facility. Alternatively, the storage configuration may be designed to provide the necessary shielding. If shielding is required, consideration needs to be given to the use of materials that do not have the possibility of becoming a mixed waste if contaminated by the radiological constituents. Guidance for DOE M 435.1-1, Section III.K discusses the selection and procurement of waste containers and the necessary information that is documented.

> *Example: A new facility generates remote-handled transuranic waste sludges with caustic properties and multiple fission products species. The container selected has been designed to withstand chemical attack from the sludge, includes sufficient absorbent to ensure there are no free liquids, and incorporates shielding. The container provides protection of workers, the public, and the environment during its intended service life.*

The anticipated service life needs to be considered when selecting a container for transuranic waste. A determination of the anticipated storage time, environment, and location (waste acceptance criteria) is essential to selecting the proper waste container. For waste that does not have an identified path to disposal, the waste container may need to be designed to remain effective for an extended and/or indefinite storage period.

> *Example: A site needs to repackage a small quantity of non-defense transuranic waste with no identified path to disposal. A policy and plan have not yet been completed for resolving the disposal issues. The selected container has been designed to last a minimum of 50 years, if stored indoors.*

When selecting containers for transuranic waste, consideration needs to be given to the full life cycle of the waste, with a goal of packaging the waste only once. The selected waste container needs to be compatible with transportation requirements and the waste acceptance criteria of the facilities expected to manage the waste. Sites have generally identified the use of the DOT-certified 55-gallon drum as the container of choice for all sized, newly-generated waste. An alternative container is the standard waste box (3.1 x 4.5 x 5.9 ft). Both 55-gallon drums and the standard waste box will fit in the TRUPACT II used to transport transuranic waste to WIPP for disposal. Sites should avoid selecting containers which allow quick containment of the waste, but are not amenable to subsequent waste management steps.

> *Example 1: A site selected a 4 x 4 x 8-ft box as the container for high volumes of miscellaneous contact-handled waste because it accommodates large amounts of waste without the need for any size-reduction. However, because consideration was not given to the entire life cycle for management of the waste, site personnel did not take into account that the box was not compatible with any approved transuranic waste disposal facility or transportation system. Consequently, in order to make the waste acceptable*

for transport and disposal at WIPP, site personnel will have to repackage the waste and may have to treat the 4 x 4 x 8-ft box as transuranic waste also.

Example 2: A requirements analysis was performed on the life-cycle plan for a specific transuranic waste stream that will generate odd-sized solid debris. The analysis indicated that a standard waste box could be used to meet all the requirements for transportation, as well as satisfy the storage and disposal facilities waste acceptance requirements.

To ensure that the waste container performs as expected, the following need to be considered when placing waste in the packaging:

- Container free of deformations or imperfections that may cause a loss of container integrity before the designed lifetime.
- Waste placement in a manner that does not adversely affect the integrity of the waste container.
- Containers utilized such that void space within the container is minimized, although care should be taken to avoid exceeding weight or other limitations identified through consideration of the life-cycle management process.
- Waste container labels and markings permanently applied.

The selection of the container is influenced by the storage conditions, storage duration, and the monitoring expected for the waste container. Ensuring waste containers provide confinement for their expected storage life is therefore dependent on ensuring an appropriate storage environment consistent with the container characteristics. Storage of waste containers is addressed in the guidance for DOE M 435.1-1, Section III.N.

Vents. Because of the relatively large flux of alpha particles associated with transuranic waste, there is a potential for radiolysis of hydrogen containing materials and the generation of hydrogen gases within transuranic waste containers. In addition, depending on the waste contents and/or the storage conditions, other gases, some of which are potentially flammable or explosive, may be created. To address this issue, containers of newly generated waste shall be equipped with vents or other mechanisms to mitigate the hazards associated with the evolution and accumulation of gases within a waste container. Implementing this requirement includes taking actions to address the accumulation of gases in inner containers such as bags, paint cans, and drum liners, in addition to addressing the outer container. Inner containers may be punctured, vented, or provided with products which have been proven to prevent the accumulation of dangerous quantities of gases. Outer containers can be provided with filtered vents or products which have been proven to

prevent the accumulation of gases. The installation of vents or other mechanisms on transuranic waste containers must not interfere with the container's ability to maintain waste containment until the waste is properly dispositioned (treated or disposed).

Waste currently in storage is to be provided with vents or other mitigating mechanisms at the soonest practical time unless it can be shown that vents are not needed. Implementation of this requirement does not require waste to be removed from storage solely for the purpose of installing vents since this would result in exposure which could otherwise be avoided. Instead, the intent is for site waste managers to install vents the next time the waste containers are accessed for some other purpose such as assaying, reconfiguring storage, recovering waste from earthen-covered storage, or preparing for transportation to the Waste Isolation Pilot Plant. The *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* requires the installation of vents on containers so they can be transported in the TRUPACT II.

The installation of vents on containers of transuranic waste in storage is not necessary if an appropriate analysis has been prepared that demonstrates that the unvented containers do not pose an unacceptable hazard. Application of this allowance within the requirement is dependent on an approved safety analysis report or equivalent which shows that gas generation is not credible or that the consequences are acceptable. An acceptable method of demonstrating that venting is not required is to show that, based on the waste container contents, radiological characteristics, and/or environmental factors, it is not credible to generate gases which pose a fire or explosion hazard or create conditions which would otherwise breach the containers, such as over-pressurization. In this usage, credible has the same meaning as used in safety analysis reports. If over-pressurization or generation of ignitable or explosive gases is credible or assumed to be credible, the analysis must show that the consequences of an accident are within established limits for radiation dose to workers (10 CFR Part 835) and to the public (DOE 5400.5).

The *Radioactive Waste Management Manual*, Section III.D requires the development of a radioactive waste management basis for transuranic waste management facilities, operations, and activities; this includes transuranic waste in storage as of the issuance of DOE O 435.1. In developing the radioactive waste management basis, site personnel need to consider the hazards associated with drums of transuranic waste which have not been provided with vents or been proven to not need vents through an approved safety analysis. For unvented containers in earthen-covered storage, the facility itself may mitigate the hazards associated with the accumulation of gases. For above-grade storage of transuranic waste containers, the radioactive waste management basis needs to include controls which mitigate the hazards associated with the accumulation of gases by restricting access to the storage area and providing equipment to protect against fire or explosion. Waste managers should evaluate unvented containers in storage and determine if it is appropriate to take prompt action to install vents rather than wait until the next time the waste is actively managed. Immediate action may be warranted if drums show signs of

gas accumulation (bulging) or if the waste and radiological characteristics are similar to other containers which contain waste which is known to evolve gases.

Segregating Defense Waste. Consistent with current legislation, the Department plans to dispose of defense transuranic waste at WIPP. Disposal at WIPP of only defense waste is a constraint in the *WIPP Land Withdrawal Act of 1992*, as amended. In contrast to defense waste, there are currently no planned facilities for the disposal of non-defense waste. The intermixing of defense and non-defense transuranic waste is therefore a practice that must be avoided, if feasible, so waste can be accepted for disposal at WIPP. The *Radioactive Waste Management Manual*, DOE M 435.1-1, includes a requirement (DOE M 435.1-1, Section III.G) that identification of waste as defense or non-defense must be included in facility waste acceptance requirements. Additional discussion of what qualifies as defense waste is included in the guidance for Section III.G of this document.

The language in the *Nuclear Waste Policy Act of 1982,* as amended, defines "atomic energy defense activity" to include "any activity...performed in whole or in part in carrying out...defense nuclear waste and materials by-products management" (Nordhaus). Based on this definition, the disposal of commingled defense and non-defense transuranic waste at WIPP is permissible in those cases where it is not feasible to segregate the waste. This is a result of the source of the waste being "in part" from defense nuclear waste management. The feasibility of segregating and packaging defense waste separate from non-defense waste needs to be made at the time the waste is packaged, and needs to be based on consideration of the cost and risk associated with performing the waste packaging. Waste managers must make a good faith effort to evaluate whether there is the potential for commingling defense and non-defense waste streams and whether it is feasible to segregate them prior to generating and packaging the wastes. It is inappropriate to generate and package waste without regard to the source being a defense or non-defense activity then claim that it is not feasible to segregate waste once it is commingled in a container. If the actions necessary to segregate defense waste from non-defense waste would not normally be performed and performing them would result in undue costs or risk (radiation exposure), then segregation would not be considered feasible.

> *Example: Site A has an examination and experimental facility which has a series of gloveboxes used for performing work on materials containing transuranic isotopes. Both defense and non-defense experiments are performed in the gloveboxes, however, generally they are not performed at the same time. A project involving the examination of materials in support of the Office of Science has been completed. Prior to commencing the next project, a general clean-out of the gloveboxes is performed in which material associated with the project, e.g., unused specimens and one-time use materials (swipes, etc.), are removed from the gloveboxes. These waste materials are packaged as non-defense waste. Various equipment and tools remain in the gloveboxes for use in subsequent experiments. Whenever there is a more thorough cleanout of the*

gloveboxes, when maintenance (change-out of gloves or HEPA filters) is performed, or when failed equipment is removed, it is recognized that there is a commingling of contamination from defense and non-defense activities. However, because the waste is in part from defense activities, it is packaged and disposed of as defense transuranic waste. Similarly, when the gloveboxes are decommissioned and removed, the fact that they were used for defense program activities makes them eligible for disposal as defense waste.

Waste that is generated after issuance of DOE O 435.1 is to be identified as either defense or non-defense waste. In this usage, generated means any waste that is packaged after issuance of DOE O 435.1, including waste from processing plants, treatment plants, cleanup activities, and retrieval activities. Once identified, if feasible, the waste must be packaged separately and the containers clearly marked as to whether they contain defense or non-defense transuranic waste. Identification of waste containers as defense or non-defense can be included in machine-readable code on the container, but should also be human readable. Different categories can be distinguished through markings or labeling of waste packages or through color coding. This provides a ready indication that a waste package is eligible for disposal at WIPP because personnel involved in the transfer operation can easily see that waste containers are of the correct category in addition to having the information on records.

Example: A site that stores transuranic waste uses color coding to distinguish defense from non-defense transuranic waste. The site already uses white drums for the storage of transuranic waste, so opts to have non-defense transuranic waste drums painted with 2-inch red stripes around the drum about 12 inches from each end. In addition to the characterization documentation indicating the type of waste, the red-striped drums are easy to distinguish from the plain white drums that contain defense transuranic waste.

The Manual does not require waste containers that were previously (e.g., prior to issuance of DOE O 435.1) placed in storage in buildings or other accessible above-ground configurations to be removed from storage so they can be marked or labeled to distinguish those containing defense waste from those containing non-defense waste. In fact, such an action would be counter to one of the purposes of these requirements, namely to avoid personnel exposure attributable to unnecessary handling of waste containers. Also, it is not the intent of this requirement to segregate defense and non-defense waste that was previously commingled in a waste container. Such waste is to be considered defense waste. However, when waste containers are removed from storage for some other reason, such as preparation for transfer to WIPP, waste managers are to label or mark them as defense or non-defense and/or segregate them to facilitate future waste handling. Similarly, waste containers in earthen-covered retrievable storage configurations must be marked or labeled during the time they are recovered, assayed, and transferred to another waste management activity. If the containers of waste in earthen-covered retrievable storage have failed and the waste is determined to be transuranic, the new container provided for repackaging the waste must be marked, labeled, or color coded as discussed above.

> *Example: Transuranic waste is stored in drums in a dense-pack array in a storage facility. Records indicate that most of the waste is defense waste. In the process of certifying the waste for transfer to WIPP in accordance with the approved certification program, each waste container is being assayed to determine its transuranic isotope concentration. As personnel remove and assay each drum, they also apply stickers in three locations on each drum that indicate whether the waste is defense or non-defense. This determination is made based on a review of records of the programs that generated the waste. Those drums identified as containing both defense and non-defense waste are labeled as defense waste and are eligible for disposal at WIPP. When the waste containers are returned to storage, personnel segregate the containers of defense waste from those of non-defense waste.*

Containers of non-defense transuranic waste are to be segregated from containers of defense waste in storage facilities in a manner that minimizes and simplifies future waste container handling. In placing waste into storage, consideration needs to be given to the timing of transferring waste containers to a subsequent waste management step. Segregation within a storage facility does not require construction of separate facilities for storing waste or even providing separate bays within a facility. Segregation can be provided by how and where the waste is placed in the storage facility and it can be delineated by lines painted on the floor, by rope barriers, or similar means. The principal concern to consider in storing waste that has been segregated as defense or non-defense is the ability to access waste for future management without having to handle other waste. Since WIPP has been identified as the defense transuranic waste repository, it is likely that waste management steps leading to transfer to WIPP will occur with defense waste on a schedule separate from actions to be taken with non-defense waste. Therefore, to the extent practical, waste should be placed in storage to allow access of the WIPP-bound waste without having to move the non-defense waste.

<u>Marking and Labeling</u>. The marking and labeling of waste containers need to be done in a manner that allows traceability to the documentation of the waste characteristics and container information. The marking or labeling needs to be applied such that it will be visible if the waste package is on the outside of a storage or transportation array. For a 55-gallon drum, this is generally accomplished by placing the marking or labeling about every 120 degrees around the outside of the drum. For a waste box, acceptable labeling can be accomplished by placing labels on each side of the box. Waste package identification should be in medium to low density Code 39 bar code symbology in accordance with ANSI/AIM-BC1-1195. Bar coding is to be a minimum of 1 inch high and should be accompanied by human-readable alphanumeric characters at least ½ inch high. Durability and readability of marking and labeling is one of the items included in the inspection program for waste in storage (see guidance for DOE M 435.1-1, Sections III.N and III.Q).

Example: A transuranic waste generator is packaging waste in accordance with the site certification program that successfully passed a Waste Isolation Pilot Plant Waste Certification Program audit. In accordance with the site certification procedures, labels meeting ANSI/AIM-BC1-1995 that contain the site identifier and unique identifier are placed in three locations equally spaced around each drum. This satisfies the marking and labeling requirement.

Waste characterization and the container documentation is to be associated with each individual container of waste. Guidance related to documentation is discussed in guidance for Waste Transfer (DOE M 435.1-1, Section III.K). The documentation needs to include the aspects relative to container selection including the designed service life, the environments that the container was designed for and is compatible with, and other information necessary to allow proper use of the container.

Compliance with the packaging requirement is demonstrated by procedures which document proper packaging protocols, including documented evidence that, where feasible, non-defense transuranic waste has been packaged separately from defense transuranic waste and by never having to repackage transuranic waste that is packaged after issuance of DOE O 435.1 in order to maintain containment. However, the above protocol may not be satisfied by containers that were placed in storage prior to issuance of the DOE O 435.1. For those containers, the goal is to only have to repackage the waste one time after it is retrieved and characterized. Further, acceptable performance is demonstrated by containers of waste having marking and labeling that allows correlation with waste characterization data and container information. Successful performance of this requirement is also demonstrated by a record of container performance in which failure has not routinely occurred.

Supplemental References:

1. DOE, 1995. *Departmental Materials Transportation and Packaging Management,* DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

2. DOE, 1996. *Packaging and Transportation Safety,* DOE O 460.1A , U.S. Department of Energy, Washington, D.C., October 2, 1996.

3. DOT. *Shippers-General Requirements for Shipments and Packagings,* 49 CFR Part 173, U.S. Department of Transportation, Washington, DC.

4. ANSI, 1995. *Uniform Symbology Specification,* ANSI/AIM-BC1-1995, American National Standards Institute, Automatic Identification Manufacturers, August 16, 1995.

5. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

6. Nordhaus, 1996. Robert R. Nordhaus to Al Alm, memorandum, *Interpretation of the Term "Atomic Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act,* U.S. Department of Energy, Washington, D.C., September 9, 1996.

7. Dials, 1997. G.E. Dials to Distribution, memorandum, *Carlsbad Area Office Interim Guidance on Ensuring that Waste Qualifies for Disposal at the Waste Isolation Pilot Plant,* Carlsbad Area Office, U.S. Department of Energy, Carlsbad, NM, February 18, 1997.

8. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992,* as amended, October 30, 1992.

9. *Nuclear Waste Policy Act of 1982,* as amended, January 7, 1983.

III. L.(2) Transportation. To the extent practical, the volume of waste and number of transuranic waste shipments shall be minimized.

Objective:

The objective of this requirement is to reduce the risk associated with transuranic waste management by reducing the number of miles traveled transporting waste. This is to be done by the efficient use of waste containers, minimizing the volume of waste which requires shipment, and optimizing shipping plans and schedules.

Discussion:

The need for transportation requirements specific to waste management concerns was evaluated in the development of DOE O 435.1, *Radioactive Waste Management*, and DOE M 435.1-1 the *Radioactive Waste Management Manual*. An analysis of existing requirements affecting waste transportation identified the Department of Transportation (DOT) regulations and the DOE Orders, DOE O 460.1A and DOE O 460.2 (see DOE M 435.1-1, Section I.1.E.(11)), as sources of applicable requirements. Generally, the DOT requirements apply to offsite shipments. *Packaging and Transportation Safety* (DOE O 460.1A) invokes the DOT requirements, or documented requirements providing equivalent safety, for onsite shipments. *Departmental Materials Transportation and Packaging Management* (DOE O 460.2) includes DOE policies and requirements specific to DOE that supplement the DOT regulations. Requirements from DOE O 460.2 relevant to transuranic waste transportation address development of a

Transportation Plan for high-visibility shipment campaigns (e.g., shipments to WIPP), use of the Department's Transportation Tracking and Communications System, and administrative requirements. Additionally, for waste exceeding Type A quantities of radioactive material per DOT regulations, notification of the expected date of arrival is to be given to the site to which the waste is being shipped, and if the waste is not received on the expected day, notification of the shipper is mandated.

The DOT regulations and DOE packaging and transportation requirements were considered adequate for ensuring safe transportation of the waste. However, recognizing that one of the higher risks associated with waste management is from the number of miles traveled in transporting waste, transuranic waste shipments should be minimized to reduce worker exposure, risk, and cost. This can be achieved, in part, by ensuring that all containers or primary packagings (e.g., drum or waste box) are used to capacity, and that transportation systems are efficiently utilized. Reaching the capacity (volume or weight) of the waste container should be a goal of every waste packaging operation. Containers should be filled so as to minimize headspace volume and allow closure, without exceeding its weight capacity or compromising its integrity.

> *Example 1: Miscellaneous defense transuranic waste such as personnel protective equipment, contaminated tools, and paper and plastic sheeting are being packaged in 55-gallon drums for disposal at WIPP. Site personnel use a compactor to maximize the amount of waste placed in the drum. Administrative controls ensure that drum weight limits are not exceeded.*

> *Example 2: Defense transuranic waste is being thermally treated and packaged in 55-gallon drums for disposal at WIPP. Because of the density of thermally treated waste, site personnel fill each drum to its maximum weight capacity, 1000 pounds, although excess headspace remains.*

There may be circumstances that require the use of dunnage in the form of empty drums when transporting transuranic waste. Due to TRUPACT II limits on weight, wattage, curies or dose rate, it may not be possible to include a full complement of containers with waste in a shipment. Some empty containers may have to be included in the normal 14 drums (or 7 for a half pack) which constitutes a shipment. In optimizing shipments, the amount of dunnage used is to be minimized to the extent practical.

The same goal applies to transport systems. Containers of waste should be held and accumulated until a sufficient number of packages is available to make cost-effective use of the transportation system.

> *Example: Defense transuranic waste is being thermally treated and packaged in 55-gallon drums for disposal at the WIPP. Because of the density of thermally treated*

waste, each drum is filled to its maximum weight capacity of 1000 pounds. A sufficient number of drums (7) is then accumulated at a staging area to enable full and efficient use of the Halfpack packaging for shipment to the WIPP.

The distance transuranic waste is transported, and the number of times waste is physically handled is directly related to the risk of release or exposure. As part of the planning and documentation concerning the life-cycle management of transuranic waste, the Site-Wide Waste Management Program should seek to reduce the number of times the waste is handled or otherwise transported. Site transuranic waste management programs need to ensure that both on-site and off-site transport and handling is minimized.

Example 1: A small quantity site performed an optimization study and determined the nominal volume of transuranic waste that needed to be shipped off-site for the year. Staging the waste prior to transport reduced the number of shipments and allowed the transfer of the waste to occur during the summer when road conditions were best.

Example 2: A waste management operation on a large DOE reservation generates transuranic waste that can only be fully characterized by facilities located elsewhere on the reservation. Staging the waste and transferring it during off-peak traffic hours reduced the number of shipments across publicly-traversed roads on the reservation, and helped minimize the risk to the public.

Transuranic waste transportation needs will be specific to each site. Availability of treatment, storage, and disposal capabilities, as well as funding profiles, will influence the need to ship transuranic waste. In this requirement, the term, “to the extent practical” means that site personnel have latitude in making decisions regarding what is practical for their particular situation. This requirement is not intended to force decisions that are contrary to safe waste management, regulatory compliance, or cost-effectiveness. Detailed and documented planning that provides the rationale for a waste shipment regimen is the best way to balance this requirement with site-specific realities.

Example: A site-specific evaluation was performed to support a recommendation on either building transuranic waste storage capacity or maintaining the current number of small off-site shipments. The evaluation indicated that concerns over building the storage facility outweighed the benefits of minimizing shipments and the current shipment regimen was continued. The evaluation was included as part of the Site-Wide Waste Management Program documentation.

Transportation over the nation's highways and railways results in the most direct contact between the Department’s radioactive waste and the general public, stakeholders, and representatives of States, Tribes, and local government organizations. These groups are primarily concerned with

the shipment of these materials through states, cities, and neighborhoods. Efforts to minimize the volume and number of transuranic waste shipments will help alleviate their concerns.

Compliance with this requirement can be demonstrated by a combination of site procedures directing the efficient use of waste container capacity and documentation showing that transuranic waste shipments are systematically planned and make optimal use of the shipment system (e.g., TRUPACT II) to the extent practical.

Supplemental References:

1. DOE, 1995. *Departmental Materials Transportation and Packaging Management,* DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

2. DOE, 1996. *Packaging and Transportation Safety*, DOE O 460.1A , U.S. Department of Energy, Washington, D.C., October 2, 1996.

3. DOT. *Shippers-General Requirements for Shipments and Packagings*, 49 CFR Part 173, U.S. Department of Transportation, Washington, D.C.

III. M. <u>Site Evaluation and Facility Design</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for transuranic waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new transuranic waste facility or expansion of an existing transuranic waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Objective:

The objective of this requirement is to ensure that natural and human environmental factors and geotechnical characteristics of proposed sites are accounted for in selecting the location and design features of new transuranic waste management facilities or significant modifications of existing facilities, and that locations are avoided if facility design cannot compensate for negative site characteristics or environmental conditions.

Discussion:

The *Radioactive Waste Management Manual* (DOE M 435.1-1, Section I.1.E.(18)) invokes the requirements of DOE O 420.1, *Facility Safety,* and DOE O 430.1A, *Life Cycle Asset Management* in site evaluation and facility design. In the development of DOE M 435.1-1, it was determined that specific attention should be given to selection of a waste management facility location with consideration given to the beneficial and detrimental aspects of the site.

Site evaluation includes the identification and characterization of potential sites (locations within a DOE reservation) for new transuranic waste management facilities or significant modifications of existing facilities. Selection of sites for DOE facilities is generally constrained to those federal lands owned and managed by DOE. Within DOE reservations, the process of selecting sites has the purpose of identifying the best location with consideration of features which are desirable for a facility.

In the context of this requirement, the environmental and geotechnical characteristics include:

- ecology - the flora and fauna that have evolved and adapted to the other environmental characteristics of the site;
- topography - the physical features of the ground surface at and around the site;
- meteorology - the normal and extreme weather events of the site;
- hydrology - the surface and ground water at the site;
- geology - the sediment and structural features of the earths crust at the site;
- seismology - the earthquake potential of the area;
- soil characteristics - characteristics of the soil that affect its load-bearing, water infiltration, and percolation;
- human activities - proximity of the public and human-induced events or feature;
- emergency services and response - proximity of services and population sheltering; and
- hazards to other facilities - proximity of existing facilities and proposed facility.

Characterization of a site is to result in collection of the data necessary to support a decision on acceptability of a site and for use in site-specific design of a facility. The site characterization and selection process will vary from one DOE site (reservation) to the next because of substantial differences in their environmental and geotechnical characteristics. Similarly, the interests of stakeholders which vary from site to site are likely to influence the issues to be addressed in site characterization and selection. The level of characterization needs to reflect application of a data quality objective-type process where the type and amount of information to be collected is commensurate with the hazards and the decisions which have to be made based on the data. The resulting site characterization program needs to include the investigations and studies needed to evaluate site and facility performance.

Natural Phenomena Hazards. The characterization of a site for natural phenomena hazards is to identify the range of normal and extreme natural events that should be taken into account in the siting and design of the facility. The amount of characterization necessary will be influenced by the hazard associated with the facility and release of the radionuclide inventory. Guidance on

characterization and consideration of natural phenomena hazard in the design of DOE facilities is contained in the following standards supporting implementation of *Facility Safety* (DOE O 420.1):

- *Natural Phenomena Hazards Characterization Criteria*;
- *Natural Phenomena Hazards Assessment Criteria*;
- *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*;
- *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*; and
- *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities*.

Example: A new storage facility is being considered at the Hanford Site. Due to the environmental setting, wind effects and seismic activity are factors that have to be considered in the design regardless of the location selected at the Site. However, due to the local topography, concerns about flooding can be addressed by selecting a location on the Site's central plateau. A similar facility is being considered at the Savannah River Site. The Savannah River Site evaluation includes the consideration of flooding and high winds in the design regardless of location. However, seismic concerns are minimal because of the region of the country; also flooding impacts can be mitigated by selecting an appropriate area of the Site.

In carrying out characterization activities, field studies need to be performed so as to not compromise the integrity of the land to be dedicated to waste management activities. This is particularly relevant to disposal facilities where improper design or installation of core sampling or groundwater sampling wells can lead to a preferential path for the migration of contaminants from a facility. Also, the characterization is to be carried out in accordance with the site's quality assurance program, including maintaining records of data collected. Documentation of the results of the site characterization program is not only needed for use in design, but may also provide information necessary for complying with requirements of the NEPA process.

Human Activities. The site of a proposed transuranic waste management facility needs to be evaluated with respect to the effects of the facility on human activities and the effect of human activities on the facility. Effects of the facility location on human activity includes consideration of:

- transportation routes;
- present and future population distribution (future population considerations should be constrained to reasonable time frames consistent with regional land use planning, not thousands of years);
- present and proposed land and water uses in the region; and
- any special characteristics that would influence the consequences of releases of radioactive material during the life cycle of the facility.

The potential impact of the waste management facility construction, operation, and decommissioning need to be evaluated, considering current and future land use plans and population distribution. Evaluation and selection of the location for a facility should ensure that there is and will remain a buffer between the facility and the public. Such considerations in site selection provide defense in depth by ensuring there is space for corrective actions to be taken if there are unplanned releases and by establishing distance for attenuation of such releases so that impacts are minimized.

Example: Site Z is going to construct a facility to treat remote-handled transuranic waste to make it acceptable for disposal. There are no natural environmental characteristics that make any of the proposed locations superior to others. However, one location is in the center of the site and the others are either near the current site boundary or in areas being cleaned up so they can be released from DOE control. Because the criteria for selecting a site include consideration of the proximity to current and future populations, the location near the center of Site Z is preferred.

Another aspect of human activities is the effect that they may have on the waste management facility. Locating a facility near other facilities on or near the DOE site may impact the design or performance of the facility. For instance, a tall building may create a wake on its downwind side that would cause the exhaust effluent from a nearby, downwind facility to be dragged down to ground surface in a short distance with the potential of impacting workers or nearby members of the public. To counteract this effect, the waste management facility would have to extend its stack higher than the wake effect, or an alternative location for the facility should be considered.

Compliance with this requirement is demonstrated by performing an appropriate site evaluation for new facilities or expansions of existing facilities, and by the ensuring that the environmental and geotechnical characteristics of the site which are significant to protection of workers, the public or the environment are accounted for in selection of the site or through facility design.

Supplemental References:

1. DOE, 1989. *General Design Criteria*, DOE 6430.1A, U.S. Department of Energy, Washington, D.C., April 6, 1989 (canceled).

2. DOE 1992. *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities*, DOE-STD-1024-92, Change 1, U.S. Department of Energy, Washington, D.C., 1992.

3. DOE, 1993. *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, DOE-STD-1021-93, Change 1, U.S. Department of Energy, Washington, D.C., 1993.

4. DOE, 1994a. *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, DOE-STD-1020-94, Change 1, U.S. Department of Energy, Washington, D.C., 1994.

5. DOE, 1994b. *Natural Phenomena Hazards Characterization Criteria*, DOE-STD-1022-94, Change 1, U.S. Department of Energy, Washington, D.C., 1994.

6. DOE, 1995. *Natural Phenomena Hazards Assessment Criteria*, DOE-STD-1023-95 Change 1, U.S. Department of Energy, Washington, D.C., 1995.

III. M.(2) Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

Objective:

The objective of this requirement is to ensure that a minimum set of facility requirements and general design requirements determined from hazards analyses or policy considerations are applied to transuranic waste management facilities.

Discussion:

The facility requirements and general design criteria included in DOE M 435.1-1, Sections III.M.(2) (a) through (e), are included as requirements to ensure adequate protection of the public, workers, and the environment from nuclear hazards. The requirements contained in these sections apply to new and existing transuranic waste management facilities, unless the requirement specifies otherwise.

During the development of DOE O 435.1 and DOE M 435.1-1 an analysis of the hazards associated with the management of waste indicated that appropriate facility safety requirements and general design requirements are essential to ensuring the protection of the public, workers, and the environment. Therefore the intent is to apply these requirements to all transuranic waste management facilities, both existing and new. However, it is recognized that in some cases it may not be practical, or possible, to apply these requirements to existing transuranic waste facilities or operations. Such conditions as limited programmatic usage, expected short service life of the operation, or factors that make long-term, capital-intensive upgrades unreasonable may be bases for not applying the requirements. In such cases, an exemption to the requirement may be warranted. The Implementation paragraph of DOE M 435.1-1 provides for an exemption to a requirement provided it is processed in accordance with the requirements of DOE M 251.1-1A, *Directives System Manual.*

> *Example: At Site Z it is determined that the requirement in DOE M 435.1-1, Section III. M.(2)(e), Monitoring, for an existing transuranic waste tank is unreasonable due to the planned short service life of the tank. The existing tank is not routinely being used and would only be used over the next 18 months for emergency storage of liquid transuranic waste. A replacement for the tank is under construction. In accordance with DOE M 251.1-1A, Chapter VII, "Exemptions," an Exemption Request is prepared that supports the position that application of the requirement is not justified by any safety and health benefit. The exemption request also notes that procedures will be implemented to ensure a once per shift visual check to ensure no waste is inadvertently transferred to the tank. The Exemption Request is processed in accordance with the requirements contained in paragraph 4, Exemption Process, in Chapter VII.*

DOE M 435.1-1 also allows for the use of the "Necessary and Sufficient Closure Process" or the integrated "Safety Management System." Use of these processes for deriving facility design requirements that provide protection comparable to the requirements contained in DOE M 435.1-1, Sections III.M.(2) (a) through (e) is also acceptable at sites where these processes are invoked by contract.

Application of these requirements to all existing transuranic waste facilities may appear to contradict the direction or guidance provided by some other DOE Orders that are invoked by DOE M 435.1-1, Section I.1.E., *Requirements of Other Regulations and DOE Directives*. In such cases the requirements contained in DOE M 435.1-1 do apply.

> *Example: Section I.1.E.(18), Site-Evaluation and Facility Design, invokes DOE O 420.1, Facility Safety. Guidance to DOE O 420.1 states that the design criteria included in the Order are "applicable to the design and construction of new nonreactor nuclear facilities and for modifications to existing nonreactor nuclear facilities when modifications significantly increase the probability or consequences of a nuclear accident or require a*

> *change in the Technical Safety Requirements (TSRs) of a facility. The definition of 'significant' is intentionally left to the judgment of the proposing contractor and the approving DOE authority. In part, this is intended to allow upgrading of existing safety equipment or installation of minor new improvements without subjecting the process to onerous procedural requirements and thus discouraging improvements." Thus, under DOE O 420.1 an existing transuranic waste management facility that is to be "insignificantly" modified does not have to meet the design requirements of DOE O 420.1. However, under DOE M 435.1-1, the same facility must meet the design requirements of DOE M 435.1-1, Section III.M.(2) (a) through (e), or follow the DOE M 251.1-1A exemption process. The requirements contained in DOE M 435.1-1 have precedence, and should be implemented.*

A "backfit" process has been discussed by the Department in the past to address changes that may be required through the imposition of a new DOE safety requirement. Such changes may be problematic for transuranic waste facilities and systems that have been in existence for over 20 years. It is not the purpose of DOE O 435.1 and DOE M 435.1-1 to create such a process for the Department; however an existing or new field-office or Program Secretarial Office backfit analysis and review process may be applied to determine whether implementation of a proposed backfit could be justified on the basis of a substantial safety improvement or on a cost-benefit basis. One example of a candidate process is contained in expired DOE N 5480.5, *Imposition of Proposed Nuclear Safety Requirements*, which expired in 1993 because of an administrative provision. Another candidate process is described Draft DPOM-FS-300, "Treatment of Proposed Backfits," which was developed for the Office of Defense Programs, but not formally adopted. A third candidate process is documented in Westinghouse Savannah River Company, High Level Waste Management Engineering Procedure, ENG. 12, "HLWMD Backfit Analysis Procedure." For development of new backfit processes Nuclear Regulatory Commission requirements in 10 CFR 50.109 and 10 CFR 76.76 should be consulted.

Compliance with this requirement is demonstrated by documentation that supports the implementation of the requirements at DOE M 435.1-1, Section III.M.2. (a) through (e), or documentation that supports the "Necessary and Sufficient Closure Process" or integrated "Safety Management System," or the DOE M 251.1-1A exemption process.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE G 420.1-X, September 1995.

2. DOE, 1993. *Defense Programs Operations Manual, "Treatment of Proposed Backfits,"* Revision 0, Draft DPOM-FS-300, U.S. Department of Energy, Washington, D.C., February 5, 1993.

3. DOE, 1998. *Directives System*, DOE O 251.1A, U.S. Department of Energy, Washington, D.C., January 30, 1998.

4. DOE, 1998. *Directives System Manual*, DOE M 251.1-1A, U.S. Department of Energy, Washington, D.C., January 30, 1998.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(a) Confinement. Transuranic waste systems and components shall be designed to maintain waste confinement.

Objective:

The objective of this requirement is to ensure that the design of transuranic waste management facilities and equipment include features necessary to prevent the uncontrolled releases of radioactive materials.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the unexpected or uncontrolled release of radioactive materials at different stages of waste management were identified as potential hazards that could impact workers, the public, or the environment. The DOE M 435.1-1, Section I.1.E.(18) invokes the *Facility Safety* and *Life Cycle Asset Management* Orders, DOE O 420.1 and DOE O 430.1A, respectively, as directives applicable to the design of radioactive waste management facilities. The current requirement supplements those directives by specifically requiring that waste management systems and components of those systems be designed to maintain waste confinement.

The term "confinement" is defined as:

> "An area having structures or systems from which releases of hazardous materials are controlled. Primary confinement systems are process enclosures (gloveboxes, conveyors, transfer boxes, and other spaces normally containing hazardous materials). Secondary confinement areas surround one or more primary confinement systems (operating area compartments)."

In broad terms the purpose of waste confinement is to minimize the spread of radioactive and/or hazardous materials during normal operations, abnormal operations, and potential accidents. The

Packaging and Transportation requirements (DOE M 435.1-1, Section III.L) address confinement of solid transuranic waste in packaging. The Disposal requirements (DOE M 435.1-1, Section III.P) invoke performance-based requirements for confinement of transuranic waste disposal facilities. Therefore, the focus of the following guidance is on incorporating confinement features into the design of treatment or liquid storage systems.

The designs of confinement features should be tailored on a case-by-case basis (i.e., graded approach) based on a consideration of the quantity and form of the transuranic waste and on the conditions for potentially dispersing the contamination. For liquid waste storage or treatment, the vessels, piping, pumps, valves, etc. must provide the primary confinement. Similarly, in treatment systems for solid transuranic waste, hoods, gloveboxes, and process equipment must be designed to control the spread of contamination. Design of these systems should take into account the chemical characteristics of the materials to be managed so that appropriate materials of construction can be selected. Engineering evaluations, trade-offs, and experience should be used to develop practical designs that achieve the confinement objective. The adequacy of confinement systems to effectively perform the needed functions needs to be documented and accepted through the facility or operation safety analysis report or similar documentation.

> *Example: A treatment system for transuranic waste generates an acidic by-product waste stream. The facility is designed so that the liquid waste stream is collected in tanks in the facility, then is batch processed to meet the disposal facility's waste acceptance criteria. The design requires the storage vessel, piping, and valves to be constructed of stainless steel rather than carbon steel because of the pH of the waste stream. In addition, all of the piping and connections are to be welded construction to prevent the potential for leaks developing at threaded or flanged fittings.*

The need to design secondary confinement into the waste management systems or components needs to be based on the analysis of the hazards associated with the potential failure of the primary systems. However, it is generally expected that systems handling liquid wastes will have secondary confinement to minimize the impacts of leaks, spills, or overflows. The secondary level of confinement may be provided by use of double-walled equipment, e.g., double-walled vessels or pipelines, or by using catchments, e.g., diked or bermed areas, or drip pans.

Designs must also account for the flow of air necessary to maintain waste confinement. Air flow is to be from areas of lesser contamination to areas of greater contamination. To ensure that proper airflow is maintained, the ventilation system design includes equipment which monitors air pressure between different levels of confinement and provides alarms if an adequate pressure differential is not maintained. From the area of highest contamination the air needs to be exhausted through an appropriate filtration system (see guidance below on ventilation).

Example: A treatment facility is designed for processing remote-handled transuranic waste in a process cell. The process cell is in a room which serves as a secondary confinement. The building ventilation system is designed so that the air flows from the nonradiological portions of the building, into the process room, and from the process room into the process cell. The ventilation system is also designed to measure the relative pressure between adjacent confinement layers. If the pressure within the process cell is not negative relative to the pressure in the process room, or if the pressure in the process room is not negative relative to the pressure in the rest of the building an alarm sounds to indicate that confinement has been compromised.

Compliance with this requirement is demonstrated by transuranic waste treatment and storage facilities providing primary and secondary confinement commensurate with hazards identified in a safety analysis or similar documentation.

Supplemental References: None.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(b) Ventilation.

1. Design of transuranic waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations in treatment or storage facilities, ventilation or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Objective:

The objective of this requirement is to ensure that airborne effluents released from transuranic waste management facilities are in accordance with applicable DOE Orders and external

regulations, and to preclude or mitigate the accumulation of flammable or explosive gases which could lead to fire or explosion and the uncontrolled release of radioactive material.

Discussion:

This requirement is based on a similar requirement developed to address a group of hazards that was identified during the development of the high-level waste chapter of the *Radioactive Waste Management Manual*, DOE M 435.1-1. During the development of the Manual, it was determined that hazardous conditions can result from the unexpected or uncontrolled release of radioactive material that could result from poorly designed ventilation systems or due to the accumulation and ignition of flammable or explosive gases. Similar situations could occur at a transuranic waste management facility and should be addressed to prevent uncontrolled airborne releases of radioactivity that could endanger workers, the public, or the environment. Subrequirement III.M.(2)(b)1 is discussed below under Airborne Effluent Filtration Systems and subrequirement III.M.(2)(b)2 is discussed under Flammable and Explosive Gases.

Airborne Effluent Filtration Systems. The subrequirement to maintain radioactive material in airborne effluents from transuranic waste management facilities to appropriate levels through the use of filtration systems is to be implemented using the graded approach. This requirement is intended to ensure that transuranic waste management facilities have adequate filtration where necessary, not to dictate that each facility must have a particular type of air filtration or removal efficiency. Therefore, the safety analysis or assessment for each facility will provide the basis for determining the level of filtration required.

> *Example 1: A transuranic waste treatment facility is constructed so transuranic waste packages can be opened, the waste sorted, and the appropriate waste thermally treated. In order to ensure worker protection, the building ventilation system is constructed to draw air from radiologically clean areas, to radiologically-controlled areas and finally to airborne contamination areas such as glove boxes and thermal treatment equipment. Through the auditable safety assessment, it is determined that the potential exists for releases of radioactive materials through the exhaust system. The building exhaust system is therefore equipped with high-efficiency particulate air filters to ensure that releases are controlled to within limits. Monitoring is used to ensure the necessary removal efficiency is maintained by the air filter system.*

> *Example 2: A storage building is designed and operated to receive only closed containers of transuranic waste and to perform nondestructive testing. Through the preparation of an auditable safety assessment it is determined that the potential for release of radioactivity in the building is very low. Consequently, the ventilation system provided for the building is only for climate control and not for contamination control. The building exhaust system is determined to need no extra filtration to comply with the*

requirements to meet applicable release standards, and the rationale and basis of the analysis is incorporated into the facility safety documentation.

Standards for DOE compliance with airborne releases are contained in DOE 5400.5, *Radiation Protection of the Public and the Environment*, and 40 CFR Part 61. The limits for release cited in these documents are for the DOE site (i.e., all the activities of the Department), not for individual facilities. Therefore, the operational limits for any individual facility need to be established based on the potential impacts from all facilities on the site. Consistent with Departmental practices and an underlying principle in development of the *Radioactive Waste Management Manual*, airborne effluent releases need to be kept as low as reasonably achievable.

The number, size, and design of air filtration equipment need to meet the performance requirements dictated by the safety analysis or assessment. The location of air filtration units in the ventilation system is established as close as practical to the source of contamination so as to minimize spread to the remainder of the ventilation system. The system is designed for ease of maintenance and periodic inspection and has provisions (test ports) to facilitate insertion of measuring devices for testing filter performance. Where larger loads are expected or predicted on the filtration systems (e.g., dusty condition), pre-filters need to be considered to extend the life of the main filter and reduce maintenance.

<u>Flammable and Explosive Gases</u>. The subrequirement addressing explosive or flammable concentrations of gases is intended to ensure that the design of facilities and equipment includes consideration of the potential for generating these types of gases. Generation of flammable or explosive gases has been a concern in the storage of liquid waste (e.g., high-level waste tanks), but also needs to be recognized as a potential problem in other situations, such as in treatment systems.

Where sampling data and safety analyses indicate a potential for accumulating gases in concentrations approaching the lower flammability limit, facilities and equipment shall be provided to prevent the conditions which could lead to fire or explosion. This is normally accomplished by the design and installation of ventilation equipment which provides enough air flow to maintain gases below flammable or explosive concentrations. In situations where gas evolution is episodic and the concentration of gases approaches the lower flammability limit for short periods of time in spite of the ventilation system, spark-proof technology needs to be employed in the design of ventilation equipment so that the equipment itself does not become a source of ignition.

Attention to fire protection for the filtration system also needs to be considered to ensure the facility can perform under off-normal conditions. Guidance for protection of filtration systems in ventilation plenums for nuclear facilities is provided in the *Fire Protection Design Criteria* (DOE-STD-1066-97). This guidance addresses materials of construction, location of filters, fire ratings of protective walls, and internal detectors for fire and heat.

Other methods can be employed to prevent conditions which could lead to ignition of flammable or explosive gases. One such method is the introduction of a sufficient flow of inert gases into the headspace where flammable or explosive gases would accumulate. The inert gases need to be supplied at a rate that keeps the concentration of the flammable or explosive gases and of available oxygen/oxidants below levels that could result in deflagration or detonation. As with ventilation equipment, the specific conditions of gas generation and of providing an inert atmosphere in the headspace must be evaluated and a decision made as to whether spark-proof technology should be included in the design of the system.

Compliance with this requirement is demonstrated by analyses that support the level of filtration provided on a transuranic waste management facility, and if airborne effluent monitoring data are available, a demonstration of compliance with the site-established operational guidelines for the facility. In addition, acceptable implementation is demonstrated by analyses, monitoring data, or both showing that the potential for generation of explosive or flammable concentrations of gases has been considered and where the potential exists, the presence of ventilation equipment or other means that prevent deflagration or detonation. The analysis and rationale for the selected controls must be documented in the radioactive waste management basis.

Supplemental References:

1. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

2. DOE, 1997. *Fire Protection Design Criteria*, DOE-STD-1066-97, U.S. Department of Energy, Washington, D.C., 1997.

3. EPA. *National Emission Standards for Hazardous Air Pollutants*, 40 CFR Part 61, U.S. Environmental Protection Agency, Washington, D.C.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing transuranic waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Objective:

The objective of this requirement is to ensure the incorporation of the concept of life-cycle waste management into the design and construction of radioactive waste management facilities to minimize the amount of radioactive waste that must be managed in the future from decontamination and decommissioning activities, and to reduce the number of facilities that must be dismantled due to contamination rather than re-used for another beneficial purpose.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the concept of life-cycle management of waste was identified as a key theme that would promote safety and provide a long-term benefit in reducing hazards associated with radioactive waste management. This requirement was developed to extend the life-cycle management concept to the design of facilities used for the management of radioactive waste. The goals of applying this concept at the design stage are to minimize the future generation of waste and to promote the planning for subsequent beneficial use or decommissioning of a facility at the end of its original mission. Decontamination and decommissioning activities also becoming a significant part of the life-cycle costs for transuranic waste facilities. This requirement addresses this situation by promoting proactive consideration of design features that facilitate decontamination and dismantlement activities that will lead to a beneficial use or decommissioning.

New transuranic waste facilities are defined as those whose design basis was not approved prior to the implementation date of DOE O 435.1. The term design basis is defined in the Manual Definitions. If a transuranic waste facility's design basis is defined after the issuance date of DOE O 435.1, the requirements of this section are applicable. Similarly, if a significant modification to an existing facility is made after the implementation date of DOE O 435.1, this requirement to incorporate features that facilitate decontamination and to consider eventual facility decommissioning or reuse applies. Application of these requirements to existing facilities should be considered and applied on a case-by-case basis. To support this decision, an analysis needs to be conducted comparing the expected benefits by the application of these requirements to the costs of implementing such measures. These costs include programmatic impacts, resource and schedule impacts, as well as potential impacts such as additional worker exposures due to radiation and chemical hazards, and future costs.

<u>Design to Facilitate Decontamination</u>. Decontamination is defined by the Implementation Guide to DOE O 420.1, *Facility Design*, as "the act of removing a chemical, biological, or radiological contaminant from or neutralizing its potential effect on a person, object, or environment by washing, chemical action, mechanical cleaning, or other techniques." In conjunction with DOE O 420.1, DOE M 435.1-1 requires that transuranic waste facilities incorporate measures to reduce areas of contamination or to simplify decontamination of areas that may become contaminated

with radioactive or hazardous materials to facilitate either decommissioning or reuse of the facility. Following are design features that need to be considered:

- Service piping, conduits, and ductwork kept to a minimum in areas that could be potentially contaminated and, if included in such areas, their design arranged to facilitate decontamination.

- Cracks, crevices, and joints filled and finished smooth to prevent accumulation of contaminated material.

- Walls, ceiling, and floors in areas vulnerable to contamination finished with washable or strippable coverings.

- Metal liners, e.g., stainless steel cell lining, used in areas that have the potential to become highly contaminated with radioactive materials.

- Contaminated or potentially contaminated piping systems have provisions for flushing and/or cleaning.

- Accessible, removable covers for inspection and cleanouts provided.

- Construction materials that reduce the amount of radioactive materials requiring disposal and that are easily decontaminated.

Example: A transuranic waste thermal treatment facility is being planned. The facility design is reviewed to determine the ease with which the constructed treatment facility could be decontaminated following its operational life. The evaluation finds that transuranic waste transfer lines can be modified by including liners, and certain areas are found to be amenable to the use of strippable coverings. The design is modified to incorporate these changes and improve the ability to decontaminate the facility.

<u>Design to Support Decommissioning</u>. Decommissioning, also defined in DOE O 420.1, is “the process of closing and securing a nuclear facility or nuclear materials storage facility to provide adequate protection from radiation exposure and to isolate radioactive contamination from the human environment.” Design features that need to be considered to support decommissioning or a reuse of the facility include:

- Use of modular radiation shielding, in lieu of or in addition to, monolithic shielding walls.

- Use of modular, separable confinements to preclude contamination of fixed portions of the structure.

- Designs that ease cut-up, dismantlement, removal, and packaging of contaminated equipment, such as glove boxes, air filtration equipment, large tanks, vessels, and ductwork, from the facility.

- Use of localized liquid transfer systems that avoid long runs of buried, contaminated piping; emphasis on localized batch solidification of liquid waste. Special provisions may also be included in the design to ensure the integrity of joints in buried pipelines.

- Piping systems that carry contaminated or potentially contaminated liquid that free drain by gravity.

- Location of exhaust filtration components of ventilation systems at or near individual enclosures to minimize long runs of internally contaminated ductwork.

- Equipment, including effluent decontamination equipment, that precludes to the extent practicable, the accumulation of radioactive or other hazardous materials in relatively inaccessible areas, including turns in piping and ductwork.

- Provisions for suitable clearances, where practical, to accommodate remote handling and safety surveillance equipment required for future decontamination and decommissioning.

- Use of lifting lugs on large tanks and equipment.

Decommissioning and Reuse Planning. Due to the high life-cycle costs of transuranic waste facilities, this subrequirement is also intended to promote post-mission planning of transuranic waste facilities by requiring the identification of possible decommissioning methods or reuses of transuranic waste facilities as early as possible. To meet this requirement transuranic waste facility designs, or significant modification efforts, need to include analysis to determine the best decommissioning methods, using currently available technologies, and factor the results of this analysis into the facility's design. Likewise, if a reuse of the facility is envisioned, any features that can support this reuse mission need to be considered in the design effort.

Life-Cycle Asset Management, DOE O 430.1A, addresses deactivation and decommissioning requirements of DOE facilities. Refer to DOE O 430.1A and its Guides for further information on additional information on deactivation and decommissioning activities. Refer also to a new

DOE Standard, listed below, on the integration of safety and health requirements into facility disposition activities.

Compliance with this requirement is demonstrated by the existence of design documentation that indicates decontamination was considered during the design of new transuranic waste facilities or significant modifications to transuranic waste facilities. Additionally, Site-Wide Radioactive Waste Management Program documentation demonstrates that post-mission planning was considered, as early as possible in the life of a facility, to assist in the identification of possible decommissioning methods or facility reuse.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft G 420.1-X, U.S. Department of Energy, Washington, D.C., September 1995.

2. DOE, 1997. *Decommissioning Implementation Guide*, Draft G 430.1-4, U.S. Department of Energy, Washington, D.C., October 1, 1997.

3. DOE, 1997. *Integration of Safety and Health into Facility Disposition Activities*, Draft for DOE Complex Wide Review 9/26/97, DOE-STD-1120-98, U.S. Department of Energy, Washington, D.C., September 26, 1997.

4. DOE, 1998. *Life-Cycle Asset Management*, DOE O 430.1A, U.S. Department of Energy, Washington, D.C., October 14, 1998.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of transuranic waste treatment and storage facilities to provide volume inventory data and to prevent spills, leaks, and overflows from tanks or confinement systems.

Objective:

The objective of this requirement is to ensure that engineered controls are included in the design of transuranic waste storage and treatment facilities to minimize the likelihood of release of radionuclides that could lead to exposures or contamination of the environment.

Discussion:

This requirement for instrumentation and engineering controls is invoked to address a group of hazards that was identified during the development of DOE O 435.1 and DOE M 435.1-1 -- the failure to promptly detect and prevent conditions which could lead to a release of radioactive material from transuranic waste storage or treatment facilities that could impact workers, the public, or the environment. This requirement is closely related to the previous design requirement for monitoring systems. However, this requirement focuses on controls to prevent the loss of containment.

The engineered controls referred to in this requirement are those systems or design features that are provided to detect and prevent the loss of containment of transuranic wastes volumes in treatment or storage facilities, and to provide volume inventory data, where appropriate. During the design of storage or treatment systems, the flow of waste material through the system should be evaluated to determine where there is a potential for the loss of containment by overfilling or spilling. Examples of engineering controls include flowmeters and level-sensing devices coupled with anti-siphon devices or shut-off valves, and any other instrumentation and controls that maintain sufficient freeboard within a storage vessel or unit. Other instruments and controls include devices that measure changes in characteristics of liquid waste, e.g., temperature, pressure, pH, and/or other characteristics providing a measure of a materials stability, that are combined with shutoff or diversion routing devices. Although this requirement most obviously applies to management of liquid wastes, it also needs to be considered and applied, as appropriate, to solid transuranic waste.

> *Example 1: A tank system has been installed to receive and store transuranic wastes pending treatment. The wastes are transferred by pipeline to the tanks. The design of each tank includes a liquid level sensor which is coupled to an alarm and diversion valve. When the liquid level is at 88% of the tank depth an alarm sounds on the control room annunciator panel. When the liquid level reaches 92% of the tank depth the diversion valve is automatically actuated and the liquid level is transferred to a spare tank.*

> *Example 2: A facility is being designed to provide thermal treatment of transuranic waste. The thermal treatment unit is designed for continuous feed and continuous discharge of the ash and slag to a disposal container. To avoid the loss of containment, an interlock is included in the design which prevents feed from entering the combustion chamber and waste product from leaving the chamber if a disposal container is not in place at the discharge of the thermal treatment unit.*

The graded approach is used in determining the appropriate level of engineering controls to incorporate into the design of transuranic waste management facilities. As indicated in the

preceding examples, sensing devices, alarms, and spill or overflow prevention features are most appropriate in facilities storing liquids or with continuous, automatic processes. Other instances involving bulk or solid transuranic waste may need to invoke these controls as well, where a simple shutoff of the equipment could prevent overfilling or other hazardous conditions.

The design of engineering controls to meet this requirement will most likely be directed by the facility-specific safety analysis or safety assessment prepared for the waste management facility. Such safety analyses or assessments may dictate that certain engineering controls be designed as safety-class or safety-significant systems, structures, or components (SSC) to ensure they survive design-basis accidents. Use of the safety analysis process, as prescribed by DOE 5480.23, *Nuclear Safety Analysis Reports*, to identify the necessary engineering controls to meet this requirement for both new and upgrades to existing transuranic waste treatment and storage facilities, is considered appropriate and encouraged.

Loss of containment at a waste storage or treatment facility can result from overflows, spills, leaks, or siphoning of waste from a storage vessel. Incorporation of design measures at these facilities to prevent such loss of containment is necessary, but is not necessarily sufficient to adequately control the hazards associated with release of radioactive materials. Equipment of this nature, in spite of rigorous maintenance, can fail over its expected service life. Therefore, as discussed in the above guidance on confinement, an engineered barrier to fully contain the spilled waste or a diversion mechanism to channel the waste to a desired location provides defense-in-depth for the circumstances where the engineering controls do not function.

> *Example: At the Liquid Transuranic Waste Storage Facility, the engineering controls on the liquid transuranic waste storage tanks include a waste feed line shut-off valve, activated by a tank liquid level-sensing device, to prevent overflow of waste from the tank. In addition, the tank is designed with an overflow line so that if the valve malfunctions and the tank is overfilled, the overflow is routed to another waste tank that is maintained as a spare at the storage facility.*

Compliance with this requirement is demonstrated by the incorporation of engineering controls in storage facilities or treatment processes that provide detection and automatic shutoff or diversion of the flow of waste materials that could otherwise spill or overflow the system as documented in the facility's safety documentation.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE G 420.1-X, U.S. Department of Energy, Washington, D.C., September 1995.

2. DOE, 1992. *Nuclear Safety Analysis Reports,* DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(e) Monitoring. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of transuranic waste storage, treatment, and disposal facilities to provide rapid identification of failed confinement and/or other abnormal conditions.

Objective:

The objective of this requirement is to ensure the design and installation of equipment capable of identifying failures in containing transuranic waste and other conditions that could result in exposure of the public, workers or releases to the environment.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the hazards analysis identified releases resulting from confinement failure of a component or from failure to stop transfer of waste when the receiving vessel (e.g., tank or bin) is full as a hazard that needs to be mitigated. The requirement discussed here is generally directed toward prompt detection of acute releases (releases that are detectable visually or by some other gross indicator) that become apparent over a time frame of hours or days. In contrast, the requirements for monitoring (see DOE M 435.1-1, Section III.Q) for compliance with release limits is directed toward detection of releases that generally evolve slowly and may be detected by low threshold environmental monitoring devices weeks, months, or longer after the release begins.

As in implementation of all of the requirements of DOE O 435.1 and DOE M 435.1-1, the graded approach is used for determining the appropriate level of rigor in applying this control to the management systems employed at a particular waste management facility. Also, monitoring for leakage and contamination spread needs to be performed by means appropriate for the type and character of radioactive waste being managed at the facility. Rigorous application of this requirement may be most appropriate for circumstances involving storage or treatment of liquid transuranic waste, for example, highly acidic liquid waste in a single-walled, mild steel tank may require continuous monitoring coupled with alarms and transfer equipment. A treatment facility involving solid waste may need to implement monitoring systems such as portable constant air monitoring systems designed to detect airborne contamination spread from dry processes. A

facility storing containerized waste may rely on a program of container inspections to meet the needs for monitoring for leaks and abnormal conditions.

For transfer systems, designers may need to consider the use of continuous flow monitors to allow comparisons of total volume input to total volume output as an indicator of the integrity of the transfer system. The containment integrity of waste transfer systems can also be monitored for radiation levels in excess of those expected from residual waste in the transfer system.

A highly reliable means of monitoring for releases is the use of secondary confinement which is then checked for waste. It also offers the benefit of providing defense-in-depth in containment of releases of transuranic waste.

> *Example: A liquid transuranic waste transfer line from a storage tank to a treatment facility is enclosed in a larger diameter secondary containment tube. The transfer line and containment tube were constructed with sufficient pitch to cause any leakage into the containment tube to flow back to the storage tank area. The transfer line developed a leak at a coupling which was discovered when waste was found in the secondary containment at the storage tank area.*

What constitutes rapid detection of failed confinement or abnormal conditions needs to be established for each facility, operation, or activity. Monitoring design requirements and engineering controls to address catastrophic failures will be established through the conduct of safety analyses. The failures and conditions being addressed by this requirement are those that are not catastrophic, but could result in releases of radioactivity or doses to workers or the public in excess of established limits if they were allowed to continue over a period of hours or days. Detection equipment needs to be designed to detect confinement failures or abnormal conditions rapidly enough that action can be taken before the situation degrades to the point that response and recovery would result in doses to workers that approach the dose limits for radiation protection of workers (10 CFR Part 835). Similarly if the failure releases radioactivity to a air or liquid effluent stream, detection needs to occur rapidly enough to prevent environmental releases from exceeding annual limits.

Compliance with this requirement is demonstrated by a documented basis for the design of monitoring for transuranic waste systems and the capability to monitor waste volume and detect volume changes in a time frame that will allow implementation of corrective measures to limit public and worker doses to allowable levels and to limit releases to the environment.

Supplemental References:

1. DOE. *Occupational Radiation Protection,* 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

III. N. Storage.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Transuranic waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Objective:

The objective of this requirement is to promote safe storage of transuranic waste by eliminating from storage materials which could result in fires or explosions due to their reactivity or ignitability.

Discussion:

The safe storage of transuranic waste can be jeopardized by the presence of materials which may ignite or explode. To avoid the potential for accidental releases from stored wastes, this requirement prohibits storage of materials that are known to be readily capable of ignition or explosion, or which may degrade over time to be ignitable or explosive. In establishing waste acceptance criteria for storage, waste managers must prohibit the acceptance of materials which have the potential of igniting or exploding. The following materials are not to be stored:

- Reactive metals - metals that can react violently with water, form potentially explosive mixtures with water, or ignite when exposed to air; e.g., uranium or plutonium metal turnings are reactive metals.

- Certain dried ion exchange resins - organic ion exchange resins which have been used for treating solutions containing nitrates have the potential of igniting or exploding if they are allowed to dry out.

- Cellulosic materials contaminated with strong oxidizers - cellulosic materials can spontaneously ignite due to the presence of strong oxidizers, e.g., concentrated nitric acid.

- Volatile materials if stored in areas of high temperatures - storage of volatile materials in closed containers subject to high temperature can result in pressurization of the container and, depending on the waste materials, evolution of flammable gases.

- Pyrophoric materials - nonradioactive materials which can ignite spontaneously are not to be packaged for storage. Radionuclides which may be pyrophoric are to constitute less than 1% by weight of the container contents unless they are treated to eliminate the pyrophoric characteristic.

When waste with the characteristics described above have been generated, it is necessary to treat them prior to placing them into storage. The treatment may consist of causing the reaction to occur under controlled conditions, e.g., oxidation of pyrophoric metals such as uranium fines, or may involve the stabilization of waste materials so that they are no longer flammable or explosive.

> *Example 1: In the process of cleaning out a glovebox, paper absorbent was used to clean up an acid spill. Prior to placing the absorbent material into a drum for prolonged storage, it is taken to a RCRA-permitted treatment facility where the acid is neutralized and the absorbent dried. The treated absorbent materials are then packaged to meet the waste acceptance requirements of the transuranic waste storage facility.*
>
> *Example 2: Metal fines from machining operations are routinely generated as a transuranic waste stream. In order to meet the storage requirements and make the waste acceptable for future disposal, the fines are treated by solidification in a cement matrix in 1-gallon cans. Upon curing, the 1-gallon cans are placed in 55-gallon drums along with filler material that prevents shifting within the drum. The drums are then sent to the on-site storage facility.*

Compliance with this requirement is demonstrated by having waste acceptance requirements which prohibit waste that is ignitable or explosive from being accepted for storage unless it has been treated.

Supplemental References: None.

III. N.(2) Storage Integrity. Transuranic waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Objective:

The objective of this requirement is to ensure that the selection of the location and method for storing transuranic waste is made so that both workers and the containers of waste are provided with adequate protection.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the storage of radioactive waste was identified as an activity that presented potential risk to the public, workers, and the environment. Numerous weaknesses and conditions which could lead to release of waste or exposure of workers were identified during the safety and hazards analysis and subsequent reviews conducted in support of the Manual documentation. In addition, previous reviews of radioactive waste storage conditions and management practices (e.g., *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities)* revealed inadequately or improperly stored waste, which presents the possibility of human exposure to radiation and the potential for adverse environmental effects.

The evaluations of storage that were conducted during development of the Order and Manual revealed a variety of current practices and required lengths of storage for transuranic waste. Transuranic waste is stored in dense-pack arrays, in earthen-covered configurations, and in modern, RCRA-compliant storage facilities. In addition, in order to protect the transuranic waste containers, buildings not originally designed or intended for storage are sometimes used when other storage capacity is not available.

As discussed in the General Requirements guidance on storage (DOE M 435.1-1, Section I.2.F.(13)), a principal element of proper storage is ensuring that the container is protected from degradation so that it can perform its intended function until it is disposed. This requires that containers be protected from mechanical damage and from environmental conditions that could impact the waste and container.

> *Example 1: Due to a large decommissioning project generating unanticipated volumes of transuranic waste, Site Z decided to store transuranic waste outside until indoor storage space could be made available. In accordance with the Packaging and Transportation requirements, filtered vents were installed on the drums used for packaging the waste. However, in establishing the radioactive waste management basis for the outside storage pad, personnel failed to recognize the potential for precipitation entering the drums. Rain accumulated on the tops of the drums, then due to fluctuations in barometric pressure, the drums "breathed" through the vents. Water was sucked in through the vents resulting in the need to repackage the waste so that the containers would not corrode and so they could meet the waste acceptance requirements for disposal. Subsequently, any waste drums that had to be left outside were provided with covers that prevented water from accumulating on the tops.*

> *Example 2: Due to a large backlog of transuranic waste, Site Y is required to store transuranic waste outside until it can be shipped to the Waste Isolation Pilot Plant for disposal. The waste is stored in containers which prevent the entrance of precipitation*

(lid with lips extending down over the sides) and which resist corrosion (painted carbon steel). Controls are in place to limit mechanical damage from vehicles and other operations in the area. The containers are inspected on a monthly basis for deterioration and repaired as necessary to maintain containment of the waste (e.g., painted, contained). Personnel are only in the outside storage area during periods of inspections, container maintenance, and container movement. The outside storage has been analyzed and documented to provide adequate protection for the expected storage time. This storage maintains the integrity of the waste and minimizes worker exposure.

Transuranic waste may be stored in facilities designed specifically for waste storage, as well as in facilities or portions of facilities which originally served another function but have now been converted for use a storage facility. Any facility to be used for transuranic waste storage must comply with the applicable requirements of DOE O 420.1, *Facility Safety*. Special attention is to be given to DOE O 420.1, Section 4.2, Fire Protection, when a facility is to be used for the storage of combustible materials. If facilities have the appropriate provisions (e.g., ventilation, fire suppression) for the type of waste being stored, their use is preferable to storing the waste containers outside and subjecting them to the elements.

In making a decision to use a facility for storage and in developing a radioactive waste management basis for the activity, particular attention to protection of workers is needed. Waste is not to be stored in areas where workers are required to spend extended periods of time in performing other duties (i.e., any duties not related to managing and monitoring the waste). This limits the facilities or areas of facilities that should be used for waste storage to those that are excess to current site missions or those that are infrequently accessed as part of normal operations.

Compliance with this requirement is demonstrated if sites have storage capabilities for transuranic waste that provide protection of waste containers so that their integrity will not be damaged through physical or chemical (corrosion) processes and that keep personnel from spending extended periods of time in the areas where transuranic waste is stored.

Supplemental References: None.

III. N.(3) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of transuranic waste to ensure container integrity is not compromised.

Objective:

The objective of this requirement is to prevent or minimize the potential exposure of workers and release of radioactive contamination to the environment that could result from allowing transuranic waste containers to degrade. The requirement is intended to ensure that the confinement abilities of containers is routinely evaluated and action taken to ensure the waste remains contained.

Discussion:

The containment of transuranic waste in its container is essential for its safe and effective management. During the development of the *Radioactive Waste Management Manual* (DOE M 435.1), inadequate or substandard waste containers and deterioration of containers were identified as a conditions that could result in the loss of waste containment and potentially impact workers, the public, or the environment. The General Requirements of the *Radioactive Waste Management Manual* (DOE M 435.1-1, Section I.2.F.(13)) assign the Field Element Manager responsibility to ensure that all waste is stored in a manner that protects the integrity of the waste container for the expected time of storage. The responsibility for providing adequate storage that protects the integrity of waste containers is complemented by this requirement to routinely inspect the packages and correct any conditions of container deterioration. This is particularly important for transuranic waste that is to be in relatively long-term storage (e.g., waste that will not be shipped to WIPP for a number of years or non-defense waste for which a disposal facility has not been identified). This requirement applies to all storage of transuranic waste, not just storage at a designated storage facility.

> *Example: An assay facility has two areas where waste is staged, one for containers of waste awaiting assay and another for those to be placed into storage after they have been assayed. The assay facility personnel have established operational procedures for the routine physical examination of all waste containers in either staging area. Existence of the inspection process mitigates concerns about waste residing in the staging areas for longer than normal as a result of assay equipment failure or maintenance. The facility procedures also address actions to be taken if waste container integrity is suspect.*

<u>Inspection</u>. The waste container inspection and corrective action process is to ensure that container integrity is maintained throughout the storage or staging period. The process needs to be tailored to the storage situation. Ideally, the storage configuration would allow visual or remote visual inspections of the outsides of waste containers. The inspection considers:

- General condition of the container, such as areas of rust, scratches, and minor dents. The inspection process includes an evaluation of minor surface conditions to determine their impact on the integrity of the container. Such conditions may

not require any action, but are to be noted and corrected if there is a trend indicating eventual deterioration.

- Functioning of the waste container closures. Waste container closures are in place and securely fastened.

- Evidence of leakage. Leakage can indicate a number of problems including unacceptable materials in the waste, inadequate internal containers, insufficient absorbent, or failure of the outer container.

- Evidence of structural problems with the container such as buckling or split seams.

- Bulging of the waste container indicating build up of pressure in the container. Bulging of the container may indicate inappropriate storage conditions (e.g., storing tightly sealed waste containers where they are subject to excessive heating), a condition inside the container that needs to be remediated, and the need to replace the container.

- Examination of waste container marking and labeling to ensure that they are maintained in a legible condition.

Example: Transuranic waste is stored in rows two drums wide and two drums high with an aisle between the rows. The site procedure calls for an operator to inspect the condition of the drums every two weeks and record any potentially adverse conditions.

Some older storage configurations (e.g., dense pack storage where there are multiple rows and layers of waste packages without access space between them) may not allow for direct visual inspection. In such cases, the inspection may have to be done using remote or indirect techniques. Remote techniques include the use of video cameras which provide real time or recorded displays of waste containers which are not accessible for direct inspection. Indirect methods include the use of radiation detectors to determine when a waste container has failed. To the extent possible, direct remote visual inspections are to be used in preference to indirect methods since indirect methods force the inspection and maintenance process into a reactive mode of fixing problems once they have occurred (as detected by an increase in radioactive contamination) rather than a proactive mode of preventing breaching of the waste container.

Example: Drums stored in a dense pack array are in a building that has a continuous air monitor. To ensure adverse waste package conditions are detected as soon as practical, additional monitoring is performed on a routine basis. The additional monitoring involves the collection of smear samples by placing swabs on extensions to check for loose contamination within the array.

Waste containers should be physically examined about every 30 days to ensure that storage conditions have not caused the integrity of the container to be compromised. All waste packaging that exhibits serious deterioration or exhibits a potential for containment of the waste to be jeopardized need to be replaced or overpacked.

> *Example: During the routine inspection of waste drums at a staging area a drum was identified as possibly damaged. Upon detailed inspection, it was determined that a seam of the waste drum had separated. The waste was repackaged and the old drum removed from service.*

<u>Maintenance</u>. The process for waste container maintenance is to include preventive actions as well as corrective actions. Preventive actions would address minor conditions associated with ensuring waste containment. Actions might include cleaning and painting small areas on metal to curb corrosion that could eventually compromise the container. The process also is to provide capabilities to respond to more serious conditions up to and including breaching of the container (e.g, from accidental puncture or corrosion).

Maintenance of containers in response to acute conditions (i.e., conditions where there is a release or imminent threat of a release) provides for prompt containment of the release, assessment of the situation, and remedying the situation. The immediate response is to ensure that release of contamination is controlled. Control actions may be as simple as replacing a bolt or closure ring on a drum, or covering a hole in a container with tape. More serious conditions may require placing the waste container in a catch tray or immediately placing it in an overpack. The condition causing the breach or potential breach must be assessed so that, if necessary, the causative factors can be corrected. If corrosion is affecting the waste container, the reason for the corrosion needs to be determined so an effective response can be made. If there is a corrosive material in the waste container, overpacking may only temporarily correct the problem. In such a situation, it may be more appropriate to treat the waste or to provide a liner that is resistant to corrosion. If there is buckling of the waste container or split seams, an assessment needs to be made of whether the contents are too heavy, whether the container is improperly designed, or whether it was mishandled (e.g., dropped). In cases where an external event is the cause of the damage (e.g., a waste container is dropped or struck by equipment), repackaging or overpacking in a similar container is appropriate.

> *Example: The inspection process in a storage facility identified a waste drum that was corroding even though the container was stored in acceptable conditions and the paint on the drum was in good shape. Storage facility personnel recognized that there was a need to investigate whether the contents of the container were causing the corrosion. Evaluation of the container contents confirmed that the waste was contaminated with corrosive material. The waste was treated to neutralize its corrosivity, then repackaged in a similar container.*

Waste managers are not to interpret the term “maintenance” to imply that refurbishment of deteriorating waste containers is required. The basic premise of this requirement is that potential doses to workers are to be avoided. Therefore, overpacking may be the most appropriate action as opposed to an action requiring handling of the waste and a failed container.

Compliance with this requirement is demonstrated by a documented process for waste container inspection and maintenance at every facility managing transuranic waste, and documentation for all waste container inspections and maintenance actions performed.

Supplemental References: None.

III. N.(4) Retrievable Earthen-Covered Storage. Plans for the removal of transuranic waste from retrievable earthen-covered storage facilities shall be established and maintained. Prior to commencing waste retrieval activities, each waste storage site shall be evaluated to determine relevant information on types, quantities, and location of radioactive and hazardous chemicals as necessary to protect workers during the retrieval process.

Objective:

The objective of this requirement is to promote the removal of retrievably-stored transuranic waste from earthen-covered storage and its transfer to subsequent waste management facilities where there is less potential of release to the environment. Additionally, the purpose of the requirement is to ensure that, to the extent practical, information about the waste is collected and analyzed so hazards associated with the waste can be mitigated through selection of equipment, development of procedures, and implementation of work practices.

Discussion:

The General Requirements chapter of DOE M 435.1-1 assigns the Field Element Manager responsibility for ensuring that waste is stored in a manner that is protective of the public, workers, and the environment. Additionally, the Field Element Manager is responsible for ensuring the integrity of waste containers during the time they are stored (DOE M 435.1-1, Section I.2.F.(13)). This requirement supplements the General Requirement by encouraging the removal of waste from storage configurations that may contribute to the degradation of waste containers.

Following implementation of the 1970 Immediate Action Directive (AEC, 1970) concerning solid waste management, the Department began storing waste suspected of being transuranic waste

with the intent of retrieving it for future disposal. Waste disposed of prior to the implementation of the 1970 Immediate Action Directive is not retrievably stored transuranic waste and therefore, is not subject to this requirement. Generally, such wastes are managed pursuant to the *Comprehensive Environmental Response, Compensation, and Liability Act*.

To implement the Immediate Action Directive, a number of DOE sites designed storage configurations that involved placement of containers of transuranic waste (or waste suspected of being transuranic waste) in lined or unlined trenches, or at grade, then covering them with soil. At the time of emplacement, the configuration was intended for 20-year retrievable storage. Much of this waste is still in earthen-covered storage, some of it beyond the originally planned 20 years. Experience gained through investigations and retrieval activities has shown that in some cases the integrity of the containers has been compromised (e.g., moisture condensing on metal containers has led to significant rusting).

During the development of DOE M 435.1-1, *Radioactive Waste Management Manual*, a safety and hazards analysis identified the potential release of radioactivity to the environment from waste packages in earthen-covered storage and the concomitant hazard to retrieval workers, as conditions for which radiological controls were needed. Likewise, it was also recognized that the longer waste containers remain in earthen-covered storage configurations, the greater the likelihood of a release. Therefore, this requirement was developed to promote the movement of waste to more acceptable conditions (i.e., better storage conditions, treatment, or disposal). The hazards to workers are to be mitigated by acquiring as much information as practical about what will be encountered upon exhumation and implementing controls to address those hazards.

Retrieval Plans. Plans for retrieval of waste from earthen-covered storage will vary depending on the stage of development of the retrieval program, and will need to be updated (maintained) as the program progresses. In the early stages, the planning will be primarily programmatic with the focus on identifying and developing the information and infrastructure needed to effect retrieval. This planning integrates with the documented Site-Wide Program (see DOE M 435.1-1, Section I.2.F.(1)) because it reflects the same commitments and milestones addressed in the Site-Wide Program. The plans for retrieval may suffice as the documentation for that portion of the Site-Wide Program. Recognizing that some of the waste placed in earthen-covered storage may not meet the current definition of transuranic waste, the planning needs to address determining whether retrieved containers have transuranic or low-level waste, and the disposition of the different types of waste. The early planning includes the following:

- The scope of the retrieval activity (i.e., the facilities (trenches, above-grade pads, etc.) from which waste will be retrieved);

- A conceptual description of the approach to be used (e.g., method of removing overburden, means of removing tarps and/or plywood covering the waste packages, contamination control during removal operations);

- Data collection (see Pre-Retrieval Evaluation below), analyses, and studies to be conducted in support of retrieval operations;

- Identification of primary facilities and equipment needed to retrieve waste (weather enclosures, drum handling equipment, drum venting equipment, earth moving equipment, transportation vehicles);

- Identification of existing and new support facilities (e.g., needed treatment, storage, and/or disposal facilities);

- Evaluation of retrieved waste containers (inspection, overpacking, assay);

- Management steps for retrieved packages (e.g., venting, storage, treatment, disposal);

- Plans for decommissioning the earthen-covered storage facility following removal of the waste; and

- The cost and schedule for preparing for and accomplishing retrieval of the waste.

Example: A site has waste that was placed into earthen-covered storage under the assumption that it was transuranic waste. As part of the site-wide waste management program, a document is prepared that describes the facilities and equipment envisioned to be needed and the process for retrieving the waste. The document also includes a schedule for collecting and evaluating data associated with the waste, providing the needed facilities and equipment, developing control documentation (e.g., permits, procedures, safety analysis report, health and safety plan), conducting startup activities (operational readiness reviews), and performing the retrieval. The documentation also includes a budget estimate for preparing and conducting the retrieval.

As information is acquired and the infrastructure to support retrieval evolves, the plans for retrieval will need to be updated and become more focused. The planning will become more project specific and include the development of the time-phased plans for retrieving waste, characterization plans, radiological control plans, health and safety plans, and emergency response plans. The planning done at this stage will also be more specific as to the process for exposing and handling drums, including cover removal; waste management (e.g, contaminated soil, plastic, plywood); inspections to be performed; handling non-routine drums (e.g., those that are bulging

or deteriorated); venting of drums; assaying; specific plans for disposition of different waste types (including segregation of defense and non-defense transuranic waste as discussed below); marking and labeling; and movement of drums. The planning provides the basis for developing the procedures that will control waste retrieval.

Pre-Retrieval Evaluation. In the early stages of planning, a key activity is the collection and evaluation of data about the waste that is to be retrieved. Some of these data (e.g., location, volumes) may be readily available in existing data bases and will be used in the early planning. However, prior to developing project-specific plans and procedures controlling retrieval activities, a thorough evaluation of available data needs to be made so that appropriate worker protection can be planned.

The evaluation of information relevant to waste characteristics will involve collecting information on the character of the waste, waste containers, and the storage configuration. The evaluation includes an examination of existing burial records, production records, and design drawings of waste containers and the storage facility and can be supplemented by interviews with current and former employees. To the extent the information is available, the evaluation is to identify the following:

- Type of earthen-covered storage facility (e.g., trenches, above-grade pads, drum stacks);
- Waste storage facility design and construction (e.g., above-grade, below-grade, use of tarps and/or plywood);
- Types of containers present (e.g., 55-gallon drums, fiberglass-reinforced plywood, wooden, or metal boxes) and their approximate sizes and weights;
- Radionuclide species and inventory in the containers;
- Chemical constituents in the waste;
- The presence of waste containers with high dose rates (i.e., above contact-handled limits per site radiological control practices);
- Any other waste or facility characteristics that may affect health, safety, or the environment.

Example: To prepare for retrieval of waste from earthen-covered storage, site personnel undertake a review of available information. They compile copies of as-built blue-prints for the storage facility, review the shipping and transfer records that accompanied the

> *waste when it was received, and based on the records, identify the containers in which the waste is contained. The shipping and transfer records identify the facilities from which the waste was received, which leads to interview of staff who worked at the facilities that generated the waste. Interviews indicate that there may be other radionuclides present than the few reported on the shipping and transfer records. Expected dose rates from the waste containers available from the shipping and transfer records are corroborated by the staff from the generating facilities.*

Evaluation of data about the facility and waste is to be used in developing the detailed retrieval plans and procedures, particularly as they relate to ensuring worker safety. The data can be used to support decisions on container handling procedures (e.g., remote versus contact handling) and the type of personnel protective equipment that may be appropriate. Even if data indicate that a low level of personnel protective equipment is sufficient, initial contact with retrieved waste needs to be undertaken using a high level of protection (e.g., EPA level A or B). Only after the expected level of hazard has been confirmed to be low should the level of personnel protection be lowered.

> *Example: The evaluation of information about an earthen-covered storage facility leads to the expectation that the waste containers will be in good shape. This means that only Level C protective equipment (anticontamination clothing, no respiratory equipment) is required and that the waste can be contact handled. During initial entry into each storage module, frequent dose rate surveys are conducted and personnel wear respirators until it is confirmed that dose rates are low and there is no airborne hazard.*

Compliance with this requirement is demonstrated if personnel have developed plans and continue to show progress towards removing waste from earthen-covered storage facilities and the level of planning is commensurate with the stage of the retrieval program. Early planning describes the approach to be followed and actions to be taken to initiate waste retrieval. Later planning includes the specific activity-based plans that are necessary to support actual waste retrieval. Compliance also is demonstrated by site personnel having collected and compiled information about the storage facility and waste to be retrieved. In addition, the plans and procedures for waste retrieval should reflect consideration of the information compiled about the facility, containers, and waste to be retrieved.

Supplemental References: None.

III. O. Treatment.

> **Transuranic waste shall be treated as necessary to meet the waste acceptance requirements of the facility receiving the waste for storage or disposal.**

Objective:

The objective of this requirement is to emphasize that transuranic waste must be treated as necessary to meet the waste acceptance requirements of the storage, or disposal facility or facilities to which it will be transferred.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, treatment of waste was identified as an activity that presented potential risks to the public, workers, and the environment. Requirements that address the weaknesses and conditions that could lead to potential adverse impacts were found in external regulations (e.g., *Clean Air Act* or *RCRA*) or other DOE directives (e.g., 10 CFR Part 835, *Occupational Radiation Protection* or DOE O 360.1, *Training*). The Field Element Manager has a performance-oriented responsibility for ensuring that waste treatment is protective of the public, workers, and the environment (DOE M 435.1-1, Section I.2.F.(14)). The current requirement focuses attention on taking the treatment actions necessary to make waste acceptable for subsequent waste management steps.

The decision to treat waste, i.e., changing the physical or chemical character of the waste, can be driven by either dictated requirements or programmatic needs. Required treatment includes treatment necessary to comply with external regulations (e.g., RCRA, FFCA) or to render waste acceptable for transfer to another facility (i.e., to meet waste acceptance requirements). Waste acceptance requirements for a facility to which transuranic waste is transferred are required by DOE M 435.1-1, Section III.G. These requirements are based on safe handling of the waste and on regulatory compliance. During the development of DOE M 435.1, certain materials which represented a potential fire or explosion hazard were identified as being unacceptable for storage, leading to the need to treat waste composed of these materials so it can be accepted for storage. Waste treatment may range from actions as simple as sorting waste to remove materials which would make the waste unacceptable (e.g., aerosol cans), to more complex technologies such as incineration.

Storage Prohibitions. Manual requirements for transuranic waste storage include classes of items which are prohibited from storage because they represent potential fire or explosive hazards. The materials or classes of items which cannot be stored include dry nitrate-contaminated ion exchange resins, cellulosic material contaminated with strong oxidizers, reactive metals, pyrophoric materials, and volatile organics in high temperature areas. Wastes containing the

above-listed materials must be treated to remove or counteract the potential hazard. Nitrate-contaminated ion exchange resins can be stored wet or stabilized so they cannot react. Cellulosic materials can be oxidized under controlled conditions or the oxidizers can be neutralized. Reactive metals and pyrophoric materials can either be oxidized or stabilized (e.g., in concrete) to remove their hazards. Similarly, waste contaminated with volatile organics can be oxidized if it necessary to store the waste in an area of high heat.

Waste with No Path to Disposal. Available treatment options need to be evaluated before a waste is categorized as having no path to disposal, as discussed in Section I.2.F.(19). Application of appropriate treatment can potentially resolve waste acceptance issues for waste types such as:

- heterogenous wastes which contain unacceptable items (e.g., pressurized containers);
- liquid wastes which can be absorbed or solidified;
- wastes classified for security reasons because of shape;
- wastes containing high explosives; and
- wastes containing in excess of 50 ppm polychlorinated biphenyls.

Example: An activity generates an aqueous transuranic waste. In order to make the waste acceptable for storage and eventual disposal at WIPP, a study is performed to determine the most appropriate means of treatment. On the basis of the study, the liquid waste is solidified with an appropriate solidification agent so that the waste meets the acceptance criteria of both the storage facility and WIPP.

For defense waste, WIPP is the disposal facility, so evaluations of needed treatment generally need to consider the waste acceptance requirements of WIPP. However, there are some transuranic wastes for which treatment either is not currently available or will not solve the problem that makes the waste unacceptable for disposal at WIPP (e.g., non-defense waste). Such waste needs to be treated to the waste acceptance requirements of the storage facility to which it will be sent to ensure that it remains safe during the protracted storage period that will be required before disposal issues can be resolved.

Mixed Transuranic Waste. Treatment necessary to comply with agreements reached pursuant to the *Federal Facility Compliance Act of 1992* must also be considered in making treatment decisions. Although it was generally assumed that mixed transuranic waste would be sent to WIPP without treating for the RCRA-regulated component, site personnel need to ensure that

commitments made in the Site Treatment Plans and consent orders/agreements are met for both current and newly-generated transuranic wastes.

Treatment for Programmatic Reasons. The requirement to treat waste to meet the waste acceptance criteria of the appropriate storage or disposal facility is not intended to prohibit treatment for other reasons. Waste managers may elect to treat waste for programmatic reasons, but in so doing, must ensure that the waste will still meet the waste acceptance criteria of the facility(ies) to which it will be transferred. Programmatic reasons for treating waste may be to make more efficient use of the TRUPACT II transportation system and thereby reduce risk and cost associated with transportation to WIPP (see Section III.L.(2)), or to decrease the storage or disposal capacity needed.

> *Example: A site is generating significant amounts of compactable transuranic waste. Due to the time expected to pass before shipment to WIPP begins, waste projections indicate that additional onsite storage will be needed to accommodate the as-generated waste volumes. Results of a study indicate that use of a compactor will allow the site to store the projected wastes without building a new storage facility, and will also result in transportation cost savings because fewer TRUPACT II shipments to WIPP will be needed.*

Compliance with this requirement is demonstrated by the custodian of transuranic waste maintaining documentation which identifies the plans for treating waste, and maintaining the records that show waste was treated, if necessary, to meet the waste acceptance requirements of the storage or disposal facility to which it was transferred.

Supplemental References:

1. *Resource Conservation and Recovery Act of 1976,* as amended, October 21, 1986.

2. *Federal Facility Compliance Act of 1992,* as amended, October 6, 1992.

3. *Toxic Substances Control Act*, as amended, , October 11, 1976.

4. DOE, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. P. Disposal.

Transuranic waste shall be disposed in accordance with the requirements of 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*.

Objective:

The objective of this requirement is to ensure transuranic waste is disposed of in a facility that meets the appropriate regulatory requirements and to establish Headquarters as the DOE authority for making compliance determinations for transuranic waste disposal facilities other than WIPP.

Discussion:

Responsibility for actions associated with transuranic waste disposal are addressed in the *Radioactive Waste Management Manual.* In DOE M 435.1-1, Section I.2.E., the Deputy Assistant Secretary is assigned responsibility for reviewing and approving certain transuranic waste disposal facility performance assessments. Paragraphs included in this portion of guidance explain the cases in which this applies. As discussed in DOE M 435.1-1, Section I.2.F.(15), the Field Element Manager of a site with a transuranic waste disposal facility is responsible for ensuring the safe disposal of transuranic waste, for reviewing performance assessments prior to submitting them to Headquarters, and for maintaining performance assessments.

Starting in the 1970s, the Department began storing waste that was suspected of being contaminated with transuranic isotopes at a concentration greater than 10 nCi per gram of waste. The concentration of 10 nCi/g (370 Bq/g) was an interim limit used pending completion of a technical basis for developing a limit. In 1982, the technical analyses for establishing a limit were discussed at an interagency workshop and the limit was changed to 100 nCi/g (3,700 Bq/g). Shortly after this workshop, the Environmental Protection Agency (EPA) proposed standards which included the 100 nCi/g limit for management and disposal of transuranic waste.

The EPA is responsible for developing generally applicable standards for protection of the environment from radioactive materials pursuant to authority granted by *Atomic Energy Act of 1954*, as amended, and the *Nuclear Waste Policy Act of 1982*, as amended. In 1985, the draft standards EPA proposed in 1982 were promulgated as the *Environmental Standards for the Management and Disposal of Spent Fuel, High-Level and Transuranic Radioactive Wastes*, 40 CFR Part 191. In 1987, the U.S. Court of Appeals for the First Circuit remanded Subpart B of the 1985 standards, "Environmental Standards for Disposal," for further consideration (*Natural Resources Defense Council, Inc.* v. *United States Environmental Protection Agency*, 824 F.2d 1258). In 1992, Congress reinstated a portion of the remanded disposal standards with the

passage of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992,* as amended. Congress also directed EPA to resolve the issues that were the basis for the court remand and reissue the remaining disposal standards. On December 20, 1993, EPA issued the revised sections of the requirements. They became effective on January 19, 1994 (*58 FR 66398*).

Requirements Applicable to Disposal. The bulk of DOE's transuranic waste is related to defense activities and will ultimately be acceptable for disposal at WIPP. Consistent with this fact, most of the Department's focus on transuranic waste disposal has been on the development and opening of WIPP consistent with the requirements of 40 CFR Part 191. For WIPP, and any future facilities if they are developed, the requirements of 40 CFR Part 191 apply, including the revised individual protection and groundwater protection standards.

> *Example: A site determines that it must construct an enhanced engineered disposal facility for a small amount of transuranic waste that cannot be made to meet the WIPP waste acceptance criteria. Since the facility will operate after January 1994, it must comply with the January 1994 revisions to 40 CFR Part 191.*

However, for transuranic waste disposal facilities subject to 40 CFR Part 191 that operated prior to the January 1994 effective date, the older (1985) standards apply. In the Supplementary Information published in the 1993 Federal Register promulgating the revisions to the rule, EPA acknowledges that it previously informed the Department that the 1985 version of 40 CFR Part 191 applied to the Greater Confinement Disposal Facility (Nevada Test Site). The EPA further states that this determination is not changed by the *WIPP Land Withdrawal Act of 1992,* as amended, or the issuance of the revised regulation.

Departmental personnel should also note that the 40 CFR Part 191 regulations do not apply to disposal that occurred prior to promulgation of the regulations. The 1985 version of the regulations states under the applicability section of Subpart B, "Environmental Standards for Disposal," that the standards do not apply to waste disposed prior to the effective date of the rule. This excludes from the regulations waste that is colloquially known as "pre-1970 TRU waste", "suspect buried transuranic waste", and possibly by other names, if the waste is left in place. If the waste is exhumed, the waste becomes subject to the currently applicable regulations. However, as a good management practice, it is recommended that waste meeting the current definition of transuranic waste that was disposed of after 1970, but before 1994, be evaluated in accordance with the 1985 regulations.

> *Example: A site was in the middle of a three-year campaign to dispose of transuranic waste at the time 40 CFR Part 191 was promulgated in 1985. Consequently, some of the waste was disposed of before the effective date of the regulation and some was disposed of after. The site manager decides to include all of the transuranic waste in the performance assessment prepared under 40 CFR Part 191. Because the operation ended*

prior to 1994, the 1985 version of the regulations are applied as the performance measures in the assessment.

Approval Authority. Determination of compliance with the requirements of 40 CFR Part 191 depends on the facility being considered. In the *WIPP Land Withdrawal Act of 1992*, as amended, Congress assigned EPA the responsibility for issuing the standards discussed above and for certifying that WIPP meets the standards. In carrying out this responsibility, the EPA issued criteria by which they would evaluate the DOE certification application and published them as 40 CFR Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations; Final Rule*. The Department is responsible for submitting an application for compliance certification to the EPA. Subsequently, the EPA must determine if the Department complies with the requirements.

Sites other than WIPP are "regulated" by the implementing agency, in this case, DOE. As discussed in the General Requirements chapter of the *Radioactive Waste Management Manual* (DOE M 435.1-1, Section I.2.F.(15)), the Field Element Manager is responsible for reviewing and submitting a performance assessment to Headquarters. The Headquarters Deputy Assistant Secretary for Waste Management will establish a process similar to that used for low-level waste disposal facilities for reviewing and approving performance assessments, and also considers the following:

- General provisions including purpose, scope, definitions, communications, conditions of compliance, and alternative provisions;
- Compliance determinations including completeness and accuracy of compliance submissions and reference materials;
- General requirements that address inspections, quality assurance, models and computer codes, waste characterization, future state assumptions, expert judgment, and peer review;
- Containment requirements considering application of release limits, scope of performance assessments, consideration of drilling events in performance assessments, and results of performance assessments;
- Assurance requirements including active and passive institutional controls, monitoring, engineered barriers, and consideration of natural resources; and
- Individual and groundwater protection requirements that consider the protected individual, exposure pathways, underground sources of drinking water, and the scope and results of the performance assessment.

Example: The manager of a site that disposed of a small amount of transuranic waste ensures the development of a performance assessment that provides a reasonable expectation of meeting the performance measures in 40 CFR Part 191 for the onsite facility. Since the facility is not WIPP, following his review, the site manager submits the performance assessment to Headquarters for approval. The Deputy Assistant Secretary for Waste Management has previously assigned this task to a team that has developed a review plan that documents the criteria to be used. The team proceeds with the review and provides a recommendation back to the Deputy Assistant Manager who makes a final determination and documents it in a memorandum to the site manager.

Compliance with this requirement is demonstrated by timely completion of a technically-acceptable performance assessment that projects compliance with the standards contained in the appropriate version of 40 CFR Part 191 as discussed above. Another aspect of acceptable performance relative to this requirement is development and implementation of a review process that results in completing the compliance determination within one year of Headquarters' receipt of the performance assessment.

Supplemental References:

1. EPA, 1985. "Final Rule, 40 CFR Part 191, Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

2. EPA, 1993. "Final Rule, 40 CFR Part 191, Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 58, No. 242, U.S. Environmental Protection Agency, Washington, D.C., December 20, 1993.

3. EPA, 1996. "40 CFR Part 194, Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations," *Federal Register*, Vol. 61, No. 28, U.S. Environmental Protection Agency, Washington, D.C., February 9, 1996.

4. EPA, 1996. *Compliance Application Guidance for 40 CFR Part 194*, EPA 402-R-95-014, U.S. Environmental Protection Agency, Washington, D.C., March 29, 1996.

5. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended, October 30, 1992.

6. *Nuclear Waste Policy Act of 1982,* as amended, January 7, 1983.

7. *Atomic Energy Act of 1954*, as amended, 42 U.S.C. 2011 et seq, 1954.

III. Q. Monitoring.

The following requirements are in addition to those in Chapter I of this Manual:

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

Objective:

The objective of this requirement is to specify minimum parameters for which information will be routinely collected and analyzed for the purpose of anticipating or identifying undesirable conditions in the management of transuranic waste.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the hazards and safety analyses identified timely monitoring of radioactive waste management facilities as an effective means of mitigating numerous weaknesses and conditions associated with all phases in the life cycle of waste management. An analysis of existing Departmental requirements for environmental monitoring in DOE 5400.1 and DOE 5400.5 found that they were applicable to all radioactive waste types and all radioactive waste management facilities. Many of the individual conditions evaluated in the safety and hazards analysis which warranted monitoring are already addressed due to implementation of these Order requirements. These two DOE Orders are invoked by DOE M 435.1-1, Section I.1.E.(7).

However, while the general environmental monitoring program and the environmental monitoring plans mandated by DOE 5400.1 and DOE 5400.5 are adequate for most circumstances, requirements have been included in DOE M 435.1-1 to require identification of specific warning signs of impending conditions that could lead to releases, especially for storage of liquid transuranic waste. Requirements III.Q.(1) and III.Q.(2) address these aspects of additional monitoring for transuranic waste facilities.

Parameters Specified. The minimum parameters specified in the requirement (temperature, pressure, radioactivity in effluents, flammable/explosive mixtures of gases) were selected based on their potential significance in predicting and identifying undesirable conditions. Each facility's radioactive waste management basis should include an evaluation of the applicability and significance of the minimum parameters. This evaluation also needs to consider additional parameters to be sampled or monitored to ensure the protection of the public health, the

environment, and the workers. If a minimum parameter specified in the requirement is deemed to be not applicable in any way to the active operation of that facility, then that justification should be included in the radioactive waste management basis and when approved, constitutes an exemption to the Manual.

The parameters need to be sampled or monitored with a frequency that is consistent with the need to detect changes in facility performance. The accuracy and precision of measurement required is dictated by the expected variations in the parameters and the level of accuracy and precision needed to identify problems. The monitoring frequency for specific parameters is likewise determined based on the possible time variation of the parameter and the response time required to take mitigating action. For facilities that release radioactivity in effluents, frequent monitoring or continuous monitoring should be considered.

> *Example: A tank is used to store liquid transuranic waste. In evaluating the potential for releases from the tank, it is determined that waste temperature, head space pressure, and radioactivity in the ventilation exhaust must be continuously monitored. An organics sniffer is used on a weekly basis to check for flammable/explosive mixtures of gases in the tank. There are no liquid effluents, so no sampling or monitoring is required.*

The verification that controls and systems are functioning properly is based upon the nature of the transuranic waste management activity and the potential impact resulting from a failure. Verification of active control systems for sampling and monitoring critical facility parameters may require frequent visual inspections or performance testing. Passive controls such as the floor and curbing in a storage facility may only require physical inspection once every year. Verification activities are part of the radioactive waste management basis and are to be documented appropriately.

All transuranic waste management facilities are required to apply the sampling or monitoring requirement for the specified parameters using a graded approach. As previously noted, the methods used and the frequency should be commensurate with the significance of a change in the parameter. This graded approach can extend to determining that it is inappropriate or unnecessary to monitor or sample for specific parameters, but the basis for such a determination needs to be documented.

> *Example: A building is used for the storage of packaged transuranic waste. Based on the auditable safety analysis, sampling and monitoring for the minimum specified parameters are applied in a graded manner depending on the parameter. The facility ventilation system is equipped with a continuous monitor and a sampler. Radioactivity in liquid effluent and pressure are not monitored or sampled because the parameters do not apply to the facility. The inspection procedures for the facility specify that personnel should note whether the temperature in the building is within a range of 55 to 85 degrees*

Fahrenheit. In addition, procedures require personnel to record visual observations of the drums, including whether there is any bulging that indicates pressurization.

Compliance with this requirement is demonstrated if monitoring or sampling for the stated parameters is performed for all facilities with an accuracy, precision, and frequency consistent with timely identification of developing problems and a justification exists in the approved radioactive waste management basis for those specified parameters which are not monitored or sampled.

Supplemental References:

1. DOE, 1988. *General Environmental Protection Program,* DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

2. DOE, 1990. *Radiation Protection of the Public and the Environmental,* DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

III. Q.(2) Stored Wastes. All transuranic wastes in storage shall be monitored, as prescribed by the appropriate facility safety analysis, to ensure the wastes are maintained in safe condition.

Objective:

The objective of this requirement is to ensure that the results of safety analyses performed as part of the authorization of transuranic waste facility operations are appropriately translated into monitoring requirements for waste storage so conditions that could lead to exposure of the public or workers, or releases to the environment are detected and mitigated.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, monitoring at radioactive waste management facilities was identified as an effective mitigation of numerous weaknesses and conditions associated with all phases of the life-cycle of waste management. An analysis of existing Departmental requirements for environmental monitoring in DOE 5400.1 and DOE 5400.5 found that they were applicable to all radioactive waste types and all radioactive waste management facilities. Many of the individual conditions that warranted monitoring that were evaluated in the safety and hazards analysis are mitigated due to the implementation of these Order requirements. Therefore, DOE M 435.1-1, Section I.1.E.(7) requires that these two DOE Orders be implemented for environmental monitoring of radioactive waste management facilities.

While the environmental monitoring mandated by DOE 5400.1 and DOE 5400.5 is adequate to detect environmental releases, it was determined that due to the long storage times that occur with transuranic waste, monitoring of additional systems or parameters was needed. The DOE regulation governing radiation exposure of workers (10 CFR Part 835), was also identified as a source of requirements that would require that a set of controls be put in place to protect workers from radiation exposure.

> *Example: Transuranic waste is stored in a building which contains a change room used by waste management workers. Access to the change room requires workers to pass through the area where the waste is stored. The health physics staff takes dose rate readings along the face of the stored transuranic waste, then cordons off a radiological control area that minimizes exposure to staff that must pass through the building.*

Additional systems or parameters that could warn of impending conditions that could lead to worker exposure or releases to the environment may be indicated in the safety analyses performed for transuranic waste management facilities. Some of the monitoring that safety analyses indicate is needed may be also addressed minimum requirements in the other subparagraphs of this monitoring requirement.

The *Nuclear Safety Analysis Reports* Order (DOE 5480.23) and related standards (DOE-STD-3009-93, DOE-STD-1027-92, DOE-EM-STD-5502-04) and the *Facility Safety* Order (DOE O 420.1) provide information on the hazard categorization of facilities and the safety analyses to be performed. Through the conduct of safety analyses, whether they are formal safety analysis reports or auditable safety analyses, facility personnel identify the quantity and form of radioactive and/or hazardous material to be handled at the facility and the operations for managing the waste. The safety analysis establishes a basis for defining the acceptable operations envelope for the facility, and provides the basis for technical safety requirements (TSRs). The technical safety requirements may include requirements for monitoring, however, facility personnel are to also review the safety analysis to determine if the analyses indicate other monitoring that would be prudent.

> *Example: An auditable safety analysis is performed as part of the startup of a transuranic waste storage facility. The safety analysis indicates that a monitoring and sampling system is required on the building exhaust system to ensure releases do not endanger workers, the public, or the environment. Site personnel decided that alpha monitors will be installed in the waste storage bays, in addition to the monitor that is on the building ventilation system, consistent with the defense-in-depth philosophy.*

The safety analyses may also indicate the need for routine inspection of waste packages in storage. Inspections to be performed on waste packages in storage are addressed by DOE M 435.1-1, Section III.N and are discussed in the guidance for that requirement.

Compliance with this requirement is demonstrated if the monitoring requirements in the facility procedures include, at a minimum, monitoring the systems and parameters as indicated by the safety analysis.

Supplemental References:

1. DOE, 1994. *DOE Limited Standard: Hazard Baseline Documentation*, DOE-EM-STD-5502-04, U.S. Department of Energy, Washington, D.C., August 1994.

2. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

3. DOE, 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C., December 1992.

4. DOE, 1993. *SAR Preparation Guide*, DOE-STD-3009-93, U.S. Department of Energy, Washington, D.C., 1993.

III. Q.(3) Liquid Waste Storage Facilities. For facilities storing liquid transuranic waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Objective:

The objective of this requirement is to ensure monitoring of parameters that indicate the quantity of liquid transuranic waste stored in tanks so that changes can be promptly checked to determine if they indicate leakage, overfilling, or other problems. The objective of this requirement also includes tracking of the chemical characteristics of the waste to anticipate and avert undesirable storage conditions.

Discussion:

This requirement specifies additional parameters to be monitored at facilities storing liquid transuranic waste. In developing the requirements for DOE O 435.1 and DOE M 435.1-1, a hazards analyses identified releases resulting from failed containment or from overfilling liquid waste storage tanks as hazards that can result in exposure of workers or the public and releases to the environment. The requirement addresses the operation of monitoring systems to detect storage tank or transfer equipment failure that is of sufficient magnitude to cause a detectable volume change, as well as volume increases that could lead to overfilling of tanks. The

monitoring capability should be coupled with operational devices such as automatic shutoffs and bypasses and alarms that will alert operators that action is needed to prevent or mitigate a release. Regardless of the radiological hazard of the waste being stored, leak detection equipment and inspection of catch basins for liquid waste storage facilities should be included in the monitoring program, consistent with the requirements in DOE 5480.22, to prevent unplanned releases of liquid waste in storage.

<u>Liquid Level or Waste Volume</u>. Some changes in liquid level or waste volume can occur normally due to slight changes in temperature or pressure. This requirement addresses measuring liquid level or waste volume in a storage tank for the purpose of prompt detection of acute releases (releases that are detectable visually or by some other gross indicator) and more chronic releases that become apparent over a time frame of hours or days.

> *Example. A large diameter liquid transuranic waste storage tank includes a mechanical level indicator that is read and recorded daily. The level indicator remains stable for six months following the last addition of waste to the tank. The level indicator readings then begin to show a downward trend that totals two inches over a two week period. The level indicator change alerts operators of a potential problem that requires further investigation.*

Surface level is a relatively straightforward parameter to monitor for detection of leakage from a liquid waste storage system. In general, the surface level in a storage tank is an appropriate indicator of waste volume. However, operations and mechanisms that could change the volume in a tank must be considered to ensure all unexplainable level changes are investigated and to discount explainable level changes.

Gas generation and evaporation, as well as intentional additions to and removals from the storage tanks, must be accurately accounted for if the waste liquid level (or volume) is to be used to monitor for leakage. Also, consideration needs to be given to the separate monitoring of the liquid fraction and sludge or solid fraction present in the tank, if layering of the waste is present.

> *Example: In the tank in the example above, an unexpected chemical reaction generates gas that is trapped within the waste matrix or under a semipermeable layer of waste that retards percolation of the gas to the surface of the waste. Consequently, there is an increase in the surface level of the waste. Over time, the gas is released and the waste volume returns to its normal level. Although the change in liquid level in the tank did not appear to be a problem once the gas was released, the generation of gas is identified as an issue that needs further investigation.*

<u>Chemical Characteristics</u>. Experience with situations threatening confinement of liquid radioactive waste in storage tanks led to the part of the requirement focused on monitoring

chemical characteristics. Chemical characteristics that are not compatible with the material of construction of waste tanks or transfer equipment often presage containment failure. The frequency of monitoring and the identification of significant tank chemistry parameters should be determined on a facility-, waste-, and tank-specific basis. A recommended program for monitoring and managing waste chemistry as it relates to tank corrosion is described in *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks* (BNL-UC-406). Tank waste chemistry also is to be monitored for the potential generation of flammable or explosive gases. Once waste has been characterized and shown to be in essentially a steady state relative to gas generation, it is the addition of new waste that needs to be most closely watched. Selection of parameters is based on the need to protect the public health, the environment, and workers. Monitoring is performed to provide statistically valid information of the relevant tank chemistry and any detected changes in the chemistry of the tank.

> *Example: Some very minor volumes of laboratory spill waste are planned to be added to liquid storage tank YTR. Tank YTR is made of carbon steel and has been in service since 1978. The pH of the spill waste is measured, then adjusted to a pH of 12 to meet the waste acceptance requirements for waste transfers to the tank. The pH testing of the waste is part of the routine monitoring for tank YTR.*

<u>Graded Approach</u>. A graded approach needs to be applied to implementation of this requirement for monitoring liquid wastes in storage. The first consideration for a graded approach is that monitoring parameters and frequencies for liquid waste storage tanks should be specific for each tank. Also, the frequency of monitoring is selected to detect changes commensurate with the potential failure mechanisms and resulting risks of the specific waste being stored.

> *Example: A highly radioactive acidic waste is stored in a stainless steel tank. The tank is at capacity so no waste additions are planned. Monitoring consists of a permanently installed liquid level detector and monthly monitoring of tank pH and chlorine compounds which could cause corrosion. Another tank constructed of carbon steel is routinely used for receipt of new waste. In addition to monitoring the liquid level in the tank and tracking additions and removals, the tank chemistry is checked weekly for pH to ensure that the waste is maintained at a high pH.*

Compliance with this requirement is demonstrated by developing operational procedures for monitoring liquid transuranic waste storage tank liquid level, waste volume, and tank chemistry so that waste volume or chemistry changes are detected in a time frame that will allow implementation of corrective measures to limit public and worker doses and to mitigate unplanned releases of stored liquid waste.

Supplemental References:

1. DOE, 1992. *DOE Fundamentals Handbook, Chemistry*, DOE-HDBK-1015, Module 2: "Corrosion," U.S. Department of Energy, Washington, D.C., June 1992.

2. DOE, 1993. *DOE Fundamentals Handbook, Material Science*, DOE-HDBK-1017, Module 2: "Properties of Metals," U.S. Department of Energy, Washington, D.C., January 1993.

3. DOE, 1997. *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, BNL-UC-406, Brookhaven National Laboratory, Upton, NY, January 1997.

4. DOE, 1992. *Technical Safety Requirements*, DOE 5480.22, U.S. Department of Energy, Washington, D.C., February 25, 1992.

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IMPLEMENTATION GUIDE
for use with DOE M 435.1-1

Chapter IV

Low-Level Waste Requirements

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IV. A. Definition of Low-Level Waste.

Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in section 11e.(2) of the *Atomic Energy Act of 1954,* as amended), or naturally occurring radioactive material.

Objective:

The objective of this requirement is to provide the criteria for determining which DOE radioactive wastes are to be managed as low-level waste in accordance with DOE M 435.1-1, Chapter IV, *Low-Level Waste Requirements*.

Discussion:

DOE M 435.1-1, Section I.1.C., Radioactive Waste Management, requires that all DOE radioactive waste shall be managed as either high-level waste, transuranic waste, or low-level waste within one of the existing Office of Environmental Management radioactive waste management programs. To assist in determining whether a particular waste stream is low-level waste, see Figure I.1, Logic Diagram for Determining Radioactive Waste Type, which accompanies the guidance for the requirement.

Management of wastes containing radioactivity that do not meet or are excluded from the definition of low-level waste above, (i.e., 11e.(2) byproduct material, residual radioactive material as defined in the *Uranium Mill Tailings Radiation Control Act* (UMTRCA), or naturally occurring radioactive material) should continue to be managed under the provisions of the UMTRCA or DOE 5400.5, *Radiation Protection of the Public and the Environment.* However, DOE M 435.1-1 allows for small quantities of these wastes to be managed in accordance with this chapter. See the guidance on DOE M 435.1-1, Section IV.B.(4).

Basis. The definition of low-level waste is based on, and is essentially equivalent to, the definition used in the *Nuclear Waste Policy Act of 1982*, as amended. The requirements analysis (see methodology discussion of Technical Basis and Considerations, Appendix A) conducted in development of DOE O 435.1 and DOE M 435.1-1 indicated the *Nuclear Waste Policy Act of 1982,* as amended, definition should form the basis for the Department's definition to be consistent with the full set of legal drivers for radioactive waste management that are now in public law. This definition also is consistent with the definition in 10 CFR 61.3, NRC's requirements for low-level waste disposal.

Section 161 of the *Atomic Energy Act of 1954*, as amended [Section 161(b)] authorizes the Department to promulgate rules "to govern the possession and use of special nuclear material,

source material, and byproduct material" and Section 161(i) authorizes the Department to prescribe such regulations as it deems necessary to govern any activity authorized pursuant to the *Atomic Energy Act of 1954*, as amended, specifically including standards for the protection of health and minimization of danger to life or property. Although most sources of ionizing radiation are encompassed by the terms "byproduct material," "source material" and "special nuclear material," some sources, such as machine-produced radioactive material, are not. Because all ionizing radiation has the potential to cause harm, the Department does not limit its radioactive waste management requirements to situations involving byproduct, source and special nuclear material.

Low-level radioactive waste is defined by what it is not. The definition provides the framework for this concept by listing the basic radioactive waste types that are not low-level waste, thereby limiting the wastes that are to be managed as low-level waste. Thus, an understanding of the definitions of high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material, and naturally occurring radioactive material is necessary to determine whether a subject waste is to be managed as low-level waste in accordance with DOE M 435.1-1, Chapter IV. The definitions of and relevant guidance on high-level waste (see Chapter II.A) and transuranic waste (see Chapter III.A) are contained in the guidance on Chapters II and III of the Manual, respectively. The guidance on definitions in Chapters II and III should be consulted first for making a determination on how to properly manage a suspect waste stream. Specific waste determination cases discussed in that guidance may provide assistance on deciding which radioactive wastes are to be managed as low-level waste. Many of these specific waste stream decisions are referenced and/or discussed again in the following guidance on the definition of low-level waste.

<u>High-Level Waste Exclusion</u>. High-level waste is the first type of radioactive waste excluded from the definition of low-level waste. Guidance on the definition of High-Level Waste in Chapter II clarifies the meaning of that term for applicability to certain DOE waste streams. That guidance should be consulted first for determining if a waste stream should be managed as high-level waste. Those waste streams that should be managed as low-level waste must meet the requirements of DOE M 435.1-1, Chapter IV.

Radioactive waste that meets the requirements of waste incidental to reprocessing, either by citation or evaluation, is excluded from the scope of high-level waste. It is the intent of the requirements of DOE O 435.1 and DOE M 435.1-1 that wastes which are excluded from the high-level waste management requirements because they have been determined to be not high-level waste through the waste incidental to reprocessing determination process and contain transuranics less than 100 nCi/g are low-level waste to be managed in accordance with Chapter IV of DOE M 435.1-1. (See guidance on Waste Incidental to Reprocessing, DOE M 435.1-1, Section II.B).

> *Example: At the Hanford Site the high-level waste program used the evaluation process to gain NRC support for on-site disposal of the low-activity waste stream removed from the high-level waste tanks as waste incidental to reprocessing. The on-site disposal facility shall meet the low-level waste requirements for disposal in accordance with DOE M 435.1-1.*

Spent Nuclear Fuel Exclusion. Spent nuclear fuel is excluded from the definition of low-level waste. Spent nuclear fuel is defined in the *Nuclear Waste Policy Act of 1982*, as amended, as "*...fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.*" The term refers to the spent fuel rods and assemblies as they are managed upon removal from a reactor, especially in terms of the applicability of provisions for management of spent fuel in the *Nuclear Waste Policy Act of 1982*, as amended. Guidance on the definition of high-level waste for Chapter II, DOE M 435.1-1 clarifies the meaning of spent nuclear fuel for applicability to certain Department waste streams that could fit the description of spent nuclear fuel. That guidance should be consulted first for determining whether one of these waste streams is to be managed as high-level waste. Those waste streams that are determined should be managed as low-level waste must meet the requirements of DOE M 435.1-1, Chapter IV.

> *Example: Site Q has irradiated target elements in long-term storage that must be disposed. The targets contain neither fissile material, nor do they meet the definition of transuranic waste. The targets are managed for disposal as low-level waste.*

Transuranic Waste Exclusion. Transuranic waste is excluded from the definition of low-level waste. As mentioned, the definition of transuranic waste is further explained in the guidance on Requirement III.A. That guidance clarifies the applicability of the term transuranic waste for certain DOE radioactive waste streams. The guidance should be consulted first for determining if a waste stream should be managed as transuranic waste. Those streams that should be managed as low-level waste must meet the requirements of Chapter IV, DOE M 435.1-1.

Three exceptions to the definition of transuranic waste are discussed in the guidance for transuranic waste requirements (DOE M 435.1-1, Section III.A). The first exception is high-level waste which, as discussed previously, is also excluded from the definition of low-level waste. The second exception is waste that DOE, with the concurrence of the EPA Administrator, has determined does not need the degree of isolation that is provided by implementation of the disposal requirements of 40 CFR Part 191. This waste is to be managed as low-level waste in accordance with Chapter IV of DOE M 435.1-1. The third exception applies to waste generated by commercial activities that have concentrations of radionuclides that would result in categorization as transuranic waste. As long as the waste is not high-level waste, it could be accepted (with NRC approval not to invoke 40 CFR Part 191) as Greater-than-Class-C (GTCC) low-level waste per the classification system in 10 CFR 61.55. This waste is to be managed as

low-level waste in accordance with Chapter IV of DOE M 435.1-1. However, GTCC waste is to be disposed of in a facility licensed by the U.S. Nuclear Regulatory Commission (See the guidance on Complex-Wide Low-Level Waste Management Program concerning management of commercial (NRC licensed) GTCC, DOE M 435.1-1, Section IV.C.).

Also, consistent with the guidance on transuranic waste (DOE M 435.1-1, Section III.A), radioactive waste that does not meet the definition of transuranic waste in accordance with the measurement, error, and uncertainty guidance described in *Transuranic Waste Characterization Quality Assurance Program Plan, Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* and/or other controlling documents is also to be managed as low-level waste in accordance with Chapter IV of DOE M 435.1-1.

Dilution of a transuranic waste stream to reclassify the waste as low-level waste (i.e., reducing the concentration to less than or equal to 100 nCi (3700 Bq) per gram) is not permitted by the Department. While it is recognized that in the course of stabilizing a waste stream some changes in waste concentration may occur, actions to dilute a waste stream below the concentration limits for transuranic waste are prohibited. It is also recognized that actions taken to process a waste stream for safety or technological reasons that are justified, may result in the waste being reclassified after processing as low-level waste.

> *Example: Due to the moisture content of a transuranic waste sludge, the waste does not meet the WIPP WAC. The site evaluates several treatment options taking into consideration factors such as worker exposure, waste minimization, cost and complexity of the treatment process and disposal facility waste acceptance requirements. The treatment process selected involves adding grout to the transuranic waste sludge to eliminate free liquids resulting in a solidified waste form that contains transuranic radionuclides in concentrations less than 100 nCi (3700 Bq) per gram and meets the waste acceptance criteria for a low-level waste disposal facility.*

<u>Byproduct Material Exclusion</u>. Byproduct material as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*, as amended, is also excluded from the definition of low-level waste. Byproduct material is defined as: "*. . . (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.*" Section 11e.(2) byproduct material is included in the waste types not managed as low-level waste because Congress determined that this waste stream had unique qualities, particularly the generation of radon gas, and needed to be managed in accordance with its own set of environmental standards and technical requirements. The *Uranium Mill Tailings Radiation Control Act* (UMTRCA) provides the legal framework under which 40 CFR Part 192 and the Department's program for remediation of old uranium mill tailings sites was developed and implemented.

<u>Naturally Occurring Radioactive Material Exclusion</u>. Waste with naturally occurring radioactive material is also excluded from the definition of low-level waste. Naturally occurring radioactive material, or NORM, is material that contains natural radioactivity and is not regulated by NRC under the *Atomic Energy Act of 1954*, as amended. In some cases, changes in the composition, radionuclide concentrations, availability, or proximity to man of such material as a result of human practices cause a potential for increased exposure to the public. The *Atomic Energy Act of 1954*, as amended and the *Energy Reorganization Act of 1974* charge DOE with protecting the public from exposure to radiation caused by its research, development, or production activities. Therefore, DOE regulates such exposures under its radiation protection directives. For non-DOE activities, the Congress provided NRC authority for only source, byproduct, and special nuclear material and not for the generation of consumer products or other products from natural material. However, DOE does have responsibilities for NORM that has been technologically enhanced by DOE activity.

The policy of the Department is that small quantities of naturally occurring and/or 11e.(2) byproduct materials or wastes containing such materials may be disposed in DOE low-level waste disposal facilities provided that the requirements for disposal of low-level waste are met.

> *Example: A small amount (100 cubic meters) of 11e.(2) materials that are similar to mill tailings, but from an apparently different process, are discovered at the remedial action site near Garden City. These materials are removed from their current location and are packaged and stored. An evaluation of the performance assessment at Site X indicates that these materials are acceptable for disposal there. The wastes are certified and shipped to Site X for disposal.*

Chapter IV of DOE 5820.2A addresses this matter and provides the requirements for management of small quantities of 11e.(2) and naturally occurring radioactive material as low-level waste. This practice may continue under DOE M 435.1-1, IV.B.(4). Guidance for this requirement should be consulted for discussions on management of small quantities of 11e.(2) byproduct and naturally occurring radioactive material as low-level waste.

Supplemental References:

1. *Nuclear Waste Policy Act of 1982,* as amended, January 7, 1983.

2. NRC. *Licensing Requirements for Land Disposal of Radioactive Waste,* 10 CFR Part 61, U.S. Nuclear Regulatory Commission, Washington, D.C..

3. CAO, 1998. *U.S. Department of Energy, Transuranic Waste Characterization Quality Assurance Program Plan,* Revision 1, CAO-94-1010, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1998.

4. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

5. DOE, 1988. *Radioactive Waste Management*, DOE 5820.2A, U.S. Department of Energy, Washington, D.C., September 26, 1988.

IV. B. Management of Specific Wastes.

The following provide for management of specific wastes as low-level waste in accordance with the requirements in this Chapter:

(1) Mixed Low-Level Waste. Low-level waste determined to contain both source, special nuclear, or byproduct material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. Low-level waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(3) Accelerator-Produced Waste. Radioactive waste produced as a result of operations of DOE accelerators is low-level waste and shall be managed in accordance with DOE O 435.1, *Radioactive Waste Management*, and this Manual, and all applicable Federal or State requirements.

(4) 11e.(2) and Naturally Occurring Radioactive Material. Small quantities of 11e.(2) byproduct material and naturally occurring radioactive material may be managed as low-level waste provided they can be managed to meet the requirements for low-level waste disposal in Section IV.P of this Manual.

Objective:

The purpose of this requirement is to (1) ensure that DOE low-level waste is managed in accordance with the applicable requirements of external regulations, specifically those of the *Resource Conservation and Recovery Act* (RCRA) and *Toxic Substances Control Act* (TSCA), that address non-radiological hazards, in addition to being managed in accordance with the requirements of DOE O 435.1 and the *Radioactive Waste Management Manual*, DOE M 435.1-1, and (2) allow for the management of certain other radioactive wastes as low-level waste that are the responsibility of the Department under the *Atomic Energy Act of 1954*, as amended.

Discussion:

The *Radioactive Waste Management Manual*, DOE M 435.1-1, contains requirements for managing the radioactive character of low-level waste. Through the safety and hazards analysis process used in developing the Manual, non-radiological hazards associated with managing certain wastes were identified. During the development of the requirements necessary to control the identified hazards, it was concluded that sufficient external regulations, promulgated pursuant to RCRA and TSCA, exist for controlling the non-radiological hazards.

Section 161 of the *Atomic Energy Act of 1954*, as amended [Section 161(b)] authorizes the Department to promulgate rules "to govern the possession and use of special nuclear material, source material, and byproduct material" and Section 161(i) authorizes the Department to prescribe such regulations as it deems necessary to govern any activity authorized pursuant to the *Atomic Energy Act of 1954*, as amended, specifically including standards for the protection of health and minimization of danger to life or property. Although most sources of ionizing radiation are encompassed by the terms "byproduct material," "source material" and "special nuclear material," some sources, such as machine-produced radioactive material, are not. Because all ionizing radiation has the potential to cause harm, the Department does not limit its radioactive waste management requirements to situations involving byproduct, source and special nuclear material.

Through the safety and hazards analysis, it was also recognized that the Department has management responsibility over some other radioactive waste, namely accelerator-produced, naturally occurring, and 11e.(2) byproduct material, which is specifically excluded from the definition of low-level waste, but for which the Department is responsible for protecting the public, workers, and the environment from the radioactivity from the waste under the *Atomic Energy Act of 1954*, as amended, and therefore needed to be considered to cover the full inventory of radioactive waste that must be managed under DOE O 435.1 and DOE M 435.1-1. The analysis to develop requirements concluded that the Department's policies, requirements, and guidance currently in place under DOE 5820.A should be continued and improved where needed. Guidance below under <u>Accelerator-Produced Waste</u> and <u>11e.(2) and Naturally Occurring Radioactive Material</u> discusses the continuation of the 5820.2A policies and practices and provides discussion for meeting requirements of DOE O 435.1 and DOE M 435.1-1 for these wastes.

<u>Mixed Low-Level Waste</u>. In managing low-level wastes which are subject to RCRA and TSCA requirements, personnel need to be cognizant of the requirements for storage and disposal of the waste. The ability to dispose of RCRA or TSCA waste that has a radioactive component is very limited. Therefore, waste generators should avoid creating a mixed or TSCA-regulated low-level waste, and generators and waste managers should avoid actions that result in generating low-level waste with no path to disposal (see guidance for DOE M 435.1-1, Section I.2.F.(19)).

Example: It is typical for personnel within a radiological control area at Laboratory A to always declare all waste to be radioactive. It is recognized that all the waste is not low-level waste; however, by managing it as such, the facility saves time and money in surveying and performing radioactive/clean determinations. However, RCRA or TSCA waste is not automatically declared radioactive out of convenience, because such designation would greatly limit the management and disposal options for the waste and increase the overall waste management costs at Laboratory A. Instead, personnel specifically survey any waste that has been identified as RCRA- or TSCA- regulated in order to make a radioactive/clean determination and thus minimize the amount of waste that will be designated as mixed or TSCA regulated.

<u>RCRA and State Hazardous Waste Regulations</u>. The *Resource Conservation and Recovery Act* required the Environmental Protection Agency to promulgate regulations for management of hazardous waste. The legislation also provides for states to promulgate and implement hazardous waste regulatory programs that are at least as protective as the Federal program. The hazardous waste requirements that personnel must follow in managing (i.e., generating, transporting, treating, storing or disposing) mixed low-level waste and in closing affected facilities are primarily in 40 CFR Parts 260 through 270, or authorized state regulations. A variety of guidance manuals and information relevant to the management of the hazardous component of mixed low-level waste has been prepared both by the state regulatory agencies and the Environmental Protection Agency (see for example *U.S. Environmental Protection Agency, Catalog of Hazardous and Solid Waste Publications, EPA530-B-96-007, September, 1996)*. These guidance documents should be consulted when developing management programs for mixed low-level waste.

Hazardous waste regulations promulgated by states with RCRA authority may be more restrictive than the Federal regulations. The more restrictive requirements may include a broader definition of hazardous waste than the Federal requirements or may impose another state's definition of hazardous waste when waste is received from that state. Waste management personnel therefore need to be aware of the requirements of the regulations in their own state as well as the implications of the regulations in states to which they intend to transfer waste.

Example 1: In a state that invokes regulations equivalent to the EPA hazardous waste regulations, waste oil that meets the criteria for low-level waste would not be managed as mixed low-level waste. However, if the oil was to be shipped to another state in which the state regulations defined hazardous waste to include waste oil, the waste would have to be packaged, manifested, transported, and stored as a mixed waste.

Example 2: If the direction of waste transfer in the above example were reversed, a different situation could arise. The waste would be declared a mixed waste in the state of origin because the state regulations had a broader definition of hazardous waste. The state to which it was to be shipped does not specifically regulate waste oil as a hazardous

waste. However, the state regulations of the receiving site require that waste be considered to be as it was categorized in the state of origin. In this case, the waste would still be considered to be and need to be managed as mixed waste even after it was shipped to the state that did not explicitly regulate waste oils.

The RCRA requirements prohibit storage of hazardous (including mixed) waste that are restricted from land disposal except for purposes of accumulating sufficient quantities to facilitate recovery, treatment, or disposal. The *Federal Facility Compliance Act of 1992* required the Department to prepare site-specific treatment plans to address treatment of mixed waste to meet the land disposal restrictions at each facility at which DOE generates or stores mixed waste. To meet the requirement, site-specific treatment plans were developed, and through agreements or consent orders, commitments to schedules to treat or otherwise meet the land disposal restrictions were made. These site-specific treatment plans and agreements or consent orders need to be part of the life-cycle planning performed in accordance with Waste Generation Planning (DOE M 435.1-1, Section IV.H).

<u>PCB, Asbestos, and Other TSCA Wastes</u>. Low-level wastes contaminated with PCBs or asbestos do not meet the definition of mixed waste. However, the situation is similar because external regulations promulgated under the authority of the *Toxic Substances Control Act* (TSCA) must be complied with in addition to the requirements of DOE O 435.1 and the Manual. Waste managers responsible for managing PCB-containing products should consult the EPA requirements at 40 CFR Part 761. The regulations impose requirements for the destruction, storage awaiting destruction, and disposal of PCBs. Waste managers responsible for managing materials containing asbestos should consult the EPA requirements at 40 CFR Part 61, subpart M. These regulations impose requirements for the removal of asbestos during demolition and renovation and disposal of asbestos-containing waste. This regulation includes cross-references to several other regulations governing management of asbestos that may also apply. Planning for management of these wastes and any low-level waste that includes a component which is regulated under TSCA needs to be addressed in the Complex-Wide Low-Level Waste Management Program and the Site-Wide Waste Management Programs (DOE M 435.1-1, Sections I.2.B.(1), I.2.F.(1), and IV.C).

Example: A site has determined that contaminated transformer oil from an on-site electrical source contains PCBs. The site makes arrangements for treatment at another facility which is permitted under TSCA for PCB treatment (PCB destruction) and return of the low-level waste (grouted ash) for disposal at the generating site.

The DOE M 435.1-1 requirements imposed on the radioactive component of RCRA or TSCA waste should not create a duplication of management activities that can be satisfied by compliance with either a RCRA or TSCA requirement. Also, documentation required by RCRA or TSCA

requirements which provide the same or similar documentation as required by DOE M 435.1 can be used to satisfy the DOE M 435.1-1 requirement.

> *Example: Mixed low-level waste is being transferred from one site to another for treatment. The Uniform Hazardous Waste Manifest is prepared as required by 40 CFR Part 262. The manifest is determined to satisfy the need to document the transfer of ownership of the waste, the transfer date, the physical location of the waste, and other information specified in DOE M 435.1-1. If the waste acceptance requirements of the facility receiving the waste allow it, the manifest may also provide the necessary information on the chemical and physical characteristics of the waste.*

Accelerator-Produced Waste. Commercially generated accelerator-produced waste is not source, special nuclear, or byproduct material that must be licensed by the NRC under the *Atomic Energy Act of 1954*, as amended. However, the Department retains the responsibility under the *Atomic Energy Act of 1954*, as amended, for protection of the public, workers, and the environment from the radioactivity produced from Department of Energy accelerators. Such waste may include shielding and structures which are activated by operation of an accelerator, or the targets that are bombarded by the accelerator beam. Radioactive waste produced from Department of Energy accelerator activities is to be managed as low-level waste. Accelerator-produced wastes have been managed as low-level waste by the Department in the past, and this provision in DOE M 435.1-1 maintains this practice.

Accelerator-produced waste may be mixed with hazardous constituents that are regulated under RCRA or state-equivalent legislation. In this case, Department Field Elements need to interact with state authorities concerning the appropriate management of these wastes. These wastes are not mixed waste to the extent that the accelerator-produced materials are not source, byproduct, or special nuclear material. However, they should still be managed appropriately for the dangers posed by both the radioactivity and the hazardous component, as if they were mixed waste. Some states may have agreed with Department Field Elements already on the appropriate set of requirements that these wastes should be managed under. The Department is fully responsible for ensuring that the requirements associated with the hazardous components are complied with, as well as managing the waste for its radioactivity in accordance with Chapter IV of the Manual.

> *Example 1: Lead (Pb) bricks are used as shielding in a new tritium production accelerator in State S. When the shielding is discarded, the resultant waste is a RCRA-regulated hazardous waste (and is not a "mixed waste" because the radioactive component is not source, special nuclear, or byproduct material). The lead brick shielding waste is managed in accordance with State S hazardous waste requirements. The shielding waste is managed as mixed waste, however, because all DOE Manual Chapter IV requirements are also met. The tritium production accelerator includes management requirements for this waste in a RCRA-based agreement with State S.*

Example 2: A Department of Energy research accelerator uses a variety of target materials. None of the targets contain hazardous constituents, however, once a research activity is completed, the discarded targets have been activated. The discarded targets are handled to protect against exposure to radiation and are managed as low-level waste including disposal at a DOE low-level waste disposal facility.

11e.(2) and Naturally Occurring Radioactive Material. This section of DOE M 435.1-1 was provided to continue the policies, requirements, and guidance in place under DOE 5820.2A concerning disposal of small quantities of 11e.(2) and naturally occurring radioactive material. Under the *Nuclear Waste Policy Act of 1982*, as amended, and the *Low-Level Radioactive Waste Policy Act*, low-level waste is defined to exclude 11e.(2) byproduct material. However, DOE O 435.1 continues the Department's existing policy that small quantities of these materials may be managed as low-level waste in accordance with the low-level waste requirements of DOE M 435.1-1. This requirement is not intended to allow large volumes of 11e.(2) material from sites subject to 40 CFR Part 192 would be routinely disposed in a low-level waste disposal facility. These wastes, waste quantities too large for acceptance at DOE low-level waste disposal sites, and other 11e.(2) byproduct and naturally occurring radioactive materials that are inappropriate for management as a low-level waste are to be managed under the provisions of UMTRCA, 40 CFR Part 192, or DOE 5400.5, *Radiation Protection of the Public and the Environment*, as applicable. Recognizing DOE's responsibility for properly managing these materials when generated or encountered during cleanups, DOE 5400.5 contains requirements that are applicable for the management of naturally occurring radioactive material waste streams. [Although the Department is unlikely to manage any of these, examples of such wastes are rare earth processing facility wastes, mineral extraction byproducts, such as phosphogypsum and copper tailings, coal ash, and oil and gas extraction byproducts.]

The Department manages other radioactive waste streams that contain naturally occurring radioactive material that are excluded from the definition of low-level waste. These waste streams are those in which the naturally occurring radioactive material has been technologically-enhanced and intentionally altered for the purpose of utilizing the radioactive properties of the material. Examples of these are sealed sources containing radium and compounds of uranium which no longer are considered source material, but which have not been converted to a form that could be used productively. These waste streams are appropriately managed as low-level waste to provide adequate protection of workers, the public, and the environment.

To understand what is meant by the term "small quantities," the legislative intent of the UMTRCA as implemented in the policies of the Department provide the needed guidance. In enacting the UMTRCA, Congress addressed a problem of large volumes of diffuse material in several locations that required proper controls. These residual radioactive materials regulated under UMTRCA are managed by the Department according to the requirements of 40 CFR Part 192 and disposed at specially designated tailings disposal sites established under the UMTRCA.

It is the policy of the Department that small quantities of naturally occurring and/or 11e.(2) byproduct materials or wastes containing such materials may be disposed in DOE low-level waste disposal facilities provided that the requirements for disposal of low-level waste are met.

The requirement, in stating that the disposal requirements in DOE M 435.1-1, Section IV.P must be met, means the naturally occurring or 11e.(2) byproduct material must be included in the performance assessment and composite analysis for the facility, that adequate controls are established for the waste stream based on the evaluations, and the minimum disposal requirements of Chapter IV are to be met. The inclusion of a significant quantity of naturally occurring or 11e.(2) byproduct material in a low-level waste disposal facility is expected to result in additional controls for that waste stream due to the risk posed by radon emanation from the waste, where "significant" in this context is to be determined through the performance assessment and composite analysis evaluations and other considerations included in the radioactive waste management basis for the disposal facility.

> *Example 1: A significant amount (100,000 cubic meters) of new mill tailings are discovered in a location not previously determined to be contaminated at the UMTRCA site at Slick Rock, CO. These mill tailings will be removed from their location and either be disposed of at the Cheney disposal cell or DOE will pay a UMTRCA Title II site to dispose of the tailings, consistent with UMTRCA, as amended.*
>
> *Example 2: A small amount (100 cubic meters) of 11e.(2) materials that are similar to mill tailings, but from an apparently different process, are also discovered at this contaminated site near Slick Rock. These materials will also be removed from their current location and managed in the same manner as discussed in Example 1.*
>
> *Example 3: Some uranium bearing waste from processes undertaken at the Fernald facility is proposed for disposal at the Site Y disposal facility. Sufficient capacity is available to dispose of the amount of the waste to be generated. The waste is included in the performance assessment and composite analysis, and controls are established. These include provisions for stabilizing the waste and placing it in specially designed boxes, for additional analysis of the cover that will eventually be placed on the disposal unit used, and for additional information in the records for the disposal facility concerning the nature of the waste in this specific disposal unit.*
>
> *Example 4: Small quantities (a few vials) of paints and other items containing radium are discovered among the radioactive materials that DOE has agreed to take possession of from a university professor who retired. DOE has no use for the materials, and is not aware of any needs outside of the Department. The material is considered waste, and is disposed by the laboratory personnel who took possession of the materials as low-level*

waste, after consultation with the disposal facility who will receive the waste that the amount is not significant and no additional controls for its disposal are needed.

In addition, naturally occurring or 11e.(2) byproduct material determined to be manageable as low-level waste that is also mixed with constituents covered under RCRA or TSCA must also meet all of the requirements in those laws and be managed as mixed low-level waste in accordance with DOE O 435.1 and DOE M 435.1-1.

Supplemental References:

1. *Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act*, 42 U.S.C. 6901 et seq., 1984.

2. *Federal Facility Compliance Act of 1992*, as amended, October 6, 1992.

3. *Toxic Substances Control Act*, as amended, October 11, 1976.

4. *Uranium Mill Tailings Radiation Control Act*, as amended, 42 U.S.C. 7901 et seq., 1978.

5. EPA, 1993. "Final Rule; Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 58, No. 242, U.S. Environmental Protection Agency, Washington, D.C., December 20, 1993.

6. EPA. 40 CFR Parts 260-270, U.S. Environmental Protection Agency, Washington, D.C.

7. EPA. *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*, 40 CFR Part 761, U.S. Environmental Protection Agency, Washington, D.C.

8. EPA, 1996. *U.S. Environmental Protection Agency Catalog of Hazardous and Solid Waste Publications*, EPA530-B-96-007, U.S. Environmental Protection Agency, Washington, D.C., September 1996.

9. EPA, 1973. *National Emissions Standards for Hazardous Air Pollutants – National Emission Standard for Asbestos*, 40 CFR Part 61, Subpart M, U.S. Environmental Protection Agency, Washington, D.C., April 6, 1973.

10. DOE, 1990. *Radiation Protection of the Public and Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

IV. C. Complex-Wide Low-Level Waste Management Program.

A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure the development, documentation, and implementation of a complex-wide low-level waste management program to provide for cost-efficient and integrated management of low-level waste throughout the complex and within individual site radioactive waste management programs. Mixed low-level waste is, as appropriate, reflected in low-level waste plans and through its own program plan.

Discussion:

The Department's management of low-level waste occurs at numerous sites that generate, stage, and store waste, and at several sites that treat and dispose of the waste. A complex-wide program and plan establish the overall mission for the Department's management of low-level waste and to provide a framework within which the individual site programs operate. The *Radioactive Waste Management Manual*, DOE M 435.1-1, General Requirements (Section I.2.B) assigns the Assistant Secretary for Environmental Management the responsibility for developing and maintaining complex-wide, waste-type programs. The *Manual* General Requirements (Section I.2.D) also assigns the Deputy Assistant Secretary for Waste Management the responsibility for developing and implementing complex-wide, waste-type program plans. The complex-wide low-level waste management program and plan are developed following the guidance provided for DOE M 435.1-1, Section I.2.B and I.2.D requirements.

Mixed Low-Level Waste Program. Mixed low-level waste is managed within the Department through an existing Mixed Low-Level Waste Management Program. Appropriate management interfaces and exchanges of technical information need to be identified in the low-level waste management program wherever necessary to affect safe and effective management of both mixed and non-mixed low-level waste. The systematic planning of mixed low-level waste can either be integrated with low-level waste planning or as a subset of low-level waste as appropriate. Mixed low-level waste interfaces, exchanges, inputs, and subsets discussions need to be included in the documentation of the complex-wide low-level waste management program and in the site radioactive waste management programs, as appropriate. The low-level and mixed low-level waste management programs should utilize existing data wherever possible.

> *Example: A laboratory facility is providing information to be included in the Complex-Wide Low-Level Waste Management Program Plan. Existing mixed low-level waste data and plans from the lab's Site Treatment Plan prepared under the Federal*

> *Facilities Compliance Act are provided and are included in the appropriate sections of the Complex-Wide Program Plan or in a separate Mixed Low-Level Waste Management Program Plan, as needed.*

Greater-Than-Class C Program. Commercial Greater-than-Class C (GTCC) radioactive waste (generated by an NRC licensee) is also managed within an existing GTCC Program in the Department. Appropriate management interfaces and exchanges of technical information also need to be identified in the low-level waste management program wherever necessary to ensure safe and effective management of both DOE low-level waste and commercial GTCC low-level waste. The systematic planning of commercial GTCC waste management can either be integrated with the low-level waste planning or as a subset of low-level waste, as appropriate. Commercial GTCC low-level waste interfaces, exchanges, inputs, and subsets discussions need to be included in the documentation of the complex-wide low-level waste management program and in the site radioactive waste management programs, as appropriate. The low-level waste management and the GTCC programs should utilize existing data wherever possible.

As specified in the *Low-Level Radioactive Waste Policy Act*, the facility that will be used to dispose of commercially generated GTCC from NRC licensees must be licensed by the NRC, in accordance with 10 CFR Part 61. Therefore, the Complex-Wide Low-Level Waste Management Program, and the site-wide programs where commercial GTCC will be managed until disposal, needs to include inventory control, waste tracking, and recordkeeping that will lead to the successful licensing of the commercial GTCC disposal facility.

Performance Assessment and Composite Analysis Maintenance. Performance assessments of DOE low-level waste disposal facilities have been developed over a number of years. Composite analyses for low-level waste disposal facilities have recently been developed. Maintenance of these analyses is required to ensure that performance assessments and composite analyses adequately represent the current and expected future state of the low-level waste disposal facilities for which they are required. Such maintenance is properly the responsibility of the individual DOE sites conducting performance assessments and composite analyses. However, to promote efficient use of resources and foster an appropriate degree of consistency among the site programs, a complex-wide performance assessment and composite analysis maintenance program should be developed and implemented as part of the Complex-Wide Low-Level Waste Management Program as described in the *Complex-Wide Strategy for Maintenance of Department of Energy Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis*.

Compliance with this requirement is demonstrated by the presence of the performance assessment and composite analysis maintenance element in the Complex-Wide Low-Level Waste Management Program, and the appropriate inclusion of interfaces, technical information, data,

inputs, and subsets of the DOE mixed low-level waste program and the commercial GTCC programs into the Complex-Wide Low-Level Waste Management Program.

Supplemental References:

1. DOE, 1998. *Complex-Wide Strategy for Maintenance of Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses,* U.S. Department of Energy, Washington, D.C., October 1998.

IV. D. Radioactive Waste Management Basis.

Low-level waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, composite analysis, disposal authorization statement, closure plan, waste acceptance requirements, and monitoring plan.

Objective:

The objective of this requirement is to ensure that the hazards associated with low-level waste management facilities, operations, and activities have been identified, their potential impacts analyzed, and appropriate controls documented, implemented, and maintained for the protection of workers, the public, and the environment.

Discussion:

As described in the guidance on DOE M 435.1-1, Section I.2.F.(2) requires the radioactive waste management basis to provide for development and documentation of controls to ensure the safe and efficient management of radioactive waste. Requiring an approved radioactive waste management basis for the initiation of new, or continuation of existing, radioactive waste management activities should prevent the operation of facilities without the appropriate controls. The term "controls" used here and elsewhere in the discussion of a radioactive waste management basis refers to processes, procedures, equipment, instruments, and other items that are intended to curb the likelihood of, or the consequences from, a problem that could arise from managing radioactive waste. Controls includes such things as placards, alarms, tools, shielding, training checklists, duplication of critical steps, redundant monitoring, analysis, sampling and testing, etc. As discussed in Section I.2.F.(2), the radioactive waste management basis for low-level radioactive waste management facilities, operations, and activities must be documented.

The required elements of the radioactive waste management basis vary with the type of waste management operation or facility and the types of hazards associated with the facility. As stated in the introductory statement of this requirement, the items required for a radioactive waste management basis listed in the requirement for the four types of low-level waste management facilities, operations, and activities is not a complete list of those items which should be included in a radioactive waste management basis. Several processes, procedures, and documents that are required by other directives and requirements provide for radioactive waste management controls that should be considered part of the radioactive waste management basis. The guidance on DOE M 435.1-1, Section I.2.F.(2) discusses this aspect of the radioactive waste management basis in detail.

> *Example: Site Q operates a low-level waste storage facility. The Field Element staff is required to ensure that it operates under a radioactive waste management basis. The staff reviews the items in the requirement cited above, plus the facility-specific procedures for implementing the site's radiological control program, health and safety plan, training program, quality assurance program, and record-keeping plan, and determines an adequate radioactive waste management basis exists.*

Also, as discussed in the DOE M 435.1-1, Section I.2.F.(2) guidance, if a low-level waste management facility already operates under an approved Authorization Basis, it may not need any additional controls to demonstrate that it has a radioactive waste management basis. In this case, the Authorization Basis documentation is reviewed and evaluated to determine whether it sufficiently covers the requirements needed for a radioactive waste management basis. The Field Element Manager has the responsibility to ensure the low-level waste management facilities under his or her authority have a radioactive waste management basis.

> *Example: The Authorization Basis documentation for a Liquid Radioactive Waste Handling Facilities at Site T, which includes a Liquid Treatment Facility (a low-level waste treatment facility), is reviewed. Based on the review, it is determined that the following Authorization Basis documents and associated programs include significant descriptions of the controls for the management of low-level waste at the Effluent Treatment Facility:*
>
> - *Safety Analysis Reports (SARs)*
> - *Technical Justification for Continued Operation/Basis for Interim Operation/Design Basis Accident Analysis Report*
> - *Operational Safety Requirements/Technical Safety Requirements (includes waste acceptance requirements of the Effluent Treatment Facility)*
> - *Technical Standards*
> - *SAR Update Request Packages*

- *Other Documents Identified by DOE and the contractor as Authorization Basis Documents (Safety Evaluations, Exemptions, Unreviewed Safety Questions Evaluation)*
- *DOE Safety Evaluation Reports*
- *Listing of Documents that are to be Configuration Managed but are not AB Documents (includes Liquid Treatment Facility Waste Certification Program Plan for certifying waste to the Solid Waste Disposal Area)*

Following analysis of the information, the DOE field office concludes the complete set of operational requirements relied upon by the site to ensure that the public, workers, and the environment are protected from the hazards associated with the management of the radioactive waste at the Liquid Treatment Facility are in place. A radioactive waste management basis statement is prepared that concludes the basis is covered in the Authorization Basis documents.

For a facility that generates low-level waste, the radioactive waste management basis is to include the program for certifying that waste meets the waste acceptance requirements of the facility(ies) to which the waste will be sent. The waste certification program is reviewed against the applicable requirements of DOE M 435.1-1 and approved in accordance with the manual before becoming part of the radioactive waste management basis. As discussed in guidance on DOE M 435.1-1, Section I.2.F.(2), several other processes and procedures will contribute to a complete radioactive waste management basis at a generating facility.

Example: A small laboratory facility on DOE's Site R generates low-level waste. The radioactive waste management basis for the facility is established through the review and approval of the lab's waste certification procedure and a review of the following for adequacy: the site Health and Safety Plan, the site Training Program, and the site Waste Transfer Procedure. This is documented in a radioactive waste management basis statement covering the laboratory.

Facilities that store or treat low-level waste are to have approved waste acceptance requirements (see DOE M 435.1-1, Section IV.G) prior to the issuance of a radioactive waste management basis. The waste acceptance requirements will usually suffice as the documentation of the radiological, physical, and chemical limitations on waste that can be safely received at the facility, provided they are developed correctly considering the hazards of the waste to be managed, and are kept up-to-date. A facility that stores or treats waste also is generally expected to have a waste certification program. Waste from these facilities will have to be certified as meeting the waste acceptance requirements of the facility to which it will be transferred, and the facilities have the potential for generating radioactive waste (e.g., secondary processing streams from treatment, monitoring and sampling, radioactive release cleanup). Consequently, storage and treatment

facilities should also have an approved waste certification program as part of their radioactive waste management basis.

The radioactive waste management basis for low-level waste disposal facilities is to be based on documented controls similar to those discussed for treatment or storage facilities, but with additional conditions imposed by the performance assessment and composite analysis required in DOE M 435.1-1, Section IV.P and by the disposal authorization statement issued following Headquarters review and approval of the performance assessment and composite analysis. As described in DOE M 435.1-1, Sections IV.Q and IV.R, the preliminary closure plan and preliminary monitoring plan are also to be reviewed as part of the evaluation of the performance assessment and composite analysis leading to the issuance of the disposal authorization statement. The results of the performance assessment and composite analysis, along with the controls based on the safety analyses required by DOE 5480.23, provide the basis by which the quantities and concentrations of radionuclides that can be accepted for disposal will be identified and documented in the waste acceptance requirements.

The responsibility for the radioactive waste management basis for low-level waste disposal facilities resides with the Field Element Manager. However, Headquarters review and approval of the performance assessment and composite analysis and issuance of the disposal authorization statement is necessary prior to issuance and documentation of the radioactive waste management basis, in accordance with the requirements in the Manual. Also, the documents required for the radioactive waste management basis for disposal facilities are related to one another and depend on information contained in or as a result of information or analysis in one or another of the other documents.

> *Example: The radioactive waste management basis for a low-level waste disposal facility, includes (among many controls, including safety and health plans, training programs, etc.) limits on tritium that can be accepted in a disposal unit, as calculated by the performance assessment. This limitation is included in the waste acceptance requirements of the facility as a limit per package. The disposal authorization statement also includes a condition that the closure plan is to be updated within 18 months of the issuance of the disposal authorization statement to include consistent monitoring locations with the preliminary monitoring plan submitted separately. The radioactive waste management basis statement references the disposal authorization statement to include these conditions for continued operations.*

The Headquarters review and approval of the performance assessment and composite analysis will lead to the issuance of the disposal authorization statement to the Field Element Manager, who should combine this with his/her own findings on the waste acceptance criteria and preliminary closure and monitoring plans to document the radioactive waste management basis for the disposal facility. Guidance on DOE M 435.1-1, Sections IV.P.(2) [performance assessment],

IV.P.(3)[composite analysis], IV.P(5)[disposal authorization statement], IV.Q.(1)[preliminary closure plan], and IV.R.(3)[preliminary monitoring plan] provide details on what information needs to be addressed in these documents for review and approval for a radioactive waste management basis to be issued.

As part of the radioactive waste management basis, site personnel needs to implement a system or process for tracking the waste inventory at a storage, treatment, or disposal facility. Tracking the waste inventory is a means of ensuring that radionuclide limits established in accordance with a safety analysis or performance assessment will not be exceeded. In addition, a system or process for accurately tracking waste received at a facility can facilitate providing information to the complex-wide waste management data system (see guidance Section I.2.D.(2)).

Compliance with this requirement is demonstrated by a demonstrated radioactive waste management basis that is signed by the Field Element manager or a designee for each low-level waste management facility, operation, or activity. Using a graded approach, it may be possible to include multiple activities under a single radioactive waste management basis, but it should be possible to objectively identify which activities are covered. Further, the documented radioactive waste management basis includes or references the controls that are established on a facility-specific basis to address the unique waste management requirements and circumstances for each facility, operation, and/or activity.

> *Example: A storage facility that stores mixed and non-mixed low-level waste has approved waste acceptance requirements and a waste certification process that enables low-level waste to be stored for 9 months and then shipped to a specific facility for disposal. The mixed low-level waste is stored indefinitely. The radioactive waste management basis statement references the waste certification process and the waste acceptance requirement documentation, which in turn invokes the waste acceptance requirements of the disposal facility. In addition to other site-wide programs and plans (e.g., radiological control, health and safety, training), the radioactive waste management basis statement also cites the RCRA permit issued for storage of mixed low-level waste, and the facility operating procedure for segregating mixed and non-mixed waste within the facility.*

Supplemental References:

1. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

IV. E. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving high activity or high hazard liquid low-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated low-level waste contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of high activity or high hazard liquid low-level waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to mitigate the impacts on the public, workers, or environment in the event that a leak develops in a tank storing high activity or high hazard liquid low-level waste or in a facility processing such waste. The mitigation is provided by ensuring spare waste storage capacity is a required part of a site's emergency management program. To meet this objective, there needs to be both capacity to handle the largest volume of any single storage tank or liquid waste in process, and the capability to transfer the waste.

Discussion:

This requirement shall be implemented through and included in site emergency management programs that are required by DOE O 151.1, *Comprehensive Emergency Management System.* The directive DOE O 151.1 is referenced in DOE M 435.1-1, Chapter I and considered necessary for the safe management of radioactive waste. The Comprehensive Emergency Management System requires the development of a complex-wide system for preparing for and managing emergencies. At the site level, personnel are to establish an Operational Emergency Base Program that provides the framework for responding to events involving, among other subjects, health and safety, and the environment. The program requires a qualitative hazards survey to identify the emergency conditions, describe the potential impacts, and summarize the planning and preparedness requirements that apply.

During the development of the requirements of DOE M 435.1-1, *Radioactive Waste Management Manual*, a waste management hazard and safety analysis identified the loss of containment of a storage tank or waste processing facility containing radioactive liquids as a hazard requiring mitigation. In addition to requiring facility designs to maintain waste confinement (see DOE M 435.1, Section IV.M.(2)), the ability to respond to leaks or other off-normal conditions if they occur was also considered necessary. Consequently, the requirements to have adequate spare capacity and the ability to transfer waste to the spare capacity were established.

Liquid low-level waste is considered high activity if procedural or physical controls are required to protect workers from radiation exposure. Liquid low-level waste is considered a hazard if it presents a situation that has the potential to adversely impact the health and safety of personnel, the public, or the environment. High hazards are those with the potential for onsite and offsite impacts to large numbers of persons or with the potential for major impacts to the environment or national security.

Operating procedures are developed and utilized for transfer of high activity or high hazard liquid low-level waste to contingency storage. The procedures should address maximum operational capacities and limits for components of the operational system (e.g., spare storage capacity available in tanks). The procedures should define and address all possible emergency transfer scenarios needed to comply with this requirement.

Contingency Storage. Contingency storage is to be provided for both stored liquid low-level waste and for liquid low-level waste treatment facilities. In the case of storage tanks, adequate volumetric capacity must be available to receive the largest volume of waste stored in any single tank. In the case of a treatment facility, adequate capacity must be available to allow all in-process liquids in the facility to be moved into storage in the event of emergency or off-normal conditions.

A number of factors are considered in maintaining spare capacity. First, the requirement includes a provision that the spare capacity has "adequate capabilities." Therefore, the spare capacity must have the necessary features and functionality as dictated by the design and safety analysis for the facility and wastes of concern. Features to be taken into account include appropriate materials of construction, shielding, ventilation and filtration, heat dissipation, liquid level monitoring, and mixing. Similarly, if the waste that may need to be transferred is regulated by some external regulation (e.g., RCRA), the tank(s) that would be used for spare capacity should be properly permitted. Likewise, the design bases events for the facility must be considered in determining the design of contingency storage, and whether some events may be severe enough that additional considerations must be included in the siting design, or operation of contingency storage to ensure its availability if there were a leak in an existing storage tank.

The requirement specifies that the contingency storage provided is to meet the requirements of DOE O 435.1 and DOE M 435.1-1. Of prime interest is the ability of existing contingency tanks or other facilities to meet the requirements for confinement in Low-Level Waste Treatment and Storage Facility Design DOE M 435.1-1, Section IV.M.(2). Additionally, compliance with the requirements for ventilation, instrumentation and control systems, and monitoring systems for storage facilities is also very important for tanks or facilities that will be used for contingency storage. Meeting these requirements, in combination, ensures that the use of existing tanks or other facilities for contingency storage minimize the potential impacts of off-normal or emergency situations involving high activity or high hazard liquid low-level waste.

Spare capacity may be provided by a single tank or by the combined available volume in multiple tanks. In cases where radiation fields are sufficiently low, spare short-term capacity may be able to be provided by portable tanks, tankers (i.e,. railroad cars), or tank trucks, provided that all applicable requirements can be met. Due to the potential of airborne radioactive material, impoundments or bermed areas open to the air generally should not be used for spare storage capacity, unless a safety analysis shows that the risk to workers and the public is low.

> *Example: Liquid radioactive waste is stored in six underground storage tanks with a design capacity of 250,000 gallons each. The waste in the all tanks has the same chemical and radiological characteristics. One tank contains 200,000 gallons and each of the others contain about 100,000 gallons. Capabilities exist to retrieve waste and transfer it among the six tanks. This system meets the requirement because the largest volume of 200,000 gallons can be distributed between any two of the other tanks.*

<u>Transfer Equipment</u>. The ability to perform waste transfer is just as important as having the capacity. Equipment necessary to transfer each tank or treatment facility volume of high activity or high hazard liquid low-level waste in the event of a leak or other off-normal condition is to be identified and documented.

> *Example: Liquid radioactive waste is stored in six underground tanks with the volumes and characteristics described in the previous example. Although there are transfer lines to any of the tanks from a central diversion box, the tanks were constructed without the capability to retrieve the waste. This situation does not comply with the requirement. Although there is adequate capacity, the ability to transfer the waste does not exist.*

Equipment necessary to transfer the contents of each tank is tested and inspected as part of a routine maintenance program (see DOE M 435.1-1, I.1.E.(9)). Special attention should be given to including in the maintenance program equipment and transfer lines that are not routinely used in managing liquid wastes. Inspection and testing includes the following items:

- leak testing of transfer pipelines;
- ensuring the availability of any jumpers necessary for completing waste transfer;
- confirming that instrument panels, control panels, valves, pumps and any necessary ventilation equipment is supplied with the necessary electrical power, air (for pneumatically-controlled items), steam, and water; and
- performing functional tests of instruments, controls, valves, pumps, and ventilation equipment.

The capability to perform an emergency transfer of high activity or high hazard liquid low-level waste is to be maintained at all times. Therefore, every shift must include or have immediate access to qualified individuals and the equipment necessary to perform transfers in a timely manner, unless analysis of the hazards associated with the waste concludes that an immediate transfer is unnecessary.

Example: A large shielding block is in place over a jumper pit that needs to be accessed during an emergency transfer of liquid waste. The block can only be moved by a crane. Therefore, implementation of this requirement entails making sure that the crane is always operationally available (in a matter of hours rather than days) and every shift has access to an individual qualified to operate the crane and remove the block.

Spare capacity may also be shared by different waste types, however mixing radioactive wastes of different types should be evaluated and is generally not acceptable.

Example: A tank farm contains both high activity liquid low-level waste and liquid transuranic waste in separate tanks and a third empty tank for contingency. An empty mobile tank is maintained and available for emergency transfers of either waste in the event that the contingency tank must be used by either the low-level transuranic waste. Mixing waste types is prohibited in this case.

Compliance with these requirements are demonstrated if adequate spare capacity and transfer equipment exists for emergency transfers of all high activity and high hazard liquid low-level waste. In addition, the capability to perform emergency transfers is demonstrated by having waste transfer routings identified, operational procedures to direct transfers, staff trained to the procedures, and records showing that the spare capacity and transfer capability are kept in operating condition.

Supplemental References:

1. DOE, 1995. *Comprehensive Emergency Management System*, DOE O 151.1, U.S. Department of Energy, Washington, D.C., September 25, 1995.

IV. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

Objective:

The objective of this requirement is to ensure that actions will be taken to preclude, minimize, or mitigate hazards whenever a situation arises at a low-level waste management facility that could threaten worker or public safety, or the environment.

Discussions:

DOE M 435.1-1, Section I.2.G states that all personnel have a responsibility to identify conditions that require corrective actions to achieve compliance with the Order and Manual requirements or to address health and safety conditions that pose an imminent or possible danger. The Manual states that this responsibility includes considering shutdown or curtailment of facilities and activities, if warranted by the seriousness of the circumstances. This requirement ensures that this responsibility is implemented for all low-level waste management facilities and activities.

Corrective actions are activities which, when implemented, will address and correct noncompliant or hazardous conditions. Corrective actions can include improvements to documentation (e.g., procedures, plans, authorization basis documents), training and qualification programs or procedures, physical and process design changes, changes to operating conditions, or a combination of these activities.

Corrective Action System. A corrective action system exists for addressing noncompliant or hazardous conditions for low-level waste management facilities, operations, and activities. Corrective actions in response to quality assurance program assessments are addressed in the *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance.* The corrective action system provides for documenting noncompliant or hazardous conditions, identifying the organizations or individuals responsible for developing and implementing corrective actions, providing corrective action status, and tracking progress through final implementation of the actions. The corrective action system is instituted as a fundamental part of the systematic evaluation of radioactive waste activities that is implemented by the site-wide radioactive waste management program (see guidance for DOE M 435.1-1, Section I.2.F.(1)).

A problem requiring corrective action could range from a minor deviation from a procedure, to a situation that poses an immediate threat to health and safety from an uncontrolled release of large quantities of radioactive material. For situations where a problem could pose an immediate risk to a worker, member of the public, or damage to the environment, immediate shutdown of the process or facility may be appropriate as the first step in addressing the problem (see guidance for DOE M 435.1-1, Section IV.F.(2)).

> *Example: An employee of the Site Q laboratory facility noticed that a drum of mixed low-level waste which was supposed to be closed and ready for shipment did not have a rim lock and was not correctly labeled. He alerted the lab manager, who alerted central waste management. The laboratory corrective action system resulted in a corrective action plan that identified the lab manager as the responsible individual for producing a revised procedure on locking and labeling waste drums, and providing training to the lab staff. A reminder memo was sent to affected staff and a follow-up review was scheduled for 45 days after the occurrence .*

If a facility or activity can be allowed to operate while a noncompliant or hazardous condition exists, the allowance and any associated limitations must be defined as part of the facility or activity's radioactive waste management basis, identified as a configuration controlled item in a configuration management plan or included in a revision or modification to an operating procedure or similar controlled documentation. If a noncompliance impacts safety associated with use of a procedure, system, or facility, the corrective action system must provide for preventing the use (e.g., locking out) of the affected procedure, system, or facility.

> *Example: In the example above, waste generation was temporarily curtailed so that no new waste drums would be filled until the revised procedure was in place. Waste generation was allowed to resume as the training took place. No new drums were ready for locking and labeling until training had been completed.*

Corrective Actions for Low-Level Waste Disposal Facilities. Situations could be present at low-level waste disposal facilities that may require corrective measures even though there is no immediate or obvious safety or environmental concern. This is because some situations, left unchecked, could result in performance degradation to an extent that the ability of the disposal facility to continue to meet performance objectives could be compromised at some time in the future. Monitoring to detect degrading performance factors must be incorporated in the performance monitoring plan required by DOE M 435.1-1, Section IV.R (see guidance on DOE M 435.1-1, Section IV.R.(3)(c)). Some factors that should be considered include:

- Routine and special inspection of site conditions;

- Detection of events or conditions that could degrade performance of the disposal site;

- Periodic studies and surveys to determine the extent of migration of radionuclides, projection of potential future public doses, and their significance relative to the performance objectives;

- Specification of graded levels of response for each pathway; and

- Identification of corrective measures.

Conditions that have resulted in, or may lead to, site performance failure from ponding or flooding need to be corrected or mitigated as necessary. Ponding and flooding at the site provide opportunity for increased infiltration of water into the waste disposal units. Corrective measures to be considered include filling and regrading of the ponded area, construction of adequate surface water control systems such as dikes or diversion dams, and contouring of surfaces to control surface runoff.

Conditions at the disposal facility that may lead to site performance failure because of water accumulation in excavations also need to be corrected. Hydrologic conditions to be considered include:

- Infiltration through the excavation cover;

- Lateral intrusion; and

- Elevation of the water table.

Other site conditions to be considered include subsidence or cracking of the excavation cover and inadequate or damaged surface water diversion system. Corrective measures to be considered include:

- Reduction of the permeability of the excavation cover by compaction;

- Contouring of the cover material for controlled removal of surface water;

- Installation of subsurface drainage;

- Installation of barriers of low-permeability materials;

- Modification of nearby topography and surface material to reduce infiltration into the surrounding soils;
- Excavation of cover subsidence zone (add fill material, compact, contour, and stabilize, if subsidence is due to voids between packages, grout can be injected into void space);
- Pothole subsidence (fill, compact, and recontour);
- Cracking (excavate zone around crack, fill, compact, and recontour);
- Design and installation of diversion system to prevent offsite surface water from entering the site; and
- Repair or installation of onsite drainage system to remove onsite runoff.

Conditions at the site that may lead to exposure of the waste need to be corrected, since such exposure is a danger to workers and provides the opportunity for radionuclide transport by surface water and air pathways or by vectors (insects, rodents, etc.). These conditions include wind and water erosion of the excavation cover, subsidence or cracking of the excavation cover, burrowing by animals into the waste, and growth of deep-rooted plants. Corrective measures to be considered include:

- Filling and regrading the surface;
- Establishing erosion resistant cover;
- Filling of burrow holes;
- Installing physical, chemical, and/or biological barriers;
- Removal of deep-rooted plants; and
- Vector control.

Compliance with this requirement is demonstrated if a corrective action system addresses noncompliant or hazardous situations involving low-level waste management facilities in a systematic fashion, and allows identification of problems by all personnel.

Supplemental References:

1. DOE, 1996. *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance*, DOE G 414.1-1, U.S. Department of Energy, Washington, D.C., August 1996.

2. DOE, 1990. *Environmental Monitoring for Low-level Waste Disposal Sites: Low-level Management Handbook Series*, Revision 2, DOE/LLW-13Tg, National LLW Management Program, Idaho Falls, ID, 1990.

3. DOE, 1986. *Exposure and Improved Techniques in Radiological Environmental Monitoring at Major DOE Low-level Waste Disposal Sites*, DOE/LLW-54T, National LLW Management Program, Idaho Falls, ID, 1986.

IV. F.(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Objective:

The objective of this requirement is to limit the operation of waste management activities and facilities as necessary to avoid creation of near- or long-term safety or environmental hazards.

Discussion:

DOE M 435.1-1 requires that a radioactive waste management basis be established for each low-level waste management facility, operation, or activity. The radioactive waste management basis documents the conclusion that the potential hazards from management of radioactive waste have been sufficiently evaluated and that adequate controls are in place to provide assurance that the public, workers, and the environment are being protected. Field Element Managers are responsible for ensuring a radioactive waste management basis is developed, reviewed, approved, and maintained for each DOE radioactive waste management facility, operation, or activity (DOE M 435.1-1, Section I.2.F.(2)). The guidance for that requirement should be consulted for additional details on the development, review, and approval of a radioactive waste management basis. Also, additional discussion concerning the radioactive waste management basis for low-level waste generator, treatment, storage, and disposal facilities is discussed under guidance for DOE M 435.1-1, Section IV.D.

As part of the Field Element Manager's responsibilities for maintaining the radioactive waste management basis for low-level waste management facilities, operations, and activities under

his/her authority, the Field Element Manager evaluates the compliance of the facilities, operations, and activities with the constraints and controls documented in the radioactive waste management basis by ensuring that routine assessments are conducted. If the Field Element Manager determines, either through routine assessment or by virtue of an occurrence or off normal event, that an operation, activity, or facility is not operating in compliance with an approved radioactive waste management basis, it must be curtailed or shut down. The action taken is commensurate with the hazards associated with the noncompliance and with the continued operation of the facility.

This requirement is to be implemented in a graded manner. Actions to be taken are based on assessments of adherence to radioactive waste management bases, and can range from shutdown of an operation or facility to placing limits or constraints on what activities can be performed or how the activities are to be performed. Shutdown of a facility involves stopping all operations in the facility except surveillance or monitoring activities necessary to maintain the facility in a safe standby condition. Shutdown is considered appropriate when there is either a potential imminent threat to safety or environmental protection that cannot be mitigated, or a blatant failure to establish or comply with a radioactive waste management basis.

Alternatively, there may be cases where the facility, operation, or activity assessment determines that the radioactive waste management basis is no longer current or has been violated, but there is no imminent threat to public, worker, or environmental protection. In such a case, the Field Element Manager may decide that shutdown of the facility is not necessary. It may be sufficient to impose certain limits until the radioactive waste management basis is made current. The limits imposed may prohibit the generation, receipt, or processing of certain waste streams, or may involve constraints on the processes that may be performed.

> *Example: Site Q conducts bi-annual assessments of the Building B low-level and mixed low-level storage facilities for compliance with the radioactive waste management basis. The 1996 biannual assessment found two non-compliance findings and five observations. The corrective action system implemented at Site Q requires the non-compliance findings to be entered and formally responded to with corrective action plans, but not the observations. The non-compliances were in document control and training, so the storage activities were not curtailed in any way while the document control and training procedures were improved. The facility was assessed again in 1997 to determine if the corrections were in place, which was an accelerated assessment schedule from the normal bi-annual assessments.*

The action taken in response to the failure to establish a radioactive waste management basis is to be clearly documented in a formal communication (e.g., letter, memorandum). Such communication needs to identify the reason for the shutdown or curtailment, and identify what is necessary to initiate restart. Generally, development of a corrective action that is implemented

through the corrective action system discussed in the preceding section would be appropriate for responding to a shutdown or curtailment of activities at a low-level waste management facility.

In concert with Core Requirement #6 of the Integrated Safety Management System, “Feedback and Improvement,” the Field Element Manager should use the audits and assessments to identify opportunities for improvement in the implementation of an activity or facility’s radioactive waste management basis. Identified improvement actions should be shared with like organizations and tracked by management to determine whether they are yielding the anticipated improvements. Communicating the results of assessment upward in the DOE and contractor organization will allow the findings to reach the management level with authority necessary to effect improvements.

Compliance with this requirement is demonstrated with a documented system of routine assessments to determine whether waste management activities and facilities are operating in accordance with an approved radioactive waste management basis that provides for graded limitations that can be placed on activities and operations that do not have, or are operating outside of, an approved radioactive waste management basis, including shutdown of the facility.

Supplemental References:

1. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE P 411.1, U.S. Department of Energy, Washington, D.C., January 28, 1997.

2. DOE, 1996. *Safety Management System Policy*, DOE P 450.4, U.S. Department of Energy, Washington, D.C., October 15, 1996.

3. DOE, 1997. *Line Environment, Safety and Health Oversight*, DOE P 450.5, U.S. Department of Energy, Washington, D.C., June 26, 1997.

4. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities Manual*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

IV. G. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all low-level waste storage, treatment, or disposal facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides.

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal.

(c) Restrictions or prohibitions on waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance.

Objective:

The objectives of the waste acceptance requirements are to ensure that low-level waste which is received at a facility contains only the radionuclides that the facility can safely manage, and only in concentrations and/or total activities which are compatible with the work to be undertaken in the facility; ensure that low-level waste which is to be received at a facility is in a form or container that will maintain its integrity and retain acceptable configuration under the conditions that are expected to be encountered during the management steps the waste will undergo; and ensure that no low-level waste received at a facility contains materials that will compromise the safety or integrity of the facility under the expected operating conditions.

Discussion:

As discussed in Section I.2.F.(6) of the guidance for Chapter I, General Requirements, the waste acceptance requirements establish the conditions for waste that facilities can safely receive. Therefore, the acceptance requirements for a low-level waste storage, treatment, or disposal facility include all requirements that low-level waste must meet to be acceptable for receipt, and for the subsequent storage, treatment, or disposal, as appropriate.

In conducting the analyses for development of the DOE M 435.1-1 requirements, minimum acceptance requirements that must be specified in the waste acceptance documentation for storage, treatment, and disposal facilities in order for low-level waste to be safely handled were identified. DOE M 435.1-1, Sections IV.G.(1) (a) through (c), and (e) provide minimum

acceptance requirements that must be in all low-level waste storage, treatment, and disposal facility waste acceptance requirements. DOE M 435.1-1, Section IV.G.(1)(d) provides additional minimum acceptance criteria that must be in all low-level waste disposal facility requirements. Guidance on subrequirement (a) is provided below under Radionuclide Content or Concentration. Guidance on subrequirements (b) and (c) is provided under Waste Form and Package Criteria and Prohibitions. Guidance on subrequirements (d) and (e) is provided under the citations of those requirements following the guidance on subrequirements (a) through (c).

Development of Waste Acceptance Requirements. A facility receiving waste for storage, treatment, or disposal is required to document the waste acceptance requirements for the facility. These requirements have their foundation in facility design capabilities such as volume, handling weight, allowable contents, and radiological limits (i.e., criticality, radiation, contamination). Other requirements may include any number of regulations promulgated by the EPA, NRC, DOT, the host state, and DOE itself. The designer and operator of the facility receiving waste are likely to be most knowledgeable and understanding of the requirements and limitations of the facility and, therefore, are in the best position to establish the waste acceptance requirements or criteria that must be met for waste sent to the facility.

A low-level waste management facility at a site may have its own specific stand-alone waste acceptance requirements. Or a site may have general waste acceptance requirements applicable to all low-level waste management facilities at the site, with separate facilities, adding facility-specific acceptance requirements to the site waste acceptance requirements as necessary. This practice may be particularly effective at sites with many facilities which manage small quantities of waste with multiple locations for staging, storage, and/or central management of waste. At such facilities, most of the process and procedural waste acceptance requirements could be in one document applicable to the whole site, which would be supplemented with specific technical requirements for acceptance at each of the separate management locations. If activities across various facilities are similar, they could share the same supplemental waste acceptance requirements documents. Likewise, if several activities are carried out at locations that are close to one another, or are managed by the same entity, then one supplemental technical document may be prepared to cover those activities.

The waste acceptance requirements and documentation for a facility receiving waste for storage, treatment, or disposal is prepared using a graded approach commensurate with the hazards associated with the management of the waste in the facility and the complexity of the activities to be conducted in the facility and upon the waste. The waste acceptance requirements document for a facility which receives major transfers of large quantities of low-level waste from many generators, or with high specific activities or highly variable contents may need to address many hazards and consequently be more detailed. By contrast, a storage facility which will only pass-through properly packaged waste directly to a disposal facility without any additional processing or packaging may only need a minimum set of requirements. Perhaps only a few administrative

requirements would be necessary for proper receipt of waste at such a storage facility, along with assurance that waste received at the storage facility meets the disposal facility technical waste acceptance requirements.

> *Example 1: A large DOE low-level waste disposal facility accepts waste from many offsite generators, from a variety of processes, including a variety of types and concentrations of radionuclides. Waste acceptance requirements for receipt and disposal of low-level and mixed low-level waste are prepared as a stand-alone set of requirements due to the complexity and diversity of the wastes received. The processes for acceptance, and technical and administrative requirements for the waste are unique to this disposal facility.*

> *Example 2: At a large DOE site, several facilities are used for storage of low-level waste. One waste acceptance requirements document is prepared containing all of the necessary administrative requirements for all storage buildings. Each storage facility has a technical procedure which contains the specific technical criteria for the facility, and which implements the administrative waste acceptance requirements document for the processes and forms, etc. that are needed for storage of low-level waste.*

The performance assessment, composite analysis, disposal authorization statement, safety analysis report, criticality analysis, and any other appropriate safety and/or authorization basis documents are to be used to establish the waste acceptance criteria for receiving facilities low-level waste for storage, treatment or disposal. These documents and analyses provide the basis for radioactivity (concentration and inventory) limits, waste classes or categories, waste form and/or packaging stability requirements, allowable chemical content, allowable free liquid content, and any other necessary waste package or form requirements to ensure that the facilities' design bases, performance, and operating bases are protected.

DOE M 435.1-1, Chapter IV requires the conduct of a performance assessment maintenance program. Under this program the performance assessment must be revised if changes occur in radionuclide inventories beyond expected limits, facility design, or the understanding of the site or any other features that change the conclusions of the existing performance assessment. Thus, when the performance assessment is changed, the waste acceptance requirements need to be reviewed to determine if the performance assessment changes affect any acceptance criteria. If so, then the acceptance requirements are modified as appropriate.

> *Example: Monitoring wells located on the boundary of a low-level waste disposal facility indicate the presence of migrating radionuclides sooner than estimated by performance assessment calculations. The data affecting release rates for these radionuclides in the performance assessment are analyzed following this discovery. The analysis indicates the presence of a significant chemical catalyst which results in higher*

release rates. The calculations in the performance assessment are updated and waste acceptance requirements and radionuclide inventory limits are revised based on the new performance assessment modeling results.

Radionuclide Content or Concentration. Radiological limits for storage, treatment, and disposal facilities may be derived from a number of technical as well as administrative sources. In developing radionuclide limits, personnel need to consider legislative and/or regulatory limitations, the disposal facility performance assessment and composite analysis, safety analysis reports, and criticality analyses. In addition to establishing general radiological limits (e.g., a contact dose rate), these sources identify specific radionuclides whose concentration or total activity must be limited in the waste acceptance criteria in order to remain within the bounds for safe and legal facility operation.

The results of the performance assessment and composite analysis will provide information on certain critical radionuclides that are most important for assuring that the long-term performance of the low-level waste disposal facility will be maintained. In some cases, the critical radionuclides need to be specifically identified in the waste acceptance criteria, and additional technical or administrative requirements specified for them. A critical radionuclide may require specific information on the characterization documentation that must be input into the disposal facility records. The waste acceptance requirement documentation specifies what this information is and how it is to be provided to the facility receiving waste for storage, treatment or disposal.

Example: The results of the performance assessment for a specific low-level waste disposal facility indicates that control of several specific radionuclides is important to the protection of ground water resources. The waste acceptance requirements for the facility state the limits on each of these radionuclides and that the amount of each of these nuclides must be specifically reported on the characterization documents for packages of low-level waste received at the facility. The waste acceptance requirements indicates that the lower limit of detection of equipment used to characterize waste must be included in the characterization information where a 0 (zero) is reported for any of these radionuclides.

The performance assessment analysis may also indicate that some waste streams or forms to be disposed at the disposal facility being evaluated need to be packaged or otherwise disposed in a structurally stable form. These wastes may be identified specifically and identified in the waste acceptance requirements as needing to be structurally stable prior to acceptance at the disposal facility. Alternatively, the waste acceptance requirements may include a site-specific classification or categorization system which requires stability, or some other additional management steps, for wastes containing certain concentrations of specific radionuclides. The waste acceptance requirements may also allow for acceptance of certain wastes in a bulk, non-containerized fashion.

Example: The results of an intruder analysis in the performance assessment for a specific low-level waste disposal facility indicate that wastes containing concentrations of three radionuclides greater than calculated values may not be acceptable for near-surface disposal unless measures are taken to provide intruder protection from the wastes. A supplementary intruder analysis is conducted using new assumptions of a more stable waste form. The supplementary intruder analysis indicates that a higher concentration of the radionuclides can be accepted using the more stable waste form assumed in the analysis. Therefore the waste acceptance criteria are developed to allow for wastes to be received containing the lower concentration of the radionuclide in untreated waste, and allows for wastes to be received containing the higher concentration of the radionuclides, if the waste is treated to the more structurally stable waste form.

The safety analysis report prepared for a low-level radioactive waste management facility may also identify specific radionuclides that warrant specific attention from a worker safety standpoint, and may require special handling if received and managed at the facility.

Example: A storage facility that manages low-level mixed waste is subject to RCRA Part B permit requirements for routine inspection of the waste. An analysis of worker radiation exposure associated with inspection of the storage configuration indicates that several radionuclides need to be controlled below certain concentrations to maintain doses to workers as low as reasonably achievable. The waste acceptance requirements for the facility reflect the allowable concentrations from the safety analyses as maxima for waste that can be accepted for storage in the facility.

Any criticality analysis that will be conducted to derive the criticality safety program in conformance with DOE M 435.1-1, Section I.1.E.(4) may also result in some limitations on acceptance of fissile radionuclides. These limitations need to be included in the waste acceptance requirements, as appropriate.

Waste Form and Package Criteria and Prohibitions. Waste acceptance requirements should specify that wastes received at the facility are in a physically/chemically stable form. As used in this requirement, stability refers to the physical and chemical properties of waste that are necessary for it to be handled safely at a facility and to undergo the management steps normally performed at that facility. Such stability is dependent on the waste management steps to be performed with the waste (e.g., treat, store, or dispose) and the time to complete the management step (e.g., time until treatment or length of expected storage period). Therefore, waste acceptance requirements must specify the necessary physical and chemical stability for the specific operations and activities for a given facility. Waste acceptance requirements for a low-level waste treatment facility need to specify the physical and chemical precautions and conditions under which untreated waste can be received at the facility so that facility safety and effective operations will not be compromised. Any physical or chemical stabilization of waste prior to transfer to a

receiving facility need to be done according to a systematic process that may include consideration of bench scale testing and verification that the process is producing satisfactory results.

The waste acceptance requirements need to specify waste streams, classes, or categories of waste requiring application of specific physical, chemical, or structural stabilization methods, as determined by the results of site-specific analysis of site conditions, the waste that needs physical or chemical stabilization, and the desired performance of the facility. For treatment and storage facilities, the results of safety analysis or other safety documentation may indicate certain waste streams require specific physical or chemical stabilization to be safely handled by workers. The waste acceptance requirements should specify limitations or technical criteria for these waste streams, classes, or categories to meet. For disposal facilities, the performance assessment and composite analysis may conclude that certain waste streams require stabilization in order to contribute to a reasonable expectation that the disposal performance objectives will be met. Again the waste acceptance requirements should specify the structural stability limitations or criteria for these waste streams to meet.

> *Example: The results of the performance assessment for a specific low-level waste disposal facility indicate that wastes containing three long-lived radionuclides are acceptable for near-surface disposal provided some measures are taken to provide additional protection to water resources. The waste acceptance requirements identify low-level wastes containing these radionuclides as Category G low-level wastes (G for groundwater). These category G low-level wastes will only be accepted in high integrity containers and then be disposed in trenches containing special groundwater protection barriers.*

Acceptable waste forms, containers, and packages providing structural stability or inadvertent intrusion protection are specified by the waste acceptance requirements. Structural stability refers to the property of the waste to provide for stability of the disposal site during and after operations to reduce the amount of subsidence and prevent or minimize radionuclide migration from the disposal unit. Any structural stabilization that is conducted to meet waste acceptance requirements needs to also be done according to a systematic process that includes consideration of bench scale testing and verification that the process is producing satisfactory results, as appropriate. The waste acceptance requirements indicate the testing and verification processes that are acceptable. Consideration should be given to incorporating the technical positions and tests discussed in the US Nuclear Regulatory Commission’s Technical Positions on Waste Form (Refs. 1 and 2) into the low-level waste disposal site waste acceptance requirements for acceptable verification tests for structurally stable waste.

The waste acceptance requirements need to list any specific packages and containers pre-approved as acceptable for the low-level waste management facilities, as well as acceptable

overpacks. Consideration should be given to the policy on use of standardized low-level waste disposal containers (Ref. 3) and its attendant guidance on recycling of radioactively contaminated carbon steel.

The waste acceptance requirements need to identify any of the following specific technical requirements that must be included to ensure that waste received at any storage, treatment, or disposal facility is consistent with the operating basis of the facility:

- the acceptable limits for waste package external surface dose rate for both contact and remote handled packages, and heat generation;
- the acceptable limits for free liquid content, specified on a per package basis;
- the acceptable limits for maximum void space, specified on a per package basis;
- the necessary labeling and marking to be applied to low-level waste packages;
- the necessary information about any bar coding or other tracking system used at the facility receiving the waste and the application of the system by generators;
- any specific requirements associated with acceptance of bulk waste, including any additional restricted materials or limitations on materials and any specific technical requirements bulk waste must meet for compatibility with disposal operations and the conditions or specifications for handling bulk waste containers that will not be disposed;
- any specific radionuclides or chemical or hazardous materials that are prohibited from acceptance at the facility;
- any specific requirements associated with acceptance of mixed low-level waste, including any additional restrictions or limitations on the waste or specifications for handling mixed waste containers;
- any specific packages or types of packages or containers that are prohibited from or restricted in acceptance at the facility;
- any specific requirements associated with acceptance of special low-level waste streams needing out of the ordinary attention for receipt, handling, storage treatment, or disposal, (e.g., sealed sources), including any additional restrictions or limitations on the waste or specifications for handling the waste containers;

- any package protection requirements needed for transport and receipt to provide needed physical protection to the packages to prevent breaching and so that the certified status of the waste is preserved;

- the necessary shipping arrangements for transport to the facility receiving the waste, including any electronic traffic data bases or scheduling system used.

Example 1: The Site B mixed waste incinerator waste acceptance criteria contains a list of acceptable radionuclides and their acceptable concentrations, states the acceptable limits for waste package external dose rate, contains a list of acceptable RCRA hazardous constituents that can be destroyed by the incinerator, states that all waste must be received in specially designed fiberboard boxes (expedites waste feed), prohibits acceptance of Polychlorinated Biphenyls (PCBs) (it does not have a Toxic Substances Control Act approval), and prohibits acceptance of gaseous, reactive, and explosive waste.

Example 2: The Central Waste Management Unit Storage and Transfer Facility at Site B provides centralized collection, staging, and transfer for all Site B low-level, mixed low-level, and transuranic wastes. Site B waste is transferred/shipped to a variety of storage, treatment, and disposal facilities, some on- and some off-site. The waste acceptance requirements for the Central Waste Management Unit Facility specifies that all waste must be certified to the waste acceptance criteria of the downstream facility to which it goes next. The requirements also contain instructions on obtaining specific site-specific labels containing barcoding from the Central Waste Unit, and instructions for attaching specifically colored waste drum ring bands corresponding to a code that correlates with the wastes' next destination established by Central Waste that facilitates sorting and segregating of the waste at the Transfer Facility.

Compliance with these waste acceptance requirements is demonstrated if they are documented, contain clear and precise criteria specifying the radionuclide limits in the form of contents or concentrations that can be accepted, the limitations and prohibitions on waste forms and packages that can be received, and the limits, prohibitions, or instructions concerning any other technical information so that the waste is compatible with the safety basis of the facility, and which will result in acceptable waste at subsequent steps in managing the low-level waste.

Supplemental References:

1. NRC, 1983. *Final Waste Classification and Waste Form Technical Position Papers*, U.S. Nuclear Regulatory Commission, Washington, D.C., May 1983.

2. NRC, 1991. *Technical Position on Waste Form*, Revision 1, U.S. Nuclear Regulatory Commission, Washington, D.C., January 1991.

3. Cowan and Owendoff, 1996. Steven Cowan and James Owendoff to Distribution, memorandum, *Use of Standardized Low-Level Waste Disposal Containers*, U.S. Department of Energy, Washington, D.C., April 17, 1996.

IV. G.(1) Technical and Administrative.

(d) The following are additional waste acceptance requirements that shall be specified in low-level waste disposal facility waste acceptance requirements:

1. Low-level waste must contribute to and not detract from achieving long-term stability of the facility, minimizing the need for long-term active maintenance, minimizing subsidence, and minimizing contact of water with waste. Void spaces within the waste and, if containers are used, between the waste and its container shall be reduced to the extent practical.

2. Liquid low-level waste or low-level waste containing free liquid must be converted into a form that contains as little freestanding liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the waste volume when the low-level waste is in a disposal container, or 0.5 percent of the waste volume after it is processed to a stable form.

3. Low-level waste must not be readily capable of detonation or of explosive decomposition or reaction at anticipated pressures and temperatures, or of explosive reaction with water. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

4. Low-level waste must not contain, or be capable of generating by radiolysis or biodegradation, quantities of toxic gases, vapors, or fumes harmful to the public or

workers or disposal facility personnel, or harmful to the long-term structural stability of the disposal site.

5. Low-level waste in a gaseous form must be packaged such that the pressure does not exceed 1.5 atmospheres absolute at 20 C.

Objective:

The objective of the technical and administrative requirements for low-level waste disposal is to ensure that low-level waste disposed in DOE waste disposal facilities are in a form and/or packaged so that the waste contributes to the facility meeting the performance objectives for disposal of low-level waste.

Discussion:

The analyses performed in developing the DOE M 435.1-1 requirements indicated that minimum waste form requirements were needed for disposed low-level wastes to be able to continue to have reasonable assurance that the long-term hazards from the waste would not adversely impact the public, workers, or the environment. These minimum waste form requirements are designed to achieve the performance objectives of the disposal facility over the long term. In order to effectively contribute to meeting the performance objectives, the waste form and/or packages should contribute to the goals of minimizing: (1) the need for long-term active maintenance of the facility following closure; (2) subsidence during and after waste emplacement; and (3) the contact of water with disposed waste. To assist in achieving these goals, the requirement includes reducing void spaces within the packages of waste and within the waste itself, minimizing the amounts of liquid that could be released through leaching or if a waste container were breached, ensuring that waste packages do not contain any materials which would be potentially harmful to the public or workers if a container was breached during operations or which would create an unstable condition in the disposal unit following disposal.

Facility Stability. Subrequirement (DOE M 435.1-1, Section IV.G.(1)(d)1.) is intended to provide a set of minimum requirements for waste forms and containers to contribute to the long-term stability of the disposal site and thus contribute to a reasonable expectation that the performance objectives for the disposal facility will be met for a long time into the future. Waste acceptance requirements are to specify site-specific limits or criteria for acceptable structural stability of waste forms and containers based on site conditions, the waste that requires stability, and the desired performance of the facility. (Long-term stability of a low-level waste disposal facility is discussed and described further in guidance on Section IV.M.(3), Low-level Waste Disposal Facility Design.)

Waste forms and containers should maintain their basic shape and form for a period of time corresponding to the period of time necessary to achieve performance objectives. For most low-level waste, standard 55-gallon drums and boxes such as B-25 boxes are adequate. Containers should be designed to withstand the loads that are likely to be present in the disposal unit, including waste disposed above and any overburden and closure cover materials. Consideration needs to also be given as to whether live loads (i.e., vehicles) will be present at the disposal units.

Disposal units disposing of bulk wastes like contaminated dirt and construction rubble need to compact the disposal units to minimize subsidence. The practice of compaction as a regular part of disposal unit operations may also be considered for the disposal of waste in cardboard boxes, which could degrade in an uncontrolled fashion and contribute to subsidence problems unless they are dynamically compacted at the time of disposal unit covering.

The subrequirement also includes the minimization of void spaces to contribute to the stability of the site. This applies to both the amount of void spaces within the waste, as well as between the waste and its packaging if containers are used. The control of void spaces is achieved visually for containers containing job control waste, for example, as well as being an integral parameter for wastes prepared using a process control. The use of encapsulation methods, such as grout, may need to be considered for wastes containing highly-activated components that are likely to remain hazardous well beyond any foreseeable period of time a waste container is likely to last.

Liquid Wastes. The intention of the free liquid subrequirement (DOE M 435.1-1, Section IV.G.(1)(d)2.) is for liquid wastes or wastes that contain free liquid to be treated or packaged so that there is as little liquid remaining as is reasonably achievable. The requirement is also intended to address liquids that could become free liquids during transportation or which could be released due to thermal cycling or vibration that occurs during shipment. This can be accomplished through solidification or stabilization methods, by a dewatering process, or by packaging the waste with absorbent material. (It is, in fact, good practice to add a small quantity of absorbent (e.g., a quarter inch) in the bottom of most containers of waste. “Dry” waste is often not completely dry. Condensation also often occurs. The use of absorbent helps to reduce incidence of surface contamination and needless problems of appearance should small drops of condensation leak from a container.) For waste placed into a disposal container, the process or design for removing or reducing the liquid shall result in free liquid that is no more than 1 percent of the container volume. For wastes that are processed to a stable form, that is, where the waste form itself acts as a monolithic form and will be placed into the disposal unit without a container, the process or method shall result in free liquid that is no more than 0.5 percent of the volume of the waste form. The volume of the waste form in this case is the final volume following treatment to the stable form. If a waste is treated through a process that results in a processed, stable form, but it is also inside a container, then the free liquid requirement for the stable form shall be followed, that is, there should be no more volume of free liquid than 0.5 percent of the volume of the stabilized waste inside the container of stable waste.

A challenge is presented in determining compliance with the free liquid requirement because of the need to minimize or prevent exposures to workers. This would be a concern because one way to determine compliance would be to randomly examine waste forms and containers to determine the volume of free liquid. This has been done in the past at some older disposal operations by puncturing a hole in a container as it is received and measuring the amount of liquid that is obtained from the package. A better approach is to utilize processes, procedures, or methods whose results can be assumed appropriate as long as written protocol is followed, or which can be tested without damaging the waste package, for example, through test runs with surrogate materials. ANS Standard 55.1 (Ref. 1) is recommended for performing measurements of free liquids in solidified low-level waste forms and containers.

When using a container with absorbent materials, the process and procedure for loading the container with waste needs to call for introduction of more absorbent by volume than is needed for the amount of free liquid calculated in the waste, both for a safety factor, and because it is difficult to calculate exactly how much liquid will be freed during transportation and handling. Another measure in using absorbents to be considered would be redundancy, such as using two different kinds of absorbents, or using layering, such as double bagging. For processing waste to a stable form, or for a dewatering process, the use of test runs to produce samples that could undergo analysis using non-radioactive surrogate materials to determine optimum processing parameters that will result in meeting the liquid requirement is recommended. Likewise, the results of test or actual runs could be used to establish parameters for a subsequent treatment process when the waste material and feed are the same as a previous successful treatment process, and the correlation can be justified and verified.

Particular attention needs to be placed on the treatment and packaging of low-level waste to minimize free liquids for waste streams having a high initial moisture content. Additional measures could be considered for inclusion in waste acceptance criteria that call for specific calculations of how much of the interstitial liquid could become free liquid during handling and transportation, specific testing of absorbent to be used for such waste streams, consideration of the addition of a certain minimum amount or specification of absorbent, or the required solidification, stabilization, or additional packaging of waste streams that may be of particular concern (e.g., high-activity liquids present).

Soils present a particular challenge in regards to the free liquid requirement since many soils have a high initial moisture content, yet, in many cases the soil will not yield a significant amount of free liquid. Modifications to the measures discussed need to be considered to provide the needed information without the expenditure of resources that may be necessary for certain operations waste that may yield free liquids. For example, the evaluation for determining how much of the interstitial liquid could become free liquid during handling and transportation could be done on a set of standard soils from the site, with the results being provided on a generic basis rather than on a container-by-container basis.

Nuclear power plants employ a "process control program" to consistently produce products which are acceptable for disposal and which will meet waste acceptance requirements of receiving facilities. General guidance and requirements for process control programs can be found in NRC's standard review plan for nuclear power plants (NUREG-800) (Ref. 2).

Explosive, Reactive, Pyrophoric, and Degrading Low-Level Waste. The intention of the explosive, reactive, and pyrophoric subrequirement (DOE M 435.1-1, Section IV.G.(1)(d)3.) is that wastes containing a material that could react with water or spontaneously detonate or ignite be treated or packaged so that the chance for this to occur is significantly reduced. This is accomplished through solidification or stabilization or by packaging methods. The requirement is not intended to prohibit waste from containing potentially explosive or pyrophoric materials, only that they be appropriately treated, prepared, and packaged so the chance of ignition or explosion is significantly reduced.

Similarly, the intention of the radiolysis, biodegradation, and toxic subrequirement (DOE M 435.1-1, Section IV.G.(1)(d)4.) is that wastes must not be capable of generating toxins that will be harmful to workers during operations if a container were to be breached, or which could contribute to a slow degradation of the stability of the disposal site. The requirement in this case explicitly states that the waste must not contain any of the gases or vapors to begin with, but it also states that the waste shall not be capable of generating any from the materials present in the waste. In this case, just like above, a treatment or packaging method is used to render the waste incapable of generating the gases or vapors.

Gaseous Low-Level Waste. The gaseous low-level waste subrequirement (DOE M 435.1-1, Section IV.G.(1)(d)5.) is intended to protect workers and the long-term stability of the site by specifying the maximum pressure at which gaseous radioactive waste is to be packaged. The requirement is also intended to apply to the situation where gases are generated within the waste packages following closure of the package. An analysis may need to be conducted on any waste materials that could potentially generate gases due to conditions of storage or treatment to ensure that the pressure stated in the requirement will not be exceeded. The analysis needs to also include the potential for any conditions inherent in the waste and/or waste form that could cause gas generation. For example, spent ion exchange resins could generate hydrogen gas while in storage due to radiolysis.

Compliance with the waste acceptance requirements for low-level waste disposal facilities is demonstrated if they contain these minimum disposal facility requirements, or equivalent.

Supplemental References:

1. ANS, 1979. *American National Standard for Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants*, ANS 55.1, American Nuclear Society, La Grange Park, IL, 1979.

2. NRC, 1981. *Standard Review Plan for Nuclear Power Reactors*, NUREG-0800, U.S. Nuclear Regulatory Commission, Washington D.C., 1981.

IV. G.(1) Technical and Administrative.

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

Objective:

The objective of this requirement is to ensure that formal procedures exist and a decision process is clear concerning the granting of exceptions to waste acceptance requirements.

Discussion:

Waste acceptance requirements are established to ensure that facilities can safely manage waste received for storage, treatment, or disposal, and is particularly critical for disposal facilities in assuring the long-term performance will be maintained. Thus, exceptions or deviations to acceptance criteria cannot be routine and must be carefully reviewed and documented, especially to provide for the permanent record of waste disposed. The procedures for granting exceptions needs to clearly state the entire process for requesting an exception, describe acceptable bases for granting exceptions, and identify any additional information that is needed to supplement the documentation normally provided for waste transfers. The approval process needs to be clearly spelled out so the generator can conduct the request appropriately.

Example: The waste acceptance requirements for a low-level waste storage facility specifies three acceptable containers that can be received at the facility. It also includes a procedure for obtaining an exception to the waste acceptance criteria concerning containers only. (The requirements specifically state that no other exceptions will be granted). The procedure for the container exceptions includes minimum information about any containers other than the three pre-approved that must be submitted, who it is

to be submitted to, and the criteria that will be used to determine if the container may be found acceptable as an exception.

Waste acceptance requirements are acceptable if they are documented and contain a clear description of the procedure and bases obtaining for an exception or deviation to the acceptance criteria for low-level waste to be received at the facility.

Supplemental References: None.

IV. G.(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Objective:

The objective of this requirement is to establish a process by which personnel at a facility receiving low-level waste for storage, treatment, or disposal determine that the waste being transferred is acceptable in accordance with the waste acceptance requirements and for that process to specifically address the management of waste that does not conform with all of the requirements when it is received at the facility.

Discussion:

This requirement makes it the responsibility of officials at a facility to which waste is transferred to confirm that waste is in compliance with the established waste acceptance requirements and also provides a mechanism by which the officials confirm that waste can be accepted and safely managed.

Evaluation and Acceptance. The methodology for implementation of this requirement needs to be flexible and defined on a facility-specific basis. The complete process and procedures, including the responsibilities of the generating facility, need to be clearly documented so that both the generator and the facility receiving the waste understand the process that will be used. As with implementation of other parts of DOE M 435.1-1, this requirement is implemented using the graded approach process. Facilities receiving low-level wastes from many generators, offsite generators, or high activity low-level wastes, may need to implement more detailed waste evaluation and acceptance processes than a facility receiving waste from a small number of onsite generators.

The evaluation and confirmation process consists of one or more of the following approaches, and is designed to demonstrate that the waste presented meets the waste acceptance requirements of the facility receiving waste for storage, treatment, or disposal:

- Testing, sampling, and analysis of the contents of a representative sample of waste packages as they are received at the facility;

- Testing and analysis of a number of samples taken by the generator facility;

- Detailed review of sampling and analysis data generated by the sending facility or an independent laboratory employed by the generating facility;

- Audit, surveillance, or observation of the sender's waste characterization activities and processes and waste certification programs.

Testing, sampling, and analysis of the contents of a representative sample of waste packages upon receipt is complicated by the fact that additional risk is posed if a technique such as opening of drums and obtaining grab samples is used. Therefore, consideration needs to be given to implementing non-destructive examination technologies if receipt sampling and analysis is the preferred approach. Likewise, analysis of samples taken at the generator's site may involve additional risk, and also may be expensive to implement. If this method is employed, samples which are representative, either statistically or correlated with generator profiles, need to be obtained for analysis to ensure this method is effective. This sampling would include packages from the generators sending the largest volumes of waste to the facility or packages containing the critical radionuclides as identified in the waste acceptance requirements.

The use of a detailed review of the sampling and analysis data gathered by others would include an evaluation of the methodologies used for collecting the sample, maintaining the integrity of the sample and data (e.g., through a chain of custody), and performing the radioanalyses. As above, the samples collected would need to be representative of the waste, either statistically or with a bias towards large generators or generators of significant radionuclides (i.e., those that are most limiting for the storage, treatment, or disposal facility).

The use of assessments audits, reviews or surveillances to verify compliance of the waste generators certification programs with acceptance requirements would need to be conducted on a schedule commensurate with the frequency of waste generation and shipments. The documentation of the verification process would include organization and authorities; frequency of assessments; methods to be employed; the information that will be documented as a result; and the qualifications of personnel.

Example: The waste acceptance process for Storage Building B on the Western Site, which receives waste from multiple generators involves assay to confirm transuranic waste and to segregate transuranic and low-level waste, and sample collection and analysis to confirm the RCRA status of waste. The process calls for assaying and sampling one waste package of every 25 from established waste streams and one of every 5 for new waste streams of for waste from generators who have a history of poor compliance with the waste acceptance criteria.

Discussions contained in *Methods for Verifying Compliance with Low-Level Radioactive Waste Acceptance Criteria* (Reference 2), provide additional guidance for evaluation and acceptance of waste at receiving facilities.

Non-Conforming Low-Level Waste. Facilities receiving low-level waste for storage, treatment or disposal need to have a documented process to be used in the event a non-conforming waste is received. A non-conforming waste is a waste container or shipment which is certified by the generator as meeting the waste acceptance requirements of the receiving facility but which is found to be in violation of the acceptance requirements during the receiving facility's waste receipt and acceptance process. Facility procedures need to address how non-conforming waste will be segregated from acceptable waste, the process for notifying the sender of the non-conformance, and the acceptable methods for dispositioning the non-conforming waste. The process includes prior notice to the sender of the actions to be taken by the facility receiving the waste and the sender's obligations, particularly regarding the cost of the actions, to support the disposition of the non-conforming waste.

Example: A low-level waste storage facility's waste acceptance process includes returning non-conforming waste to the generator under all circumstances, billed to the generator. The paperwork/certifications for waste return is included in the paperwork accompanying all packages to facilitate return of packages.

Compliance with the waste acceptance requirements for a low-level waste management facility is demonstrated if they include a process for evaluation and acceptance of incoming waste to ensure the acceptance criteria of the facility receiving the waste are met that includes one of or a combination of: (1) testing, sampling, and analysis of representative samples of waste upon receipt; (2) testing, sampling, and analysis of split samples of waste taken at the generator site; (3) evaluation of testing, sampling, and analysis of data provided by the generator, or (4) audits, reviews, surveillance, or observations of generator waste certification programs and characterization activities. Additionally, acceptable waste acceptance requirements for a storage, treatment or disposal facility will have documented procedures and actions to be taken if a waste that does not conform to the waste acceptance criteria is received at the facility.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

2. DOE, 1993. *Methods for Verifying Compliance with Low-Level Radioactive Waste Acceptance Criteria*, DOE-LLW-185, U.S. Department of Energy, National Low-level Waste Management Program, Idaho Falls, ID, September 1993.

IV. H. **Waste Generation Planning.**

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all low-level waste streams.

Objective:

The objective of this requirement is to provide for the disposal of all low-level waste that is generated in the future by ensuring that prior to generating a new low-level waste stream, the specific waste management facilities necessary for safe management of the waste from the time it is generated up to and including its disposal are identified and sites are discouraged from generating low-level waste that does not have an identified path to disposal.

Discussion:

The *Complex-Wide Review of DOE Low-Level Waste ES&H Vulnerabilities* conducted in response to Defense Nuclear Facilities Safety Board Recommendation 94-2 identified storage of low-level waste with no identified path forward to disposal as a major complex-wide vulnerability. The safety and hazards analysis conducted as part of the preparation of DOE O 435.1 also identified significant weaknesses and risks associated with low-level wastes being generated without a path to disposal, particularly weaknesses associated with long-term storage of waste and potential loss of characterization data from generators and the subsequent need for recharacterization. Therefore, as part of the generator planning requirements in General Requirement I.2.F.(7), specific requirements are identified for planning for management of waste prior to its generation, and for approval to generate low-level waste streams with no path forward to disposal.

Life cycle planning for all low-level waste. The Site-Wide Waste Management Program required in Chapter I of DOE M 435.1-1, Section I.2.F.(1), calls for systematic planning of the management of all radioactive waste at DOE sites. Guidance on the Site-Wide Waste Management Program discusses information to be included in life-cycle planning documentation for all low-level waste streams at the site.

However, additional information is required of certain low-level wastes to ensure full life cycle planning is being done for all waste. The additional information needed for certain waste streams is influenced by the fact that, on the implementation date of the Order, the low-level waste will be in one of three stages of its life-cycle: (1) waste generated in the past (in storage), (2) waste being generated at present; and (3) wastes not yet generated (future wastes); and will either have an identified path to disposal, or will not.

Therefore, from a waste generation planning perspective, there are six different "states" of low-level waste, depending on when the waste was or is generated and whether it has or will have a path to disposal. The following paragraphs explain the recommended life cycle information for these different low-level wastes.

Low-Level Waste With a Path to Disposal

Generated currently - The life-cycle information for low-level waste that is currently generated with an identified path to disposal includes a description of the management steps for the waste as discussed in guidance for the Site-Wide Radioactive Waste Management Program.

Generated in the future (from a new process) - The life-cycle information for low-level waste with an identified path to disposal that is generated from a new process includes a description of the management steps for the waste as discussed in guidance for the Site-Wide Radioactive Waste Management Program.

Generated in the past (in storage) - In addition to the basic information on management steps, life cycle information for low-level waste with a path to disposal that is in storage (due to budget constraints, delays due to regulatory matters or management decisions, or for other reasons) includes a schedule for achieving disposal.

Low-Level Waste Without a Path to Disposal

Generated in the past (in storage) - The life-cycle information for low-level waste in storage as of the issuance of DOE O 435.1 for which there is not an identified path to disposal includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues.

Generated in the future (from a new process) - The life-cycle information for low-level waste without an identified path generated from a new process to disposal includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues. This information will be assembled in the course of getting the generation of this waste approved in accordance with the process required in DOE M 435.1-1, Section I.2.F.(19), and which is discussed in the next section of this guidance.

Generated currently - The life-cycle information for low-level waste without an identified path to disposal includes the basic information on the management steps for the

waste which can be identified, and a discussion of the issues that hinder disposal of the waste and the plans and schedule for achieving resolution of the issues. These waste streams are not expected to receive approval for generation in accordance with General Requirement I.2.F.(19). However, the life-cycle planning information needs to address the continued generation of this waste. The life-cycle planning information for continuing to generate a no path forward waste needs to include consideration of the necessity to generate the waste, an understanding of what prevents the disposal of the waste, the needed capacity and capabilities for continued storage of the waste, and the plans for future disposal of the waste. Discussions would also be included on any alternatives to the process that generates the no path forward waste that have been considered.

Providing the life cycle information discussed above for waste streams already being generated is relatively straightforward. Essentially for most low-level waste, the information already exists and has been utilized for other planning documents such as the Programmatic Environmental Impact Statement. [Low-Level Waste Baseline Disposition Maps contain much of the information necessary to satisfy the planning requirements discussed here. An example Disposition Map is included as Figure IV.H.1 at the back of this section of guidance.]

Example 1: A low-level waste generating facility operating at Site A continues to operate with no alterations. The facility generates the same low-level waste streams it has been generating for years, and none of them are waste streams without a path forward to disposal. The life-cycle information about low-level waste generated at this facility is included in the current waste inventories and capacities section of the Site A Radioactive Waste Management Plan, and no technical or programmatic issues are included in the Plan concerning these waste streams.

Example 2: The same Site A as Example 1 has three waste streams with a path to disposal that have been in Storage Building 200 for two years. These wastes are also included in the current waste inventories and capacities section of the documentation of the Site A Radioactive Waste Management Plan. Also, the issues (one waste contains PCBs but is not approved for shipment to the TSCA incinerator, the other two wastes require special shipping casks which have not been approved) that prevent their disposal are explained in the issues for path forward waste in storage section of the Site A Radioactive Waste Management Plan, along with discussions of steps toward their resolution (e.g., the special shipping cask approval is expected January 2000).

Example 3: The disposal facility planned to receive the three wastes discussed in Example 2 is suddenly closed. The three wastes are now without a path to disposal. The next time the Site A Plan is updated, they are still included in the current waste inventories and capacities section, and a determination to move the three wastes from Building 200 to Building 400 in 2003 is described. A new section of the Plan is written

for issues for no path forward waste in storage, which describes the issues of PCBs and special casks, but also includes the loss of disposal capacity. Also discussed is the use of the special cask, once it is approved, to act as a high integrity storage container. Plans are also described for determining alternate disposal locations, to be completed in July 2002.

To provide waste management steps for waste streams that have not been generated yet, it would likely be inappropriate to assume that the same management steps will be taken as some already generated waste. Instead, some investigations of appropriate management steps may be necessary to provide adequate life cycle planning information. The bulk of these generator planning requirements and the rest of this guidance address planning for new waste streams.

Waste generator planning prior to generation. Planning, prior to generating low-level waste (subrequirement H.(1)), is intended to address low-level waste streams that do not already exist. Low-level waste streams that are first generated after issuance of the Order are subject to this requirement. Waste generator planning is a component of the waste generator program required in I.2.F.(7) of the General Requirements Chapter of DOE M 435.1-1. Waste generator planning activities need to be integrated in the generator program with waste characterization, certification, and transfer activities.

Generator planning prior to generation addresses the life-cycle of the waste to disposal, including the interim steps of waste management. This can be accomplished by preparing a waste stream profile and reviewing it with the facility(ies) that will need to manage the waste. The waste stream profile format used needs to be consistent with the needs of the storage, treatment, and/or disposal facility that will be involved in managing the waste stream. An example of a waste stream profile form derived from the *Nevada Test Site Waste Acceptance Criteria* (NTSWAC) is included at the back of this guidance as Figure IV.H.2. The waste generator confirms with potential storage, treatment, and disposal facilities that the waste stream can be managed appropriately based on the facility's current waste stream characteristics and the planned facility capacity. So conceivably, a generator may need to contact multiple facilities (e.g., a storage and/or treatment facility in addition to the disposal facility) to ensure proper waste management.

Example 1: A previously operating high-level waste treatment facility that generates a low-level waste stream has been shut down for eighteen months and is scheduled to restart operations six months after DOE O 435.1 is issued. Low-level waste generation planning is performed. The planning determines that the previous disposal option for the low-level waste is not available, but an alternative disposal location is easily arranged. Therefore, the planning provides early warning of a potential problem which is resolved prior to the generation of the waste.

Example 2: Waste stream ARL-111 is a new mixed low-level waste stream to be generated from a process at Laboratory X. The waste stream is similar to another waste stream that has been generated for some time, and which receives treatment at the mixed waste incinerator facility Y, and the residues are disposed at the Low-Level Waste Disposal Facility. A Laboratory X waste profile is prepared and transmitted to both the Y incinerator and the disposal facility. After discussions, it is verified that the new waste stream can be managed at the two facilities.

The determination of whether a low-level waste stream has an identified path to disposal is based on the availability of existing or planned facilities and operations and on the technical capability of managing the waste at the facility. A planned facility is considered to be available if it has been authorized (e.g., a line item in a Congressional appropriation or equivalent approval for design and construction). A facility is not considered available if it is not authorized to accept or manage a particular waste type or concentration. If a planned facility is designated in the planning information, then the planning information also needs to address the schedule for when the facility will be operational, and the appropriate management steps that will be taken for waste designated for that facility until it becomes operational.

For purposes of planning for disposal of a low-level waste stream, a facility or capabilities that are part of a program or strategic plan, but have not been authorized are not considered available. If an available planned facility is canceled, the generator site needs to revise the planning for the life-cycle of the low-level waste, an alternate path to disposal needs to be identified and documented, and approval to generate the low-level waste needs to be obtained from the cognizant Field Element Manager as required in the General Requirements at I.2.F(19).

Example 1: Site X generates a low-level waste with concentrations of uranium that are too high to be suitable for on-site disposal. A new disposal cell for high-activity long-lived radionuclides will be developed at another site. The new facility has been authorized by Congress as a line item and will be operational by 2006. Since this is the only facility that may be able to dispose of this waste, Site X reflects the assumption to use the new facility by 2007, subject to operation and certification, since they have no other path forward for disposal.

Example 2: As in the above example, Site X generates a high-activity long-lived waste stream that cannot be disposed on site. An existing disposal operation at another site is technically capable of disposing this waste. The facility, however, has not completed the necessary analyses under NEPA to be able to accept waste from off site. Until the necessary NEPA analyses have been completed, the disposal facility is not available to Site X.

Whether a path to disposal can be identified is also based on the acceptability of the waste at the facilities at which it must be managed. For existing facilities, this involves no more than an evaluation of the waste stream properties against the waste acceptance requirements of the facility and determining there are no impediments for its management. For planned facilities, this determination is more involved. For some waste streams, the acceptability at a planned facility could be determined based on similar circumstances already known to exist in the Complex. This may be a common situation for wastes that do not have a full path to disposal because of issues that are not entirely technical (e.g., commercially generated [NRC licensed] Greater-than-Class-C low-level waste). For other waste streams, particularly those with a technical impediment to disposal, the acceptability may need to be evaluated and a judgement made that a planned facility will be able to accept the waste provided some necessary treatment is performed (e.g., low-level waste approved to go to a disposal facility but which is waiting for a final PEIS decision), or some administrative step is successfully accomplished (e.g., a RCRA permit is obtained so that mixed waste can be accepted).

The generator is responsible for ensuring that low-level waste is not generated unless there is due consideration for the ultimate disposal of the waste. The objective of this requirement is not to prohibit, under all conditions, the generation of low-level waste that does not have an identified, achievable path to disposal. In meeting the DOE O 435.1 planning requirements, it is appropriate for waste management organizations to provide assistance to the generator in determining the waste management path, particularly in cases where the waste management organization may utilize offsite treatment, storage, or disposal facilities.

Compliance with this planning requirement is demonstrated by the individual sites establishing a process for evaluating the life-cycle of low-level waste prior to its generation, including the identification of low-level wastes with no path to disposal and appropriate records justifying the newly generated low-level waste stream(s), and site personnel possessing planning information showing the location(s) where low-level waste will be stored, treated, and/or disposed along with a confirmation that the personnel managing the facilities agree that the low-level waste may be managed at those facilities.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

IV. H.(2) Waste With No Identified Path to Disposal. Low-level waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Objective:

The objective of this requirement is to ensure that prior to generation of a new low-level waste stream with no path to disposal, the need to generate the waste is carefully considered, and plans for safe long-term storage and for resolving issues that prevent disposal of the wastes are developed.

Discussion: There are instances where programmatic needs may necessitate the generation of low-level waste without an identified path to disposal. In these instances, the Field Element Manager must ensure development of a process for identifying generation of low-level waste with no path to disposal and approving the conditions under which such low-level waste can be generated (see Section I.2.F.(19)). The process of identifying waste with no path to disposal and establishing conditions for its generation is intended to raise to the attention of DOE management that a commitment is being made with the generation of such a waste, including prolonged storage of this waste and resolving those issues that prevent the waste from being disposed.

> *Example: Through generation planning it is discovered that a proposed project to remediate an old glove box facility would generate some low-level waste streams that would most likely not have a path to disposal using existing facilities. The Field Element Manager determines that generating low-level waste streams with no path to disposal is not worth the benefit of proceeding as planned with the project. Cleanup strategies and schedules are changed that allow the project to commence and avoids generating the no path forward waste while determinations are made on disposal options.*

The minimum conditions for generating a waste without an identified path to disposal are identified in this requirement. They include evaluations and considerations that involve both the waste generating and waste management organizations. The decision to proceed with the activity generating the waste is made considering the total situation based on these minimum considerations.

<u>Programmatic need to generate the waste</u>. There must be a clear identification of the programmatic mission being served that results in the generation of low-level waste with no

identified path to disposal. Alternate means of accomplishing the mission without generating the waste should be discussed. These could include use of alternative materials to achieve the mission, use of different processes, or substitution of chemicals other than the ones originally to be used.

<u>Characteristics and issues preventing the disposal of the waste</u>. The reasons that the low-level waste cannot be disposed of must be identified. These may be technical or programmatic reasons. For example, if a waste needs to be treated in order to meet a disposal facility waste acceptance criteria and an appropriate treatment facility is not available, the lack of treatment would be identified as the reason the waste does not have a path to disposal. Identifying the characteristics and issues preventing disposal is necessary to support the development of plans for achieving disposal.

<u>Safe storage of the waste until disposal can be achieved</u>. Since the waste cannot be disposed of pending the resolution of programmatic or technical issues, facilities must be available for safe storage. In order to evaluate the ability to provide for the storage of the waste, there needs to be an estimate of the amount of the waste that will be generated, as well as an estimate of the time necessary to keep the waste in storage. Identification of the requirements for safe storage and acceptable storage facilities is a prerequisite to generating the waste so that unique or risky aspects of storage that may make long-term storage problematic can be identified.

<u>Activities and plans for achieving final disposal of the waste</u>. The decision to generate waste with no identified path to disposal must be based on a plan to eventually achieve disposal. The plan to achieve disposal of the waste needs to identify the activities being pursued to resolve issues preventing disposal and a schedule for their resolution. The activities described may be fairly detailed if the problems are technical and involve only one waste stream at a site. In other cases involving more programmatic issues, or which involve several waste streams at several sites, the activities and schedules to resolve issues may be less certain because they are dependent on other internal or external organizations (for example, approval of another Field Element Manager to ship waste).

Consideration might be given to delaying the generation of a waste stream for which there is no reasonable alternative to generating the no path forward waste if there are difficult problems that must be overcome to achieve safe storage or final disposal.

For many of the wastes that are currently without an identified path to disposal, programmatic and/or complex-wide problems and issues contribute to the lack of final disposal. Thus, all or part of the solution to an individual problem low-level waste stream may be programmatic or complex-wide steps taken as part of the Site-Wide Radioactive and/or Complex-Wide Low-Level Waste Management Programs that will address the vulnerabilities associated with no path forward waste

and lead to resolution of issues and disposal of the waste. This process is also discussed in several places in the General Requirements guidance.

Satisfaction of this planning requirement can be demonstrated by the waste generation organization having documentation concerning the decision to generate a low-level waste stream that does not have an identified path to disposal. This documentation needs to include the cognizant Field Element Manager or designee approval to generate the waste, an explanation of the need for the process that generates the low-level waste, a discussion of the reason it cannot be disposed of, the proposed management plan for the waste, and an up-to-date schedule of activities being pursued to resolve constraints to the disposal of the subject waste.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

Figure IV.H.1. Example Low-Level Waste Disposition Map

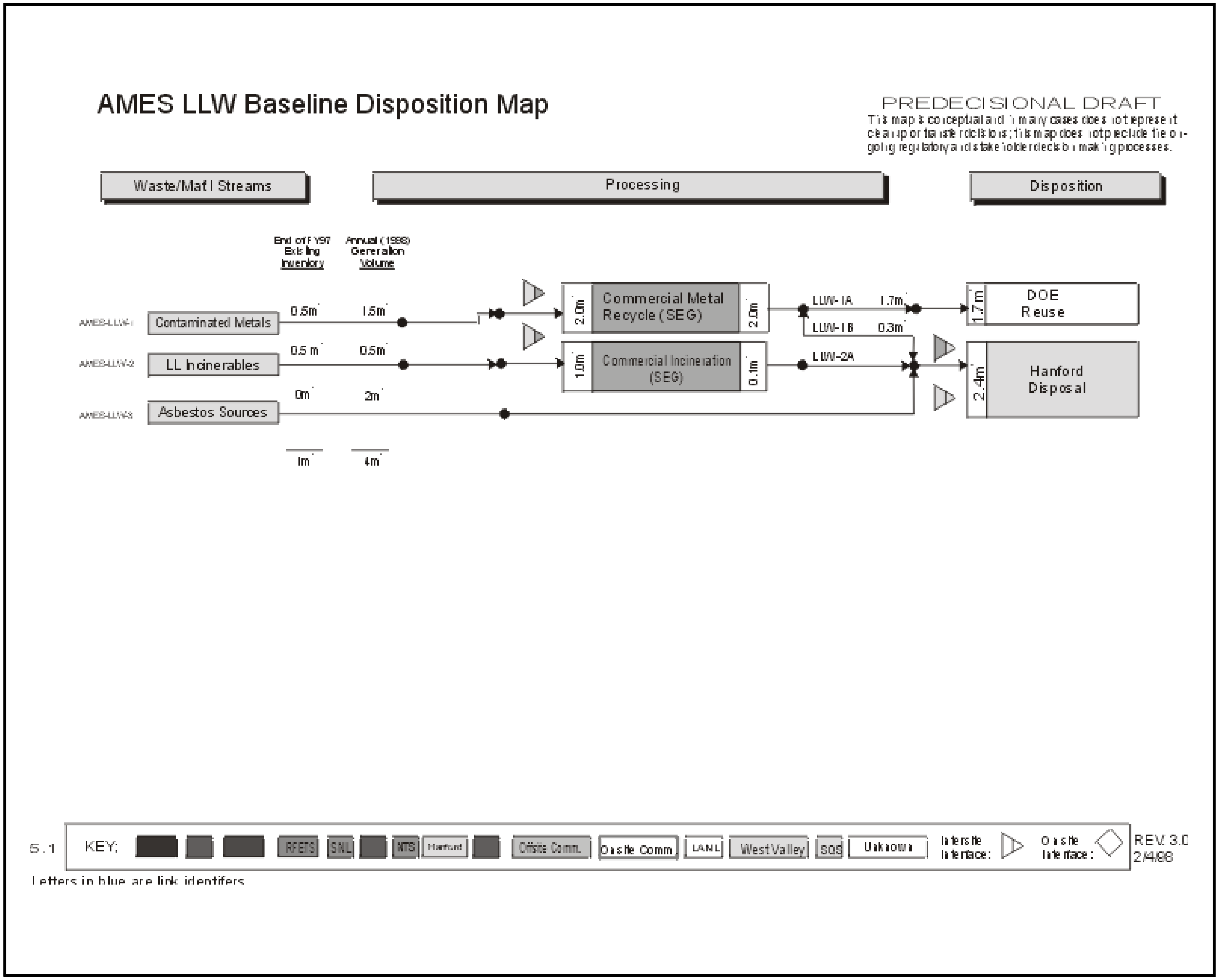

Figure IV.H.2. EXAMPLE WASTE PROFILE FORM (FOR GENERATION PLANNING)

A. Generator Information

1. Waste Certification Official ______________ Phone ______________ FAX __________

2. Technical __________________________ Phone ______________ FAX __________

3. DOE Contact _______________________ Phone ______________ FAX __________

4. Facility Name ____

Address ____

City ______________________________ State ______________ ZIP __________

5. EPA Identification Number __________

B. General Waste Stream Information

1. Waste Stream Identification Number ____

Profile Revisions Number ______________________ Profile Revision Date ______________

2. Waste Description ____

3. Waste Category ☐ Low-Level ☐ Mixed Low-Level

4. Generating Process Description ____

____

____

Process Description continuation Page Attached ☐ Yes ☐ No
Flow Diagram Attached ☐ Yes ☐ No

5. Estimated Rate of Generation ☐ One Time Only ________ m^3
☐ Ongoing ________ m^3/yr

C. Physical Properties

1. Waste Form Description
☐ Solid ☐ Solidified ☐ Encapsulated ☐ Sludge ☐ Powder/Dust
☐ Sealed Sources ☐ Absorbed Liquid ☐ Other ______________________________

2. List waste stream components Estimated Percent by ☐ Volume ☐ Weight

		Estimated Density (kg/m^3)
____________	______ to ______	____________
____________	______ to ______	____________
____________	______ to ______	____________
____________	______ to ______	____________
____________	______ to ______	____________
____________	______ to ______	____________

Component Continuation Page Attached ☐ Yes ☐ No

3. Does the waste contain the following?

☐ Yes ☐ No Free Liquids

☐ Yes ☐ No Particulates

☐ Yes ☐ No Gases

☐ Yes ☐ No Etiologic Agents

☐ Yes ☐ No Chelating Agents

☐ Yes ☐ No Polychlorinated Biphenyls

☐ Yes ☐ No Explosives

☐ Yes ☐ No Pyrophorics

☐ Yes ☐ No Regulated Asbestos-Containing Material

☐ Yes ☐ No Radioactive Animal Carcasses

☐ Yes ☐ No DOE Equivalent Greater-Than-Class C Packages

☐ Yes ☐ No Other

D. RCRA Characterization

1. RCRA Characterization by ☐ Process Knowledge ☐ Sampling and Analysis ☐ Both

2. Does the waste exhibit any characteristic of hazardous waste as defined in 40 CFR Part 261?

☐ Yes ☐ No Ignitability

☐ Yes ☐ No Corrosivity

☐ Yes ☐ No Reactivity

☐ Yes ☐ No Toxicity

3. ☐ Yes ☐ No Is the waste listed as defined in 40 CFR Part 261?

4. ☐ Yes ☐ No Is the waste hazardous per state-of-generation regulations?

____
State of generation

5. ☐ Yes ☐ No Has the waste been treated?

6. If sampling and analysis was used for RCRA characterization, complete applicable portions of summary table below. If analytical results are available for additional hazardous constituents, attach an equivalent summary table.

	Known or Expected? Yes	Analysis No	Sample (mg/L) (Statistical Mean)	Confidence Interval	Detection Limit (mg/L)	Exceeds Regulatory Level? Yes	No
TCLP Metals:							
Arsenic	☐	☐	________	______ to ______	________	☐	☐
Barium	☐	☐	________	______ to ______	________	☐	☐
Cadmium	☐	☐	________	______ to ______	________	☐	☐
Chromium	☐	☐	________	______ to ______	________	☐	☐
Lead	☐	☐	________	______ to ______	________	☐	☐
Mercury	☐	☐	________	______ to ______	________	☐	☐
Selenium	☐	☐	________	______ to ______	________	☐	☐
Silver	☐	☐	________	______ to ______	________	☐	☐

	Sample Known or Expected? Yes	Analysis No	(mg/L) (Statistical Mean)	Confidence Interval	Detection Limit (mg/L)	Exceeds Regulatory Level? Yes	No
TCLP Volatiles: Benzene	☐	☐	________	_______ to _______	_________	☐	☐
Carbon Tetrachloride	☐	☐	________	_______ to _______	_________	☐	☐
Chlorobenzene	☐	☐	________	_______ to _______	_________	☐	☐
Chloroform	☐	☐	________	_______ to _______	_________	☐	☐
1,4-Dichloro-benzene	☐	☐	________	_______ to _______	_________	☐	☐
1,2-Dichloro-ethane	☐	☐	________	_______ to _______	_________	☐	☐
1,1-Dichloro-ethylene	☐	☐	________	_______ to _______	_________	☐	☐
Methyl ethyl ketone	☐	☐	________	_______ to _______	_________	☐	☐
Pyridine	☐	☐	________	_______ to _______	_________	☐	☐
Tetrachloroethylene	☐	☐	________	_______ to _______	_________	☐	☐
Trichloroethylene	☐	☐	________	_______ to _______	_________	☐	☐
Vinyl chloride	☐	☐	________	_______ to _______	_________	☐	☐
TCLP Semivolatiles:							
0-Cresol	☐	☐	________	_______ to _______	_________	☐	☐
M-Cresol	☐	☐	________	_______ to _______	_________	☐	☐
p-Cresol	☐	☐	________	_______ to _______	_________	☐	☐
Cresol	☐	☐	________	_______ to _______	_________	☐	☐
2,4-Dinitrotoluene	☐	☐	________	_______ to _______	_________	☐	☐
Hexachlorobenzene	☐	☐	________	_______ to _______	_________	☐	☐
Hexachlorobutadiene	☐	☐	________	_______ to _______	_________	☐	☐

	Sample Known or Expected? Yes	No	Analysis (mg/L) (Statistical Mean)	Confidence Interval	Detection Limit (mg/L)	Exceeds Regulatory Level? Yes	No
Hexachloroethane	☐	☐	________	_______ to _______	_________	☐	☐
Nitrobenzene	☐	☐	________	_______ to _______	_________	☐	☐
Pentachlorophenol	☐	☐	________	_______ to _______	_________	☐	☐
2,4,5-Trichloro-phenol	☐	☐	________	_______ to _______	_________	☐	☐
2,4,6-Trichloro-phenol	☐	☐	________	_______ to _______	_________	☐	☐
TCLP Pesticides and Herbicides:							
Chlordante	☐	☐	________	_______ to _______	_________	☐	☐
2,4-D	☐	☐	________	_______ to _______	_________	☐	☐
Endrin	☐	☐	________	_______ to _______	_________	☐	☐
Heptachlor (And its hydroxide)	☐	☐	________	_______ to _______	_________	☐	☐
Lindane	☐	☐	________	_______ to _______	_________	☐	☐
Methoxychlor	☐	☐	________	_______ to _______	_________	☐	☐
Toxaphene	☐	☐	________	_______ to _______	_________	☐	☐
2,4,5-TP(Silver)	☐	☐	________	_______ to _______	_________	☐	☐

E. Radiological Properties

1. Radiological Characterization by (Check all that apply)
   ☐ Process Knowledge ☐ Sampling & Analysis ☐ Materials Control & Accountability
   ☐ Direct Measurement ☐ Gross Radiation Measurement ☐ Other _______________

2. Were the following used in radiological characterization ? ☐ Scaling Factors ☐ Ratios

3. List reportable radionuclides.

Radionuclide	Activity Range (BQ/m^3)			Activity Representative of Final Waste Form (Bq/m^3)
		to		
		to		
		to		
		to		
		to		
		to		
		to		
		to		
		to		
		to		
		to		

4. ☐ Yes ☐ No Does the waste contain transuranic waste creating nuclides?

Transuranic Nuclides	Activity Range (nCi/g)			Activity Representative of Final Waste Form (nCi/g)
		to		
		to		
		to		
		to		
		to		

5. ☐ Yes ☐ No Is enriched uranium present? If yes, provide enrichment of U-253 by weight percent _________. Provide Maximum mass U-235 per package __________ g/package. Reference controlling documents.

____
____
____
____

6. ☐ Yes ☐ No are other fissionable nuclides present? If yes, list below.

Nuclide	Maximum Activity Concentration (Bg/m^3)
________	____________________
________	____________________
________	____________________

F. Packaging Description

1. Container type(s) ____

   DOT Specification(s) ____

   ☐ Yes ☐ No ☐ N/A Does container meet 3,375 lb/ft^2 strength test?

2. Standard container external dimensions ____
   Packaged bulk external dimensions ____

3. Weight Range ______ kg to ______

4. ☐ Yes ☐ No Waste stream includes unclassified material.

5. ☐ Yes ☐ No Waste stream includes classified material.

6. ☐ Yes ☐ No Estimated radiation dose rate at disposal package surface.
   _____ to _____ mSv/h, at 1 mwrwe _____ to _____ mSv/h.

G. Generator Signature

To the best of my knowledge, the information in this document and attachments is true and accurate.

______________________________	______________________________	____________
Preparer's Printed Name	Signature	Date
______________________________	______________________________	____________
Waste Certification Official's Printed Name	Signature	Date
______________________________	______________________________	____________
U.S. Department of Energy	Signature	Date

IV. I. Waste Characterization.

Low-level waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

Objective:

The objective of this requirement is to ensure that sufficient knowledge of low-level waste's characteristics (e.g., chemical, physical, radiological) is available to protect workers handling the waste and to support effective decision-making for its management. This information is to be maintained from generation, through storage and treatment in sufficient detail to ensure that the requirements of subsequent treatment and storage facilities, transportation regulations, and the disposal requirements for low-level waste will be met.

Discussion:

The *Radioactive Waste Management Manual* assigns the Field Element Manager the responsibility of ensuring development, approval, and implementation of a program that addresses the responsibilities of waste generators, including waste characterization (DOE M 435.1-1, Section I.2.F.(7)). The characterization data acquired during generation, storage, and after treatment of low-level waste need to be reliable and in sufficient detail to ensure subsequent management can be conducted safely and to meet the waste acceptance requirements of all subsequent receiving facilities. Accurate characterization of low-level waste is essential to: 1) waste planning by generators, as required by DOE M 435.1-1, Section IV.H; 2) waste certification by generators and other senders of waste, as required by DOE M 435.1-1, Section IV.J; 3) waste transfers by generators and other senders of waste, as required by DOE M 435.1 Section IV.K; and; 4) waste evaluation and acceptance by receivers of waste, as required by DOE M 435.1-1, Section IV.G.

In conducting the analyses for development of the DOE M 435.1-1, characterization was identified as necessary to ensuring the safe management of waste from generation through disposal. Waste characterization is defined (DOE M 435.1-1, Attachment 2) as:

> "The identification of waste composition and properties, such as by review of acceptable knowledge (which includes process knowledge), or by nondestructive examination, nondestructive assay, or sampling and analysis, to comply with applicable storage, treatment, handling, transportation, and disposal requirements."

Accurate waste characterization is necessary so that the waste and waste containers are compatible and worker handling of waste containers can be performed safely. All information necessary for personnel to safely handle a container of low-level waste needs to be known at all times during the life-cycle of the waste.

Waste characterization is a tool for gathering information that supports defensible decisions regarding safety, process, environmental and compliance matters in the management of low-level waste. The significance of the waste management decision will guide the graded application of this requirement, as well as the more detailed characterization requirements addressed in subsequent sections of this guidance. These subsequent sections address application of a data quality objectives process to guide characterization (Section IV.I.(1)) and minimum characterization requirements (Section IV.I.(2)).

Use of Direct and Indirect Methods. Waste managers are to characterize low-level waste using an appropriate combination of direct and indirect methods. The appropriate method for characterizing waste depends on the parameter being measured, the hazards associated with acquiring the information, and the amount and quality of the data needed as determined through a data quality objectives or similar process.

Direct methods of characterizing waste can be used to established certain physical and chemical attributes as well as radiological characteristics. The most common direct methods for characterizing the chemical and/or radiological characteristics are sampling and laboratory analyses and certain nondestructive evaluation techniques (e.g., real-time radiography). Direct characterization methods are conducted in accordance with the quality assurance program and plan governing the site and laboratory facilities.

Indirect methods of characterization use non-destructive examination techniques and acceptable knowledge to replace, supplement, and/or initially provide data that might otherwise be collected by direct, intrusive characterization of the waste. In the safety and hazard analysis performed in support of development of DOE M 435.1-1, the use of indirect methods was identified as an appropriate means of characterizing waste and at the same time complying with the as low as reasonably achievable (ALARA) principle for keeping radiation exposures to a minimum. An additional benefit of characterizing low-level waste by the use of indirect methods is the avoidance of the generation of waste associated with sample materials, and laboratory equipment and expendables.

In order for indirect methods of low-level waste characterization to serve their purpose of providing information necessary for the safe management of waste, the data need to be sufficiently accurate. The level of accuracy is determined through application of data quality objectives, or comparable process. Consistent with the data quality objectives, correlations demonstrating that data provided by indirect methods are representative of the actual waste may need to be

supported through the application of direct methods. The methodology could employ a number of techniques, some of which involve some direct sampling and analysis of the waste stream. The following guidance paragraphs discuss different indirect methods.

Similar to the EPA and NRC guidance on characterizing mixed waste, DOE endorses the use of indirect methods such as the use of acceptable or waste knowledge for characterizing physical, chemical, RCRA-regulated and radioactive components of waste. The term acceptable knowledge (or waste knowledge) includes process knowledge; records of analyses performed prior to the effective date of a requirement; or a combination of process knowledge and previous records, supplemented with chemical analyses (NRC/EPA, 1997). Process knowledge refers to detailed information on processes that generate waste subject to this requirement or information on processes similar to that which generated the waste being characterized.

Acceptable knowledge characterization of low-level waste is based on an understanding of the materials and processes used to generate the waste, or analytical data obtained from the process or waste stream or both. Acceptable knowledge also includes information regarding the source of the waste stream, the physical form and materials comprising the waste, the chemical constituents of the waste, and the nature of the radioactivity present. Acceptable knowledge may be used to describe low-level waste if the source information is consistent, defensible, and auditable. In practice, acceptable knowledge can be effectively used where low-level waste is generated in well known and tightly controlled processes for which the product is highly predictable.

While the development of a process for identifying and documenting low-level waste acceptable knowledge is not dictated by this requirement, the following guidance provides an overview of elements of an acceptable process for assembling acceptable knowledge documentation:

- Acceptable knowledge is compiled in an auditable record.

- Correlations within waste streams in terms of time of generation, waste generating processes, analytical data, and site-specific facilities are clearly described.

- A reference list of applicable documents, databases, quality control protocols, and other sources of information that support the acceptable knowledge information is prepared.

- Procedures which outline the methodology that is to be used to identify and assemble auditable acceptable knowledge records, including the origin of the documentation, how the assembled information was or will be used, and any limitations associated with the information.

Characterization data gained through acceptable knowledge must be within the acceptable range of certainty and precision identified by the data quality objectives or similar process. Additionally, the effects of time-dependent processes must either be negligible or predictable. If acceptable knowledge is supported by the collection, analysis, and comparison of statistically valid samples with the acceptable knowledge records, periodicity of sampling and analysis should correlate with the nature of any changes in the process creating the waste or with changes that are being documented in characterization data.

Non-destructive examination and assay techniques use methods such as passive-active neutron assay, high resolution gamma ray spectroscopy, and thermal neutron capture to non-destructively collect data relating to the radionuclide constituents in the waste. Acceptable performance of assay techniques is determined through measurement of known standards and comparison to established quality assurance objectives of the applicable characterization program. A process, similar to the one discussed above regarding acceptable knowledge needs to be established and documented in site procedures that outline the exact nature of the acceptable use of non-destructive examination techniques for providing characterization information on waste.

Another indirect method of providing radionuclide characterization data is through the use of a known relationship, or scaling factors, between a measured radionuclide or a dose rate and the radionuclide(s) of interest. As discussed above for acceptable knowledge and non-destructive examination techniques, use of scaling factors must be correlated with actual data.

The use of scaling factors is generally established by an initial characterization that provides a statistical basis for use of the scaling factors. As with any indirect method, the characterization program needs to include confirmatory measurements. The frequency of the confirmatory measurements is based on the consistency of the process generating the waste. Additionally, the history of previous confirmatory measurements may also influence the frequency of future confirmatory measurements with results that are very consistent providing justification for less frequent confirmatory measurements.

> *Example: A low-level waste stream from an actinide processing building is sampled and analyzed and determined to be composed of three primary nuclides: Pu-239, Am-241, and Pu-238. The samples are found to contain the three radionuclides in essentially the same ratio. The process is known to be uniform and is therefore expected to generate similar concentrations in the waste stream as the facility is operated. Therefore, the contents of future waste containers are routinely characterized based on a gamma energy analysis which detects gamma radiation from the Am-241 and Pu-238. The characterization program requires the collection and full analysis of samples once a month to confirm that the ratio of the three radionuclides falls within an acceptable range (based on application of the data quality objectives process).*

Characterization Documentation. The requirement states that characterization data shall be documented in sufficient detail to enable the waste acceptance requirements of the receiving facility to be met. The following elements are essential to this process for acquiring and controlling characterization data:

Organization(s) and Responsibilities - Identification of the organizations involved and responsible for characterization of low-level waste.

Quality Assurance - Characterization data need to be subjected to a quality assurance program and the program that applies need to be identified and documented.

Procedures - The process for obtaining waste characterization data is formalized in procedures which describe to the user the steps that are to be followed and the administrative process for ensuring the data are of the quality needed. Topics that need to be proceduralized include the processes for sampling, packaging, transportation, laboratory analysis, and data control.

Procurement/Purchasing Controls - The procurement and/or purchasing of items or services that are significant to characterizing low-level waste are controlled and documented. Such procurement includes the purchase of sampling equipment and sample transport containers, as well as services such as laboratory analyses (onsite or offsite). As dictated by the type of procurement, the documentation needs to include (or reference) the technical specifications for the item/service being procured, identification of quality assurance requirements including any required inspections, specifications of documentation requirements (e.g., certification of compliance or conformance, laboratory analytical results), and a statement ensuring access to the provider’s facilities as necessary to perform audits and inspections. The characterization data need to be traceable through the provider’s process of generating it and verifying its accuracy.

Document/Data Change Control - Records that contain characterization data, whether it has been generated through sampling and analysis, nondestructive assay, or acceptable knowledge, need to be controlled. In addition, the waste characterization procedures and quality assurance program documentation are subject to document control. Document and data control need to include review, approval, and distribution to designated recipients (users), and a controlled process for making revisions to documents or data. Existing document and data control programs at a site may be adequate to provide the necessary controls for documents related to low-level waste characterization data, but will need to be reviewed to ensure the objectives of DOE M 435.1-1 requirements are met.

Training - Characterization data are generated and managed only by personnel that are properly trained to recognize the significance of the data. Generally, training of laboratory

personnel will be adequate to support low-level waste characterization, but needs to be reviewed versus the goals of the characterization. Other staff managing and using characterization data need to understand what is to be done with the data (i.e., what decisions are to be made) once data are collected.

Records - Waste characterization records include those that are necessary to meet the waste acceptance requirements of receiving facilities, and as specified by the waste certification program DOE M 435.1-1, Section IV.J.

As noted above, existing programs at a site may provide the framework within which the elements of waste characterization can be addressed (e.g., quality assurance, training, document control).

The waste acceptance requirements of a facility to which the waste is sent also may impose additional requirements on what is to be included in the waste characterization data. The waste acceptance requirements for the receiving facility include specific quality assurance, administrative, or documentation requirements so that waste characterization data are acceptable to the facility.

Example: Requirements have been established for the characterization of low-level waste for the disposal facility at the Nevada Test Site. These characterization requirements are documented in Chapter 4.0 of the Nevada Test Site Waste Acceptance Criteria (NTSWAC), Revision 1. One of the requirements described there is the preparation and submittal of waste profile forms containing characterization information.

Compliance with this requirement is demonstrated by a program for documenting and the existence of records that document the process for acquiring and verifying the validity of low-level waste characterization data acquired through the use of direct or indirect methods.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, DOE/WIPP-069, Revision 5, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

2. EPA, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

3. NRC/EPA, 1997. “Joint NRC/EPA Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste,” *Federal Register*, Vol. 62, No. 224, U.S.

Environmental Protection Agency and U.S. Nuclear Regulatory Commission, November 20, 1997.

IV. I.(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Objective:

The objective of this requirement is to invoke a process for determining the type, quantity, and quality of characterization data needed to support the safe management of low-level waste so as to ensure that needed data are acquired, the data meet the objectives they are being collected for, and resources are not wasted on unnecessary, incomplete, or unusable data collection efforts.

Discussion:

The type, quantity, and quality of characterization data obtained for the safe management of low-level waste need to be consistent with the purpose for which the characterization information will be used. The uses of low-level waste characterization data include: complying with storage, treatment, and disposal facilities' waste acceptance requirements; determining radiation shielding and other protective measures; evaluating compliance with processing requirements; and meeting legislative or regulatory commitments. This requirement is included in DOE M 435.1 to ensure that the appropriate characterization data to support the safe management of low-level waste are generated. The requirement is intended to promote a structured process for the collection and use of low-level waste characterization data and to avoid the collection of data that is neither necessary nor defensible.

Input from various waste management organizations and interested groups is necessary to establish a clear understanding of the characterization data needs and the level of data quality that is acceptable for making low-level waste management decisions. The current requirement invokes the use of a structured process for determining the type, quantity, and quality of characterization data needed. Such a process, called a data quality objectives process, has been developed by the Environmental Protection Agency and is documented in *Guidance for the Data Quality Objectives Process* (Reference 1). Application of the EPA process and use of the EPA guidance is an acceptable way of meeting this requirement. However, use of other comparable processes that employ a structured approach to yield similar results is also acceptable.

The objectives of applying a structured process such as the data quality objectives process are to:

- manage and control the risks of making incorrect decisions;

- determine the data required to support making specific decisions;
- determine the type and quality of required data;
- allow stakeholders, decision makers, data users, and relevant technical experts to participate in planning and assessment;
- determine the quantity, location, and type of samples required;
- quantify the uncertainty in data through development of statistical sampling plans; and
- reduce overall costs by identifying resource-efficient sample collection and analytical methods by optimizing the sample and analysis plans.

The data quality objective process is a strategic planning approach based on the scientific method that is used to prepare for a data collection activity. The value of using this process to develop low-level waste characterization parameters is that it: reduces radiation exposure and saves resources by making characterization data collection operations more resource-effective; enables characterization data users and others to participate in characterization data planning; and provides a structured method for defining characterization data performance requirements, i.e., quality.

To foster the development and implementation of an effective data quality objectives or similar process, individuals are assigned responsibility for specific activities for each application of the process. Key activities of the process include:

- preparing the data quality objectives documentation;
- identifying stakeholders;
- identifying technical experts;
- ensuring opportunities for input and coordinating stakeholder and technical experts into the data quality objective process;
- reviewing and commenting on the developed data quality objectives; and
- approving the data quality objectives documents.

A more detailed description of the assignment of specific responsibilities for implementing a data quality objectives or similar process is presented in the Hanford "Data Quality Objectives Procedure" (Reference 2).

The data quality objectives process consists of seven steps. The output from each step influences the choices that will be made later in the process. Even though the data quality objectives process is depicted as a linear sequence of steps, in practice it is iterative; the outputs from one step may lead to a reconsideration of prior steps. This iteration is encouraged since it will ultimately lead to a more efficient data collection design. During the first six steps of the process, a team of process-cognizant personnel should develop decision performance criteria (i.e., data quality objectives) that will be used to develop the data collection design.

The final step of the process involves developing the data collection design based on the data quality objectives developed in the first six steps. The first six steps need to be completed before the team attempts to develop the data collection design because the design is dependent on a clear understanding of the first six steps taken as a whole.

Following is a listing and brief description of each of the seven steps. This is followed by an example of how the data quality objectives process can be applied to low-level waste characterization.

1. State the Problem – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

2. Identify the Decision – Identify what questions the study will attempt to resolve, and what actions may result.

3. Identify the Inputs to the Decision – Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

4. Define the Study Boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.

5. Develop a Decision Rule – Define the statistical parameter of interest, specify the action level, and integrate the previous data quality objective outputs into a single statement that describes the logical basis for choosing among alternative actions.

6. Specify Tolerable Limits on Decision Errors – Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

7. Optimize the Design – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all data quality objectives.

Example: The Blue Disposal Facility at Site X needed to establish the requirements for acceptable waste potentially containing free liquids for disposal. Due to their performance assessment and public concerns, the operating manual for the facility will specify that no free liquids shall be disposed, so the acceptance documentation must specify what specifically must be done to waste before it is shipped to ensure there will be no free liquids upon arrival. They used a data quality objectives-like process to answer some of the questions or issues related to the waste acceptance criterion. The Site X personnel worked with technical experts from several waste generators to address the issues. The question was formulated as, what does a generator have to do with waste that contains liquids that could potentially become free due to vibration and thermal cycling during transport? The answer to this question could make a significant difference in the cost of making waste streams consisting of soils from cleanups acceptable for disposal depending on how much testing and/or treatment was required by the Blue Facility's waste acceptance criteria. The data quality objective that was developed was:

> *The moisture content of low-level waste with high moisture contents (greater than 35%) must be specified on waste profile data sheets, and shall be packaged with approved absorbents (see approved absorbents list at Appendix A). The amount of absorbent added to a waste package shall be equivalent to 2 times the amount necessary to absorb the amount of free liquid which would result if 80% of the contained liquid, based on the moisture content, were to become free. [Approved absorbent must be added in accordance with Recommended Procedure BL-23.]*

The above description of the use of the data quality objectives process, and the example, are provided as an introduction to the process. A more detailed description of the process can be found in the referenced EPA guide. The data quality objectives process is most useful during the planning stages of identifying low-level waste characterization and uncertainty parameters, i.e., before the data are needed and collected. The value of the process is diminished significantly if the characterization data have already been collected because there is a tendency to make the questions that need to be answered fit the available data. The data quality objectives process is applied in a graded manner, i.e., the depth of detail and the magnitude of the resources expended in implementing the process should be commensurate with the relative importance of the characterization data in terms of the decisions to be made and protection of the public, workers and the environment.

The intent of this requirement is not that waste streams with characterization processes already in place and accepted by storage, treatment, and disposal facilities be recharacterized using the Data

Quality Objectives Process, or a comparable process, or that the characterization processes be revised using the Data Quality Objectives Process, or a comparable process. The intent is that, as new waste streams are identified and generated, the Data Quality Objectives Process, or a comparable process, be used for identifying characterization parameters and acceptable uncertainty in characterization data. If the characterization parameters of an existing waste stream characterization data. If the characterization parameters of an existing waste stream characterization process are to be significantly modified, then the Data Quality Objective Process, or a comparable process, should be used.

Compliance with this requirement is demonstrated by the documented use of a data quality objectives or a comparable process for determining the type, quantity, and quality of characterization data needed to safely manage low-level waste.

Supplemental References:

1. EPA, 1994. *Guidance for the Data Quality Objectives Process,* EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

2. WHC, 1996. *Data Quality Objectives Procedure*, Revision 1, WHC-IP-1216, Westinghouse Hanford Company, January 31, 1996, (included as Appendix A in draft Manual HNF-SD-WM-PROC-021, Revision 0, Lockheed Martin Hanford Corporation, January 2, 1997).

IV. I.(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any stabilization or absorbent media;

(c) Weight of the container and contents;

(d) Identities, activities, and concentrations of major radionuclides;

(e) Characterization date;

(f) Generating source; and

(g) Any other information which may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with applicable performance objectives.

Objective:

The objective of this requirement is to establish minimum low-level waste data that have been determined to be necessary for safe and effective management during the life cycle of the waste.

Discussion:

In the process of developing DOE O 435.1 and DOE M 435.1-1, the safety and hazard analysis indicated that certain characterization data were critical because several consequences could be avoided or minimized if certain basic information was accurately known about low-level waste. This requirement identifies those critical characterization data points that must be known for safe handling and proper management. The sections below provide guidance on each of these specific characteristics.

Physical and Chemical Characteristics. Physical characteristics support handling and packaging activities. Parameters should include a description of the material, its density, consistency, and appearance. Chemical characteristics impact handling, storage, containment, and can impact treatment processes. These characteristics determine the compatibility of the waste with other waste and the waste container, as well as its compatibility with proposed treatment processes. Parameters should include pH, reactivity, chemical compounds present, and the presence of hazardous and/or toxic constituents. Physical and chemical characteristics can be determined directly by visual examination and/or sampling and analysis. Physical characteristics can be determined directly, indirectly by use of acceptable knowledge and/or by non-destructive examination techniques such as computed tomography or real-time radiography. Chemical characteristics can also be determined by use of acceptable knowledge.

Volume and Weight. Volume and weight information is necessary for proper control of storage and disposal facility capacities as well as proper payload control for transportation and handling systems. Typical parameters include:

- container volume, measured as the external volume of the waste container which represents the volume that will be occupied in a storage or disposal facility (e.g., 55 gallon drum or 120 cu ft (for a 4 x 5 x 6 box));

- actual waste volume, including stabilization media;

- container weight; i.e., the total weight of the container and all of its contents (waste, shielding, stabilization media) that would have to be handled;

- identification of the stabilization medium, if used; and

- waste container utilization factor, measured as the percentage of the packaging volume that is filled with waste, including stabilization media. This parameter does not require an individual calculation be made of stabilization or absorbent media volume, but that those media be included in the total waste volume calculation.

These characteristics are generally determined by acceptable knowledge (e.g., container size, stabilization medium) or by measurement (e.g., weight).

Radionuclide Data. Radionuclide information allows for proper control of thermal loads for storage and disposal facilities, determination of personnel safety procedures, control of total activity limits for transportation, storage, and disposal, and also determination of the waste type. Parameters which constitute radionuclide information may include the following:

- total activity in the container, in curies;

- identity and activity per unit mass of the major radionuclides. For purposes of this guidance, major radionuclides are those which affect the determination that a waste is low-level waste, that the waste is within a site- or facility-specific category or class of low-level waste (e.g., a category that requires solidification), and any others determined to be of importance to the receiving facility (e.g., by safety analysis, performance assessment, etc.);

- radiation dose levels at the surface of the container; and

- container external surface contamination levels.

These characteristics can be determined directly by smear survey or radiochemical analysis of the waste, or indirectly by waste container non-destructive assay, radiation survey, and/or by documentation of nuclear materials accountability information or individual assays performed on components contained in the container.

Characterization Date and Generating Source. The date of characterization and generating source information help to determine the validity of currently held documentation on the waste, which, in turn, will determine the need for additional sampling or analysis. Parameters include characterization date, packaging date, DOE site, building location of the process which generated the waste and the generating process, if available.

Performance Assessment and Compliance Data. Additional data about waste that are important to performance or evaluating performance of the disposal facility, or to complying with laws, applicable regulations, or authorizing conditions (e.g., of a permit) may also need to be collected. The specific data needed will, by necessity, be identified by the disposal facility operator. Parameters which need to be included with waste characterization data may be identified by the analysts developing the disposal facility performance assessment, specified through conditions imposed on the site through the review and approval of the performance assessment, or derived from internal regulatory compliance evaluations. Examples of the types of data that may be needed are the presence and amounts of chelating agents which can enhance the transport of radionuclides from the disposal facility, or the presence and concentrations of specific chemicals which are not acceptable above specific limits (e.g., reporting polychlorinated biphenyls concentrations versus a limit of 50 ppm).

All of these data may not be required for a particular phase in the management of the waste's life cycle. The specific data needed will be determined by the waste acceptance criteria of a particular receiving facility.

> *Example: Experimental work in a laboratory generates a liquid low-level waste stream that is transferred via a pipeline to a central storage tank. Although the minimum characterization requirements include "weight of the container and contents," this is not relevant to this waste stream and the characterization data in the waste acceptance requirements for the central storage tank do not include packaging weight.*

Compliance with this requirement is demonstrated by the existence of a program or procedure for determining and records that document characterization of low-level waste consistent with the minimum characterization data requirements.

Supplemental References:

1. NRC, 1983. *Final Waste Classification and Waste Form Technical Position Papers*, U.S. Nuclear Regulatory Commission, Washington, D.C., May 1983.

IV. J. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving low-level waste for storage, treatment, and disposal are met.

Objective:

The objective of this requirement is to ensure that low-level waste transferred to a facility for storage, treatment, or disposal meets the receiving facility's waste acceptance requirements to reduce the likelihood that transferred wastes contain unacceptable materials or characteristics, and to avoid hazards that would occur from the transportation and handling of waste packages which do not meet acceptance requirements. Certification also ensures that the storage, treatment, or disposal facilities receiving the low-level waste operate within limits established through safety analyses and/or performance assessments.

Discussion:

The *Radioactive Waste Management Manual*, General Requirements, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the waste acceptance requirements of the facility to which it is transferred. The generator requirements address generation planning, waste characterization, waste certification, and waste transfer. As discussed in this guidance, a certification program is to be established by generators of radioactive waste to provide a mechanism for confirming that waste is in compliance with the waste acceptance criteria of the facility to which the waste is being transferred. The certification program is required by any organization or facility that transfers waste to another facility.

> *Example: The Building Five Storage Facility has low-level waste that it has received for storage over the last year. Facility personnel plan to continue to receive low-level waste and store it until it can be transferred to the Nevada Test Site disposal facility. Building Five operates under a certification program in accordance with the Nevada Test Site Waste Acceptance Criteria (NTSWAC) that certifies the waste meets the Nevada Test Site technical acceptance criteria.*

The certification program is part of the waste generator program that is approved by the Field Element Manager or designee. The certification program requires that an authorized official confirms compliance with the waste acceptance requirements of the facility to which waste is

being transferred. Additional guidance correlated to the waste certification requirements of Chapter IV, Low-Level Waste Requirements, is provided below.

Program Development and Documentation. The waste certification program to meet this requirement consists of a documented, structured process that works in concert with the DOE M 435.1-1 requirements for low-level waste acceptance (Section IV.G) and transfer (Section IV.K) to control the transfer of waste to a storage, treatment, or disposal facility. Development of the waste certification program involves defining and documenting controls for those items and activities that affect certifying that a waste and its packaging meets the waste acceptance criteria of the receiving facility. The documentation should include the following:

> Organizations and Responsibilities - Certification program documentation needs to identify the organizations and officials involved in the certification process and the responsibilities of each. Officials who are authorized to certify waste are identified in the documentation.
>
> Quality Assurance - The certification program is subject to quality assurance controls. The quality assurance controls that apply to waste certification activities need to identified and documented. The use of existing quality assurance program under which the certification activities will be performed is acceptable and appropriate.
>
> Procedures - The process for certifying waste is to be formalized in procedures. The procedures need to describe to the user the steps that are to be followed and the administrative process for ensuring waste containers are certified. The procedures require a signed statement certifying waste meets the appropriate criteria. The procedures also document the steps necessary for complying with the applicable transportation requirements (e.g., requirements from a safety analysis report for packaging and/or from Title 49, Code of Federal Regulations).
>
> Procurement/Purchasing Controls - The procurement and/or purchase of items or services that are significant to certifying that a waste meets the waste acceptance criteria of a receiving facility need to be documented. Such procurements may include the purchase of materials such as waste containers, or laboratory services (onsite or offsite). As dictated by the type of procurement, the documentation should include (or reference) the technical specifications for the item/service being procured; identification of quality assurance requirements including any required testing or inspections; specification of documentation to be provided on delivery (e.g., fabrication inspection and/or test records; a certificate of compliance or conformance; laboratory analytical results); and a statement ensuring access to the provider’s facilities as necessary to perform audits and inspections. The certification program ensures that the procurement documentation is reviewed and approved by an official with knowledge of the need, intent, and requirements for the

procurement. The program also provides for documented verification commensurate with the relative importance and complexity of the items or services being procured.

Document Control - The principal documents that constitute the certification program need to be subject to document control. Program documentation will identify which documents are to be controlled. The waste certification program description, waste certification procedures, and quality assurance program documentation need to all be subject to document control. Document control includes review and approval, distribution to designated recipients (users), and a controlled process for making changes to the documents. Existing document control programs at a site may provide the necessary controls for documents that are part of the waste certification program.

Training - The certification program needs to identify the training requirements for the various individuals who are involved in the program. At a minimum, the program will require training of the official who certifies the waste meets the waste acceptance criteria of the facility(ies) to which the waste is being transferred. In addition, individuals will need to be trained in the procedures that control the part of the certification process with which they are involved.

Records - The certification program documentation needs to describe the management of certification records (see guidance for subparagraph (1) of this Waste Certification requirement).

Example: A site generates a small amount of low-level waste that is sent to a central facility managed by a waste management organization. The generating organizations work with the receiving facility to define the waste certification program for the site. Through a review of the existing site procedures, site personnel determine the waste certification program can operate under the existing site quality assurance program, document control program, procurement process, and records management program. However, they determine that the site training program does not adequately address the certification process. Consequently, the waste managers work with the training department and develop a training module that explains the purpose and process of waste certification. The certification program documentation identifies these other programs are applicable, specifies the facilities from which waste would be transferred, designates the officials responsible for waste certification at those facilities and their training requirements, and specifies a procedure (within the document control program) that ensures compliance with the waste acceptance criteria. Within the existing programs, site personnel identify the records to be maintained and retention times, technical specifications and receipt requirements for obtaining waste packaging materials, and requirements for analytical data.

Operating within the parameters defined by the program, the waste generators are able to certify waste for transfer to the onsite receiving facility.

As noted in the preceding example, existing programs at a site may provide the framework within which elements of the waste certification program can be addressed (e.g., quality assurance, training, document control). The waste acceptance requirements of the facility to which the waste is to be sent may impose additional requirements on what is to be included in the waste certification program. Whether the waste acceptance requirements of the facility to which waste is transferred mandate a waste certification program (e.g., a commercial facility), the organization transferring the waste is responsible for developing and implementing a certification program to provide internal assurance that the waste acceptance requirements will be met.

Implementation. The waste certification program is implemented through the use of the documented controls, processes, and procedures. The key document in a waste certification program is the certification statement or equivalent. The certification statement is the documentation signed by a designated official that certifies that the low-level waste meets the appropriate requirements. The list below is a generic listing of the topics that are recommended for consideration in development of certification statements for waste shipments that go from one DOE site to another.

1. Container and Physical Properties

   - container type or description
   - labeling/markings
   - weight
   - vents
   - liquids

2. Nuclear/Radiological Properties

   - fissile content
   - transuranic activity
   - other radioactivity
   - dose rate
   - surface contamination
   - thermal power

3. Chemical Properties

   - mixed waste
   - polychlorinated biphenyls

- other hazardous constituents
- pyrophorics
- explosives
- corrosives
- compressed gases
- volatile organic compounds

4. Packaging/Shipping Data

- packaging
- shipping information

Graded Approach. A graded approach is used in implementing the waste certification program. As mentioned, the above list is recommended for the intersite transfer of low-level waste. Intersite transfers involve certifying that the waste is in compliance with the requirements for the receiving facility itself and with Department of Transportation requirements. However, even though the above list should be considered, it may be shortened and simplified for onsite transfers where the organizational relationships and knowledge of waste and waste generating activities may reduce the information that needs to be documented and transferred with each individual waste container or shipment. For onsite transfers, much of the information may already be available to the receiving facility. Onsite transportation of waste should be certified as meeting Department of Transportation or site-specific requirements for transportation.

> *Example: For an onsite transfer of waste at Site D, the receiving facility/organization already has a waste stream profile provided by the generator facility/organization. Because of the existence of the waste stream profile, the certification is performed by an individual trained in the waste packaging and certification procedures signing a waste pick-up request that provides the radionuclide inventory of the waste packages being transferred and the waste stream identification number.*

The waste acceptance requirements of the facility receiving the waste (see DOE M 435.1-1, Section IV.G) may dictate additional items which must be part of the certification statement. Even if such information is not dictated by the receiving facility, the waste acceptance criteria should be used to identify key elements to include on the waste certification statement.

Compliance with the development and documentation portion of the certification requirement is demonstrated by a waste certification plan that identifies the organizations involved, assigns responsibilities for implementing the program, and describes or references the quality assurance, training, procurement controls, records management, and procedures to be used by the program. Acceptable performance for implementing the program is demonstrated when appropriate personnel are trained and follow the procedures that govern their part of the waste certification

process. Additionally, acceptable performance is demonstrated if the waste certification plan and procedures are current and controlled in accordance with a document controls program, and records related to certification (e.g., certification statements, training records, procurement records, characterization records, container records) are generated and managed in accordance with the established site program.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

IV. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

Objective:

The objective of this requirement is to ensure waste certification programs are developed that clearly identify the documentation required for certifying low-level waste, specify personnel with the authority to make the certification, and provide a traceable and verifiable record of and basis for certification.

Discussion:

Officials who have the authority to certify low-level waste meets the waste acceptance requirements of the receiving facility must be designated by a cognizant manager. To avoid having personnel who are not knowledgeable of waste acceptance and transfer requirements authorizing the release of waste, the program needs to identify, by title or name, the officials who are authorized to certify the waste. The official(s) are qualified by virtue of position, responsibilities, and training to make this certification. The official(s) have sufficient familiarity with the waste being generated and have been trained relative to the acceptance criteria of the receiving facility (and applicable transportation requirements) to be able to certify in writing that the waste is acceptable for transfer. The official(s) need to also have authorization from the receiving facility to transfer the waste (see DOE M 435.1-1, Section IV.K, Waste Transfer). Implementation of this element should be tailored to specific site needs and situations.

Example: Onsite transfers of low-level waste at Site E from multiple laboratories or processes to the central waste management facility involves training multiple personnel (e.g., one for each laboratory or process) who have the authority to certify waste as meeting the onsite waste acceptance requirements. However, for the transfer of low-level waste from the central waste management facility at Site E to an offsite facility, there is one designated official at the site who is trained on the acceptance criteria of the offsite storage, treatment, or disposal facility waste acceptance criteria and transportation requirements, and is authorized to certify the waste.

The waste certification program needs to specifically identify the documentation to be produced to support the certification that low-level waste meets the waste acceptance criteria of the receiving facility. The required documentation may include the following:

<u>Waste Stream Profile (or record relating the waste to a previous profile)</u>. The waste stream profile is a description of the waste stream, generally identifying the source, physical and chemical description, and upper limits on radionuclides.

<u>Radionuclide Characterization Data</u>. Radionuclide characterization data include the concentration and/or inventory of radionuclides as determined by characterization (see guidance for DOE M 435.1-1, Section IV.I, Waste Characterization).

<u>EPA Uniform Hazardous Waste Manifest</u>. The EPA manifest is required by 40 CFR Part 262 for the transfer of a hazardous or mixed waste.

<u>Waste Container Data and Integrity Maintenance Documentation</u>. Container data includes information about the containers dimensions and physical attributes and procurement information. Integrity documentation includes the records of ownership and “transfer” of waste containers and data. (See guidance for Waste Transfer, DOE M 435.1-1, Section IV.K.)

<u>Radiological Survey Results (or documentation referencing a survey record)</u>. Survey results include the determination of the surface contamination of the waste container and the external dose rate.

<u>Bill of Lading</u>. A document indicating the contents of a shipment.

<u>Real-time Radiography Results</u>. The results of radiography performed to detect unallowed material in the waste package (e.g., liquids, compressed gas cylinders).

Certification Statement. The statement required by DOE M 435.1-1 to document that waste is in compliance with the acceptance criteria of the facility to which the waste is being transferred.

Authorization to Transfer. Documentation indicating that an official from the facility to which the waste is to be transferred has authorized transfer of the waste to the facility.

As noted for other elements of this requirement, the organization developing the certification program uses a graded approach in determining which of these documents are needed. Regardless of the extent of the required documentation, the certification statement can serve as a checklist that all of the waste acceptance criteria have been considered and the waste is in compliance.

In order to ensure that information is available if or when it is needed in the future, the low-level waste certification program needs to identify which records are to be maintained and how they are to be maintained. The certification program documentation may include specific records management requirements, or may simply invoke an existing acceptable records management program. Although no minimum record retention times are established in DOE M 435.1-1, certain records may need to be maintained indefinitely. Whereas hazardous waste regulations require only a three-year retention period, DOE low-level waste disposal facilities should plan on maintaining pertinent records at least through the operations, closure, and post-closure monitoring periods, and consider making them part of any local land use records. The pertinent records would be those which identify physical, chemical, and radiological characteristics of the waste and the certification of that information. Generating, storage, or treatment facility waste management records may not be required beyond the life of the facility or operation, provided pertinent information has been supplied to the facility where the waste will be disposed.

Example: Personnel at a storage facility maintain records describing when they received waste, what the waste was (characterization and container data provided by the generator), and to whom the waste was eventually transferred. Once the waste is disposed of and the waste characterization and container information is in the possession of the organization responsible for the disposal facility, the organization responsible for the storage facility disposes of its records.

To meet the requirement for auditability and retrievability, the method of records storage and retention needs to allow a person to trace shipment or waste container information back to the generator certification data (e.g., characterization data, source data, container data). In accordance with the DOE M 435.1-1 Transfer Requirements (Section IV.K), information on the source and characteristics of the waste are to be transferred when waste is transferred. However, it is not the intent of this requirement to mandate that a certification statement be generated for

waste already in storage as of the issuance of DOE O 435.1. Such documents must be created for any subsequent transfers of waste.

> *Example: A site should be able to provide the characterization, container, and certification information for any waste container within a storage, treatment, or disposal facility if that waste container is transferred after issuance of DOE O 435.1.*

Compliance with this requirement is demonstrated by a program or procedure for record keeping and records showing that low-level waste is certified as having met the waste acceptance criteria of the facility to which it was transferred and that the certification statement is supported by additional records regarding the waste source, characterization, and container.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

IV. J.(2) Certification Before Transfer. Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Objective:

The objective of this requirement is to certify that low-level waste meets the acceptance requirements of the storage, treatment, or disposal facility before it is transferred to prevent transferring waste that could endanger receiving facility personnel, and to avoid the delay and potential hazards associated with corrective actions taken to remedy non-compliant conditions.

Discussion:

The waste certification requirements above address development, implementation, and content of a waste certification program. The requirement that waste be certified before transfer ensures that the program is effective in preventing the transfer of waste that does not meet the waste acceptance criteria of the facility receiving the waste for storage, treatment, or disposal. In accordance with this requirement, waste should be released for transfer to another facility only after there is a certification by an authorized official that the waste acceptance requirements have been met. Ensuring certification occurs prior to allowing the physical transfer of waste prevents potential hazards associated with managing waste rejected by the facility to which it is transferred. Requiring certification before waste is transferred also reduces the likelihood of having to recall a waste shipment due to a discovery by the certification official, after the waste is in transit, that the

waste does not comply with the waste acceptance requirements. Guidance on DOE M 435.1-1, Section IV.K discusses when a transfer occurs, and can be consulted to determine when this requirement needs to be met.

Certification that the waste is ready for transfer and meets the waste acceptance criteria and the applicable transportation requirements is a control point in the transfer process. The procedures controlling waste transfer do not allow the transfer to occur unless the certification statement has been signed. Once signed, the certification statement becomes part of the record for the transfer of the waste (see Waste Transfer, DOE M 435.1-1, Section IV.K). An example of a certification statement for shipment of low-level waste to the Nevada Test Site is included as Figure IV.J.1 (in this case, the certification statement is a label that is affixed to the waste container.) The signature on the certification statement confirms that the waste has been characterized for physical, chemical, and radiological characteristics, properly packaged, and necessary container markings and shipping data have been prepared.

> *Example: Central Waste Management Facility personnel are responsible for receiving waste, providing storage for a short time, and making transfers to an offsite low-level waste storage facility. In order for the workers at the Central Waste Management Facility to place a waste container on a truck for transfer, the operating procedures for the facility require that they have a signed certification statement that correlates to the container(s) (either bar coded or numbered). Once a waste container is loaded, a copy of the certification statement is included in the waste transfer papers and another is included in the Central Waste Management Facility files.*

Compliance with this requirement is demonstrated by the presence of a certification program which includes procedures requiring a signed certification statement prior to the release of waste for transfer, and by dated records showing that waste was certified before being transferred.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

IV. J.(3) Maintaining Certification. Low-level waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Objective:

The objective of this requirement is to ensure that certified low-level waste is managed to maintain the certification status and avoid the unnecessary handling of waste containers that would be necessary for recertifying waste.

Discussion:

There may be instances where low-level waste that is already certified to a disposal facility's waste acceptance requirements must be stored before transferred to the next stage in the waste management process (usually the disposal facility, but it could be another storage facility). If low-level waste is certified as meeting the waste acceptance criteria of another facility in addition to the receiving facility, it needs to be stored and controlled so that the certification for the subsequent management step remains valid until the waste can be transferred.

Waste needs to be stored under conditions and with controls to protect it from physical damage, and to prevent tampering (i.e., placement of unallowed materials into the container) so it can be transferred for disposal without re-certification. Also, certifying officials need to be aware of any limitations on the amount of time a waste can be stored without invalidating the certification. Actions necessary to certify a low-level waste that involve potential radiation exposure to workers are deferred, if possible, until there is a reasonable expectation that the waste can be transferred to the receiving facility within the time that the certification is valid. Routine monitoring required for waste in storage may not allow all activities that could result in worker exposure to be deferred.

This requirement is not to be interpreted in a manner that interferes with a facility performing a normal, acceptable waste management function. Therefore, if a low-level waste is certified as meeting the waste acceptance criteria of a treatment facility, the requirement to maintain the certification is not intended to prevent the treatment facility from treating the waste. Even though treating the waste will not “maintain” the certification, the purpose of the certification is to ensure the waste can be safely accepted for treatment. Maintenance of the certification status is intended to cause the waste to be stored, transported, and staged at the treatment facility in a manner that will allow personnel to treat the waste without concern that it no longer meets the acceptance criteria. In addition, despite the protection provided for the waste, sampling prior to treatment may still be a necessary process control step.

Specific requirements for protecting the certification status of low-level waste are generally negotiated with the receiving facility. Requirements to be considered include protecting the waste container, preventing unauthorized introduction of material into the waste, and protecting the data written or stamped on the waste container. The Waste Transfer requirements (DOE M 435.1, Section IV.K) also address protecting waste packages and data to ensure that characterization and container data remain accurate and useable by waste managers. Waste containers need to be

provided with sufficient protection from the elements (e.g., precipitation, wind, flooding, excessive heat), such that the character of the waste and container, and therefore the certification are not altered. Waste containers need to also be stored in a manner that prevents modifying their contents (e.g, under lock and key or with a tamper indication device) and in a location where the waste container will not be damaged (away from equipment high traffic areas where there is the possibility of damage). In addition, it is necessary to be able to relate each waste container to information about the contents of the container. Container markings must be protected from defacement or removal, and records regarding container identification and contents must be safely stored.

> *Example: Mixed low-level waste is certified to be in compliance with the Site X's waste acceptance requirements, and to the waste acceptance requirements of Storage Building A where it will reside until the disposal can take place. The mixed waste is stored in accordance with a procedure that ensures the certification status to Site X is unaffected. The procedure calls for storage of the mixed low-level waste in accordance with a security plan reviewed and approved by the Site X waste acceptance personnel, storage in a specially designated area within Storage Building A, and record-keeping in a separate database from other waste in storage.*

Compliance with this requirement is demonstrated by a program or procedure reflecting this requirement is present and site personnel are able to show that the storage of low-level waste containers is in a facility or manner where the containers would not be damaged by normal weather events, and cannot be accessed by unauthorized personnel. Further, each container can be traced to its certification and the information supporting that certification.

Supplemental References:

1. DOE, 1997. *Nevada Test Site Waste Acceptance Criteria* (NTSWAC), Revision 1, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV, August 1997.

2. DOE, 1991. *Hanford Site Solid Waste Acceptance Criteria*, WHC-EP-0063-3, U.S. Department of Energy, Office of Environmental Restoration and Waste Management, September 1991.

Figure IV.J.1 - Example Waste Certification Forms

Low-Level Waste Certification

"I certify that containers:

(Container I.D. number[s])

do not contain hazardous waste as defined in Title 40 CFR Part 261 or __________ (state-of-generation) hazardous waste regulations, and do meet the NTSWAC requirements:

(1) according to the results of tests performed in accordance with the requirements as specified in Subpart C of Title 40 CFR Part 261; and/or

(2) according to the supporting documentation provided to me about the materials and processes that produced this waste.

To the best of my knowledge, I believe the information I have submitted is true, accurate, and complete."

____ _________________________
Generator Waste Certification Official (Print Name/Sign) Sign

Mixed Waste Certification for Land Disposal Restrictions:

I certify under penalty of law that I personally have examined and am familiar with the waste through analysis and testing or through knowledge of the waste to support this certification that the waste in containers:

(Container I.D. number[s])

complies with the treatment standards specified in Title 40 CFR Part 268, Subpart D, and all applicable prohibitions set forth in 40 CFR 268.32, RCRA Section 3004(d) or ___________ (state-of-generation) hazardous waste regulations.

I believe that the information I submitted is true, accurate, and complete, I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment.

____ _________________________
Generator Waste Certification Official (Print Name/Sign) Sign

IV. K. Waste Transfer.

A documented process shall be established and implemented for transferring responsibility for management of low-level waste and for ensuring availability of relevant data. The following requirements are in addition to those in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure that the responsibility for low-level waste containers is established, maintained, properly transferred, and adequately documented so that ownership, and therefore responsibility for safe management, of waste is clear. This responsibility includes maintaining the waste characterization information, the container information, and information about the treatment, storage, transportation and disposal status of containers of waste. This responsibility also includes an assurance that the container of waste has not been altered in a manner that affects its certification status or the ability of the waste to be properly managed.

Discussion:

As discussed in Section I.2.F.(7) of the guidance for DOE M 435.1-1 Chapter I, the radioactive waste generator program includes consideration of the generation planning, characterization, certification, and transfer of low-level waste. In the generator's program, initial responsibility is assigned for containers of low-level waste and a documented process for transferring the responsibility is established.

In the development of DOE O 435.1 and DOE M 435.1-1, maintaining the integrity of waste containers was identified as necessary for the proper control and safe management of low-level waste. Similarly, maintaining information about containers of low-level waste (characterization and container data) was recognized as vital to making and executing safe management decisions. In order to ensure that it is clear who has the responsibility for protecting the integrity of each container of low-level waste and associated waste and container data, there needs to be one person who is identified as being responsible for the waste at any time. Confusion over who is responsible for specific waste containers is avoided by documenting the transfer of responsibility.

This requirement is similar to the concept of chain of custody used in sample management. As with samples, low-level waste containers may be the responsibility of many different organizations during their management life cycle. At any point during the life cycle management of the waste, the identity of the individual responsible for each container of waste needs to be explicit. By clearly identifying the owner of each container of waste, there is no question regarding who is responsible for protecting the waste container and the waste characterization and container data,

and for moving the waste to the next phase of waste management (i.e., storage, treatment, or disposal).

Maintaining Waste Container and Data Integrity. The individual responsible for a container of waste is responsible for maintaining and protecting both the integrity of the container of waste and the data about the container of waste. Protecting the integrity of the waste container is the same as protecting the certification status of a waste container as discussed in the Waste Certification guidance. Essentially it involves managing the container of waste so that it is not damaged or does not degrade because of the conditions under which it is managed.

Maintaining the data about the container of waste involves ensuring receipt or traceability, or developing (as discussed below) information necessary to support subsequent waste management activities, or clearly documenting and ensuring that the information is stored and updated so that full and accurate information is available to the next individual to whom the waste is transferred.

Transferring Responsibility. The transfer of responsibility for containers of low-level waste and the associated waste and container data is to be done in accordance with procedures at each of the facilities involved. The facility from which the waste is transferred, typically establishes (for newly-generated waste) or possesses (for stored wastes) a record or data package about the waste and its container. The facility operating procedures should require the development of an ownership log sheet similar to a chain-of-custody log. This log becomes the data package that is transferred with the container of waste. Upon transfer, the facility transferring the waste is responsible for ensuring personnel at the facility to which the waste is being transferred have assumed responsibility for the waste. A signed and dated copy of the ownership log sheet can serve this purpose. All subsequent transfers, e.g., from storage or treatment facilities, are to be in accordance with procedures requiring the transfer of the data package and documentation of the transfer of responsibility for the waste.

Procedures at the storage, treatment, or disposal facility should require the receipt of certain information about any low-level waste which is received. To ensure that they have sufficient information to safely manage the waste and to transfer the waste to a subsequent waste management facility (if appropriate), it is important for storage, treatment, and disposal facility personnel to ensure they are provided information about the containers of waste for which they become responsible. The receiving facility requires the following documented information be available for all waste they expect to receive:

- Responsible individual. The name, title, affiliation, and phone number of each person who has held responsibility for the waste, starting with the generator. This listing can serve as the ownership log with each person signing the log upon accepting responsibility for the waste.

- <u>Transfer dates</u>. The date the transfer was accepted by each new "owner" of the waste.

- <u>Waste container information</u>. Information about the container (see guidance for IV.K.(2) in this section).

- <u>Characterization information</u>. Information about the waste (see guidance on Waste Characterization).

- <u>Physical location</u>. The site and name (e.g., unique identifier such as a building number) of each location where the waste was managed.

- <u>Previous transportation</u>. Dates of transportation and names of carriers.

- <u>Certification status</u>. A signed certification statement or equivalent (see guidance on Waste Certification). Only the certification statement for the facility to which the waste is being transferred must be part of the waste package data. Previous certification statements may be included if they serve the purpose of documenting other data that should be part of the data package (e.g.,container or characterization data).

- <u>The planned disposition of the waste</u>. Expected storage, treatment, and disposal (see guidance on Generation Planning and Site-Wide Radioactive Waste Management Program).

For each transfer beginning with the generator, the receiver of the waste is responsible for obtaining the proper information from the sender of the waste. The receiver's responsibility is to ensure receipt or availability of complete and accurate information concerning containers of waste. The information needs to be reviewed prior to actual transfer and is a condition of acceptance by the receiver.

> *Example: A treatment facility receives low-level waste for processing. Upon signing for receipt of the waste, the facility manager becomes the individual responsible for the waste. Facility procedures require that a copy of the data received from the generator be kept in a file cabinet which is accessible only to one individual on each shift. As the containers of waste are processed in the facility, information is recorded in a log and the data package is updated to reflect the change in status of the waste. Upon completion of the processing, the treated waste is packaged in new waste containers and a certification statement is generated indicating that the treated waste meets the waste acceptance criteria for the storage facility to which it will be shipped. Before the waste is transferred, the treatment facility personnel provide a complete set of data to the storage*

facility personnel. The data package reflects the new container numbers for the treated waste, but includes the data on the original containers received at the treatment facility. The treatment facility also keeps a duplicate copy of the data package which includes a copy of a waste log indicating transfer of ownership to the storage facility.

The responsibility for ownership of the waste can be different than that for waste certification. The individual responsible for the waste does not necessarily have to be the same individual that certifies the waste is ready to be transferred (see guidance on Waste Certification). As indicated above, the certification status is one piece of information that is transferred with the waste.

Compliance with this requirement is demonstrated if facilities have procedures for the receipt of waste and the transfer of waste, as appropriate, which address the acquisition of waste and container data and the transfer of ownership, respectively. Further evidence of acceptable performance is facility records showing that data on the waste containers is available and accurate, and that documented transfer of responsibility occurs.

Supplemental References:

1. EPA, 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, U.S. Environmental Protection Agency, Washington, D.C., June 1997.

IV. K.(1) Authorization. Low-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Objective:

The objective of this requirement is to ensure that shipments or transfers of low-level waste are made only with the cognizance and approval of personnel at the facility receiving low-level waste so that preparations can be assured for its safe management.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(7), the radioactive waste generator program includes consideration of the generation planning, characterization, certification, and transfer of low-level waste. During the development of DOE O 435.1 and DOE M 435.1-1, a review of waste management functions indicated that the receipt of waste without personnel at the facility receiving the waste having knowledge of what was sent presented a potential hazard. If waste is transferred to a facility without prior authorization, the controls necessary for the proper and safe management of the waste may not be in place. As a

consequence, the waste may be rejected and returned to the sender. This requirement represents a control to minimize the potential for exposures and releases during the handling and transfer of low-level waste.

Safe transfer of the waste can only be assured if the facility receiving the waste for storage, treatment, or disposal has considered the acceptability of the waste versus its safety operating constraints. Personnel at a storage, treatment, or disposal facility who authorize the transfer of waste are indicating that they have the capability to receive the waste and manage it in a manner that is protective of workers, the public, and the environment. Therefore for the purposes of safe life-cycle management, the receipt of authorization prior to the transfer of low-level waste to a storage, treatment, or disposal facility is essential. Meeting this requirement is the responsibility of the organization or individual transferring (sending) the waste. The following are considered transfers:

(1) Waste is physically moved from one location to another, even if ownership does not change.

(2) Waste is physically moved from one location to another and ownership changes.

(3) Waste is not physically moved, but ownership changes.

The actions and documentation necessary to obtain authorization will depend on the specific storage, treatment, or disposal facility to which waste is to be transferred. In some cases, the submittal of a waste stream profile which provides a description of the waste and a range of the waste characteristics, augmented by conversations with the generator, may provide enough information for the storage, treatment, or disposal facility staff to be confident that they can safely manage the waste. In other cases, the waste acceptance requirements of the storage, treatment, or disposal facility may dictate that an onsite visit and review of the generator’s waste certification program be performed. In order to expedite the transfer of waste, staff responsible for sending the waste need to ensure they understand what information and activities need to be completed in order to receive transfer authorization.

Authorization to transfer waste is received in writing and states the scope of the authorization. The authorization may specify a specific group of waste packages or specific number of shipments of a particular waste type. However, it is acceptable for the written authorization to specify a waste stream(s) which the generator can send on a routine basis. Any additional conditions or notification requirements can be included in the written authorization. Whereas it is the responsibility of the storage, treatment, or disposal facility to prepare the written authorization, the organization sending the waste must not transfer waste until they have authorization and understand which waste is included in the authorization.

Example: An activity at Site X results in the routine generation of low-level waste in the form of contaminated personnel protective equipment, swipes, plastic sheeting, and paper waste. The waste stream is designated by the number X-2156. Consistent with site procedures, the generator prepares a waste stream profile which describes the characteristics, packaging, and projected generation rate of the waste stream and provides it to the waste management organization. The waste management organization reviews the waste stream profile and calls the generator facility representative to clarify the information on the waste stream profile. The waste management organization has previously reviewed the generator's certification program. Based on the certification program and the waste stream profile, the waste management organization prepares a letter authorizing the generator to transfer any waste that meets the X-2156 profile until further notice. The authorization letter also states that the generator must provide the waste management organization notice of the number of waste containers to be transferred 48 hours before a transfer occurs.

When low-level waste is transferred (moved from one location to another), but the ownership of the waste does not change (i.e., the same individual is responsible for both facilities), a separate authorization may not be required. Recognizing that the intent of this requirement is to ensure that the waste is expected and can be safely managed at the facility to which it is being transferred, other documentation can serve as the written authorization.

Example: The manager of the waste management organization is the official responsible for authorizing transfer of waste to either of two separate storage facilities, Building A and Building B. Even though the waste acceptance criteria are the same for the two facilities, waste is accepted and logged into each facility separately. The manager decides to consolidate all of the waste into Building A for more efficient management. The authorization to transfer is provided by the certification statement indicating that the waste meets the Building A waste acceptance requirements, and the documentation of the new storage location on the waste characterization and container data.

Compliance with this requirement is demonstrated by sites having procedures that require a confirmation of authorization before releasing waste for transfer, and records showing that transfers are made in accordance with written authorizations.

Supplemental References:

1. DOE/CAO, 1995. *Generator Site Certification Guide,* DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, 1995.

IV. K.(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for low-level waste shall be transferred with or be traceable to the waste.

Objective:

The objective of this requirement is to establish and maintain information about the characteristics of low-level waste and the waste containers to ensure that sufficient information to support management of waste in a manner that is protective of workers, the public, and the environment is always available.

Discussion:

The *Radioactive Waste Management Manual*, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the applicable waste acceptance requirements. Generator requirements address generation planning, waste characterization, waste certification, and waste transfer. The requirement for traceability of data addresses the hazards associated with transferring low-level waste without providing or maintaining adequate information about the container and its content. Establishing and maintaining the identity of the waste, as well as maintaining controls based on the waste's hazards, are necessary for its safe transfer and subsequent management. Acquisition of information about the waste is addressed in the guidance on Waste Characterization (DOE M 435.1-1, Section IV.I). Certification that waste is ready for transfer (i.e., meets the waste acceptance requirements and transportation requirements) is discussed in the guidance on Waste Certification (DOE M 435.1-1, Section IV.J). Maintenance of documentation regarding transfer of waste is discussed later in this section of guidance.

In the process of developing DOE O 435.1 and DOE M 435.1-1, transfer was identified as the activity in the life-cycle management of waste with the greatest potential for loss of information about containers of waste, and the associated loss of adequate waste management controls needed to avoid exposure or release of radioactivity. Therefore, when waste is transferred, the waste characterization and container data must be transferred or available to the new "owner" (i.e., responsible waste manager) of the waste.

> *Example: A liquid low-level waste is being transferred to a treatment facility for solidification. The waste was characterized and the waste characterization information listed on the waste certification statement. Although the waste met the waste acceptance criteria for the treatment facility and an authorization to make the transfer was granted,*

the characterization information was not transmitted before or in conjunction with the waste transfer. Due to storage limitations at the treatment facility, the drums of waste were placed in an unheated staging area. After a three days of below freezing weather, it was noted that the drums were bulging and split. Had the characterization information been documented and transferred with the waste, treatment facility personnel would have known it was an aqueous waste and would have imposed controls on the waste to protect it from freezing conditions.

Sufficient information about the container in which waste is packaged needs to be provided to the storage, treatment, or disposal organization to which waste is transferred to ensure that the containers are handled safely.

The information about the container is supported by and traceable to the more detailed container procurement information. The organization that procures the container is responsible for properly documenting the essential information regarding the procurement. The information needs to be maintained so questions about adequacy of the container for its originally intended or alternate uses can be assessed and to answer questions about subsequent procurements. Information documented concerning the procurement of waste containers includes:

- Purpose of the container;
- Container performance requirements;
- Purchase specifications; and
- Manufacturer certifications verifying performance to purchase.

The information concerning the purpose of the container includes the designed service life, the environments for which the container was designed and is compatible with, and other information necessary to allow proper use of the container. The procurement information includes vendor information, product specifications, lot or serial number information, and other procurement information necessary to document the container purchased.

The detailed procurement data about containers can be, but do not have to be, transferred at the time waste is transferred. As long as the records are retrievable and can be correlated to the waste containers, it is acceptable for an organization transferring waste to maintain the records.

The type of container information that should be provided upon transfer of containers of waste will depend on the type of waste and subsequent waste management steps. Typically, the information includes the following:

- container size and type - generally this would be the container that is providing the primary containment of the waste (e.g., DOT 7A 55-gallon drum, standard waste box, or DOT 7A 80-gallon overpack);

- container enhancements - additional items that have been added to the primary container to facilitate container performance (e.g., shielding, liners, plastic bags, absorbents);

- lifting limitations - allowable and/or unallowable lifting points and methods; and

- load limitations - based on the physical characteristics, the maximum number of containers or weight that can be placed on top of the waste container.

When waste is initially placed in the container, the organization packaging the waste documents and manages the information regarding its characteristics (e.g., radioisotopic inventory, total activity, radiation dose, waste form). When the container of waste is physically transferred or the ownership has changed, the information regarding the waste and container must be provided or made available to the organization that acquires responsibility for the waste. A transfer is considered to have occurred if the waste is physically moved from one location to another or if there is a change in responsibility for the waste.

The following waste container characterization data are typically provided with the transfer of low-level waste:

- physical and chemical description of waste (use of item description code or waste stream identifier, if applicable);

- radiological inventory (see guidance on Waste Characterization);

- gross weight;

- volume percent utilized;

- fixed and removable surface contamination (alpha and beta/gamma);

- surface dose rate;

- tamper-indicating device number; and

- thermal power.

Example: Building 2000 is undergoing a facility cleanout that involves the decontamination of building surfaces and the removal of excess processing equipment. The organization responsible for the facility identifies two types of waste containers to be used, 55-gallon drums for small items, personnel-protective clothing, and contamination control waste, and standard waste boxes for larger pieces of equipment. The job is managed such that one operator is responsible for logging each piece of waste put into the containers. Upon filling a waste drum or box, the container is closed, and a tamper-indicating device is installed. Radiological Services personnel perform radiological surveys of each container of waste and record the data. The authorized waste certification official uses the data recorded on the waste log and survey sheets, supplemented with radiological characterization data, weight data, and other information to fill out a waste certification checklist. The checklist requires identification of waste container data as discussed above. In accordance with site procedures, the checklist is a piece of required paperwork that is to be provided to the storage, treatment, or storage facility to which the waste is transferred.

This requirement needs to be implemented with consideration given to documentation requirements imposed by other internal programs or external organizations such as the Environmental Protection Agency or Department of Transportation. These other documentation requirements, such as an EPA Uniform Hazardous Waste Manifest or a transportation bill of lading, may include much of the waste container information that is provided to the storage, treatment or disposal facility to which waste is transferred. Therefore, to the extent these other documents have the appropriate information, they may be used to meet the requirement to convey information about the waste being transferred to a subsequent waste management facility. If documentation prepared to meet requirements of other programs or organizations is used, it may need to be supplemented to provide any additional data on waste characterization and packaging addressed in this guidance.

Example: Mixed low-level waste is being sent from one site to another for storage. Since the waste is regulated under RCRA, a Uniform Hazardous Waste Manifest is prepared as required by 40 CFR Part 262. The manifest includes information about the physical and chemical characteristics of the waste, the container type, and container weight. The site has developed a 'Radiological and Supplemental Characteristics Data Sheet' to provide additional information about the containers of mixed waste. The data sheet provides additional information about the radiological inventory, surface dose rate, surface contamination, fissile material content, number of the tamper-indicating device installed on the waste containers, load limitations, and handling limitations. Between the two documents the storage facility is provided enough information so they can safely manage the waste.

Compliance with this requirement is demonstrated if there are procedures requiring that characterization and container data be provided and maintained for each low-level waste transfer and documented records of transfers show that the information is being provided.

Supplemental References:

1. EPA. *Standards Applicable to Generators of Hazardous Waste*, 40 CFR Part 262, U.S. Environmental Protection Agency, Washington, D.C.

IV. L. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging. If containers are used:

(a) Low-level waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container.

(b) When waste is packaged, vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container.

(c) Containers of low-level waste shall be marked such that their contents can be identified.

Objective:

The objective of these requirements is to ensure that when low-level waste is packaged, the container selected is adequate to contain the waste and limit radiation exposure for the entire time the waste is in storage, and to ensure that the container can be correlated to necessary information on its contents. The first subrequirement is to ensure the selection of a container for waste based on the life-cycle of the waste so that there will not be unnecessary repackaging of waste. The second subrequirement is to prevent the build up of pressure or concentrations of gases that could cause a loss of waste confinement. The third subrequirement is to ensure that it is possible to identify the contents of the container of waste during storage and when the waste is removed from storage for treatment or disposal without having to open the container.

Discussion:

The need for packaging requirements specific to waste management concerns evolved from the development of DOE O 435.1, and past experience in low-level waste transportation. The safety and hazards analysis conducted in support of the Order and Manual development identified loss of confinement of a waste container as a potential hazard affecting worker safety and releases to the environment. In addition, the inability to associate a container with data on the contents was identified as a situation that would result in unnecessary worker exposure due to the need to re-characterize the waste. Mitigation of each of these concerns can be achieved through proper packaging and compliance with the requirements of this section.

An analysis of existing requirements affecting the packaging of waste identified the Department of Transportation (DOT) regulations (49 CFR) and the DOE Orders, DOE O 460.1A and DOE O 460.2 as sources of packaging requirements (see DOE M 435.1-1, Section I.1.E.(11)) . Generally, the DOT requirements apply to offsite shipments and any other transport on publicly-accessible roads. *Packaging and Transportation Safety* (DOE O 460.1A) invokes the DOT requirements, or documented requirements providing equivalent safety, for onsite shipments. These regulations require the use of DOT Type A or Type B packaging (depending on radionuclide content) for DOE waste shipments. DOE 460.1A also establishes the means and approval authority for qualifying packaging as Type A or Type B. *Departmental Materials Transportation and Packaging Management* (DOE O 460.2) includes DOE policies and requirements that supplement the DOT regulations. Requirements from DOE O 460.2 relevant to waste packaging include the inspection of waste shipments upon receipt, provision of data to the Department's Packaging Management Plan, and performance of routine assessments of transportation and packaging operations.

While the DOT requirements and DOE packaging and transportation requirements were considered adequate for shipping waste, they were not considered sufficient to address the other low-level waste management concerns associated with long-term storage or with selecting and packaging waste based on the entire waste management life cycle.

The life-cycle management of low-level waste may involve the packaging of waste followed by a protracted storage period while awaiting disposal. Selection of a container (i.e., a receptacle and any other components or materials necessary for the receptacle to perform its required containment function) needs to account for all waste management steps expected prior to and including disposal. Therefore, the container needs to meet the requirements for transportation, storage, and eventual disposal (to the extent the disposal requirements are known). Alternatively, if waste treatment is required, the container needs to be adequate to contain the waste during storage and allow the waste to be transferred to the treatment facility where it might be removed from the container prior to treatment. Subsequent to treatment, packaging of the treated residues is based on meeting all of the requirements of the remaining waste management steps. Selection of a container that fulfills the needs of all subsequent waste management actions ensures waste confinement and eliminates the need to repackage the waste, thus avoiding potential exposure to workers.

> Example: The Site X disposal facility will be the recipient of some low-level waste that is being generated at Site Q. The waste will be stored for 3 months at Site Q, transported to another facility where it will be consolidated with other low-level waste, stored for

another 3 months, then transported to Site X for disposal. Containers that will be found acceptable for disposal at Site X were determined to be appropriate for all management steps; therefore, upon generation, the low-level waste can be immediately placed in a Site X acceptable container and will not need to be repackaged during any subsequent management step.

Containment and Protection. Low-level waste must be adequately contained and the container protected from conditions that could cause container degradation. Inadequate containers or container degradation could lead to failure and result in the spread of contaminated materials, worker exposure, or the non-acceptance by a receiving facility. When selecting low-level waste containers, consideration must be given to the conditions to which the container will be subjected. If waste is to be stored outside for an extended period and subjected to the natural environment, the container must be made of materials that have been demonstrated to maintain integrity during these conditions.

Example: Bulk contaminated soil and debris was packaged in wooden boxes and stored outside for up to four years. The boxes degraded to the point that they no longer served as containment and were literally falling apart. Due to the selection of inadequate containers for the time of storage and storage conditions, the waste had to be repackaged prior to transfer and the used wooden boxes also managed as low-level waste.

Low-level waste must not be incompatible with the container in which it is placed. The physical, chemical, and radiological attributes of the waste need to be considered when selecting a container. Container integrity must not be jeopardized due to the size, shape, or weight of objects contained in the waste. Containers need to be compatible with any unusual chemical characteristics, water content, and pH of the waste. If absorbent or other materials are used to bind liquids contained in the waste, the resultant waste matrix must not be capable of spontaneous combustion, decomposition, explosion, liquid desorption, or otherwise have the ability to affect the integrity of the containers in any way (see Storage guidance IV.N).

Shielding may also be required to provide protection to workers who handle the waste containers or who are responsible for monitoring low-level waste in storage. The necessity for shielding is considered at the time of packaging so that the shielding can be integrated into the waste container before waste is present if internal shielding is acceptable to the storage, treatment, or disposal facility. Alternatively, the storage configuration may be designed to provide the necessary shielding. If shielding is required, consideration needs to be given to the use of materials that do not have the possibility to become a mixed waste if contaminated by the radiological constituents. Guidance for DOE M 435.1-1, Section IV.K.(1) discusses the selection and procurement of low-level waste containers and the necessary information that is documented.

Example: A new facility generates high-activity low-level waste sludges with caustic properties and multiple fission products requiring remote-handling. The container selected has been designed to withstand chemical attack from the sludge, includes sufficient absorbent to ensure there are no free liquids, and incorporates shielding. The container provides protection of workers, the public, and the environment during its intended service life.

The anticipated service life needs to be considered when selecting a container for low-level waste. A determination of the anticipated storage time, environment, and location (waste acceptance criteria) is essential to selecting the proper waste container. For low-level waste that does not have an identified path to disposal, the waste container may need to be designed to remain effective for an extended and/or indefinite storage period.

Example: A site needs to repackage a small quantity of low-level waste with no identified path to disposal. A plan has not yet been completed for resolving the disposal issues. The selected container has been designed to withstand the effects of time and last a minimum of 50 years if stored indoors.

When selecting containers for low-level waste, consideration needs to be given to the full life-cycle of the waste, with a goal of packaging the waste only once. The selected waste container needs to be compatible with transportation requirements and the waste acceptance criteria of the facilities expected to manage the waste. Containers can also be designed and utilized in storage and treatment facilities that allow for direct disposal. Prior to packaging, the consideration of the management steps the waste will go through should minimize risks associated with handling and repackaging the waste. The waste container maintains structural integrity and containment until it is disposed of or the waste has been removed from it. DOE low-level disposal sites have generally identified several DOT-certified drums and standard waste boxes in their waste acceptance criteria documentation as containers that are acceptable for handling and disposal at their sites. These drums and boxes may be considered for all management steps to facilitate disposal if they are compatible with the interim management steps the waste will undergo.

Example 1: A site selected a certain 4 x 4 x 8-ft box as the container for high volumes of miscellaneous low-level waste that was to be stored for a few years prior to disposal. However, because consideration was not given to the entire life cycle for management of the waste, site personnel did not take into account that the boxes were not acceptable at the disposal facility which was to dispose of the waste. Consequently, in order to make the waste acceptable for disposal, site personnel will have to repackage the waste and may have to treat the 4 x 4 x 8-ft boxes as low-level waste as well.

Example 2: A requirements analysis was performed on the life-cycle plan for a specific new low-level waste stream that will generate odd-sized solid debris. The analysis

indicated that a standard waste box could be used to meet all the requirements for transportation, as well as satisfy the storage and disposal facilities waste acceptance requirements.

To ensure that the waste container performs as expected, the following need to be considered when placing waste in the packaging:

- Containers free of deformations or imperfections that may cause a loss of container integrity before the designed lifetime.
- Waste placement in a manner that does not adversely affect the integrity of the waste container.
- Containers utilized such that void space within the container is minimized, although care should be taken to avoid exceeding weight or other limitations identified through consideration of the life-cycle management process.
- Waste container labels and markings permanently applied.

The selection of the container is influenced by the storage conditions, storage duration, and the monitoring expected for the waste containers. Ensuring waste containers provide confinement for their expected storage life is therefore dependent on ensuring an appropriate storage environment consistent with the container characteristics. Storage of low-level waste containers is addressed in the guidance for DOE M 435.1-1, Section IV.N.

Vents. The use of vents or another mechanism for controlling the accumulation of gases and/or build up of pressure within the waste container needs to be considered when low-level waste is packaged or repackaged. Based on the characterization of the waste, a determination is made as to whether the waste contains materials which could evolve gases (e.g., through decomposition of organics or radiolysis). The life cycle management of the waste container is also considered from the standpoint of exposure to environmental conditions that could cause atmospheric pressure in the waste container to vary enough from the ambient pressure so as to cause a breach of confinement. Either of these safety-related conditions may result in a decision to use vent clips, permeable gaskets, or other means for controlling the potential hazards.

Example: Steel boxes are being used to store, transport, and dispose of low-level waste. The inherent design of the steel box eliminates any possibility for it to become pressurized or otherwise generate hazardous concentrations of gases.

If vents are warranted, waste managers need to consider installation of vents or other mitigating measures at the time the waste is packaged. By installing the vents at the time waste is packaged, unnecessary waste container handling and the associated radiation exposure can be avoided. For waste containers currently in storage, a waste manager needs to consider the safety hazards associated with the containers and install vents as appropriate to mitigate hazards. What action may be appropriate depends on the immediacy of a hazard associated with the waste containers. If hazardous concentrations of gases could be generated (e.g., based on similarity of waste container contents to waste streams known to be a problem, or physical indications such as bulging drums), action needs to be taken to prevent an accident while the waste is in storage. If there is no perceived imminent threat, the appropriate time to install vents or apply mitigating measures may be when the waste containers are being prepared for transfer to the next step in the waste management cycle.

> *Example: Low-level waste sludge is currently stored in sealed steel drums which are scheduled to be disposed shortly. Analysis of the characterization information for the waste indicates the possibility for the generation of flammable gases. Several representative drums are sampled for the suspect gas and an analysis is performed. Based on the low concentrations found it is determined that the drums do not need to be vented.*

Marking and Labeling. The marking and labeling of low-level waste containers need to be done in a manner that allows traceability to the documentation of the waste characteristics and container information. The marking or labeling needs to be applied in a manner that will be visible if the waste package is on the outside of a storage or transportation array. For a 55-gallon drum, this is generally accomplished by placing the marking or labeling about every 120 degrees around the outside of the drum. For a waste box, acceptable labeling can be accomplished by placing labels on each side of the box. Waste package identification should be in medium to low density Code 39 bar code symbology in accordance with ANSI/AIM-BC1-1995. Bar coding is to be a minimum of 1 inch high and should be accompanied by alphanumeric characters at least ½ inch high. Durability and readability of marking and labeling is one of the items included in the inspection program for waste in storage (see guidance for DOE M 435.1-1, Section IV.N.(1)(d)).

> *Example: A waste generator is packaging waste in accordance with its site certification program that successfully certifies low-level waste for disposal at the Nevada Test Site. In accordance with the NTS certification procedures, labels meeting ANSI/AIM-BC1-1995 that contain the waste stream identifier, shipment identifier, and unique package identifier are placed in two locations in accordance with Appendix C of the NTS WAC, Rev.1. This satisfies the marking and labeling requirement.*

Waste characterization and the container documentation is to be associated with each individual container of waste. Guidance related to documentation is discussed in guidance for Waste

Transfer (DOE M 435.1-1, Section IV.K). The documentation needs to include the aspects relative to container selection including, the designed service life, the environments that the container was designed for and is compatible with, and other information necessary to allow proper use of the container.

Compliance with the packaging requirement is demonstrated by: (1) procedures which document proper packaging protocols; and (2) no trends of routine repackaging of low-level waste that is packaged after issuance of DOE O 435.1. Successful performance of this requirement is also demonstrated by a record of containers for which failure has not routinely occurred under management conditions. It is recognized that there may be failed containers for waste previously placed in storage. For those containers, the goal is to only have to repackage the waste one time after it is retrieved and characterized. Further, acceptable performance is demonstrated by containers of waste having marking and labeling that allows correlation with waste characterization data and container information.

Supplemental References:

1. DOE, 1995. *Departmental Materials Transportation and Packaging Management,* DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

2. DOE, 1996. *Packaging and Transportation Safety,* DOE O 460.1A , U.S. Department of Energy, Washington, D.C., October 2, 1996.

3. DOT. *Shippers-General Requirements for Shipments and Packagings,* 49 CFR Part 173, U.S. Department of Transportation, Washington, D.C.

4. ANSI/AIM, 1995. *Uniform Symbology Specification Code 39*, ANSI/AIM-BC1-1995, American National Standards Institute, Automatic Identification Manufacturers, Pittsburgh, PA, August 16, 1995.

IV. L.(2) Transportation. To the extent practical, the volume of waste and number of low-level waste shipments shall be minimized.

Objective:

The objective of this requirement is to reduce the risk associated with low-level waste management by reducing the number of miles traveled in transporting waste. This is to be done by the efficient use of waste containers, minimizing the volume of waste which requires shipment, and optimizing shipping plans and schedules.

Discussion:

The need for transportation requirements specific to waste management concerns was evaluated in the development of DOE O 435.1, *Radioactive Waste Management* and the *Radioactive Waste Management Manual* (DOE M 435.1-1). An analysis of existing requirements affecting waste transportation identified the Department of Transportation (DOT) regulations (49 CFR) and the DOE Orders, DOE O 460.1A and DOE O 460.2 (see DOE M 435.1-1, Section I.1.E.(11)), as sources of applicable requirements. Generally, the DOT requirements apply to offsite shipments. *Packaging and Transportation Safety* (DOE O 460.1A) invokes the DOT requirements, or documented requirements providing equivalent safety, for onsite shipments. *Departmental Materials Transportation and Packaging Management* (DOE O 460.2) includes DOE policies and requirements specific to DOE that supplement the DOT regulations. Requirements from DOE O 460.2 relevant to low-level waste transportation address development of a Transportation Plan for high-visibility shipment campaigns, use of the Department's Transportation Tracking and Communications System, and administrative requirements. Additionally, for waste exceeding Type A quantities of radioactive material per DOT requirements, notification of the expected date of arrival is to be given to the site to which the waste is being shipped, and if the waste is not received on the expected day, notification of the shipper is mandated.

The DOT requirements and DOE packaging and transportation requirements were considered adequate for ensuring safe transportation of the waste. However, recognizing that one of the higher risks associated with waste management is from the number of miles traveled in transporting waste, low-level waste shipments should be minimized to reduce worker exposure, risk, and cost. This can be achieved, in part, by ensuring that all containers or primary packagings (e.g., drum or waste box) are used to capacity, and that transportation systems are efficiently utilized. Reaching the capacity (volume or weight) of the waste container should be a goal of every waste packaging operation. Containers should be filled so as to minimize void volume and allow closure, without exceeding its container weight capacity or compromising its integrity, or waste acceptance criteria of the storage, treatment, or disposal facility.

> *Example: Miscellaneous low-level waste such as personnel protective equipment, contaminated tools, and paper and plastic sheeting are being packaged in 55-gallon drums for eventual disposal. Site personnel use a compactor to maximize the amount of waste placed in the drum. Administrative controls ensure that drum weight limits are not exceeded.*

The same goal applies to transport systems, where waste containers should be held and accumulated until a sufficient number of packages is available to make cost-effective use of the transportation system. Additional guidance on accumulation of packages for cost-effective transportation (i.e., staging) is addressed under guidance on storage (DOE M 435.1-1, Section IV.N).

The distance low-level waste is transported, and the number of times waste is physically handled is directly related to the risk of release or exposure. As part of the planning and documentation concerning the life-cycle management of low-level waste, the Site-Wide Radioactive Waste Management Program should seek to reduce the number of times the waste is handled or otherwise transported. Site low-level waste management programs need to ensure that both on-site and off-site transport and handling is minimized.

> *Example 1: A site that generates small quantities of low-level waste performed an optimization study and determined the nominal volume of waste that needed shipment off-site for the year. Staging the waste prior to transport reduced the number of shipments and allowed the transfer of the waste to occur during the summer when road conditions were best.*

> *Example 2: A waste management operation on a large DOE reservation generates low-level waste that can only be fully characterized by facilities located elsewhere on the reservation. Staging the waste and transferring it during off-peak traffic hours reduced the number of shipments across publicly-traversed roads on the reservation, and helped minimize the risk to the public.*

Low-level waste transportation needs will be specific to each site. Availability of treatment, storage, and disposal capabilities, as well as funding profiles, will influence the need to ship low-level waste. In this requirement, the term “to the extent practical” means that site personnel have latitude in making decisions regarding what is practical for their particular situation. This requirement is not intended to force decisions that are contrary to safe waste management, regulatory compliance, or cost-effectiveness. Detailed and documented planning that provides the rationale for a waste shipment regimen is the best way to balance this requirement with site-specific realities.

> *Example: A site-specific evaluation was performed to support a recommendation on either building low-level waste storage capacity or maintaining the current number of small off-site shipments. The evaluation indicated that concerns over building the storage facility outweighed the potential to minimize shipments and the current shipment regimen was continued. The evaluation was included as part of the Site-Wide Waste Program documentation.*

Transportation over the nation's highways and railways results in the most direct contact between the Department’s radioactive waste and the general public, stakeholders, and representatives of States, Tribes, and local government organizations. These groups are primarily concerned with the shipment of these materials through states, cities, and neighborhoods. Efforts to minimize the volume and number of low-level waste shipments will help alleviate their concerns.

Compliance with this requirement can be demonstrated by a combination of site procedures directing the efficient use of waste container capacity and documentation showing that low-level waste shipments are systematically planned and optimized to the extent practical.

Supplemental References:

1. DOE, 1995. *Departmental Materials Transportation and Packaging Management*, DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

2. DOE, 1996. *Packaging and Transportation Safety*, DOE O 460.1A, U.S. Department of Energy, Washington, D.C., October 2, 1996.

3. DOT. *Shippers-General Requirements for Shipments and Packagings*, 49 CFR Part 173, U.S. Department of Transportation, Washington, D.C.

IV. M. Site Evaluation and Facility Design.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for low-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

Objective:

The objective of this requirement is to ensure that a suitable site location is selected and relevant features of the proposed site that should be included in the design of a low-level waste management facility are evaluated so the facility can be appropriately designed to provide protection to the public, workers, and the environment, and to identify features of the site that would be detrimental to this goal so they can be avoided.

Discussion:

DOE M 435.1-1 includes the requirement in Chapter I, *General Requirements and Responsibilities,* to adhere to the requirements contained in DOE O 420.1, *Facility Safety,* and DOE O 430.1A, *Life Cycle Asset Management,* in site evaluation and facility design. In the development of DOE M 435.1-1, additional requirements for site evaluation were considered to be necessary to ensure that full consideration of the beneficial or detrimental aspects of a site are considered to assure that the site location is adequate and to form a sound basis for facility design that is protective of the workers, the public, and the environment. The importance of site evaluation was established by the awareness that the characteristics of the site contribute to a large extent to the ability of the facility to function as planned and in the minimization of the transport of radionuclides to members of the public and the potential contamination of the environment.

The subrequirements included in this section are intended to ensure that sites selected for low-level waste management facilities are properly evaluated, especially sites for low-level waste disposal, and that sites are not used for which detrimental aspects of the site cannot adequately be designed against without still compromising the protection of the public, workers, or the environment. Guidance on subrequirement IV.M.(1)(a) discusses the minimum specific characteristics of sites for low-level waste management facilities that should be evaluated. Specific characteristics of a site for a low-level waste disposal facility are identified in the requirement that must be considered. Guidance on selection of a suitable site for new disposal facilities is also included.

Guidance on subrequirement IV.M.(1)(b) provides information on those aspects of a site for which adequate protection cannot be provided through facility design, and guidance on subrequirement IV.M.(1)(c) provides detailed guidance on evaluation of sites for low-level waste disposal facilities that provide for additional contributions to meeting the goals and objectives contained in this Order and Manual for disposal of low-level waste. Site evaluation includes the selection and characterization of potential sites, which are necessary steps in the development of a new low-level waste management facility. Selection of sites for DOE low-level radioactive waste management facilities is constrained to those federal lands owned and managed by DOE. Within DOE reservations, the process of selecting sites has the purpose of identifying the best location with consideration of those natural features which are desirable for the facility. Characterization of a selected site has the purpose of developing the necessary data to support a site-specific design of the facility.

The site selection process is likely to vary from one DOE site to the next, because of substantial differences in geology, hydrology, meteorology, ecology, and socioeconomics. Similarly, the interests of stakeholders, as they are involved in the process, are likely to influence the issues to be addressed in site selection, and vary from one DOE site to the next. Site characterization is a program of investigations and tests to determine the properties of the site that are important to the design of the facility and the analysis of facility and site performance. While generalized program elements are defined in this guidance, details of the program can only by derived from site-specific and facility-specific considerations.

> *Example: New disposal facilities are being considered at the Hanford Reservation and Savannah River Site. The Savannah River Site evaluation includes the evaluation of surface water, while the Hanford Reservation site evaluation does not. Likewise, the Hanford Reservation site evaluation includes the consideration of wind erosion, while the Savannah River Site evaluation does not.*

Compliance with this requirement is demonstrated by proposed site evaluations that are comprehensive, defensible, and provide sufficient data for facility design, other required analysis, and for avoiding site characteristics that could compromise objectives for safety and protection of the environment, and by the inclusion of the evaluations in the radioactive waste management basis documentation for the facilities.

Supplemental References:

1. DOE, 1995. *Facility Safety*, DOE O 420.1, U.S. Department of Energy, Washington, D.C., October 13, 1995.

2. DOE, 1998. *Life Cycle Asset Management*, DOE O 430.1A, U.S. Department of Energy, October 14, 1998.

IV. M.(1) Site Evaluation. Proposed locations for low-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new low-level waste facility or expansion of an existing low-level waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities, including for a low-level waste disposal facility, the capability of the site to demonstrate, at a minimum, whether it is:

1. Located to accommodate the projected volume of waste to be received;

2. Located in a flood plain, a tectonically active area, or in the zone of water table fluctuation; and

3. Located where radionuclide migration pathways are predictable and erosion and surface runoff can be controlled.

Objective:

The objective of this requirement is to ensure that specific evaluations are performed as part of the evaluation of a site for a low-level waste management facility, and that the evaluations are appropriately considered in the final site selection and layout, and the design and construction of the facility. In particular for low-level waste disposal facilities, the objective of this requirement includes ensuring that particularly important site attributes have been evaluated.

Discussion:

This subrequirement identifies the primary site characteristics that must be evaluated in the process of establishing a new low-level waste storage, treatment, or disposal facility, or an expansion of an existing facility, so that the features of the site can be thoroughly understood, that a determination can be made that the site is suitable to support the facility, and so the relevant features of the site can be appropriately factored in the facility design. Each of the items is discussed in the sections that follow.

Some of the site characterization data and evaluations specified in the requirement may already or are going to be included in documents required for authorization of facility construction and operation, or documented separately. These documents include analyses prepared in accordance with the *National Environmental Policy Act*, the Preliminary Safety Analysis Report, the Performance Assessment and Composite Analysis (for disposal facilities), and others. If data already exist or are being prepared for additional documentation or other purposes, then sufficient references to other documents should be used in establishing the suitability of the site and for inclusion in the design of the facility.

Some of the site characteristics and how they affect design are more significant if the proposed facility is a disposal facility. Specific minimum site attributes are listed in the requirement which must be thoroughly evaluated and included in the disposal facility design. These site attributes are also critical in determining the suitability of the site for a disposal facility. Guidance on these site criteria are discussed under Site Selection for a Disposal Facility.

Environmental and Geotechnical Characteristics. The basic environmental and geotechnical characteristics of a proposed site must be established to determine its suitability for the proposed use, and so that basic parameters needed for the design of the facility are identified. Basic elements of this characterization program include meteorology, surface water hydrology, groundwater hydrology for both saturated and unsaturated media, geology, soils, water quality, site stability, air quality, ecology, land and cultural resources, and socioeconomics. Field studies should be performed so as to not compromise the integrity of the land to be dedicated to waste management activities. The extent of investigation in each of these broad topic areas is dependent on the site specific characteristics of the proposed site. Data collected during the site characterization program need to reflect application of the data quality objectives (DQO) process to ensure meaningful and wise use of resources. The characterization of the site is carried out in accordance with the site's quality assurance program, including maintaining records of data collected. Documentation of the results of the site characterization program is not only needed for use in design, but it also may serve a valuable purpose in fulfilling the requirements of the NEPA process.

Design basis events need to be identified and assessed as to their potential impacts on the safe operation of the facility. Design basis events are certain severe natural events that are estimated and assumed to occur in order for their impact (or design loadings) to be imposed on the proposed facility to ensure design of a safe facility. The establishment of the severity of the events is called the design-basis event. A naturally occurring event that needs to be assumed for a design basis event may be tectonic (seismic, volcanic, ground rupture), hydrologic or meteorologic (storms, floods, hurricanes, tsunamis, seiches). Design basis events are typically assumed to occur for both the operating condition (normal) and for accident conditions (abnormal) to establish the envelope of potential hazardous situations that must be designed against.

Natural phenomena that may exist or that can occur in the region of a proposed site need to be identified and assessed according to their potential effects on the safe operation of the facility. The important natural phenomena that affect the facility design must be identified. These phenomena are considered different than the design events described above in that these are not severe events, rather they are normal active processes that are evaluated that may determine simpler design items such as the material of construction for non-critical items such as ramps, doorway overhangs, and covers for staged waste. Natural phenomena such as rainfall, snowfall, wind direction and speed, erosion rates presence of faults, landslide areas, and other natural events that could influence certain aspects of the design in addition to the design basis events discussed above are evaluated. Records of events within the region, including their severity, need to be evaluated for their reliability, accuracy, and completeness. Appropriate methods (including conservatism) are adopted for evaluating site characteristics of the region and the current state of knowledge about such events, and to select those external natural events, other than design basis events, on which the design of the facility would be based.

> *Example: A new facility for treating low-level and mixed low-level waste is proposed for a site in the northwest quadrant of the DOE site in Kansas. The particular region has severe downpours during the summer months, so the design of the facility includes drainage features to handle a severe rainfall of up to 4 inches per hour.*

Human Activities. The region needs to be examined to identify past, present, and proposed man-made facilities and activities that could affect the safe operation of the facility. Man-made facilities or influences include such items as upstream dams and other alterations to drainage basin features, mining, highway construction, housing and industrial development, or establishment of protected areas or wilderness zones. Information regarding past, present, and potential occurrences are collected and evaluated for reliability, accuracy, and completeness. Appropriate methods (including conservatism) need to be adopted for evaluating the man-induced events within the region and the current state of knowledge about such events to select those events on which the design of the facility will be based.

> *Example 1: The projected improvements of a public highway through the Oak Ridge Reservation could affect the groundwater hydrology associated with the a new disposal facility, and should be evaluated.*

> *Example 2: A proposed disposal facility is located upstream of a potential hydropower dam site. The impoundment associated with the potential dam could raise the water table underlying the site by 100 feet. The significance of this potential development should be evaluated as part of the site evaluation.*

The site of a proposed low-level waste management facility needs to be evaluated with respect to the effects construction and operation of the facility may have on the populations and

environmental characteristics of the region, including the transportation of radioactive materials to or from the facility. The evaluation is based on the population and environmental characteristics of the region including:

1) the regional extent of external phenomena;

2) present and future population distribution;

3) present and proposed land and water uses in the region;

4) any special characteristics that would influence the consequences of releases of radioactive material during the life cycle of the facility.

The potential impact of the waste management facility construction, operation, and decommissioning also need to be evaluated, considering both usual and unusual regional characteristics.

Example: A new disposal facility is proposed to receive waste from other DOE sites. The new facility will accept wastes delivered by truck with an anticipated receipt of 40 trucks per day. The capability of the existing road system of handling an additional 40 fully loaded trucks per day should be evaluated and include the potential increase in the population in the nearby community.

Site Selection for a Disposal Facility. The process of site selection for a new DOE low-level waste disposal facility is initially narrowed to the DOE reservation being considered for facility development, and the direction of the process is toward identifying the best site within the reservation. This is different from the way sites are selected for commercial low-level waste disposal facilities. Sites for commercial facilities are selected from large geographic areas where ownership of the land may be under private or public control. Site selection processes for commercial facilities are directed toward identifying sites that meet site suitability requirements, as defined in 10 CFR Part 61, Subpart D. For DOE site selection, rather than meeting suitability criteria for a site, the process seeks a site which will contribute to meeting the performance objectives and other specific technical requirements of DOE M 435.1-1. The requirement, therefore includes minimum site attributes that must be evaluated to determine their respective contributions towards meeting the performance objectives. This differing direction can lead to DOE sites being selected that are located adjacent to or within lands previously contaminated, or sites where existing characterization information supports the requirements of DOE M 435.1-1, and the costs of characterization, design, construction, operations, and closure are minimized.

The site selection process is a formalized activity that is documented, reviewed and approved by the DOE field organization and incorporates stakeholder interest to the extent appropriate. The

documentation of the site selection process needs to describe the method developed for selecting sites and the criteria used as a basis for including or excluding sites. These criteria must include the attributes listed in subrequirements (a), (b), and (c), at a minimum, and include additional site- and facility-specific selection criteria that address specific attributes that are important to site or facility operations. However, it is not intended that these criteria be used as exclusionary conditions to eliminate a site from being considered, but instead provide a measure of evaluation of the site's contributions to performance of the disposal facility. Use of existing facilities on DOE reservations should be considered to the extent practical. The minimum site selection attributes in the subrequirements are the most critical items that must be evaluated in order to respond to requirement IV.M.(1)(b) and IV.M.(1)(c). That is, these items are the most critical in terms of attributes of a site that must be avoided or that need to be prevalent in order that there is a reasonable contribution of the site towards achieving the performance objectives. As such, the specific attributes are discussed further in the following sections of this guidance.

The site selection process can and should be conducted using a reconnaissance level data base which is comprised of existing studies and available information on the various features of candidate sites within the DOE reservation. The data used in selecting a site need to be presented or referenced to provide a reasonable basis for site characterization and design investigations. The results of the site selection process lead to the identification of one preferred site for site characterization. The documentation of the site selection process also provides a useful contribution to the NEPA process, which must be addressed as part of the development of a low-level waste disposal facility.

The basic steps to be included in a site selection process for a low-level waste disposal facility are discussed in detail in the Nuclear Regulatory Commissions's NUREG-0902, *Site Suitability, Selection, and Characterization: Branch Technical Position*. For the purpose of site selection at DOE reservations, these steps are:

- Identification of the region of interest, which is the DOE reservation;

- Screening the region of interest to identify potential sites;

- Screening of potential sites against a common set of criteria to identify a slate of candidate sites; and

- Review the candidates sites in detail to identify a preferred site.

For DOE reservations, available information will likely be sufficient to complete these basic steps in the site selection process. Additional information, in the form of feasibility studies, conceptual designs, preliminary cost estimates, or performance evaluations can be useful in conducting the last step in the site selection process. The preferred site is usually the only site that is subjected to

detailed site characterization. If the site characterization program identifies a significant and unanticipated weakness, another candidate site could be considered for site characterization to the extent necessary to justify a preferred site.

> *Example: A new disposal facility is considered at INEEL where the preferred site is expected to have deep soil deposits and is located in close proximity to existing roads. A drilling program is initiated to establish the local site characteristics, which reveal shallow soil deposits. The preferred site is reconsidered and an alternative preferred site is selected where soil deposits are thicker, but the alternative preferred site is located further away from existing roads.*

Compliance with this requirement is demonstrated for low-level waste storage, treatment, and disposal facilities if the site evaluation comprehensively considers the environmental and geotechnical characteristics of the site, the design basis events, external man-induced events, and the effects of the low-level waste management facility on the region, and includes those features and events in the design of the facility. Compliance with the requirement is demonstrated for low-level waste disposal facilities if, in addition, the site evaluation comprehensively considers the site's capabilities in demonstrating whether it is located in a flood plain, tectonically active area, or in the zone of water table fluctuation, and is located where the projected volume of waste can be accommodated and where radionuclide migration pathways are predictable and erosion and surface water runoff can be controlled. All analyses and justifications for evaluation and controls must be part of the radioactive waste management basis for the facilities.

Supplemental References:

1. NRC. *Licensing Requirements for Land Disposal of Radioactive Waste*, 10 CFR Part 61, U.S. Nuclear Regulatory Commission, Washington, D.C.

2. NRC, 1982. *Site Suitability, Selection and Characterization: Branch Technical Position–Low-Level Waste Licensing Branch*, NUREG-0902, U.S. Nuclear Regulatory Commission, Washington, D.C., April 1982.

IV. M.(1) Site Evaluation. Proposed locations for low-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Objective:

The objective of this requirement is to avoid sites for which postulated severe natural events cannot be protected from adequately through design and construction and to continue to have assurance that the public safety and health will be protected and the impacts on the environment will continue to be minimized.

Discussion:

This subrequirement provides a performance-based requirement on the use of facility design for meeting the public, worker, and environmental protection requirements of DOE O 435.1 and DOE M 435.1-1. The site, in most cases, functions as the primary barrier for protection against the hazards from the low-level waste management facility during the severe events that are characterized for the site. Engineering alone generally should not be relied upon to overcome weaknesses that are of a severity such that the site itself cannot be considered a contributor to or the primary barrier against the impacts of the design basis events. Facility design and engineering must, together with environmental and geotechnical characteristics, provide adequate protection of workers, the public, and environment in accordance with the performance objectives stated in DOE O 435.1.

For a proposed low-level or mixed low-level waste disposal facility, the determination that a postulated design basis event is so severe or a site is so weak that no amount of engineering or design can make the proposed site suitable is likely to require consideration of different events and a longer period of time than other types of waste management facilities. This is because the disposal facility must perform at a high level of performance for such a long time due to the hazards present from the disposed waste (especially in comparison to the planned short life of a storage facility, for example), and the delicate nature of the behavior of ground water and other geotechnical phenomena known to affect waste disposal sites. Additional detailed guidance on meeting this DOE M 435.1-1 requirement for low-level waste disposal facilities is discussed below under guidance for DOE M 435.1-1, Section IV.M.(1)(c).

The selection, characterization, and evaluation of the proposed site for a low-level waste management facility may identify external events which cannot be adequately addressed by design to achieve the goals and objectives of the requirements of DOE O 435.1.

> *Example: Area A has been selected for more detailed evaluation for construction of a new storage facility and low-level waste disposal facility. Flooding within Area A is determined to be too severe to consider any design adequate for providing reasonable assurance that the performance objectives will continue to be met for the time of compliance currently used (1000 years) for a low-level waste disposal facility. However,*

adequate facility design controls are identified which would allow construction and operation of the proposed storage facility.

For proposed sites that cannot meet the requirements of the Order and Manual Chapter IV, the requirement states that the preferred site for the facility must be declared unsuitable. The specific determinations of areas unsuitable for low-level waste management facilities should be thoroughly documented along with justifications for this conclusion. This documentation is retained as part of the evaluation of the site which is ultimately selected for full site characterization and development.

If no areas of a DOE reservation can be found that are suitable for establishment of a new low-level waste management facility, the Field Element Manager may need to conclude that the management of low-level waste at the DOE reservation is not appropriate, and shipment of waste to another DOE site or to a commercial site for treatment, storage, and/or disposal is appropriate. This information needs to be factored into the life-cycle planning information contained in the Site-Wide Radioactive Waste Management Program and into the Complex-Wide Radioactive Waste Management Program as soon as practical.

Compliance with this requirement is demonstrated if design basis external events are evaluated and a reasonable determination is made that proposed sites for low-level waste management facilities are either suitable or unsuitable based on the protection afforded by the proposed site and from facility design to address design basis external events. The analyses and documentation of the determination must be included as part of the facilities' radioactive waste management bases.

Supplemental References:

1. NRC, 1982. *Site Suitability, Selection and Characterization: Branch Technical Position--Low-Level Waste Licensing Branch*, NUREG-0902, U. S. Nuclear Regulatory Commission, Washington, D.C., April 1982.

IV. M.(1) Site Evaluation. Proposed locations for low-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(c) Low-level waste disposal facilities shall be sited to achieve long-term stability and to minimize, to the extent practical, the need for active maintenance following final closure.

Objective:

The objective of this requirement is to ensure the selection of proposed low-level disposal sites within DOE reservations that have positive attributes toward meeting the disposal performance objectives of DOE M 435.1-1, and to the extent practical, ensure that new low-level waste disposal facilities are not sited in locations which will inherently require long-term active maintenance to achieve disposal performance objectives.

Discussion:

DOE M 435.1-1 includes the general requirements for site evaluation and facility design in Section I.1.E.(18). This additional requirement, which applies to low-level waste disposal facilities, emphasizes the need for long-term stability and minimal maintenance. This requirement recognizes the importance of stability and minimal maintenance to the long-term performance of a low-level waste disposal facility.

The evaluation of the data collected during site selection and characterization must include the consideration of long-term stability and active maintenance following closure. Consideration of the site characteristics to achieve long-term stability in site selection and facility design minimizes the need for active maintenance following site closure. As part of the documentation for selecting a preferred site, the evaluation needs to demonstrate how long-term stability of the site was considered. Furthermore, data developed during site characterization that quantifies the long-term stability characteristics of the site are to be evaluated separately. Aspects of the site stability which need to be incorporated into the design of the facility to minimize active maintenance following site closure need to be identified.

Site characteristics, waste and container characteristics, operational practices, and disposal unit closure all contribute to long-term stability. Disposal site stability is a necessary performance parameter for meeting the requirements of DOE O 435.1. During site operations and in the closure and post-closure periods, any indication that stability may be compromised needs to be addressed immediately.

> *Example: Two sites are being evaluated as potential sites for a disposal facility. One site is underlain with limestone formations associated with karst development, and the other site is underlain by cemented sandstone. All other considerations being equal, the latter site is selected as a disposal site in favor of the greater potential long-term stability provided by the cemented sandstone formation.*

As part of site maintenance, site inspection to verify the stability of the site is appropriate. Closure planning also needs to address site specific stability. Specific elements which may need to

be addressed will likely be revealed through performance assessment maintenance, or from monitoring activities.

Site Characterization. The site characterization program has the objective of developing a quantitative database for design and performance assessment through field studies and laboratory testing. A program plan describing the nature and extent of the site characterization program for a preferred site is a valuable tool for guiding investigations. The objectives of a site characterization program are discussed in detail in the Nuclear Regulatory Commission's NUREG-0902, *Site Suitability, Selection and Characterization: Branch Technical Position*. For the purpose of site characterization at DOE sites, the following specific objectives for developing technical information are useful in developing a program plan.

- Providing a reasonable expectation that the performance objectives of DOE M 435.1-1 are likely to be met;
- Evaluating the ability of the site to contribute to the containment of low-level waste;
- Providing adequate information for design of a low-level waste disposal facility;
- Identifying the interaction between the site, waste containers, and low-level waste;
- Establishing data collection points, baseline environmental data, and some portion of the environmental monitoring program; and
- Identifying potential environmental impacts from construction, operation, and closure of the facility.

The site characterization program needs to be site-specific and flexible to allow for revisions in the program as data are developed. The program needs to be developed to allow for the collection of baseline environmental data for a least one year prior to construction, with extended periods of time preferred for parameters subject to seasonal or annual variations (see guidance on DOE M 435.1-1, Section IV.R.(3)(b)). For baseline environmental data, the collection points are selected to continue to serve as collection points throughout the life cycle of the facility, to facilitate meaningful interpretation of data. Regional data collected over extended periods of time are useful supplements to the site characterization program.

Example 1: A new low-level waste disposal facility site characterization program includes the investigation of the subsurface structure with the objective of confirming the absence of perched water. Specific parameters and measurements were selected through a recently performed data quality objectives effort for the characterization program.

Drilling data indicate the presence of a perched water deposit on the perimeter of the proposed site. The subsurface investigation program is expanded to establish the extent of the perched water deposit and its significance with respect to the performance of the disposal facility.

Example 2: A new disposal facility characterization program erects a meteorologic tower to collect wind and precipitation data with the objective of confirming site conditions are representative of regional conditions. Specific parameters and measurements were selected through a recently performed data quality objectives effort for the characterization program. Initial data clearly indicate the site conditions differ from regional conditions. The frequency of data collection is increased and baseline monitoring program extended to provide sufficient data for design and performance assessment activities.

Basic elements of the site characterization program include meteorology, surface water hydrology, groundwater hydrology for both saturated and unsaturated media, geology, soils, water quality, site stability, air quality, ecology, land and cultural resources, and socioeconomics. Field studies are performed in a manner that does not compromise the integrity of the land to be dedicated to waste disposal. The extent of investigation in each of the topic areas is dependent on the site-specific characteristics of the preferred site. Data to be collected during the site characterization program need to be selected in accordance with the data quality objectives (DQO) process to ensure meaningful and wise use of resources. The quality assurance and record keeping requirements of DOE M 435.1-1 are followed for all aspects of site characterization to ensure that data records are maintained and retained throughout the life cycle of the facility. Documentation of the results of the site characterization program is used in facility design, performance assessment, waste acceptance criteria development, and in fulfilling the requirements of NEPA.

Site characterization program plans are reviewed and approved prior to initiation of investigations to ensure that important elements are included and unnecessary activities are not undertaken. The program is executed by skilled professionals with a multi-disciplinary team of experts representing environmental and facility monitoring, design, performance assessment, and waste operations. Routine reviews of collected data are performed to ensure the site characterization program is accomplishing its specific objectives. The site characterization program also needs to be integrated with other elements of facility development to ensure characterization information is correctly utilized in those other elements, principally the performance assessment and facility design.

Additional general guidance for site evaluation and siting of low-level waste disposal facilities is available from a variety of sources to be consulted (NRC Reg. Guide 4.19, DOE/LLW 64T,

DOE/LLW 75T Tab I, DOE/LLW 67T) and incorporated into site-specific investigations where appropriate.

<u>Site Features Contributing to Stability and Prevention of Maintenance</u>. The requirement to site facilities for long-term stability and to minimize active maintenance specifically states that these attributes are to be attained following closure of the low-level waste disposal facility. As discussed above, these attributes are necessary because the hazard from the disposed low-level waste will remain for years following closure. Disposal sites that do not require active maintenance following closure are more likely to be able to demonstrate a reasonable expectation that the disposal performance objectives will continue to be met. The following discussion provides additional information on site features that contribute to stability and prevention of maintenance at a site.

A low-level waste disposal site needs to be located in an area where hydrogeologic conditions allow reliable prediction of performance. Subsurface migration of radionuclides needs to be readily and confidently predictable. Such systems may be characterized by thick, partially saturated zones; low moisture flux through the burial zone; and/or geologic formations with permeability flow systems that are readily characterized.

A low-level waste disposal site also needs to protect the waste from contact with or intrusion of water. Materials that can be shaped into a final landscape that diverts offsite surface and subsurface water, combined with the resistance of the soil material to wind and water erosion and the ability of the soil material to support certain kinds of vegetation will contribute to the disposal facility remaining in a stable state.

A low-level waste disposal site needs to include characteristics of earth materials and water chemistry that favor increased residence times and/or attenuation of radionuclide concentrations in the subsurface. Attenuation of radionuclide concentrations and slow rates of migration will increase the retention of radionuclides near the burial trenches. Soil and water chemistry characteristics that favor retardation provide an additional safety factor in slowing the migration of many radionuclides.

> *Example: The site for the expansion of the low-level waste disposal facility at Site Y is considered very advantageous for this purpose. The site is underlain by a simple, sedimentary layered system consisting of clay and sand horizons which are relatively easy to conceptualize in mathematical modeling. The clay layer that will form the floor of the trench has been investigated thoroughly and the flow parameters are well understood. The layer will act as a retardant for migration of several critical radionuclides that will be disposed at the facility. Geomorphic investigations of the site have revealed no evidence of active geologic processes that would lead to erosion or*

other facility surface problems that would impact the ability of the site to maintain long-term stability.

<u>Site Features that Should be Avoided</u>. Particular features need to be avoided that contribute to site instability or transport of radionuclides from a site to potential receptors.

The disposal horizon needs to be outside of the transition zone between saturated and unsaturated flow, and preferably well above the transition zone or water table. Avoiding the transition zone requires extensive knowledge of the water table and its fluctuations. Factors to be evaluated include:

- Water table elevation and range of both seasonal and long-term fluctuations;
- Height of capillary fringe; and
- Thickness of material being excavated above the transition zone.

Complex flow systems, such as flow through cavernous, fractured, or jointed materials, may not be amenable to reliable predictions, and need to be avoided. A low-level waste disposal site needs to not be located where erosion caused by wind and water will jeopardize performance. During the required performance period, wind and water erosion needs to be at levels that would not cause intrusion on the buffer zone and/or waste cover in such a way as to uncover the waste, increase surface radiation levels above performance limits, or significantly shorten radionuclide release pathways.

Surface flooding or inundation needs to be avoided as such events can also accelerate transport of waste material and/or saturate the waste, increasing leachate formation and accelerating subsurface water flow.

Geologic hazards that could pose a threat to a low-level waste disposal site performance and which may need to be considered include:

- Seismic hazards associated with fault zones and earthquakes;
- Mass movement of earthen material, which can range from slow soil creep to slumping of oversteepened slopes to sudden massive slides of rock or debris;
- Volcanic activity; and
- Subsidence of the land surface, which frequently accompanies subsurface mining, withdrawal of oil, gas or water, or dissolution of geologic formations.

Example: The proposed site for the new Brown Facility Low-Level Waste Disposal Trenches is preferred because of its proximity to three operating treatment facilities at the Brown Site. However, the proposed disposal unit design will have the trench bottoms in the transition zone between the saturated zone and unsaturated zone, at least according to one study conducted several years before. Another more recent study indicates that the fluctuation has subsided, and that the trench bottoms are no longer in the transition zone. After further evaluations, the site for the proposed facility is moved to another location, still near the treatment facilities, but for which there is no dispute about the depth and extent of the transition zone.

Compliance with this requirement is demonstrated if low-level waste disposal facilities are sited so that natural features are present that contribute to the long-term stability of the disposal facility and helps minimize any need for maintenance after the facility is closed. Siting avoids any natural features present at the DOE reservation which would contribute to instability of the site or to migration of radionuclides from the site. Documentation of analysis of such features must be included in the radioactive waste management basis.

Supplemental References:

1. NRC, 1988. *Guidance for Selecting Sites for Near-Surface Disposal of Low-Level Radioactive Waste*, Regulatory Guide 4.19, U. S. Nuclear Regulatory Commission, Washington, D.C., August 1988.

2. NRC, 1982. *Site Suitability, Selection and Characterization: Branch Technical Position – Low-Level Waste Licensing Branch*, NUREG-0902, U. S. Nuclear Regulatory Commission, Washington, D.C., April 1982.

3. IAEA, 1994. *Siting of Near Surface Disposal Facilities*, Safety Series No. 111-G-3.1, International Atomic Energy Agency, Vienna, Austria, 1994.

4. DOE, 1987. *Site Selection: The Critical Path in Developing Low-Level Radioactive Waste Disposal Facilities,* DOE/LLW-64T, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1987.

5. DOE, 1992. *Site Characterization Handbook for Low-Level Radioactive Waste Disposal Facilities*, Revision 1, DOE/LLW-67T, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1992.

6. DOE, 1983. *Low-Level Radioactive Waste Management Handbook Series: Procedures and Technology for Shallow Land Burial*, DOE/LLW-13Td, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1983.

7. DOE, 1989. *Methodology for Compliance with DOE Order 5820.2A Chapter III: Management of Low-Level Radioactive Waste.* DOE/LLW-75T, Tab K, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, February 1989.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

Objective:

The objective of this requirement is to ensure that a minimum set of facility requirements and general design requirements determined from hazards analyses or policy considerations are applied to low-level waste treatment and storage facilities.

Discussion:

The facility requirements and general design criteria included in DOE M 435.1-1, Sections IV.M.(2) (a) through (e), are included as requirements to ensure adequate protection of the public, workers, and the environment from nuclear hazards. The requirements contained in these sections apply to new and existing low-level waste management facilities, unless the requirement specifies otherwise.

During the development of DOE O 435.1 and DOE M 435.1-1 an analysis of the hazards associated with the management of waste indicated that appropriate facility safety requirements and general design requirements are essential to ensuring the protection of the public, workers, and the environment. Therefore the intent is to apply these requirements to all low-level waste treatment and storage facilities, both existing and new. However, it is recognized that in some cases it may not be practical, or possible, to apply these requirements to existing low-level waste facilities or operations. Such conditions as limited programmatic usage, expected short service life of the operation, or factors that make long-term, capital-intensive upgrades unreasonable may be bases for not applying the requirements. In such cases, an exemption to the requirement may be warranted. The Implementation paragraph of DOE M 435.1-1 provides for an exemption to a requirement provided it is processed in accordance with the requirements of DOE M 251.1-1A, *Directives System Manual.* Additionally, note that the low-level waste treatment and storage facility design requirements need to be applied using a graded approach. The considerations and

controls identified in Sections IV. M.(2)(a) through (e) may not be applicable to some facilities, such as an outdoor storage yard for packaged low-level waste. These requirements are not intended to preclude such storage by forcing use of only facilities which possess all the items listed in requirements (a) through (e). Instead, the requirements are applied, using a graded approach, where the treatment or storage facility possesses characteristics to which the requirements are applicable.

> *Example: At Site Z it is determined that the requirement in DOE M 435.1-1, Section III. M.(2)(e), Monitoring, for an existing low-level waste tank is unreasonable due to the planned short service life of the tank. The existing tank is not routinely being used and would only be used over the next 18 months for emergency storage of liquid low-level waste. A replacement for the tank is under construction. In accordance with DOE M 251.1-1A, Chapter VII, "Exemptions," an Exemption Request is prepared that supports the position that application of the requirement is not justified by any safety and health benefit. The exemption request also notes that procedures will be implemented to ensure a once per shift visual check to ensure no waste is inadvertently transferred to the tank. The Exemption Request is processed in accordance with the requirements contained in paragraph 4, Exemption Process, in Chapter VII.*

DOE M 435.1-1 also allows for the use of the "Necessary and Sufficient Closure Process" or the integrated "Safety Management System." Use of these processes for deriving facility design requirements that provide protection comparable to the requirements contained in DOE M 435.1-1, Sections IV.M.(2) (a) through (e) is also acceptable at sites where these processes are invoked by contract.

Application of these requirements to all existing low-level waste treatment and storage facilities may appear to contradict the direction or guidance provided by some other DOE Orders that are invoked by DOE M 435.1-1, Section I.1.E., *Requirements of Other Regulations and DOE Directives*. In such cases the requirements contained in DOE M 435.1-1 do apply.

> *Example: Section I.1.E.(18), Site-Evaluation and Facility Design, invokes DOE O 420.1, Facility Safety. Guidance to DOE O 420.1 states that the design criteria included in the Order are "applicable to the design and construction of new nonreactor nuclear facilities and for modifications to existing nonreactor nuclear facilities when modifications significantly increase the probability or consequences of a nuclear accident or require a change in the Technical Safety Requirements (TSRs) of a facility. The definition of 'significant' is intentionally left to the judgment of the proposing contractor and the approving DOE authority. In part, this is intended to allow upgrading of existing safety equipment or installation of minor new improvements without subjecting the process to onerous procedural requirements and thus discouraging improvements." Thus, under DOE O 420.1 an existing low-level waste management facility that is to be*

> *"insignificantly" modified does not have to meet the design requirements of DOE O 420.1. However, under DOE M 435.1-1, the same facility must meet the design requirements of DOE M 435.1-1, Section IV.M.(2) (a) through (e), or follow the DOE M 251.1-1A exemption process. The requirements contained in DOE M 435.1-1 have precedence, and should be implemented.*

A "backfit" process has been discussed by the Department in the past to address changes that may be required through the imposition of a new DOE safety requirement. Such changes may be problematic for low-level waste facilities and systems that have been in existence for over 20 years. It is not the purpose of this order and manual to create such a process for the Department; however an existing or new field-office or Program Secretarial Office backfit analysis and review process may be applied to determine whether implementation of a proposed backfit could be justified on the basis of a substantial safety improvement or on a cost-benefit basis. One example of a candidate process is contained in expired DOE N 5480.5, *Imposition of Proposed Nuclear Safety Requirements*, which expired in 1993 because of an administrative provision. Another candidate process is described Draft DPOM-FS-300, "Treatment of Proposed Backfits," which was developed for the Office of Defense Programs, but not formally adopted. A third candidate process is documented in Westinghouse Savannah River Company, High Level Waste Management Engineering Procedure, ENG. 12, "HLWMD Backfit Analysis Procedure." For development of new backfit processes Nuclear Regulatory Commission requirements in 10 CFR 50.109 and 10 CFR 76.76 should be consulted.

Compliance with this requirement is demonstrated by documentation that supports the implementation of the requirements at DOE M 435.1-1, Section IV.M.2. (a) through (e), or documentation that supports the "Necessary and Sufficient Closure Process" or integrated "Safety Management System," or the DOE M 251.1-1A exemption process.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE G 420.1-X, September 1995.

2. DOE, 1993. *Defense Programs Operations Manual, "Treatment of Proposed Backfits,"* Revision 0, Draft DPOM-FS-300, U.S. Department of Energy, Washington, D.C., February 5, 1993.

3. DOE, 1998. *Directives System*, DOE O 251.1A, U.S. Department of Energy, Washington, D.C., January 30, 1998.

4. DOE, 1998. *Directives System Manual*, DOE M 251.1-1A, U.S. Department of Energy, Washington, D.C., January 30, 1998.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Low-level waste systems and components shall be designed to maintain waste confinement.

Objective:

The objective of this requirement is to ensure the design of low-level waste storage and treatment facilities includes the installation of equipment capable of containing low-level waste so that releases that could result in exposures to workers or the public or that could contaminate the environment are minimized.

Discussion:

This requirement is invoked to address hazards identified during the safety and hazards analysis performed in support of the development of this order and manual associated with the unexpected or uncontrolled release of radioactive material from low-level waste treatment and storage facilities that could impact workers, the public, or the environment. In addition to the facility and general design requirements contained in DOE M 435.1-1, Section I.1.E.(18), the above requirement for low-level waste confinement must be met.

The term "confinement" is defined in the DOE M 435.1-1 Glossary as:

> "The control or retention of radioactive materials within as a designated boundary. Primary confinement systems are process enclosures and other spaces normally containing hazardous materials. Secondary confinement areas surround one or more primary confinement systems."

In broad terms the purpose of confinement systems is to minimize the spread of radioactive and/or hazardous materials and the release of these materials in facility effluents during normal operations, abnormal operations, and potential accidents. One usual function of process equipment is to provide primary confinement and prevent or mitigate radioactive and/or hazardous material releases to the environment. Process equipment that would be required to provide primary confinement includes tanks, piping, pressure vessels, pumps, valves, and glove boxes. Secondary confinement are those systems that provide the next level of confinement and can include process equipment, (e.g., double-walled tanks, double-walled piping systems), as well as curbing and diking of liquid storage tank areas, or secure or closed areas of buildings, that

further prevent or mitigate uncontrolled releases of radioactive and/or hazardous materials to the environment. The need for redundancy and the degree of redundancy in these systems is determined by the safety analysis process and maintenance concerns for both active and passive components.

For a specific low-level waste facility or operation the number and arrangement of confinement systems or barriers and their required characteristics needs to be determined on a case-by-case basis. Factors that are considered in confinement system design include type, quantity, form, and conditions for dispersing low-level waste material during normal operations and design basis conditions. As in implementation of all of the requirements of DOE O 435.1 and DOE M 435.1-1, the graded approach is used for determining the appropriate level of rigor in applying this control to the management systems employed at a particular low-level waste management facility.

For treatment systems involving liquid low-level waste, it might be appropriate for primary confinement to be provided by process equipment (i.e, pipes) and facility design to provide for secondary confinement (i.e, curbing and diking). For storage of dry low-level waste, primary confinement could be provided by an appropriate container.

> *Example 1: The low-level waste management facility at laboratory A manages various types of low-level waste. Primary and secondary confinement for liquid low-level waste streams is provided by a double-walled piping and tank system maintained in the lab for management of those waste streams. Analysis indicated that the confinement provided by the containers for dry process wastes is adequate.*
>
> *Example 2: Storage of low-level waste at Site B takes place on several outside storage pads at Area 5 that were designed and built several years ago. In order to implement the DOE M 435.1-1 storage facility confinement requirement, Site B conducts an analysis of the current storage conditions at all of these pads. On one pad, some waste containers are found to be in poor condition, and the confinement requirement is met by installation of a temporary berm around the pad until repackaging in overpacks can be accomplished. The containers on the rest of the pads are in good condition, and the analysis indicates that the confinement requirement is sufficiently met by the container itself.*

Engineering evaluations, trade-offs, and experience are used to develop practical designs that achieve confinement system objectives. The adequacy of confinement systems to effectively perform the needed functions needs to be documented and accepted through the facility or operation Safety Analysis Report or equivalent documentation.

The guidance for DOE M 435.1-1, Chapter II, *High-Level Waste Requirements*, presents detailed guidance for complying with the confinement requirement for high-level waste storage tanks.

That guidance is appropriate to be consulted for any details that may be needed for complying with the confinement requirement for low-level waste treatment or storage activities that are hazardous enough that the most rigorous implementation of the confinement requirement must be applied. The guidance for DOE M 435.1-1, Section II.P.(2)(b) refers to *Resource Conservation and Recovery Act* requirements and discusses guidance for confinement that may also be useful in establishing compliant confinement in accordance with this requirement for mixed low-level or liquid low-level waste storage facilities or activities that warrant strict confinement conditions.

Compliance with the requirement is demonstrated by designing low-level waste treatment and storage facilities including systems that provide primary and secondary confinement as appropriate based on safety analysis or equivalent documentation and documenting the analyses and rationales for such controls in the facility radioactive waste management basis documentation.

Supplemental References:

1. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(b) Ventilation.

1. Design of low-level waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Objective:

The objective of this requirement is to ensure that the design of low-level waste treatment and storage facilities includes features to remove radioactive materials from airborne effluents that could endanger worker or public safety and/or the environment to levels allowed in regulations before they are released, and to preclude or mitigate the accumulation of flammable or explosive gases in the facilities which could lead to uncontrolled releases of radioactive materials.

Discussion:

This requirement is based on a similar requirement invoked to address a group of hazards that was identified by the safety and hazards analysis performed in support of the high-level waste chapter of this Manual. The analysis revealed that very hazardous conditions can result from unexpected and uncontrolled releases of radioactive material, either because of poorly designed ventilation systems or due to accumulation and ignition of flammable or explosive gases in high-level waste storage facilities. Similar circumstances occurring at a low-level waste facility are similarly problematic, and a similar requirement was believed to be justified to prevent exposures to workers or the public, radioactive leaks to the environment, and costs for damage mitigation and cleanup from unanticipated and/or uncontrolled airborne releases of radioactive material. Subrequirement IV.M.(2)(b)1. is discussed below under Airborne Effluent Filtration Systems and subrequirement IV.M.(2)(b)2. is discussed under Flammable and Explosive Gases.

Airborne Effluent Filtration Systems. The subrequirement to maintain radioactive material in airborne effluents from low-level waste management facilities to appropriate levels through the use of filtration systems is to be implemented using the graded approach. This requirement is intended to ensure that low-level waste management facilities have adequate filtration where necessary, not to dictate that each facility must have a particular type of air filtration or removal efficiency. Therefore, the safety analysis or assessment for each facility will provide the basis for determining the level of filtration required.

> *Example 1: A low-level waste treatment facility is constructed so low-level waste packages can be opened, the waste sorted, and the appropriate waste thermally treated. In order to ensure worker protection, the building ventilation system is constructed to draw air from radiologically clean areas, to radiologically-controlled areas and finally to airborne contamination areas such as glove boxes and thermal treatment equipment. Through the auditable safety assessment, it is determined that the potential exists for releases of radioactive materials through the exhaust system. The building exhaust system is therefore equipped with high-efficiency particulate air filters to ensure that releases are controlled to within limits. Monitoring is used to ensure the necessary removal efficiency is maintained by the air filter system.*

> *Example 2: A storage building is designed and operated to receive only closed containers of low-level waste and to perform nondestructive testing. Through the preparation of an auditable safety assessment it is determined that the potential for release of radioactivity in the building is very low. Consequently, the ventilation system provided for the building is only for climate control and not for contamination control. The building exhaust system is determined to not need any extra filtration to meet the requirements of applicable release standard, and the rationale and basis of the analysis are incorporated into facility safety documentation.*

Standards for DOE compliance with airborne releases are contained in DOE 5400.5, *Radiation Protection of the Public and the Environment* and 40 CFR Part 61, *Clean Air Act* regulations. The limits for release cited in these documents are for the DOE site (i.e., all the activities of the Department), not for individual facilities. Therefore, the operational limits for any individual facility need to be established based on the potential impacts from all facilities on the site. Consistent with Departmental practices and an underlying principle in development of the *Radioactive Waste Management Manual*, airborne effluent releases need to be kept as low as reasonably achievable.

The number, size, and design of air filtration equipment needs to meet the performance requirements dictated by the safety analysis or assessment. The location of air filtration units in the ventilation system is established as close as practical to the source of contamination so as to minimize spread to the remainder of the ventilation system. The system is designed for ease of maintenance and periodic inspection and has provisions (test ports) to facilitate insertion of measuring devices for testing filter performance. Where larger loads are expected or predicted on the filtration systems (e.g., dusty condition), pre-filters need to be considered to extend the life of the main filter and reduce maintenance.

Flammable and Explosive Gases. The subrequirement addressing explosive or flammable concentrations of gases is intended to ensure that the design of facilities and equipment includes consideration of the potential for generating these types of gases. Generation of flammable or explosive gases has been a concern in the storage of liquid waste (e.g., high-level waste tanks), but also needs to be recognized as a potential problem in other situations, such as in treatment systems.

Where sampling data and safety analyses indicate a potential for accumulating gases in concentrations approaching the lower flammability limit, facilities and equipment shall be provided to prevent the conditions which could lead to fire or explosion. This is normally accomplished by the design and installation of ventilation equipment which provides enough air flow to maintain gases below flammable or explosive concentrations. In situations where gas evolution is episodic and the concentration of gases approaches the lower flammability limit for short periods of time in

spite of the ventilation system, spark-proof technology needs to be employed in the design of ventilation equipment so that the equipment itself does not become a source of ignition.

Attention to fire protection for the filtration system needs to also be considered to ensure the facility can perform under off-normal conditions. Guidance for protection of filtration systems in ventilation plenums for nuclear facilities is provided in the *Fire Protection Design Criteria* (DOE-STD-1066-97). This guidance addresses materials of construction, location of filters, fire ratings of protective walls, and internal detectors for fire and heat.

Other methods can be employed to prevent conditions which could lead to ignition of flammable or explosive gases. One such method is the introduction of a sufficient flow of inert gases into the headspace where flammable or explosive gases would accumulate. The inert gases need to be supplied at a rate that keeps the concentration of the flammable or explosive gases and of available oxygen/oxidants below levels that could result in deflagration or detonation. As with ventilation equipment, the specific conditions of gas generation and of providing an inert atmosphere in the headspace must be evaluated and a decision made as to whether spark-proof technology should be included in the design of the system.

Compliance with this requirement is demonstrated by analyses that support the level of filtration provided on a low-level waste management facility, and if airborne effluent monitoring data are available, a demonstration of compliance with the site-established operational guidelines for the facility. In addition, acceptable implementation is demonstrated by analyses, monitoring data, or both showing that the potential for generation of explosive or flammable concentrations of gases has been considered and where the potential exists, the presence of ventilation equipment or other means that prevent deflagration or detonation. The analyses and rationales for the selected controls must be documented in the radioactive waste management basis.

Supplemental References:

1. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

2. DOE, 1997. *Fire Protection Design Criteria*, DOE-STD-1066-97, U.S. Department of Energy, Washington, D.C., 1997.

3. EPA. *National Emission Standards for Hazardous Air Pollutants*, 40 CFR Part 61, U.S. Environmental Protection Agency, Washington, D.C.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing low-level waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Objective:

The objective of this requirement is to ensure the incorporation of the concept of life-cycle waste management into the operations of radioactive waste management facilities to result in the minimization of radioactive waste that must be managed in the future from decontamination and decommissioning activities, and the reduction of facilities that must be dismantled due to contamination rather than re-used for another beneficial purpose.

Discussion:

During the analysis of requirements conducted in support of DOE O 435.1 and DOE M 435.1, life-cycle waste management concepts were applied to the generation of waste by waste management facilities as well as the generators of waste that send waste to waste management facilities. This requirement was developed to extend the life-cycle management concept to the design of waste management activities and facilities, with the explicit goal of minimizing the generation of waste, and also pointing to a beneficial use of the facility following its waste management use. Decontamination and decommissioning activities are also becoming a significant part of the life-cycle costs for low-level waste facilities. This requirement addresses this situation by trying to reduce the costs associated with disposition of waste management facilities following their use.

New low-level waste facilities are defined as those whose design basis was not approved prior to the implementation date of DOE O 435.1, with design basis as defined in the Manual Definitions. If a low-level waste facility's design basis is defined after the issuance date of DOE O 435.1, the requirements of this section are applicable. Application of these requirements to existing or low-level waste facilities that are to undergo significant modifications is left to the discretion of the Field Office management organization as to whether retrofitting with designed features that facilitate decontamination is reasonable. To support this decision an analysis needs to be conducted comparing the expected benefits by the application of these requirements to the costs

of implementing such measures. These costs include programmatic, resource, and schedule impacts as well as potential impacts such as additional worker exposures due to radiation and chemical hazards.

Design to Facilitate Decontamination. Decontamination is defined by the Implementation Guide to DOE O 420.1, *Facility Design*, as "the act of removing a chemical, biological, or radiological contaminant from or neutralizing its potential effect on a person, object, or environment by washing, chemical action, mechanical cleaning, or other techniques." In conjunction with DOE O 420.1, DOE M 435.1-1 requires that low-level waste facilities incorporate measures to reduce areas of contamination or to simplify decontamination of areas that may become contaminated with radioactive or hazardous materials. Examples of design features that need to be considered include:

- Service piping, conduits, and ductwork kept to a minimum in areas that could be potentially contaminated and, if included in such areas, their design arranged to facilitate decontamination.

- Cracks, crevices, and joints filled and finished smooth to prevent accumulation of contaminated material.

- Walls, ceiling, and floors in areas vulnerable to contamination finished with washable or strippable coverings.

- Metal liners, e.g., stainless steel cell lining, used in areas that have the potential to become highly contaminated with radioactive materials.

- Contaminated or potentially contaminated piping systems have provisions for flushing and/or cleaning.

- Accessible, removable covers for inspection and cleanouts provided.

- Construction materials that reduce the amount of radioactive materials requiring disposal and that are easily decontaminated.

Design to Support Decommissioning. Decommissioning, also defined in DOE O 420.1, is "the process of closing and securing a nuclear facility or nuclear materials storage facility to provide adequate protection from radiation exposure and to isolate radioactive contamination from the human environment." Design features that need to be considered to support decommissioning (or beneficial reuse) of the facility include:

- Use of modular radiation shielding, in lieu of or in addition to, monolithic shielding walls.

- Use of modular, separable confinements to preclude contamination of fixed portions of the structure.

- Designs that ease cut-up, dismantlement, removal, and packaging of contaminated equipment, such as glove boxes, air filtration equipment, large tanks, vessels, and ductwork, from the facility.

- Use of localized liquid transfer systems that avoid long runs of buried, contaminated piping; emphasis on localized batch solidification of liquid waste. Special provisions may also be included in the design to ensure the integrity of joints in buried pipelines.

- Piping systems that carry contaminated or potentially contaminated liquid that free drain by gravity.

- Location of exhaust filtration components of ventilation systems at or near individual enclosures to minimize long runs of internally contaminated ductwork.

- Equipment, including effluent decontamination equipment, that precludes to the extent practicable, the accumulation of radioactive or other hazardous materials in relatively inaccessible areas, including turns in piping and ductwork.

- Provisions for suitable clearances, where practical, to accommodate remote handling and safety surveillance equipment required for future decontamination and decommissioning.

- Use of lifting lugs on large tanks and equipment.

Decommissioning and Reuse Planning. Due to the high life-cycle costs of low-level waste facilities this subrequirement is also intended to promote post-mission planning of low-level waste facilities by requiring the identification of possible decommissioning methods or reuses of low-level waste facilities as early as possible. To meet this requirement low-level waste facility designs, or significant modification efforts, need to include analysis to determine the best decommissioning methods, using currently available technologies, and factor the results of this analysis into the facility's design. Likewise, if a reuse of the facility is envisioned, any features that can support this reuse mission need to be considered in the design effort.

Life-Cycle Asset Management, DOE O 430.1A, addresses deactivation and decommissioning requirements of DOE facilities. Refer to DOE O 430.1A and its Guides for further information and guidance on deactivation and decommissioning activities. Also refer to a new DOE Standard (see Supplemental Reference 3) on the integration of safety and health requirements into facility disposition activities.

Compliance with this requirement is demonstrated by the existence of design documentation that indicates decontamination was considered during the design of new low-level waste facilities or significant modifications to low-level waste facilities. Additionally, Site-Wide Radioactive Waste Management Program documentation demonstrates that post-mission planning was considered, as early as possible in the life of a facility, to assist in the identification of possible decommissioning methods or facility reuse.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE O 420.1-X, U.S. Department of Energy, Washington, D.C., September 1995.

2. DOE, 1997. *Decommissioning Implementation Guide*, Draft G 430.1-4, U.S. Department of Energy, Washington, D.C., October 1, 1997.

3. DOE, 1997. *Integration of Safety and Health into Facility Disposition Activities*, Draft for DOE Complex Wide Review 9/26/97, DOE-STD-1120-98, U.S. Department of Energy, Washington, D.C., September 26, 1997.

4. DOE, 1998. *Life-Cycle Asset Management*, DOE O 430.1A, U.S. Department of Energy, Washington, D.C., October 14, 1998.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of low-level waste treatment and storage facilities to provide volume inventory and to prevent spills, leaks, and overflows from tanks or confinement systems.

Objective:

The objective of this requirement is to ensure that engineering controls are included in the design of low-level waste management facilities to minimize the likelihood of release of radionuclides that could lead to exposures or contamination of the environment.

Discussion:

The requirement for instrumentation and engineering controls is invoked to address a group of hazards that was identified by the hazards analysis performed in support of the development of this order and manual – the failure to promptly detect a release of radioactive material from low-level waste that could impact workers, the public, or the environment. This requirement is closely related to the previous design requirement for monitoring systems, but focuses on controls to prevent the loss of containment.

Engineering controls in this requirement are considered to be those systems or design characteristics that are provided to prevent the loss of containment from low-level waste management facilities, and to provide volume inventory data, where appropriate. Examples of engineering controls include flowmeters and level-sensing devices coupled with anti-siphon devices or shut-off valves, and any other instrumentation and controls that maintain sufficient freeboard within a storage vessel or unit. Other instruments and controls include devices that measure changes in characteristics of liquid waste, e.g., temperature, pressure, pH, and/or other characteristics providing a measure of a materials stability, that are combined with shutoff or diversion routing devices.

The graded approach is used in determining the appropriate level of rigor in incorporating engineering controls to the management systems employed at a particular low-level waste management facility. Rigorous application of this requirement may be most appropriate for circumstances involving treatment of liquid low-level waste, for example, where flowmeters and devices measuring characteristics of the waste in the feedline of an incinerator, are continuously operating. However, some handling situations involving bulk or solid low-level waste may need to invoke these controls as well, where a simple shutoff of the equipment could prevent overfilling or other hazardous conditions.

Loss of containment at a waste storage or treatment facility can result from overflows, spills, leaks, or siphoning of waste from a storage vessel. Incorporation of design measures at these facilities to prevent such loss of containment is necessary, but is not considered sufficient to meet this requirement. Equipment of this nature, in spite of rigid maintenance and surveillance, can fail over its expected service life. Therefore, to fully meet this requirement mitigative measures to reduce the loss of containment, are necessary. As discussed in guidance on confinement above, an engineered barrier to fully contain a leak or a diversion mechanism to channel the waste to a

desired location provides defense-in-depth for the circumstances where the engineering controls do not suffice. Guidance for Confinement (DOE M 435.1-1, Section IV.M.(2)(a)) provides additional details on these mitigative measures.

> *Example: At the Site Q Low-Level Waste Storage Facility, the engineering controls on the liquid low-level waste storage tank includes a waste feed line shut-off valve, which is activated by a tank level-sensing device, to prevent overflow of waste from the tank. As a further mitigative measure in the event the valve malfunctions, a double-contained overflow line is attached to the tank to channel any overfill to another waste tank that is maintained as a spare at the storage facility.*

The design of engineering controls to meet this requirement will most likely be directed by the facility-specific safety analysis for waste management facility. Such safety analysis may dictate that some of these engineering controls be designed as safety-class or safety-significant systems, structures, or components (SSC) to ensure they survive design-basis accidents. Use of the safety analysis process, as prescribed by DOE 5480.23, *Nuclear Safety Analysis Reports*, to identify the necessary engineering controls to meet this requirement for both new and upgrades to existing low-level waste treatment and storage facilities, is considered appropriate and encouraged.

Compliance with this requirement is demonstrated by the incorporation of engineering controls that provide: timely information to facility operations personnel regarding the volumes of waste being stored; automatic shut-off, anti-siphoning devices, and automatic sensing devices to provide timely information to operations personnel; and provide mitigative measures to minimize the spread of low-level waste in the event of loss of containment, which are based on facility safety analysis and documented in the required safety analysis documentation.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE G 420.1-X, September 1995.

2. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(e) Monitoring. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of low-level

waste treatment and storage facilities to provide rapid identification of failed confinement and/or other abnormal conditions.

Objective:

The objective of this requirement is to ensure the design of low-level waste management facilities includes the installation of equipment capable of identifying failures in containing low-level waste and other conditions that could result in exposures of workers or the public to radioactivity or contamination of the environment.

Discussion:

This requirement is invoked to address a group of hazards that was identified by the hazards analysis performed in support of the development of this order and manual -- the failure to promptly detect a release of radioactive material from low-level waste that could impact workers, the public, or the environment. This particular requirement addresses the design of monitoring systems directed toward prompt detection of acute releases (releases that are detectable visually or by some other gross indicator) that become apparent over a time frame of hours or days as well as to alert operators that a vessel (e.g., tank or bin) is approaching capacity so that overfilling can be avoided. Monitoring to detect releases that may be too small to be detected in a timely manner via volume changes is addressed in guidance on Requirements IV.R, Monitoring, later in this guidance.

As in implementation of all of the requirements of DOE O 435.1 and DOE M 435.1-1, the graded approach is used for determining the appropriate level of rigor in applying this control to the management systems employed at a particular low-level waste management facility. Also, monitoring for leakage and contamination spread needs to be performed by means appropriate for the type and character of radioactive waste being managed at the facility. Rigorous application of this requirement may be most appropriate for circumstances involving storage or treatment of liquid low-level waste, for example, highly acidic liquid waste in a single-walled, mild steel tank may require continuous monitoring coupled with alarms and transfer equipment. A treatment facility involving bulk or solid low-level waste may need to implement monitoring systems such as portable constant air monitoring systems designed to detect and measure airborne contamination spread from dry processes. A facility storing containerized low-level waste may rely on a program of container inspections to meet the needs for monitoring for leaks and abnormal conditions.

> *Example: Low-Level Waste Storage Building 560 was designed and built several years ago, and is currently empty. Site plans call for resuming use of the facility for storage of containerized low-level waste awaiting disposal. In determining how to implement the*

DOE M 435.1-1 storage facility monitoring requirement, site management conducts an analysis of Building 560. The analysis indicates that there are no monitoring systems in place that would meet the requirement. A Building 560 container inspection program that involves weekly walk-throughs of the facility will be implemented to meet the storage facility monitoring requirement.

For transfer systems, designers may need to consider the use of continuous flow monitors to allow comparisons of total volume input to total volume output as an indicator of the integrity of the transfer system. The containment integrity of waste transfer systems can also be monitored for radiation levels in excess of those expected from residual waste in the transfer system.

A highly reliable means of monitoring for releases is the use of secondary confinement which is then checked for waste. It also offers the benefit of providing defense-in-depth in containment of releases of low-level waste.

Example: A liquid low-level waste transfer line from a storage tank to a treatment facilities is enclosed in a large diameter secondary containment tube. The transfer line and containment tube were constructed with sufficient pitch to cause any leakage into the containment tube to flow back to the storage tank area. The transfer line developed a leak at a coupling which was discovered when waste was found in the secondary containment at the storage tank area.

What constitutes rapid detection of failed confinement or abnormal conditions needs to be established for each facility, operation, or activity. Monitoring design requirements and engineering controls to address catastrophic failures will be established through the conduct of safety analyses. The failures and conditions being addressed by this requirement are those that are not catastrophic, but could result in releases of radioactivity or doses to workers or the public in excess of established limits if they were allowed to continue over a period of hours or days. Detection equipment needs to be designed to detect confinement failures or abnormal conditions rapidly enough that action can be taken before the situation degrades to the point that response and recovery would result in doses to workers that approach the dose limits for radiation protection of workers (10 CFR Part 835). Similarly if the failure releases radioactivity to a air or liquid effluent stream, detection needs to occur rapidly enough to prevent environmental releases from exceeding annual limits.

Compliance with this requirement is demonstrated by designing low-level waste systems with the capability to monitor waste volume and detect volume changes in a time frame that will allow implementation of corrective measures to limit public and worker doses to allowable levels and to limit releases to allowable levels, which are documented in the radioactive waste management basis for the facility.

Supplemental References:

1. DOE. *Occupational Radiation Protection,* 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

IV. M.(3) Low-Level Waste Disposal Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Low-level waste systems and components shall be designed to maintain waste confinement.

Objective:

The objective of this requirement is to ensure the design of low-level waste disposal facilities includes features and/or equipment capable of containing low-level waste so that releases that could result in exposures to workers or the public or that could contaminate the environment are minimized.

Discussion:

This requirement is invoked to address hazards identified during the safety and hazards analysis performed in support of the development of this order and manual associated with the release of radioactive material from low-level waste disposal facilities that could impact workers, the public, or the environment. In addition to the facility and general design requirements contained in DOE M 435.1-1, Section I.1.E(18), the requirement for low-level waste confinement must be met.

The purpose of confinement systems is to minimize the spread of radioactive and/or hazardous materials and the release of these materials in facility effluents during normal operations, abnormal operations, and potential accidents. For disposal facilities, confinement must also be provided after the facility is closed, for an extended period of time. Therefore, the design of the confinement systems or equipment for a disposal facility should include process equipment or features that will minimize the spread of radioactive material during the placement of waste (the operational period) and systems or equipment that will minimize the spread of radioactive material after the disposal unit has been closed and into the future. The consequences of losing confinement for the operational period of a disposal facility may be greater than the consequences if confinement were lost after closure, where the loss of confinement is generally characterized as a slow leak from a disposal unit. These differences in the characteristics of a possible loss of confinement must be considered in designing the appropriate confinement systems or equipment for a low-level waste disposal facility. The need for redundancy and the degree of redundancy in these systems for disposal facilities is determined by the safety analysis process and maintenance

concerns for the operational period and by the performance assessment and composite analysis and associated closure considerations for the post-closure period.

> *Example: At the Site S disposal facility, primary confinement during operations is provided by the trench shape of the disposal unit and depth of emplacement of the waste, and special offloading equipment being used, while post-closure confinement is being provided by layering of natural materials that have contrasting water retention properties on the bottom and sides of the disposal unit that create a capillary break.*

The number and arrangement of confinement systems or barriers and their required characteristics for a low-level waste disposal facility are determined on a case-by-case basis. Factors that need to be considered in confinement system design include type, quantity, form, and conditions for dispersing low-level waste material during operations and after closure, especially the design basis conditions postulated for the post-closure period. As in implementation of all of the requirements of DOE O 435.1 and DOE M 435.1-1, the graded approach is used for determining the appropriate level of rigor in applying this control to the management systems employed at a particular low-level waste disposal facility.

Compliance with this requirement is demonstrated by designing low-level waste disposal facilities including features and/or equipment that provide confinement for the operational period and following closure of the facility that are based on evaluations which are contained in the facility radioactive waste management basis.

Supplemental References:

1. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

IV. M.(3) Low-Level Waste Disposal Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(b) Ventilation.

1. Design of low-level waste disposal facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Objective:

The objective of this requirement is to ensure that the design of low-level waste disposal facilities includes features to remove radioactive materials from airborne effluents that could endanger worker or public safety and/or the environment to levels allowed in applicable requirements before they are released, and to preclude or mitigate the accumulation of explosive and oxidizer gases in the facilities which could lead to uncontrolled releases of radioactive materials.

Discussion:

This requirement is based on a similar requirement invoked to address a group of hazards that was identified by the safety and hazards analysis performed in support of the high-level waste chapter of this Manual and which also has been included for the design of low-level waste treatment and storage facilities. The analysis revealed that very hazardous conditions can result from unexpected and uncontrolled releases of radioactive material, either because of poorly designed ventilation systems or due to accumulation and ignition of flammable or explosive gases in high-level waste storage facilities. Similar circumstances occurring at a low-level waste disposal facility are similarly problematic, and a similar requirement was believed to be justified to prevent exposures to workers or the public, radioactive leaks to the environment, and costs for damage mitigation and cleanup from unanticipated and/or uncontrolled airborne releases of radioactive material.

The need for disposal facility ventilation systems to meet these requirements is anticipated for facilities that might impose operational and/or environmental conditions on waste containers and forms similar to those of a storage or treatment facility that requires ventilation. Generally, it is not expected that ventilation would be needed for outdoor disposal in trenches or pits. However, conditions similar to those in a storage or treatment facility might be present in an above-ground disposal vault configuration, for example, in which a spill could pose a danger to workers inside if not properly ventilated. The safety analysis documentation for the facility needs to address the hazards associated with the design of the specific disposal unit and the waste that is expected to be disposed, and include proper ventilation, as appropriate.

Guidance for subrequirement IV.M.(3)(b)1. is addressed above under Airborne Effluent Filtration Systems and subrequirement IV.M.(3)(b)2. guidance is discussed under Flammable and Explosive Concentrations in the discussion on meeting requirements IV.M.(2)(b)1. and IV.M.(2)(b)2. for low-level waste storage and treatment facilities.

Compliance with this requirement is demonstrated if ventilation systems are included in the design of low-level waste disposal facilities when appropriate that can be demonstrated will limit airborne radioactive effluents to applicable legal and/or regulatory limits and that will prevent the accumulation of explosive or flammable gases in concentrations that could result in an uncontrolled release of radioactive material.

Supplemental References:

1. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

IV. M.(3) Low-Level Waste Disposal Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(c) Stability. Low-level waste disposal facilities shall be designed to achieve long-term stability and to minimize to the extent practical, the need for active maintenance following final closure.

(d) Control of Water. Low-level waste disposal facilities shall be designed to minimize to the extent practical, the contact of waste with water during and after disposal.

Objective:

The objective of these requirements is to ensure that the design features of low-level waste disposal facilities provide for three basic objectives of safe and environmentally protective radioactive waste disposal: that the facilities will be stable for a long time; that little or no active maintenance is needed to maintain this desired stability after the facility is closed; and that contact of waste and water that could degrade waste forms or transport radionuclides is minimized.

Discussion:

During the safety and hazard analysis conducted in developing the requirements of DOE O 435.1 and DOE M 435.1, providing continued protection into the future from disposed waste was

identified as a measure to reduce potential exposures to the public, workers, and the environment. The analysis indicated that some controls are necessary after a low-level waste disposal facility has been closed and that it is prudent to address long term ramifications of the disposal of waste in the early stages of facility design. Certain features of design can be utilized to provide an additional depth of defense against exposure of workers, the public, or the environment to the hazards posed by the disposed low-level waste. These two design requirements for a low-level waste disposal facility implement two of the fundamental concepts embodied in 10 CFR Part 61, stability of the disposal site and control of surface and groundwater at the site.

Several features have been used in the designs of past low-level waste disposal facilities to achieve stability of the facility during and after disposal, to reduce the need for active maintenance once the facility is closed, and to control water so that there is little contact of waste with water, both before and after it is disposed. Engineering barriers/features can include use of rip cap, liners, and depth of cover. Many design features serve to meet both of these requirements at the same time. Also, some design features, when combined with operational practices, achieve the most benefit towards achieving the objectives of these requirements. Subrequirement IV.M.(3)(a) is discussed in the section below entitled, Stability, and subrequirement IV.M.(3)(b) is discussed in the section entitled, Control of Water.

Stability. The ability of a low-level waste disposal facility to remain stable for the long-term is a fundamental goal in the meeting the performance objectives for disposal of low-level waste as defined in Chapter IV, Section P.(1) of DOE M 435.1-1. The discussions on long-term stability in the Nuclear Regulatory Commission's rulemaking documentation and guidance for 10 CFR Part 61 note that site stability should be relied on for the indefinite future, and evaluated for a period of at least 500 years for purposes of presenting information on design of the facility in a license application. Long-term stability for DOE low-level waste disposal sites is to be considered an attribute that needs to be present for the indefinite future, and is determined on a site-specific basis from analysis of site conditions, any waste that requires structural stability, and the desired performance of the facility. Site-specific timeframes, therefore, should be used for design bases events or phenomena, where appropriate, when designing the facility to ensure long-term stability of the site for the purposes of meeting DOE O 435.1 and DOE M 435.1-1.

There are several principles in establishing the design of the facility that are key to the objective of long-term stability. First, the design features of the low-level waste disposal facility need to be directed toward the long-term isolation of the waste, the minimization of migration of radionuclides, and the avoidance of any need for continuing long-term active maintenance after closure. Second, the design of the facility needs to lead to closure and the development of a closure plan that provides assurance that the performance objectives will continue to be met into the future. Third, the disposal site needs to be designed to complement and augment wherever possible the ability of the disposal site's natural characteristics to assure that the performance objectives will continue to be met.

A low-level waste disposal facility needs to be sited and designed to permit efficient land utilization and maximum waste volume allocation, while maintaining long-term stability and isolation. Facility design is based on the projected waste volume and characteristics including the projected volume of waste to be disposed of over the life of the facility, chemical composition of the waste, radionuclide content and concentration, and the expected physical form in which the waste will be received. This information is used to estimate the number of disposal units required for the facility, and for determining the need for special engineered features. For example, based on projected receipts of high-activity low-level waste, special excavation designs such as slit trenches and auger holes may be required in order to provide adequate worker protection.

The spacing between disposal units needs to be considered in establishing the overall dimensions of units. Sufficient space between adjacent units is needed to assure disposal unit integrity, for example, the distance between disposal units is such that positioning and use of equipment at a newly excavated unit will not adversely affect the stability of the unit's walls and will not disturb nearby disposal units. Disposal unit spacing needs to also take into account the need for any buffer zone between disposal units and the boundary of the disposal facility that may be planned.

> *Example: The new disposal facility at the Brown Site has been designed using trench disposal units sized to dispose of approximately 6 months worth of waste receipts at a time. The design calls for the trenches to be separated from one another by 50 feet intervals, as configured after analysis of the expected trench side activities, including some vehicular traffic. A remedial action is taking place adjacent to the new facility, so a relatively large (300 feet) buffer zone is established between the two projects to address a concern of stakeholders regarding future continuing activities that may be necessary at the remedial action site.*

The design of individual disposal units also contributes to the long-term stability of the facility. The size of disposal units needs to be determined based on the physical size and topography of the disposal facility, the types and volumes of waste to be disposed, and the dimensions of waste containers to be buried. Soil characteristics, the need for equipment access and maneuvering space, and surface water drainage before, during, and after waste emplacement are considered in deciding on the size and type of disposal units. The depth of disposal units is also a site-specific design determination which is dependent on the depth of the ground-water table, the need for the stability of sidewalls, and the depth of disposal of certain categories of waste, if appropriate.

Disposal units generally are oriented parallel to topographic contours of the site. Slopes of the site should not be so steep as to result in significant elevation differences between sidewalls of a disposal unit. In addition, the elevation difference of the ground surface between one end of a disposal unit and the other end needs to be less that the combined thickness of the backfill overlying the waste and the disposal unit cover.

The planned sequence of use of disposal units over the facility lifetime needs to reflect the need to conduct adequate closure and stabilization operations, as each unit is filled. The location of roads and disposal unit covers, use of heavy equipment, establishment of vegetative cover, and management of surface water are planned such that operations may be conducted at each disposal unit without damage to closed disposal units. Location and access to fill and borrow areas are also planned to assure that they do not compromise the integrity of completed disposal units.

Final slopes of disposal units when shallow land trenches are used are designed to minimize erosion and failure of slopes. Both potential problems can be minimized by controlling the slope angle, particle size of the soil, degree of compaction or cementation, and vegetative cover. In arid regions, where infiltration of water is of less concern and where vegetation may be difficult to establish, gravel or cobbles may be used in place of vegetation to protect the slope.

> *Example: The trench sides at the Brown Site low-level waste disposal facility are sloped at a 80% angle, as configured by soil analysis calculations to remain stable, and are protected along the entire length of the trench by geofabrics. The trench at the end of the first row of trenches is designed to be only half as long as its predecessor trenches because the gradient of the site was beginning to increase, and more chance of instability would be likely if the same size trench was built.*

The disposal site is designed to enhance and not degrade the natural physical characteristics of the area that support long-term stability, and to minimize the consequences of potential abnormal events. Therefore, based on site characteristics, for example a large rainfall or expected damage from high winds, and the expected waste characteristics and forms, appropriate engineered barriers may be required to enhance the natural site characteristics for site stability. Primary concerns are to reduce the effects of erosion over time and to minimize the impacts to site stability by an abnormal event.

The use of common engineering materials to augment the long-term stability of a low-level waste disposal facility is to be carefully planned. A critical examination needs to be made of each component of a disposal unit and compared to that of the unit as a whole, and a determination made considering the cost and difficulty of utilizing these materials versus the benefits to maintaining stability. For example, geotextiles and geomembranes may not have a long design life, but they may contribute to the stability of the disposal unit as a whole by making placement of critical materials during closure much easier.

<u>Control of Water</u>. There are also some principles that are key to the objective of minimizing the contact of waste with water before, during, and after disposal. First, covers of disposal units need to be designed to minimize water infiltration to the extent practical, and to direct percolating or surface water away from the waste. Second, surface features need to direct surface water drainage away from disposal units at velocities and gradients which will not result in erosion that

will require ongoing active maintenance in the future. Third, the disposal unit needs to be designed to minimize the contact of waste with water during storage, the contact of waste with standing water during disposal operations, and the contact of wastes with percolating or standing water following disposal.

Disposal units are designed to minimize infiltration of water into the unit over the long term. Several factors must be considered in the design of the disposal unit to result in a disposal unit with sides and a cover which will behave as desired, including: the permeability of the natural materials the units will be constructed of and within, wind and water erosion, root penetration, animal burrowing, consolidation, subsidence, desiccation, freeze-thaw cycles, and frost heave. The design must evaluate whichever of these elements are applicable for a particular site and design, and ensure the impacts of these are accounted for in minimizing infiltration of water into the unit.

The cover is to be designed to facilitate drainage and should be several feet in thickness at its thinnest point, if appropriate. For example, at a humid site using the trench disposal method, clay barriers are desirable as part of cover systems because of its relatively low permeability. To assure the integrity of the clay portions of cover systems, it should be insulated from the surface geologic, atmospheric, and biotic processes by one of more layers of other types of materials. The cover should extend beyond the site walls of the unit and be directly tied into the surface drainage system at the original or modified grade to assure surface runoff is not directed along the sidewalls down into the unit. Cover design needs to include stabilization of some fashion to assure that it is not significantly affected by wind or water erosion. For example, in humid climatic regions, such stabilization can be achieved by planting of a shallow rooted vegetative cover.

A surface water management system may be necessary as part of the disposal facility design to minimize erosion and infiltration into disposal units. An adequate system will usually consist of three primary parts: collection, transport, and discharge. The collection part of the system is to collect runoff from disposal unit covers in drainage ditches. These ditches are sloped to allow transport of all the surface runoff to a drainage collector physically removed from the active disposal area to allow discharge of the water off-site. This type of system may be considered desirable for a shallow land trench or other near surface disposal facility within a humid or moderate climatic regime. Factors to evaluate the necessary requirements for a drainage system include the capability for managing a 10-year return flood and for diverting a postulated 500-year flood. Another method instead of this system for smaller sites could incorporate a uniform, crowned cover designed to remove the runoff by sheetwash.

> *Example: The spaces between trenches at the new disposal facility at the Brown Site are designed to steer water towards one of four collection areas in the facility. These collection areas then drain water to a central collection area away from both the low-*

> *level waste disposal facility, and the remedial action project which is adjacent to the facility for discharge.*

Disposal units must be designed to drain effectively when water enters the disposal facility. Bottom drainage can be accomplished by designing the disposal unit floor to be covered with 2 - 3 feet of pervious material, such as sand, and to be sloped across the width of the unit to a french drain. The disposal unit floor and the french drain would be sloped along the length of the unit to sumps. The bottom layer would also serve as a barrier to the capillary rise of water from below. The base of a completed disposal unit should drain faster than water enters from the top and sides of the facility. Inclusion of a system like this serves to rapidly drain off water entering the disposal unit before it is covered and minimizes the time any infiltrating water would be in contact with the waste.

> *Example: At the new disposal facility at Site Y, trench bottoms are designed with a multi-layer system of geofabrics and natural materials that will drain water towards one side of the trench and then towards one end of the trench to a monitoring well location. The geofabrics protect the layers of natural material during operations, but are not relied upon for providing drainage characteristics. The cover design includes a multi-layered system that is designed to drain water away from the trenches and reduce infiltration, and includes a deep rooted grass cover on the top. The cover does not use any geofabric, since no activities are expected on the cover which would disturb its layering.*

Void spaces between waste packages need to be filled with a freely-draining non-cohesive material, such as clean sand or gravel. These types of materials will promote rapid movement of water through the disposal unit. In addition, if the backfill has a sufficient contrast in permeability to the material in the disposal unit cap, capillary forces may promote unsaturated flow of interstitial water around the disposal unit instead of through it. Instead of a free-draining backfill, material with extremely low permeability, such as grout or concrete would be used. Clay-soil mixtures may not be suitable for backfill because of the difficulty in ensuring that void spaces are filled and the difficulty in achieving sufficient compaction to limit consolidation and permeability to acceptable levels.

Contact of waste with water during disposal operations must be minimized. Closing down site disposal operations until disposal units are free of visible water is one approach to achieving this. Active disposal units could be allowed to drain into a sump or into the inactive part of the unit before waste is emplaced. Keeping the volume of uncovered waste in the disposal units to a practical minimum is another approach to minimizing contact of waste with water, as is the practice of placing backfill over the waste as soon as possible after emplacement in the disposal unit. Acceptable low-level waste disposal facility operations are discussed in the guidance on DOE M 435.1-1, Section IV.P.(6).

Compliance with this requirement is demonstrated by the design features of the subject low-level waste disposal facility being focused on achieving and maintaining stability of the disposal site, minimizing the need for any active maintenance of the disposal facility following its closure, and preventing the contact of waste with water, both during operations of the facility and following closure, and these design considerations are justified and documented in the radioactive waste management basis for the facility .

Supplemental References:

1. NRC, 1982. *Technical Position Paper on Near-Surface Disposal Facility Design and Operation*, U.S. Nuclear Regulatory Commission, Washington, D.C., November 1982.

2. DOE, 1989. *Methodology for Compliance with DOE Order 5820.2A Chapter III: Management of Low-Level Radioactive Waste.* DOE/LLW-75T, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, February 1989.

IV. N. Storage and Staging.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Low-level waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Objective:

The objective of this requirement is to promote safe storage of low-level waste by eliminating from storage materials which could result in fires or explosions due to their reactivity or ignitability.

Discussion:

The safe storage of low-level waste can be jeopardized by the presence of materials which may ignite or explode. To avoid the potential for accidental releases from stored wastes, this requirement prohibits storage of materials that are known to be readily capable of ignition or explosion, or which may degrade over time to be ignitable or explosive. In establishing waste acceptance criteria for storage, waste managers must prohibit the acceptance of materials which have the potential of igniting or exploding. The following materials are not to be stored:

- Reactive metals - metals that can react violently with water, form potentially explosive mixtures with water, or ignite when exposed to air; e.g., non-stabilized uranium or plutonium metal turnings.

- Certain dried ion exchange resins - organic ion exchange resins which have been used for treating solutions containing nitrates have the potential of igniting or exploding if they are allowed to dry out.

- Cellulosic materials contaminated with strong oxidizers - cellulosic materials can spontaneously ignite in the presence of strong oxidizers, e.g., concentrated nitric acid.

- Volatile materials, if stored in areas of high temperatures - storage of volatile materials in closed containers subject to high temperature can result in pressurization of the container and, depending on the waste materials, evolution of flammable gases.

- Pyrophoric materials - nonradioactive materials which can ignite spontaneously are not to be packaged for storage. Radionuclides which may be pyrophoric are to constitute less

than 1% by weight of the container contents unless they are treated to eliminate the pyrophoric characteristic.

When waste with the characteristics described above have been generated, it is necessary to ensure that they are properly pre-treated or treated prior to placing them into storage. Treatment may consist of causing the reaction to occur under controlled conditions, e.g., oxidation of uranium turnings, or may involve the stabilization of waste materials so that they are no longer flammable or explosive.

Example 1: Some old glove boxes that contain laboratory equipment such as test tubes, plastic bottles, wooden utensils, record books, various unidentified materials, and some laboratory chemicals are being cleaned out at Laboratory A. Some bottles of nitric acid are included in the chemicals being discarded. The nitric acid is neutralized prior to placement in the waste container so that there is no interaction with the wooden utensils and any other cellulosic materials that might be in the lab waste.

Example 2: The fuel fabrication prototype facility at Site Z regularly generates waste containing uranium turnings from the fabrication of test fuel specimens and prototype targets. The turnings are solidified in a cement solution formulated specifically for this use in specially designed cans before being packaged in 55 gallon drums for shipment to a disposal facility.

Compliance with this requirement is demonstrated by having waste acceptance requirements which prohibit low-level waste that is ignitable or explosive from being accepted for storage unless it has been treated, and procedures for properly preparing such materials for safe storage.

IV. N.(2) Storage Limit. Low-level waste that has an identified path to disposal shall not be stored longer than one year prior to disposal, except for storage for decay, or as otherwise authorized by the Field Element Manager.

Objective:

The objective of this requirement is to limit low-level waste in storage, provide for the timely disposal of low-level waste, and to limit waste from being stored for indefinite periods of time. Low-level waste is to be actively managed so that final disposition can be achieved with a minimum of storage time during its life cycle.

Discussion:

The storage of low-level waste plays an important role in the management of low-level waste, and provides the opportunity to optimize treatment and disposal activities. The need to store low-level waste should be balanced with the potential risk that storage of the waste may present. During the development of the requirements in DOE M 435.1-1, the storage of low-level waste was identified as an activity that presented potential risk to the public, workers, and the environment. In addition, *The Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities* (DOE/EM-0280) identified inadequate storage conditions for low-level waste and storage of low-level waste that has an identified path to disposal as vulnerabilities.

The primary requirement for the storage of low-level waste is in DOE M 435.1-1, Section I.2.F.(13), which charges the responsibility for safe storage with the Field Element Manager. Storage is defined as the collection and management of waste for the purpose of awaiting treatment or disposal, in such a manner as to not constitute disposal of the waste. Three scenarios for the collection and management of low-level waste are provided for in DOE M 435.1-1, Chapter IV, and discussed in this guidance.

1. The storage of low-level waste with an identified path to disposal.
2. The storage of low-level waste that does not have an identified path to disposal.
3. The accumulation of low-level waste for less than 90 days, referred to as staging.

This requirement is directed at the storage of low-level waste with an identified path to disposal and is intended to reduce the total amount of low-level waste in storage, provide for the timely disposal of low-level waste, and minimize the indefinite storage of waste in conditions that are or could become unsuitable. Life cycle planning for the management of low-level waste is required as part of the Site-Wide Waste Management Program and includes a documented understanding of the disposal options for the waste (see Section I.2.E.(1)). An identified path to disposal determination is based primarily on the ability of the waste to meet the waste acceptance requirements of a disposal facility and authorization of the disposal facility to accept that waste. Some waste may not have current disposal options, and thus has no identified path to disposal. A waste that can meet an existing disposal facility's waste acceptance requirements is considered to have an identified path to disposal.

> *Example: A site is indefinitely storing low-level waste that has a disposal option. The waste is characterized and could meet the requirements of an off-site disposal facility if repackaged. As of the issuance of DOE O 435.1 this low-level waste should be repackaged and received by a disposal facility within one year.*

<u>One Year Storage Limit</u>. Determination of the one year time limit is based on the dates recorded by receiving facilities consistent with the documented process for transferring responsibility of the

waste described in requirement DOE M 435.1-1, Section IV.K.(3). The staging of waste at any generator or treatment facility prior to acceptance by a storage facility need not be included in the one-year time limit. In addition, the staging by a disposal facility prior to disposal also need not be included in the one-year time limit. However, if multiple storage facilities are utilized during the life cycle management of the waste, the total combined storage time of all storage facilities is used to determine if the waste has reached the one-year limit for storage.

> *Example: Low-level waste is staged at a generator facility for two months prior to transfer to a storage facility. The waste is at the storage facility for five months and transferred to a treatment facility. The treatment facility holds the waste for two months and then treats the waste. The waste has been held in storage for a total of seven months and needs to be transferred to and received by a disposal facility within five months.*

The intent of this requirement is not that an undue focus be placed on the compliance or non-compliance with the one-year limit. In other words, the requirement is not intended to force heroic efforts to remove containers of low-level waste from storage for disposal before the one year is reached, or to cause additional handling of low-level waste so the storage clock can be restarted. Rather, the intent of this requirement is to focus attention of managers at the site towards ensuring that waste is being managed to disposal under reasonable time frames. If it appears that the storage limit will be exceeded, managers should evaluate the conditions of storage and determine a proper and safe course of action. The evaluation of the existing storage conditions needs to determine if the waste has undergone any changes that could impact the characterization data or container information that exists for the waste, such as damage to any waste containers, and whether continued storage under the same conditions will maintain the waste in a condition that it can be disposed without further treatment or characterization. The manager may also need to determine if the reasons for the extended storage period will be resolved any time soon, and if the answer could be no, then deciding if alternative management paths need to be identified for the waste.

Storage longer than one year can be justified if the conditions for such storage are approved by the Field Element Manager as part of the radioactive waste management basis for the facility. The conditions are to be based on the evaluations of the existing storage conditions and any steps that are necessary to provide for timely disposal of the waste conducted by the manager when it was determined that the one-year storage limit was not going to be met. For example, conditions specifying the additional storage period beyond the one-year which is authorized and some mandatory maintenance of containers (see guidance for DOE M 435.1-1, Section IV.N.(5)) may be appropriate when the radioactive waste management basis is amended to allow for additional storage time. These provisions should also include a date or time period (e.g., 1 year) when storage conditions will be reevaluated to determine if storage longer than one year can be continued and provisions for appropriate facility operations (such as container inspections) that ensure the hazards of the waste are still controlled.

Storage for Decay. Storage for radioactive decay for a period greater than 1 year for waste that has an identified path to disposal is allowed. Adequate justification and the supporting information for storage for decay is to be documented in the radioactive waste management basis for the facility in which the storage will take place. Adequate justification for storage for decay includes reduced cost, reduced risk, and the ability to achieve disposal that might not otherwise be available. When using storage for decay as a management option, waste acceptance requirements are to be developed for the storage facility that are compatible with the requirements for waste disposal. These waste acceptance requirements are part of the radioactive waste management basis for the storage facility approved by the Field Element Manager.

Mixed Low-Level Waste. Mixed low-level waste in storage may present a dilemma for determining compliance with the storage requirements. Some mixed low-level waste generated in the complex would fall into the category of not having an identified path to disposal, and should meet only the storage requirements for no path forward waste. However, some mixed low-level waste has an identified path to disposal, but must remain in storage for some period of time that exceeds one year, awaiting treatment processes or for other reasons. The Field Element Manager needs to determine the appropriate way to exempt this waste from the storage limit requirement.

Note that because the hazardous component of mixed low-level waste is subject to the *Resource Conservation and Recovery Act*, special requirements apply, including a prohibition on storage. In accordance with the *Resource Conservation and Recovery Act* Land Disposal Restrictions, storage of land disposal-restricted waste is prohibited, other than for the purpose of accumulation to facilitate treatment. Under the *Federal Facility Compliance Act of 1992*, DOE sites were required to develop Site Treatment Plans to bring stored mixed low-level waste into compliance with these requirements. The Site Treatment Plan needs to be consulted and any mixed low-level waste stored for the purpose of accumulation to facilitate treatment must meet *Resource Conservation and Recovery Act* storage requirements. There could be several ways within different scenarios that this requirement can be met, as illustrated by the examples below, however, there are basically four ways to show compliance with the requirement and include appropriate provisions in the radioactive waste management basis for the facility in which it is stored. These provisions should include a date or time period (e.g. one year) when the storage conditions will be re-evaluated to determine if storage longer than one year can be continued and provisions for appropriate facility operations (such as container inspections) that ensures the hazard from the radioactive component of the waste is still controlled.

Legacy Waste. Several questions have arisen concerning the ability of some Department facilities to comply with the one-year storage limit because they store “legacy low-level waste.” Legacy waste generally refers to large quantities of waste at a few DOE sites that has been in storage for more than one year already, and may require additional technical studies, characterization, treatment, or resources dedicated to it, to properly dispose of the waste. The entire volume of

legacy waste at these sites cannot be removed from storage under any reasonable scenario that implements the one-year storage limit. As discussed above, the intention of the requirement is not to force malicious compliance or heroic actions which would result in increased risk or safety concerns. Rather, the intention is that waste in storage longer than one year receives additional attention to ensure that the public, the workers, and the environment are protected from the hazards of the waste, and that progress is being made to dispose of the waste. There could be several ways within different scenarios that this requirement can be met, as illustrated by the examples below, however, there are basically four ways to show compliance with the requirement:

1) the radioactive waste management basis allows for storage for no more than one year.

2) the radioactive waste management basis allows for storage for no more than one year, or for storage for decay only for periods greater than a year, which are specified on a radionuclide basis.

3) the radioactive waste management basis allows for storage for more than one year, up to a specified period of time based on a documented technical evaluation that the waste can be stored in a manner that does not cause changes to the waste or waste packages that is detrimental to the safe storage of the waste, the final disposal of the waste or to meeting the disposal performance objectives.

4) the radioactive waste management basis allows for storage for decay (with specifics) and for storage for more than one year for other low-level waste, up to a specified period of time based on a documented technical evaluation that the waste can be stored in a manner that does not cause changes to the waste or waste packages that is detrimental to the safe storage of the waste, the final disposal of the waste or to meeting the disposal performance objectives.

The documented technical evaluation the requirement if one is necessary needs to include an analysis that describes the waste containers, the design of the waste containers, the design life of the waste containers, and the storage conditions for the container over its service life. The analysis needs to address the total anticipated storage period and should demonstrates waste container integrity will be maintained for the extended time period.

Example 1: Storage of low-level waste at Site A occurs in Building 700. The storage period never exceeds 9 months before it is shipped for disposal at Site X. The radioactive waste management basis for Building 700 approves this storage with no additional provisions.

Example 2: Storage of low-level waste at Site B occurs in Building 400. The storage of low-level waste occurs over various periods of time, but never greater than 15 months before it is shipped for disposal. The Field Element Manager determines, based on container integrity and storage configuration, that the 15 month period of time is acceptable and approves the radioactive waste management basis for Building 400 with no additional provisions.

Example 3: Storage of low-level waste at Site 900 includes storage for decay for three waste streams up to a period of 5 years, and for other low-level waste streams for 14 months. The radioactive waste management basis for the Site 900 storage facility allows for storage for decay for up to 5 years for the three waste streams only, based on an analysis of container integrity, with additional provisions ensuring segregation of decay waste from other waste.

Example 4: Storage of low-level waste at Site G is being done at the generator facilities, and it can last for up to 16 months prior to disposal. The radioactive waste management basis for the generator facility does not address storage. Exceedence of the one year storage limit is a non-compliance. (Also see guidance on Staging, DOE M 435.1-1, Section IV.N.(7) below)

Example 5: Hanford's Central Waste Complex (CWC) stores Mixed Low-Level Waste (MLLW), low-level waste, and transuranic waste from inclement weather. The bulk of the CWC inventory is MLLW received from both on and off site generators to be managed until treatment technologies become available and disposal is achieved. Because it is technically impossible to dispose of the CWC's MLLW inventory within one year and the waste has an identified path to disposal, a technical evaluation is prepared. The extended storage of MLLW at CWC is fully justified, determined to be safe, and is the preferred interim management technique. Documentation supporting this decision is included in the radioactive waste management basis for the CWC, as well as a description of the container inspection and reporting program already in place to ensure continued safe storage.

Compliance with this requirement is demonstrated by the existence of a radioactive waste management basis for the storage facility approved by the Field Element Manager that includes the time frames that waste are allowed to be stored, the necessary justifications for storage for decay, and the necessary technical evaluations if storage is to extend significantly beyond the one-year time frame.

IV. N.(3) Storage Integrity. Low-level waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Objective:

The purpose of this requirement is to ensure that the selection of the location and method for storing low-level waste is made so that both workers and the containers of waste are provided with adequate protection.

Discussion

During the development of DOE O 435.1 and DOE M 435.1-1, the storage of radioactive waste was identified as an activity that presented potential risk to the public, workers, and the environment. Numerous weaknesses and conditions which could lead to release of waste or exposure of workers were identified during the safety and hazards analysis and subsequent reviews conducted in support of the Manual documentation. In addition the *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities* revealed inadequately or improperly stored low-level waste, which presents the possibility of human exposure to radiation and the potential for adverse environmental effects.

The Complex-Wide Review and the evaluations of storage that were conducted during development of the Order and Manual revealed a variety of current practices and lengths of storage for low-level waste. Low-level waste is stored in dense-pack arrays, in conditions exposed to the elements, and in modern, RCRA-compliant storage facilities. In addition, buildings not originally designed or intended for storage are sometimes used when other storage capacity is not available.

As discussed in the General Requirements guidance on storage (DOE M 435.1-1, Section I.2.F.(13)), a principal element of proper storage is ensuring that containers are protected from degradation and perform their intended function until disposal. This requires that containers be protected from mechanical damage and from environmental conditions that could degrade the confinement provided by containers.

> *Example 1: Due to a large decommissioning project generating unanticipated volumes of low-level waste, Site Z decided to store low-level waste outside until indoor storage space could be made available. In accordance with the Packaging and Transportation requirements, filtered vents were installed on the drums used for packaging the waste. However, in establishing the radioactive waste management basis for the outside storage pad, personnel failed to recognize the potential for precipitation entering the drums. Rain accumulated on the tops of the drums, then due to fluctuations in barometric*

pressure, the drums "breathed" through the vents. Water was sucked in through the vents resulting in the need to repackage the waste to meet the waste acceptance requirements for disposal. Subsequently, any waste drums that had to be left outside were provided with protective covering from precipitation.

Example 2: Due to a large backlog of low-level waste, Site X is required to store low-level waste outside until it can be treated and/or disposed. The waste is stored in containers which prevent the entrance of precipitation (lid with lips extending down over the sides) and which resist corrosion (painted carbon steel). Controls are in place to limit mechanical damage from vehicles and other operations in the area. The containers are inspected on a monthly basis for deterioration and repaired as necessary to maintain containment of the waste (e.g., painted, contained). Personnel are only in the outside storage area during periods of inspections, container maintenance, and container movement. The outside storage has been analyzed and documented to provide adequate protection for the expected storage time. This storage maintains the integrity of the waste and minimizes worker exposure.

As noted earlier, low-level waste may be stored in facilities which were not originally designed for storage. If the facilities have the appropriate provisions (e.g., ventilation, fire suppression) for the type of waste being stored, their use is preferential to storing the waste containers outside and subjecting them to the elements. However, in making a decision to use a facility for storage and in developing a radioactive waste management basis for the activity, particular attention to protection of workers is needed. Waste is not to be stored in areas where workers are required to spend extended periods of time in performing other duties (i.e., any duties not related to managing and monitoring the waste). This limits the facilities or areas of facilities that could be used for waste storage to those that are excess to current site missions or those that are infrequently accessed as part of normal operations.

Compliance with this requirement is demonstrated if sites have storage capabilities for low-level waste that provide protection to waste containers so that their integrity will not be damaged through physical or chemical (corrosion) processes and that keep personnel from spending extended periods of time in the areas where low-level waste is stored.

Supplemental References:

1. DOE, 1996. *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities*, DOE/EM-0280, U.S. Department of Energy, Washington, D.C., May 1996.

IV. N.(4) Waste Characterization for Storage.

(a) Low-level waste that does not have an identified path to disposal shall be characterized as necessary to meet the data quality objectives and minimum characterization requirements of this Chapter, to ensure safe storage, and to facilitate disposal.

Objective:

The objective of this requirement is to establish, document, and maintain minimum characterization information for low-level waste that does not have an identified path to disposal. Minimum characterization information will facilitate future disposal because the historical knowledge of the waste is preserved. Characterizing low-level waste with no identified path to disposal will enable it to be stored safely and for disposal options to be evaluated. When a disposal option is ultimately identified the nominal characterization information necessary for it to be acceptable for disposal will be available.

Discussion:

The establishment and maintenance of characterization information is essential for the safe and effective management of low-level waste. During the development of the *Radioactive Waste Management Manual* (DOE M 435.1-1), the storage of low-level waste without a path to disposal was identified as an activity that presented potential for waste to exist without being adequately characterized. *The Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities* (DOE/EM-0280) revealed that inadequacies and inaccuracies in characterization efforts complicate effective waste management activities and results in an increased risk of release to the environment and exposure to workers and the public.

> *Example: High activity low-level waste is stored in a generator facility hot cell. The waste is generally believed to have no identified path to disposal. However, because the waste has not been characterized, a path forward cannot be established and the historical knowledge of the waste is jeopardy of being lost or forgotten.*

The requirement to characterize all low-level waste is in DOE M 435.1-1, Section IV.I. In the interest of accuracy and future economics, characterization is necessary to facilitate future disposal of low-level waste without a path to disposal. If the characterization necessary for future disposal is not performed and documented in a timely manner, then the ability to dispose of the waste may be compromised. The storage of waste represents the opportunity for characterization information to be inadequately managed and ultimately lost or forgotten. This requirement is intended to capture characterization information, both direct and indirect (process knowledge,

materials accountability, etc.) so that when disposal options are available, characterization will not have to be repeated and possibly not required at all.

> *Example: A certain low-level waste stream has no identified path to disposal based on preliminary information. Prior to placement in storage the waste is nominally characterized as required and pertinent information concerning the process that generated the waste is documented. Some years later, a treatment facility is identified that is capable of accepting the waste and producing a waste form that meets the disposal facility waste acceptance requirements.*

Waste with no identified path to disposal needs to be characterized to provide the minimum information required for safe storage as well as other typical data elements required for disposal. An example of the typical characterization information that should be documented is that which would be required by an existing on-site disposal facilities waste acceptance requirements.

> *Example: A generator's preliminary information indicates that a certain low-level waste stream has no identified path to disposal. The site has no on-site disposal facility so the generator decides to characterize the waste as if complying with an existing off-site disposal facilities requirement. Characterization data are used to develop a safe storage configuration for the waste awaiting identification of a disposal option.*

Compliance with this requirement is demonstrated by documenting the characterization information for low-level waste with no identified path to disposal. The information includes the minimum data elements listed in DOE M 435.1-1, Section IV.I.(2) and the data quality objectives process is used for identifying the characterization parameters. In addition, any other characterization information that may facilitate future disposal is collected and maintained.

Supplemental References:

1. DOE, 1996. *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities,* DOE/EM-0280, U.S. Department of Energy, Washington, D.C., May 1996.

2. EPA, 1994. *Guidance for the Data Quality Objectives Process,* EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

IV. N.(4) Waste Characterization for Storage.

(b) Characterization information for all low-level waste in storage shall be maintained as a record in accordance with the

requirements for Records Management in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure that characterization information on waste in storage is maintained as a Federal record, providing a traceable path if future actions require knowledge of the original characterization information.

Discussion:

The establishment and maintenance of characterization information is essential for the safe and effective management of low-level waste. During the development of the *Radioactive Waste Management Manual* (DOE M 435.1-1), the storage of low-level waste, specifically long-term storage, was identified as an activity that presented potential for waste characterization information to be lost, forgotten, or otherwise mismanaged.

> *Example: Following characterization, it was determined that a specific low-level waste stream had no identified path to disposal. Many years later, a treatment facility was identified that might be capable of accepting the waste and producing a waste form that would meet a disposal facility's waste acceptance requirements. The complete original characterization information for the waste has been lost so an evaluation of the ability to meet the waste acceptance requirements of the treatment facility could not be performed without re-characterizing the waste.*

This requirement is applicable to all low-level waste in storage. Low-level waste with no identified path to disposal may be stored for extended periods of time pending the development of a disposal option. The characterization and waste container information must be maintained and retrievable regardless of the storage period.

The waste characterization and container information on waste in storage needs to be managed as a Federal record. The guidance on Waste Transfer (DOE M 435.1-1, Section IV.K) discusses the essential information elements relative to waste containers. Upon disposal of the waste the records are to be maintained as permanent records. DOE information management experts should be consulted for execution of this requirement.

> *Example: A low-level waste storage facility uses information management specialists to maintain a compliant records management system. In addition, training is provided that defines and addresses the procedures concerning the creation, collection, use, documentation, dissemination and disposition of records concerning the low-level waste.*

Compliance with this requirement is demonstrated by documented procedures for managing waste characterization and container information on low-level waste as a Federal record. The records are managed per the applicable polices and procedures for records management referenced in DOE O 200.1 and established at the applicable Field Element.

Supplemental References:

1. DOE, 1996. *Information Management Program,* DOE O 200.1, U.S. Department of Energy, Washington D.C., September 30, 1996.

IV. N.(5) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of low-level waste to ensure container integrity is not compromised.

Objective:

The objective of this requirement is to prevent or minimize the potential exposure of workers and release of radioactive contamination to the environment that could result from allowing low-level waste containers to degrade. The requirement is intended to ensure that the containment function of the waste containers is routinely evaluated and action taken to ensure the waste remains contained.

Discussion:

The containment of low-level waste in containers is essential for its safe and effective management. During the development of the *Radioactive Waste Management Manual* (DOE M 435.1), inadequate or substandard waste containers and deterioration of containers of waste were identified as conditions that could result in the loss of waste containment and potentially impact workers, the public, or the environment. The General Requirements of the *Radioactive Waste Management Manual* (DOE M 435.1-1) assign the Field Element Manager responsibility to ensure all waste is stored in a manner that protects the integrity of the waste for the expected time of storage (Section I.2.F.(13). The responsibility for providing adequate storage that protects the integrity of waste containers is complemented by this requirement to routinely inspect the containers and correct any conditions of deterioration. This is particularly important for low-level waste that is to be in relatively long-term storage (e.g., waste for which a disposal facility is not identified). This requirement applies to all storage of low-level waste, not just storage performed at a designated storage facility.

> *Example: An incineration facility stages waste awaiting treatment. The treatment facility has established operational procedures for the frequent physical examination of*

all waste containers. If containment of the waste is jeopardized their procedures are available for repackaging the waste, or repair of the waste containers.

Inspection. The inspection and corrective action process is intended to ensure that container integrity is maintained throughout the storage or staging period. The process needs to be tailored to the storage situation. Ideally, the storage configuration would allow visual or remote inspections of the outsides of waste containers. The inspection needs to look for:

- general condition of the waste container, such as areas of rust, scratches, and minor dents. The inspection process includes an evaluation of minor surface conditions as to their impact on the integrity of the container. Such conditions may not require action, but should be noted and corrected if there is a trend indicating eventual deterioration;

- functioning of the waste container closures, in place, and securely fastened;

- evidence of leakage, which may indicate unacceptable materials in the waste, inadequate internal packaging materials, (insufficient absorbent), or failure of the container;

- evidence of structural problems with the waste container such as buckling or split seams;

- bulging of the waste container indicating build up of pressure in the container, which may indicate inappropriate storage conditions (e.g., storing tightly sealed waste containers where they are subject to excessive heating), a condition inside the container that needs to be remediated, and the need to replace the container; and

- examination of waste container marking and labeling to ensure that they are maintained in a legible condition.

Example: Low-level waste is stored in rows two drums wide and two drums high with an aisle between the rows. The site procedure call for an operator to inspect the condition of the drums every two weeks and record any potentially adverse conditions.

Some older storage configurations (e.g., dense pack storage where there are multiple rows and layers of waste containers without access space between them) may not allow direct visual inspection. In such cases, the “inspection” may need to be done using remote or indirect techniques. Remote techniques include the use of video cameras which provide real time or recorded displays of waste containers which are not accessible for direct inspection. Indirect

methods include the use of radiation detectors to determine when a waste container has failed. To the extent possible, direct remote visual inspections are to be used in preference to indirect methods since indirect methods force the inspection and maintenance process into a reactive mode of fixing problems once they have occurred (as detected by an increase in radioactive contamination) rather than a proactive mode of preventing breaching of the waste containers.

> *Example: Drums stored in a dense pack array are in a building that has a continuous air monitor. To ensure adverse waste container conditions are detected as soon as practical, additional monitoring is performed on a routine basis. The additional monitoring involves the use of radiation detectors on extension probes to reach inside the array and a similar use of swabs to check for loose contamination within the array.*

Waste containers are to be physically examined on a routine basis to ensure that storage conditions have not caused the integrity of the container to be compromised. Waste containers that exhibit serious deterioration and a potential for containment of the waste to be jeopardized may need to be replaced.

> *Example: During the routine inspection of waste drums conducted every 30 days at a staging area a drum was identified as possibly damaged. Upon detailed examination, it was determined that a forklift had punctured the waste drum. The waste was repackaged and the old drum removed from service.*

Maintenance. The process for waste container maintenance should include capabilities for preventive actions as well as for corrective actions. Preventive actions would address minor conditions associated with ensuring waste containment. Actions might include cleaning and painting small areas on metal containers to curb corrosion that could eventually lead to compromising the container. The maintenance process also provides capabilities to respond to more serious conditions up to and including breaching of the container (e.g., from accidental puncture or corrosion).

Maintenance of a container(s) in response to acute conditions (i.e., conditions where there is a release or imminent threat of a release) needs to provide for prompt containment of the release, assessment of the situation, and remedying the situation. The immediate response is to ensure that release of contamination is controlled. Actions may be as simple as replacing a bolt and or closure ring on a drum, or covering a hole in a container with tape. More serious conditions may require placing the waste container in a catch tray or in an overpack. An assessment of the condition causing the breach or potential breach needs to be part of the process so that, if necessary, the causative factors can be corrected. If corrosion is affecting the waste container, the reason for the corrosion needs to be determined so an effective response can be made. If there is a corrosive material in the waste container, overpacking may only temporarily correct the problem. In such situations, it may be more appropriate to treat the waste or to provide a liner

that is resistant to corrosion. If there is buckling of the waste container or split seams, an assessment needs to be made of whether the contents are too heavy, whether the container is improperly designed, or whether the container was mishandled (e.g., dropped). In cases where an external event is the cause of the damage (e.g., a waste container is dropped or struck by equipment), repackaging or overpacking in a similar container may be appropriate.

> *Example: The inspection process in a storage facility identified a waste drum that was corroding even though the container was stored in acceptable conditions and the paint on the drum was in good shape. Storage facility personnel recognized that there was a need to investigate whether the contents of the container caused the corrosion. Evaluation of the container contents confirmed that the waste included a corrosive material. The waste was treated to neutralize the corrosion then repackaged in a similar container.*

The term maintenance does not imply that refurbishment of deteriorating waste containers is required. The premise of this requirement is that potential doses to workers is avoided. Therefore, overpacking may be the most appropriate action as opposed to a repackaging action requiring excessive handling of the waste and possible exposure.

Compliance with this requirements is demonstrated by: (1) a documented process for waste container inspection and maintenance; and (2) documentation for all waste container inspections and maintenance actions performed.

IV. N.(6) Storage Management. Low-level waste storage shall be managed to identify and segregate low-level waste from mixed low-level waste.

Objective:

The objective of this requirement is to prevent the commingling of low-level waste with mixed low-level waste.

Discussion:

The management of mixed low-level waste represents challenges not typically encountered with the management of low-level waste. The additional requirements imposed for the management of the hazardous constituent can represent additional management effort over that which is required for the radiological constituent. By identifying and segregating the two waste types, the amount of mixed low-level waste generated will be minimized and the effort and resources required to achieve final disposition of the waste will be minimized. Historical problems and current storage

conditions exist which indicate that a formal requirement to prevent the commingling of waste types is warranted.

> *Example: During the decontamination and decommissioning of an old laboratory a small quantity of mixed low-level waste is placed in a large wooden box with low-level waste. Segregation of the waste types is not done because it is believed that the waste will have to be repackaged for treatment in the near future. While in storage, the small amount of mixed low-level waste commingles with the rest of the waste in the wooden box. The entire contents of the wooden box must now be managed as mixed low-level waste.*

The management polices and procedures for the storage of all low-level waste need to address the identification of mixed low-level waste. Identification of mixed low-level waste needs to occur prior to the waste being placed in storage. The requirements that personnel must follow in managing (i.e., generating, transporting, treating, storing, or disposing) mixed low-level waste are primarily in 40 CFR Parts 260 through 270, or similar state regulations (see Section IV.B of this guidance).

The management polices and procedures for the storage of all low-level waste need to address the segregation necessary to avoid commingling the waste types. The segregation should be a combination of physical and procedural requirements.

> *Example: Low-level waste and mixed low-level waste is stored in the same building. Procedures have been established to prevent the waste types from coming in contact with each other. In addition, physical markers such as lines on the floor and rope barriers are in place to prevent inadvertent contact between the waste types. The entire system is based on the proper marking and labeling of the waste containers.*

Compliance with this requirement is demonstrated by: (1) a documented process for identifying mixed low-level waste in storage; and (2) documented operating procedures that prevent the storage of low-level waste in the same immediate area as mixed low-level waste.

Supplemental References:

1. DOE, 1996. *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities,* DOE/EM-0280, U.S. Department of Energy, Washington, D.C., May 1996.

2. EPA. *Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities,* 40 CFR Part 264, U.S. Environmental Protection Agency, Washington, D.C.

IV. N.(7) Staging. Staging of low-level waste shall be for the purpose of the accumulation of such quantities of waste as necessary to facilitate transportation, treatment, and disposal. Staging longer than 90 days shall meet the requirements for storage above and in Chapter I of this Manual.

Objective:

The objective of this requirement is to allow for the safe temporary accumulation of low-level waste to facilitate its management without the accumulation being considered storage and thus bound by the associated requirements for storage.

Discussion:

The storage of low-level waste is an important function required for the effective management of low-level waste. The storage of low-level waste is defined as the collection and management of waste for the purpose of awaiting treatment or disposal capacity, in such a manner as to not constitute disposal of the waste. During the development of the requirements in DOE M 435.1-1, it was recognized that storage of waste for short periods does not require the same controls that storage of low-level waste for longer periods would require. A distinction between storage for less than 90 days and storage for periods greater than 90 days was made when the less-than-90 day storage is for the temporary accumulation of low-level waste to facilitate transportation, treatment, or disposal. This temporary action is referred to as staging, and is usually associated with a subsequent management step such as treatment or disposal. The term staging helps provide a distinction from "storage" in order to know when to apply the needed extra controls that are necessary when the waste is stored.

The 90-day period was chosen as a result of the requirements analysis conducted in developing the Manual to be consistent with best management practices as reflected in the management of hazardous waste in accordance with RCRA requirements. Since this time frame is already being adhered to for mixed low-level waste, extending this to all low-level waste is prudent and should not be overly burdensome to facility operations.

The staging of low-level waste should be considered an action that is primarily for the benefit of achieving the next management step for the waste safely and cost-effectively. For example, staging could include the accumulation of low-level waste by:

- a generator prior to shipment to a receiving facility;
- a treatment facility prior to treatment;
- a treatment facility following treatment; or

- a disposal facility prior to emplacement of the waste.

The staging of low-level waste needs to be addressed in the radioactive waste management basis for the facility that is performing the staging. Generators, treatment facilities, and disposal facilities that stage waste must ensure that the action of staging is included and authorized as part of their radioactive waste management basis for the affected facilities, operations, or activities.

Determination of the 90-day time limit shall be based on the date the waste is generated or treated and the date the waste was received at a treatment or disposal facility. The information regarding the dates for determination of staging periods needs to be documented consistent with the requirement for transfer of the waste, DOE M 435.1-1, Section IV.K.

As the one-year limit for storage, the intent of this requirement is not that a focus be placed on the compliance or non-compliance with the 90-day limit. The requirement is not intended to force shipment of low-level waste when the 90-day period is reached, or to cause additional handling of low-level waste that would result in increased risk or safety concerns. Rather, the intent of this requirement is to focus attention of managers at the site towards ensuring that waste is being managed to disposal under reasonable time frames. The requirement calls for accumulation of waste longer than 90 days to be subject to the storage requirements in Chapter I and IV of the *Radioactive Waste Management Manual* (DOE M 435.1-1). Staging longer than 90 days must be justified, the conditions for such storage met, and these practices approved by the Field Element Manager as part of the radioactive waste management basis for the facility.

There needs to be flexibility in the implementation of this requirement due to the complexities of management of low-level waste and the unpredictability of events as they affect planned operations. Thus, malicious compliance with the 90-day limit is not necessary, nor is it intended that no additional "staging" time can be allowed past the 90 days.

> *Example 1: Drums accumulating in an area awaiting shipment to a disposal facility for less than 90 days is identified as staging and is included in the radioactive waste management basis of the facility holding the waste.*
>
> *Example 2: The drums described above are held for a period of 125 days. The Field Element Manager has evaluated the conditions at the facility and approves this period of time for staging in the radioactive waste management basis of the facility because the requirements for storage are being met.*
>
> *Example 3: Some of the drums described above do not get loaded in the shipment that takes place at the end of the 125 days. This is a non-compliance. The radioactive waste management basis needs to include the rationale for storage of drums not picked up in*

the accumulated amount and the conditions for their storage. One of the conditions is that the one-year storage limitation clock has already had 125 days expire.

Example 4: Low-level waste is accumulated at a treatment facility prior to repackaging and treatment. Typically, the total time waste is held before and after treatment is less than 90 days. However, certain treatment campaigns require the staging of waste at the facility for a longer period of time. The treatment facility has an approved radioactive waste management basis that includes contingency storage for these circumstances and includes meeting the applicable requirements for storage.

Compliance with this requirement is demonstrated by a staging program that limits the temporary storage of waste to only circumstances allowed in the requirement, including justifications for any staging that exceeds the 90-day period, which is documented in the radioactive waste management basis for the facility.

Supplemental References: None.

IV. O. Treatment.

Low-level waste treatment to provide more stable waste forms and to improve the long-term performance of a low-level waste disposal facility shall be implemented as necessary to meet the performance objectives of the disposal facility.

Objective:

The objective of this requirement is to ensure low-level waste is treated to meet disposal facility waste acceptance criteria, to achieve greater stability of the disposal site, and for a greater level of assurance that the disposal performance objectives are met.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, treatment of waste was identified as an activity that presented potential risks to the public, workers, and the environment. The hazards and requirements analyses identified certain characteristics of radioactive waste that would be unacceptable for long-term storage, leading to the need for treatment of such waste prior to its acceptance for storage. Several existing external regulations (e.g., *Clean Air Act* or RCRA) or other requirements (e.g., 10 CFR Part 835, *Occupational Radiation Protection* or DOE O 360.1, *Training*) were found to already address requirements pertaining to weaknesses and conditions that could potentially lead to adverse impacts. Consequently, the *Radioactive Waste Management Manual* DOE M 435.1-1, Section I.2.F.(14) assigns the Field Element Manager an umbrella, performance-oriented responsibility for ensuring that waste treatment is protective of the public, workers, and the environment. Treatment can also affect low-level waste disposal technologies and requirements. This requirement focuses attention on the treatment of low-level waste necessary to make waste acceptable for disposal.

The low-level waste treatment actions necessary to make waste acceptable for storage and disposal can be driven by dictated external requirements or requirements established by waste acceptance criteria. Waste acceptance requirements for a storage or disposal facility, established based on safe handling of the waste and on regulatory compliance, include minimum waste form characteristics and requirements for stability and other characteristics to enhance their performance. Treatment may range from actions as simple as sorting waste to remove materials which would make the waste unacceptable (e.g., aerosol cans) to solidification or vitrification.

Low-level waste may also be treated for programmatic needs. Programmatic needs include treatment to reduce the use of disposal capacity or to provide an additional protective barrier during transportation or storage of a controversial waste prior to its disposal.

Improved Waste Forms and Characteristics. The requirements for treatment of low-level waste are driven by the need for an improved waste from that provides additional protection while it is in storage or following its disposal. Minimum characteristics of waste that must be specified in disposal facility waste acceptance requirements are at DOE M 435.1-1, Sections IV.G.(1) (a) through (c). Characteristics of waste that are prohibited for waste going into storage are at DOE M 435.1-1, Section IV.N.(1). In order to meet the waste acceptance requirements derived and specified for these performance oriented requirements at storage and disposal facilities, some physical or chemical stabilization may need to be performed. Some minimum waste form requirements specific to low-level waste disposal facilities are at DOE M 435.1-1, Section IV.G.(1)(d). The disposal facility waste acceptance requirements provide for improved waste characteristics and waste forms, and low-level waste that cannot meet these minimum waste form requirements must be treated to meet the requirement prior to disposal. Liquid, pyrophoric, gaseous, infectious, toxic, and explosive wastes, must be treated prior to disposal to meet the minimum waste form requirements of a disposal facility. Guidance for the waste acceptance requirements provides discussions that can assist in the development of processes that will result in waste forms and packaged waste with the desired characteristics.

> *Example 1: Low-level waste consisting of contaminated metal turnings and fines is produced from a process at the Site G Fuel Fabrication Plant. An analysis indicates this waste is pyrophoric. A process is implemented at the Fuel Fab Plant to oxidize the turning and fines and add grout to packages to stabilize the material prior to shipment for disposal.*

> *Example 2: Low-level waste containing small amounts of volatile materials must be stored in Building 500 at the Brown Site. Building 500 is susceptible to high temperatures in the summer months, and it is unknown how long the waste must remain in storage. The waste is treated with a neutralizing agent and a solidification media prior to acceptance at the storage facility.*

Besides the prohibited storage characteristics specified in DOE M 435.1-1, Section IV.N.(1) and the minimum disposal waste form criteria that are specified in DOE M 435.1-1, Section IV.G.(1)(d), additional technical criteria for physical and chemical stability, waste compressibility, acceptable waste forms, liquid content, and other parameters may be specified by a specific facility's waste acceptance requirements. These criteria are based on safety considerations derived from the waste management facility safety documentation, or performance considerations derived from the performance assessment and composite analysis for a low-level waste disposal facility. The treatment processes and facilities must be developed and designed so that the desired waste form and characteristics are achieved with the treated waste form.

> *Example: The disposal facility at Site Q requires waste in the form of incinerator ash to be solidified. A solidification process is designed and installed as part of the Central*

Incineration Facility at Site Y to solidify incinerator ash with an approved grout in 55 gallon drums prior to shipping to Site Q for disposal.

Meeting Disposal Facility Performance Objectives. The requirement at DOE M 435.1-1, Section IV.G.(1)(a) calls for the establishment of acceptable activities or concentrations of specific radionuclides as determined by safety analyses, technical safety requirements, performance assessments, or composite analyses. As discussed in the guidance on meeting waste acceptance requirements, acceptable radionuclide activities or concentrations established through the performance assessment contribute to providing reasonable assurance that the performance objectives of a low-level waste disposal facility will be met. As discussed in that guidance, additional waste form stability requirements could be applied to some wastes with certain radionuclides to establish higher allowable activities or concentrations. As with the minimum waste form and characteristics requirements, treatment processes and facilities must be developed and designed so that the desired waste form and characteristics are achieved with the treated waste form. In the case of additional waste stability requirements that allow for higher allowable concentrations or activities of radionuclides, the desired waste form may need to last a significant period of time (e.g. 300 years) in order for there to be reasonable assurance that disposal performance objectives are met. In order for there to be confidence that a treated waste form will last for the desired period of performance, stringent controls on parameters will be necessary in the operation of whatever treatment process is developed and designed.

Example: A waste stream, composed primarily of long-lived actinides with the highest radionuclide concentrations being associated with ^{235}U and ^{238}U, is proposed for disposal at Site X. An evaluation of the results of the performance assessment and composite analysis engenders concern in some stakeholders about intruder protection and the assumptions used in the performance assessment. A treatment method is developed for this waste stream which results in a final waste form of a low grade glass shaped in rectangular blocks sized to fit tightly within approved boxes for burial at Site X at the bottom of waste disposal units. This treatment and disposal method creates a durable waste form for the long-term and satisfactorily addresses the concern regarding intruder protection.

Waste with No Path to Disposal. For waste that does not have an identified path to disposal, waste may need to be treated so the waste can be stored for an indefinite period of time. Some of the same considerations (i.e, physical or chemical stability, reducing liquids) need to be taken into account for the indefinite storage of waste. Treatment of waste that does not have a path to disposal must occur only after an analysis has been conducted that ensures the resultant waste form will not add to the no path forward condition. The proposed treatment needs to provide a reasonable assurance that the waste does not contribute to additional volumes of waste with no path to disposal. The analysis and justification needs to be part of the life-cycle planning

performed per the requirement for a Site-Wide Radioactive Waste Management Program, DOE M 435.1-1, Section I.2.F.(1).

The requirement to treat waste to meet the waste acceptance criteria of the appropriate storage or disposal facility is not intended to prohibit treatment for other reasons. Waste managers may elect to treat waste for programmatic reasons, but in so doing, must ensure that the waste will still meet the waste acceptance criteria of the facility(ies) to which it will be transferred, and ultimately for disposal.

Mixed Low-Level Waste. Treatment necessary to comply with agreements reached pursuant to the *Federal Facility Compliance Act of 1992* must be considered in making treatment decisions concerning mixed low-level waste. Site personnel need to ensure that commitments made in the Site Treatment Plans are met for both current and newly-generated low-level wastes. To the extent that other low-level waste streams could benefit from the same treatment as specified in the Site Treatment Plans, treating these wastes along with the mixed waste streams is included in the life-cycle waste management planning in the Site-Wide Radioactive Waste Management Program to ensure the most efficient waste management processing.

Compliance with this requirement is demonstrated when a treatment facility or process ensures that treated waste will meet the minimum waste form requirements of DOE M 435.1 and meet additional disposal facility-specific waste acceptance requirements for additional stability or long-term performance of facilities that will receive the treated waste.

Supplemental References:

1. *Resource Conservation and Recovery Act of 1976*, as amended, October 21, 1986.

2. *Federal Facility Compliance Act of 1992*, as amended, October 6, 1992.

IV. P. Disposal.

Low-level waste disposal facilities shall meet the following requirements.

(1) Performance Objectives. Low-level waste disposal facilities shall be sited, designed, operated, maintained, and closed so that a reasonable expectation exists that the following performance objectives will be met for waste disposed of after September 26, 1988:

(a) Dose to representative members of the public shall not exceed 25 mrem (0.25 mSv) in a year total effective dose equivalent from all exposure pathways, excluding the dose from radon and its progeny in air.

(b) Dose to representative members of the public via the air pathway shall not exceed 10 mrem (0.10 mSv) in a year total effective dose equivalent, excluding the dose from radon and its progeny.

(c) Release of radon shall be less than an average flux of 20 pCi/m^2/s (0.74 Bq/m^2/s) at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/1 (0.0185 Bq/l) of air may be applied at the boundary of the facility.

Objective:

The objective of these requirements is to ensure that all phases of low-level waste disposal (i.e., facility siting and design, operations, maintenance, and closure) are conducted in a manner that will result in a reasonable expectation that the disposal performance objectives will be met. The performance objectives are specific objectives that quantify, where possible, the desired protection of the public and the environment from disposed low-level waste.

Discussion:

As discussed in Section I.2.F.(15) of the guidance for Chapter I, General Requirements, the Field Element Manager is responsible for ensuring that low-level waste is disposed in a manner that protects the public, workers, and the environment. This protection needs to be afforded during all phases of the life of the low-level waste disposal facility, namely operations, closure, and post-closure. Since actual compliance with protection requirements for disposal of waste cannot be made before events occur, a prediction must be made of a disposal facility's capability of affording the required protection to decide whether waste will indeed be disposed safely. The performance objectives listed in this requirement provide criteria that define the desired level of protection of

the public and the environment from disposed low-level waste that leads to a comfort level that, when actually measured sometime in the future, compliance with real protection requirements will be easily achieved. Real-time worker protection is not a future concern, and is adequately defined in 10 CFR Part 835 and discussed in the guidance on DOE M 435.1, Section I.1.E.(13). The application of the performance objectives to waste disposed after September 26, 1988 coincides with the first issuance of DOE's requirement that performance assessments be prepared, and represents no change from existing requirements in DOE 5820.2A.

The performance assessment and composite analysis conducted on the disposal facility provide the reasonable expectation that the performance objectives will be met by establishing parameters, limits, and controls on the siting, design, operations, maintenance, and closure of the facility in order for there to continue to be an expectation that the criteria delineated in the objectives are met. The following guidance sections discuss the performance objectives for low-level waste disposal.

Disposal of low-level waste must be conducted in a manner that is protective of the public and the environment. The Department's requirements for radiological protection of the public and the environment are detailed in DOE 5400.1 and DOE 5400.5. These requirements apply to all activities at a DOE site. Consistent with established radiation protection practices articulated by the National Council on Radiation Protection (NCRP) and the International Council on Radiation Protection (ICRP), the projected dose attributable to any single source, practice, or activity should be some fraction less than the applicable overall dose limit. Depending on the particular source of concern, DOE, EPA, and the NRC have typically established limits of 10 to 25 percent (10 mrem [.10 mSv] to 25 mrem [.25 mSv]) of the primary dose limit for protection of the public (100 mrem [1 mSv]/year) to any particular source, although higher or lower fractions may be appropriate. The DOE performance objectives for low-level waste disposal are established with the goal of assuring that the single practice of low-level waste disposal will not consume more than 25 percent of the overall objective for protection, which is the primary dose limit of 100 mrem (1 mSv) in a year to members of the public.

Radioactive material contained in low-level waste will, over time, tend to migrate through environmental media. Because of the site-specific nature of such migration and potential eventual exposure to the public, the three specific performance objectives (a), (b), and (c), are defined to protect the public from all potential exposure pathways.

Impacts of low-level waste disposal on the public or the environment may not be realized until hundreds or thousands of years after the disposal facility has been closed. Due to the lengthy time-frame under consideration and the reliance on modeling of complicated natural processes, it is difficult to reliably predict impacts on the public or the environment. Therefore, it is not possible to provide absolute proof of a disposal facility's performance at some future time. Rather than proof, the requirement is stated in terms of a reasonable expectation. DOE M 435.1-

1 requires that a radiological performance assessment be prepared to provide a reasonable expectation that the performance objectives will not be exceeded. The performance assessment is an analysis of physical and chemical mechanisms that control the migration of radioactive materials through the environment to points of potential human exposure; it includes activities that future members of the public may conduct (e.g., drinking water, recreational activities) that could potentially result in exposure to the radioactive material.

Guidance for each specific performance objective is discussed in the following paragraphs.

All-Pathways Performance Objective. As noted above, consistent with established radiation protection practices articulated by the NCRP and ICRP, the projected dose attributable to any single source, practice, or activity should be some fraction less than the applicable overall dose limit. Depending on the particular source of concern, DOE, EPA, and the NRC have typically established limits of 10 to 25 percent (10 mrem [.10 mSv] to 25 mrem [.25 mSv]) of the primary dose limit for protection of the public (100 mrem [1 mSv]/year) to any particular source, although higher or lower fractions may be appropriate. This performance objective is used to provide a reasonable expectation that members of the public will not receive more than 25 percent of the primary dose limit of 100 mrem (1mSv) in a year from the disposal of low-level waste. The requirement is inclusive of all potential exposure pathways (e.g., groundwater, surface water, air) except for dose from radon and its decay products for which a separate performance objective is stated.

All pathways include any and all modes by which a receptor at the point of presumed public access (see discussion on point of compliance in guidance for DOE M 435.1-1, Section IV.P.(2)(b)) could be exposed to radioactive material migrating, via any and all environmental media (e.g., water, soil, biota, air), from the disposed waste. Per normal radiological protection practice, radon and its decay products are considered separately from other radionuclides. Even though a separate performance objective is established for the air pathway, the air pathway is, nevertheless, included in the all pathways dose calculation.

The performance objective is stated in terms of dose to representative members of the public to indicate that overly conservative assumptions are not made of the age, sex, or assumed activities of persons. The performance objectives are generally applied, through the performance assessment process, to hypothetical future members of the public, rather than to known and identified individuals.

Air-Pathway Objective. This performance objective requires a reasonable expectation that members of the public will not receive, via the air pathway alone, more than 10 mrem in a year, excluding the dose from radon and its progeny. This objective is drawn from the Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61, Subpart H). Consistent with 40 CFR Part 61, Subpart H, dose from radon and its

progeny are not included in assessing compliance with this performance objective. It should be recognized that the 10 mrem in a year limit is for all sources on the DOE site, not just from the disposal facility.

Radon Dose Objective. This performance objective requires a reasonable expectation that radon, either as a constituent of waste at the time of disposal or produced by radioactive decay following disposal, is not released from the disposal facility at a rate that would exceed the limit established in 40 CFR Part 61, Subpart H. Compliance with this performance objective, via the performance assessment, could address either of the two limits contained therein. The rate of radon release, over time, from the surface of the disposal facility could be projected for comparison with the flux limit. Alternatively, the concentration of radon in air could be projected for comparison with the concentration limit. In most cases, the ground surface emanation rate of 20 pCi/m^2/s should be applied. However, in cases where the disposed waste radiologically resembles uranium or thorium mill tailings, the limit on air concentration may be warranted. Alternatively, doses from radon and progeny may be included in the assessment of compliance versus the 10 mrem in a year air pathway objective. In this case, assuming that compliance with the 10 mrem in a year dose limit is projected, radon need not be addressed separately.

Compliance with this requirement is demonstrated by the performance assessment for the disposal facility including documented conclusions that there is a reasonable expectation that the three performance objectives will be met at the facility.

Supplemental References:

1. DOE, 1996. *Interim Format and Content Guide, and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments,* U.S. Department of Energy, Washington, D.C., October 1996.

2. DOE. *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses,* DOE G 435.1-1, U.S. Department of Energy, Washington, D.C. (Under preparation.)

IV. P.(2) Performance Assessment. A site-specific radiological performance assessment shall be prepared and maintained for DOE low-level waste disposed of after September 26, 1988. The performance assessment shall include calculations for a 1,000 year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in this Chapter are not exceeded as a result of operation and closure of the facility.

(a) **Analyses performed to demonstrate compliance with the performance objectives in this Chapter, and to establish limits on concentrations of radionuclides for disposal based on the performance measures for inadvertent intruders in this Chapter shall be based on reasonable activities in the critical group of exposed individuals. Unless otherwise specified, the assumption of average living habits and exposure conditions in representative critical groups of individuals projected to receive the highest doses is appropriate. The likelihood of inadvertent intruder scenarios may be considered in interpreting the results of the analyses and establishing radionuclide concentrations, if adequate justification is provided.**

(b) **The point of compliance shall correspond to the point of highest projected dose or concentration beyond a 100 meter buffer zone surrounding the disposed waste. A larger or smaller buffer zone may be used if adequate justification is provided.**

(c) **Performance assessments shall address reasonably foreseeable natural processes that might disrupt barriers against release and transport of radioactive materials.**

(d) **Performance assessments shall use DOE-approved dose coefficients (dose conversion factors) for internal and external exposure of reference adults.**

(e) **The performance assessment shall include a sensitivity/ uncertainty analysis.**

(f) **Performance assessments shall include a demonstration that projected releases of radionuclides to the environment shall be maintained as low as reasonably achievable (ALARA).**

(g) **For purposes of establishing limits on radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts to water resources.**

(h) **For purposes of establishing limits on the concentration of radionuclides that may be disposed of near-surface, the**

performance assessment shall include an assessment of impacts calculated for a hypothetical person assumed to inadvertently intrude for a temporary period into the low-level waste disposal facility. For intruder analyses, institutional controls shall be assumed to be effective in deterring intrusion for at least 100 years following closure. The intruder analyses shall use performance measures for chronic and acute exposure scenarios, respectively, of 100 mrem (1 mSv) in a year and 500 mrem (5 mSv) total effective dose equivalent excluding radon in air.

Objective:

The objective of these requirements is to ensure that all aspects of low-level waste disposal (i.e., facility siting and design, operations, maintenance, and eventual closure) are analyzed in a performance assessment to provide a reasonable expectation that the disposal performance objectives will be met.

Discussion:

Impacts of low-level waste disposal on the public or the environment may not be realized until hundreds or thousands of years after the disposal facility has been closed. Consequently, potential effects of low-level waste disposal must be calculated by simulating the various chemical and physical processes that govern migration of waste constituents through the environment to locations where future members of the public may be exposed. The calculation must also include assumptions regarding the activities that future persons may engage in that would result in exposure. The performance assessment process is used as a management tool to provide assurance that waste disposal is not likely to result in future exceedance of the performance objectives discussed in DOE M 435.1-1, Section IV.P.(1).

September 1988 Date. The performance assessment includes in its analysis only waste disposed after September 26, 1988. This date was the effective date of DOE 5820.2A which is superseded by DOE O 435.1 and DOE M 435.1-1. With the issuance of DOE 5820.2A, DOE established controls over the disposal of low-level waste similar to those contained in 10 CFR Part 61, *Licensing Requirements for Near Surface Disposal of Radioactive Waste*. Rather than attempting to apply these controls retroactively to former waste disposal, the Department assumed that under CERCLA or NEPA it would address past disposal facilities, while all current and future controls and requirements would be applied to post-September 1998 waste.

Reasonable Expectation. Certainty of compliance with performance measures or absolute proof of a disposal facility's adequate performance at some future time is not possible. Rather, DOE M

435.1-1 requires that the radiological performance assessment be prepared to provide "a reasonable expectation" that the performance objectives will not be exceeded. The performance assessment process is used to aid siting, design, and operations of the low-level waste disposal facility. Results of the performance assessment are used to specify details of design (e.g., depth of disposal units, thickness of concrete), operational controls such as waste acceptance criteria, and/or closure requirements to ensure that the low-level waste disposal performance objectives will continue to be met. The intent of the reasonable expectation standard is to provide a demonstration that, considering the uncertainties in engineered and natural systems over long time periods, the actual performance will comport with its design. The intent is to produce a reasonable analysis that evaluates the entire disposal system rather than focusing too much on the conservatism of any one individual element of the system.

Compliance Time Period. The performance assessment is to consider a period of 1,000 years, after the disposal facility has been closed, to assess compliance with the performance objectives. This time is selected to encompass the likely processes and migration of radionuclides most likely to contribute to the calculated dose. Longer times of assessment are not used to assess compliance because of the inherently large uncertainties in extrapolating such calculations over long time frames.

This requirement also includes the provision for review and approval of the performance assessment by DOE Headquarters. As discussed in guidance on DOE M 435.1-1, Section I.2.E.(1), the Deputy Assistant Secretaries for Waste Management and Environmental Restoration have the responsibility for reviewing and approving performance assessments for low-level waste disposal facilities and issuing a disposal authorization statement. The guidance on DOE M 435.1-1, Section I.2.E.(1) discusses the review and approval process in detail.

The improvement of performance assessments and their subsequent compliance reviews and approvals has been the aim of much of the revisions to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. Consequently, detailed guidance on conducting performance assessments is being developed for inclusion in DOE G 435.1-1, *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. That document needs to be consulted for additional detailed discussions of the performance objectives, preparation of a performance assessment, and the interpretation of assumptions and other technical information and evaluations contained in a performance assessment. The requirement to do a performance assessment is augmented in DOE M 435.1-1 with the specific individual requirements ((a) through (h)) that limit and define the scope and content of the analysis in the performance assessment. These seven requirements ensure that certain aspects of the analysis are not left out, consider standard methodologies and parameters, and lead to certain conclusions so that controls on waste acceptance and disposal operations are defined appropriately. Guidance for each of these seven specific requirements is discussed below. As just mentioned, detailed guidance on conducting

performance assessments will be contained in DOE G 435.1-1, *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. That document needs to be consulted for additional detailed discussions of these seven technical criteria that must be used in preparation of a performance assessment.

Reasonable Activities of the Critical Group. Performance assessment analyses should be based on reasonable activities of the portion of the exposed population likely to receive the highest dose (i.e., the critical group). However, the performance assessment analyses should not be based on "worst-case" assumptions. Rather, the analyses should be based on scenarios that represent reasonable actions of a typical group of individuals performing activities that are consistent with regional social customs, work, and housing practices, and expected regional environmental conditions at the time of the exposure scenario, and who are members of the critical group expected to receive the highest doses.

> *Example: The Site X performance assessment does not include a large-scale farming scenario because of the arid climate and the poor quality of soil prevalent in the area of the site.*

Point of Compliance. The initial assumption, or point of departure, for point of compliance in DOE M 435.1-1 for performance assessments is the point of highest projected dose or concentration beyond a 100 meter buffer zone. This is the point(s) in space, relative to the disposed waste, where the performance assessment is to provide a reasonable expectation of compliance with the performance objectives.

The concept of a buffer zone is inherent in defining a low-level waste disposal facility. The disposal facility is comprised of a number of disposal units (e.g., earthen trenches, tumuli, vaults), the space between disposal units, and space around the collection of disposal units. This latter space is called the buffer zone. The buffer zone provides some radionuclide containment capability, as well as controlled space to establish monitoring locations and, as necessary, modify or supplement the design of the disposal facility. Consistent with established radiation protection practices articulated by the National Council on Radiation Protection (NCRP) and the International Council on Radiation Protection (ICRP), the projected dose attributable to any single source, practice, or activity should be some fraction less than the applicable overall dose limit. Depending on the particular source of concern, DOE, EPA, and the NRC have typically established limits of 10 to 25 percent (10 mrem [.10 mSv] to 25 mrem [.25 mSv]) of the primary dose limit for protection of the public (100 mrem [1 mSv]/year) to any particular source, although higher or lower fractions may be appropriate. Setting the extent of the buffer zone at 100 (e.g., 25 mrem [.25 mSv]) meters ensures that active and new disposal facilities do not contribute an overly large portion of the total dose projected from all sources of radiation, particularly in the absence of final decisions on land use.

The requirement provides flexibility in establishing the extent of the buffer zone considering site-specific issues. In certain instances, e.g., if the disposal facility is located adjacent to the current DOE site boundary, it may be more appropriate to use a smaller buffer zone. In other cases, e.g., where the disposal facility is located far from the DOE site boundary, and the site's land-use planning does not envision relinquishing control of the site, a larger buffer zone, potentially extending to the site boundary, could be considered. In any case, justification for the selection of the buffer zone must be provided.

The justification for the selection of the point of compliance and size of the buffer zone is based on land use plans and commitments that have been negotiated during consent agreements or other regulatory actions. If land use planning has not progressed enough for commitments to exist, the justification could also be based on published information about site boundaries in documentation such as Environmental Impact Statements. The justification could also be based on the proximity of already existing contaminated areas or nearby operational facilities that establish a boundary, or which would render the 100 meter point of compliance as unreasonable.
The buffer zone is to be established based on land use planning and commitments, a reasonable judgement concerning nearby facilities and areas of contamination, and natural borders. The buffer zone cannot be established arbitrarily, or moved to a specific distance to achieve a disposal objective, such as accommodating a large concentration of a mobile radionuclide.

> *Example: A low-level waste disposal facility is located in a quadrant of the DOE site that includes several contaminated areas and other waste management facilities. The current land use plan negotiated with stakeholders at the site, and which is incorporated by reference in the Consent Order at the site, shows this land remaining under DOE control. The buffer zone for this facility is extended out to a point about half way between the disposal facility boundary and the site boundary.*

Natural Processes. Performance assessments need to consider reasonably foreseeable natural processes that might disrupt the intended performance of the disposal facility. Natural processes such as erosion and natural events, including severe storms, tornados, and seismic events can disrupt disposal facility barriers and result in release and transport of radioactive materials.

Low-level waste disposal facilities normally incorporate a number of barriers to reduce release and transport of radionuclides from the waste. Such barriers may include, but are not limited to, the waste form itself, packaging, engineered backfill (e.g., chemical buffering, low permeability), engineered features of the disposal unit (e.g., tumuli, vaults), and the closure design. All of these will, in time, be affected by natural processes and this phenomena should be evaluated in the performance assessment. For instance, corrosion will, in time, breach most containers; environmental conditions will, in time, consume the capacity of chemical buffers, and; erosion, burrowing animals, and intrusion by plant roots will eventually breach disposal facility closure caps. Such processes are considered to be reasonably foreseeable since, absent mitigative

measures, they take place in the present. Other processes or events, although not regularly occurring, are, nonetheless, reasonably foreseeable. Such events would include severe weather such as the probable maximum precipitation event leading to the probable maximum flood, and seismic events. Other processes, such as climate change, are considered to be too speculative for consideration in the performance assessment.

> *Example 1: The Brown Site disposal facility is located in a corner of "tornado alley" in southern Illinois. The processes considered in the Brown Site disposal facility performance assessment includes an analysis of tornado damaging the trench cap of a high-activity trench and allowing an increase in water infiltrating into the trench.*

> *Example 2: The performance assessment for the Brown Site disposal facility does not include the onset of an ice age in Illinois during the analysis period, however the progression of a meander of the Scott River from its current location approximately 1/4 mile away to a new location within the site boundary and will be evaluated.*

Dose Conversion Factors. Dose calculations in performance assessments will use established dose conversion factors for adults (i.e., reference man). The actual dose to a particular individual from a given exposure to radioactive material (external or internal) is dependent on a number of characteristics, including age and sex. However, performance assessments are not intended to predict doses to specific individuals or classes of persons. Rather, the calculations are to represent potential exposure to hypothetical future members of the general public. In such cases, the use of standard adult dose conversion factors is indicated. As indicated, only DOE-approved dose conversion factors shall be used. The currently approved DOE dose conversion factors are in Federal Guidance Report No. 11, EPA-520/1-88-020, for internal exposure, and Federal Guidance Report No. 12, EPA-402-R-93-081, for external exposure. The *Format and Content Guide*, DOE G 435.1-1, provides additional information on the current dose conversion factors which are considered approved.

Sensitivity/Uncertainty Analysis. One of the primary goals of the performance assessment process is to provide information to demonstrate that a given waste facility complies with the applicable limits. In accordance with the existing regulatory structure, these limits are expressed in terms of dose rates that have single values. Even though the dose rate estimates provided through performance assessments may also be expressed as single values, they have associated uncertainties. For this reason, it is recommended that a discussion of these uncertainties by included in expressing he outcomes of any performance assessments conducted in conjunction with waste disposal facilities. The goal of this discussion should be to bring these uncertainties to the attention of people who may interpret the outcomes of the assessments. It is also important to note the various input parameters used in conducting the performance assessments incorporate a host of conservatisms. As a result, the doses that will be experienced by any exposed population

groups will very likely be well below the estimates generated through performance assessment process.

The performance assessment must include an assessment of the sensitivity of the results to various model assumptions and an estimate of the degree of uncertainty inherent in the analysis. The sensitivity/uncertainty analysis should include the calculation of the maximum impact of the disposal facility beyond the 1,000 year period used for the compliance period, regardless of the time at which the maximum occurs.

Projections of environmental processes are inherently uncertain. Assessment of the sensitivity of the model results to assumptions, parameter values, etc., and the uncertainty in the model results, is necessary to support the determination that there is a reasonable expectation of meeting the performance objectives. At a minimum, this needs to include identifying the parameters that have the greatest impact on the projected doses, and varying these parameters through a reasonable range of values to imitate the uncertainty of the actual value of the parameter. Confidence in the conclusions can be bolstered by this varying of the sensitive parameters if it has little impact on the final results of the calculations.

Although the period of performance (i.e., the time over which the performance assessment is to provide reasonable expectation of compliance with the performance objectives) is 1,000 years, it may be helpful to extend the calculation to include the maximum impact (i.e., peak dose), even if the maximum is not realized for tens of thousands of years. This calculation may increase the understanding of the models used and the disposal facility performance, but are not used for determining compliance with the disposal performance objectives. Caution must be exercised when interpreting such results calculated thousands of years due to compounding of rounding and truncation errors which can cause results to be nonsensical. However, such calculations may help test the model or a specific aspect thereof. Conditions of operation on the facility may be considered to assist in understanding or discussing the complexity of uncertainties associated with some of the parameters in the performance assessment.

> *Example: The low-level waste disposal facility performance assessment at Site A includes the calculation to the peak dose. The peak is 50 mrem/yr, which occurs in the analysis at 8,500 years after closure. The performance assessment concludes from this result that the overall current understanding of the facility performance is consistent with the compliance finding at 1,000 years.*

<u>Performance Assessment ALARA</u>. In addition, to providing a reasonable expectation that the performance objectives will not be exceeded, the performance assessment also needs to show that low-level waste disposal is being conducted in a manner that maintains releases of radionuclides to the environment to levels that are as low as reasonably achievable (ALARA).

The goal of the ALARA process is not the attainment of a particular dose level (or, in this case, level of release), but rather the attainment of the lowest practical dose level after taking into account social, technical, economic, and public policy considerations. ALARA is meant to provide a documented answer to the question: “Have I done all that I can reasonably do to reduce radiation doses or releases to the environment?”

Performance assessments should include ALARA assessments that focus on alternatives for low-level waste disposal. The alternatives considered might include the use of different disposal unit covers, waste forms, containers, or other alternatives (e.g., concrete vaults versus earthen trenches) consistent with the situation being assessed. The rigor of the ALARA assessment, and its analysis of alternatives, needs to be commensurate with the magnitude of the risk and the decisions to be made. Depending on the situation, ALARA assessments can range from simple qualitative statements to elaborate quantitative assessments that consider individual and collective doses to members of the public.

> *Example: The Site A low-level waste disposal facility performance assessment includes an assessment of the three alternatives for certain high-activity waste streams of (1) structural stabilization, (2) placement in high integrity containers, and (3) disposing of the wastes in regular containers, but at the bottom of the trench. The results of the analysis are used in the conclusion section of the performance assessment in determining the waste acceptance criteria and disposal operational requirements for these wastes.*

Water Resources Analysis. Performance assessments include calculations of impacts to water resources. Such calculations can be used, as necessary, to establish limits on radionuclides that may be disposed in near-surface disposal facilities.

DOE M 435.1-1 does not specify the level of protection for water resources that should be used in a performance assessment for a specific low-level waste disposal facility. Rather, a site-specific approach, in accordance with a hierarchical set of criteria should be followed. This approach recognizes that there are no Federal requirements for protection of water resources for a radioactive waste disposal facility. The site-specific hierarchical approach, rather than mandating specific performance measures for all sites, is consistent with the Environmental Protection Agency strategy for groundwater protection, which recognizes that groundwater protection is a regional and local matter.

The hierarchy for establishing water resource protection is as follows:

- First, the DOE low-level waste disposal facility must comply with any applicable State or local law, regulation, or other legally *applicable* requirements for water resource protection.

- Second, the DOE low-level waste disposal facility must comply with any formal agreement applicable to water resource protection that is made with appropriate State or local officials.

- Third, if neither of the above conditions apply, the site needs to select assumptions for use in the performance assessment based on criteria established in the site groundwater protection management program and any formal land-use plans.

- If none of the above conditions apply, the site may select assumptions for use in the performance assessment for the protection of water resources that are consistent with the use of water as a drinking water source.

Intruder Analysis. Performance assessments include calculations of impacts to a hypothetical person who is assumed to inadvertently intrude into the low-level waste disposal facility. Such calculations are used to determine what is reasonable for near-surface disposal and may be used to establish limits on the concentration of radionuclides that may be disposed in near-surface (i.e., at depths less than about 30 meters) disposal facilities.

Protection of the inadvertent intruder is one of the four performance objectives that commercial near-surface disposal facilities for low-level waste must meet. The analysis used in the rulemaking for Part 61 for protecting an intruder was used as a practical means of establishing the classification system in Part 61 calling for structural stabilization of waste which have concentrations of certain radionuclides exceeding certain limits, and for deeper burial, or burial with an intruder barrier, of wastes with these higher concentration limits. The protection of the intruder also is the major reason that Greater-than-Class C low-level waste is considered to be generally unsuitable for near-surface disposal. Protection of the inadvertent intruder has also been recognized as a fundamental objective of radioactive waste management internationally, and is invoked at some disposal facilities for other types of radioactive waste in addition to low-level wastes.

Although DOE is committed to retaining control of land containing residual radioactive material, such as disposed low-level waste, it is nonetheless appropriate to consider the impacts of potential inadvertent intrusion. Intrusion should be considered as an accident scenario which could occur during lapses of institutional controls. It is a hypothetical situation assumed simply to provide a basis for determining the acceptability of waste for near-surface disposal and may be used for establishing concentrations of radioactive material in a near-surface disposal facility.

In the intruder assessment, institutional controls should be assumed to be effective in preventing intrusion for at least 100 years following disposal facility closure; longer periods may be assumed with justification (e.g., land-use planning, passive controls).

Two performance measures are to be considered in intrusion assessments. For chronic exposure (i.e., continuous or ongoing exposures over a period of time) scenarios, the performance measure is 100 mrem (1 mSv) in a year, total effective dose equivalent. For acute exposure scenarios (one time only events or single exposures), the performance measure is 500 mrem (5 mSv) in a year, total effective dose equivalent. Inadvertent intruder assessment involves formulating scenarios (i.e., sets of activities that the hypothetical person might engage in) and calculating the exposure resulting from the activities. Development of intruder scenarios needs to be consistent with best management practices and other current industry standards such as those issued by NCRP (National Council for Radiation Protection), ICRP (International Council for Radiation Protection), and others. Intruder scenarios need to consider the following:

- Intruders may carry out activities for no more than about a year before discovery.
- An intruder may perform reasonable activities consistent with regional social customs and well drilling, excavation, and construction practices, and the regional environmental conditions projected for the time that intrusion is assumed to occur.
- Intrusion events may involve random contact with waste.
- An intruder will usually take reasonable, investigative actions upon discovery of unusual materials.
- Intrusion events that contact waste may be assumed to be limited to drilling or simple excavation scenarios involving use of relatively unsophisticated tools and commonplace machinery.
- Doses calculated for an intruder will depend on waste disposal facility design and operating practices, and may be reduced by practices such as disposal below depths normally associated with common construction activities, use of intruder barriers or durable waste forms or containers, or distributed disposal of higher-activity waste.

The inadvertent intruder assessment needs to, at a minimum, consider the appropriateness of including an acute construction scenario, an acute well drilling scenario, and a chronic agriculture scenario. However, all these scenarios may not need to be assessed and development of actual scenarios should be done on a case-by-case basis.

Likelihood of Intruder Scenarios. The inadvertent intruder assessment is required by DOE M 435.1-1, IV.P.(2)(h), and must be included in the performance assessment. However, for the purposes of establishing waste acceptance requirements and other controls on the disposal facility, the likelihood of intruder scenarios may be addressed in the interpretation of the results of the

inadvertent intruder assessment. Justification of intruder scenarios' probabilities must be included if used in the intruder assessment. Similarly, the scenario chosen needs to be reasonable for the area being analyzed to be consistent with subrequirement IV.P.(2)(a). The *Standard Format and Content Guide*, DOE G 435.1-1, contains additional discussions of the inadvertent intruder assessment and the consideration of the results in establishing controls on the facility.

Compliance with this requirement is demonstrated by the performance assessment documentation including the use of the parameters and other information specified in the requirement, or, if an alternative parameter or method is used, a justification and basis for its use.

Supplemental References:

1. DOE, 1996. *Interim Format and Content Guide, and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments,* U.S. Department of Energy, Washington, D.C., October 1996.

2. DOE. *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses,* DOE G 435.1-1, U.S. Department of Energy, Washington, D.C. (Under preparation.)

IV. P.(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. Performance measures shall be consistent with DOE requirements for protection of the public and environment and evaluated for a 1,000 year period following disposal facility closure. The composite analysis results shall be used for planning, radiation protection activities, and future use commitments to minimize the likelihood that current low-level waste disposal activities will result in the need for future corrective or remedial actions to adequately protect the public and the environment.

Objective:

The objective of this requirement is to ensure that a prospective assessment be conducted to assess potential dose to hypothetical members of the public from the aggregate of residual

radioactive material that is likely to remain on a DOE site and that is likely to add to the dose from an active or planned low-level waste disposal facility.

Discussion:

Through Recommendation 94-2, the Defense Nuclear Facilities Safety Board recommended that DOE's performance assessments for low-level waste disposal facilities consider all inventories of past, present, and future low-level waste in the analysis. DOE committed to addressing this concern by performing a composite analysis of all sources of radioactivity that may interact with the disposal facility to determine appropriate courses of action concerning the continued operation of a disposal facility. The composite analysis is prepared in addition to the performance assessment, which continues to be focused on specific facilities to establish design, operation, and closure parameters. The requirement in DOE M 435.1-1 maintains this commitment made in the 94-2 Implementation Plan as a requirement for low-level waste disposal facilities.

Low-level waste disposal is not the only DOE activity that will leave residual radioactive material on the DOE site when operations at the site have ceased. Environmental restoration activities will be conducted to mitigate releases from former operations such as disposal of liquid radioactive waste to soil columns, but will not generally result in the removal of all of the radioactive material. Facilities currently operating that involve the use of or handling of radioactive material will eventually be decommissioned. However, decommissioning will not necessarily result in the removal of all of the radioactive material.

The performance assessment for active and planned low-level radioactive waste disposal facilities is necessarily focused only on the disposal facility so that design and operational controls may be established to ensure that performance objectives will be met. Thus, the performance assessment does not provide information on potential future doses that may be received by members of the public from the disposal facility plus other sources; the composite analysis is used to provide that information.

The composite analysis is a reasonably conservative assessment of the cumulative impacts from active and planned low-level waste disposal facilities, and all other sources of radioactive contamination that could interact with the low-level waste disposal facility to affect the dose to future members of the public. The composite analysis provides a suggestion of what could conceivably happen if DOE did not act to protect public health and safety. It provides information that DOE can use for planning, establishing radiation protection activities, and/or making commitments concerning future uses of land or resources.

The composite analysis can use the information from the site-wide groundwater protection management program required in DOE 5400.1, *General Environmental Protection Program*. The results of the composite analysis can be used to update and modify the groundwater

protection management program to better meet site-wide and regional groundwater protection needs if appropriate. The results of the composite analysis are also used for updating and modifying land use planning documents, identifying those sources that most significantly contribute to the total projected dose and decide on priorities for remediation, or decide on closure alternatives for active or inactive disposal areas.

> *Example: The composite analysis for the Site A low-level waste disposal facility indicates that it is reasonable for the low-level waste disposal facility to operate unconditionally, given the contribution to potential future dose form other source terms at the site. However, it is noted that the decision to stabilize in place the contaminated zones in operable unit 37 accounts for over 75 percent of the projected composite dose at the site.*

As in the performance assessment, it is not possible to provide absolute proof of the performance of the various sources of radioactive material at some future time. Rather, the Manual requires that the composite analysis be prepared to provide a reasonable expectation that the performance measures are not likely to be exceeded.

Since the focus of the composite analysis is planning for future public radiological protection, the performance measure is drawn from the Department's requirements for public radiological protection. The primary dose limit of 100 mrem in a year, total effective dose equivalent, is the basic performance measure (DOE 5400.5). Consistent with established radiation protection practices articulated by the National Council on Radiation Protection (NCRP) and the International Council on Radiation Protection (ICRP), the projected dose attributable to any single source, practice, or activity should be some fraction less than the applicable overall dose limit. Depending on the particular source of concern, DOE, EPA, and the NRC have typically established limits of 10 to 25 percent (10 mrem [.10 mSv] to 25 mrem [.25 mSv]) of the primary dose limit for protection of the public (100 mrem [1 mSv]/year) to any particular source, although higher or lower fractions may be appropriate. To prevent the potential dose from the aggregate of sources analyzed from exceeding a significant fraction of the primary dose limit of DOE 5400.5, an administratively limited dose constraint of 30 mrem in a year is used. If the dose calculated in the composite analysis exceeds 30 mrem in a year, an options analysis must be prepared to consider actions that could be taken to reduce the calculated dose and to consider the cost of those actions. The composite analysis is to consider a period of 1,000 years after the disposal facility has been closed to assess compliance with the performance measures.

Composite analyses must be reviewed and approved by DOE Headquarters. As discussed in Section I.2.E.(1), the Deputy Assistant Secretaries for Waste Management and Environmental Restoration have the responsibility for reviewing and approving the composite analysis for low-level waste disposal facilities and issuing a disposal authorization statement based on the review.

The guidance on DOE M 435.1-1, Section I.2.E.(1) discusses the review and approval process in detail.

As discussed above, the improvement of performance assessments, their reviews and approvals, and the addition of the composite analysis to the required evaluations of low-level waste disposal facilities and their subsequent reviews and approvals has been the aim of much of the improvements to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. Consequently, detailed guidance on conducting composite analyses is being developed for inclusion in DOE G 435.1-1, *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. That document needs to be consulted for additional detailed discussions of the performance measures, preparation of a composite analysis, and the interpretation of assumptions and other technical information that goes into the evaluations contained in a composite analysis.

Compliance with this requirement is demonstrated by a documented composite analysis for the low-level waste disposal facility that evaluates the cumulative impacts from the facility and all other sources for radioactive contamination that could interact with the facility and add to the dose to future members of the public.

Supplemental References:

1. DOE, 1996. *Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy Low-Level Waste Disposal Facilities,* U.S. Department of Energy, Washington, D.C., April 1996.

2. DOE. *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*, DOE G 435.1-1, U.S. Department of Energy, Washington, D.C. (Under preparation.)

IV. P.(4) Performance Assessment and Composite Analysis Maintenance. The performance assessment and composite analysis shall be maintained to evaluate changes that could affect the performance, design, and operating bases for the facility. Performance assessment and composite analysis maintenance shall include the conduct of research, field studies, and monitoring needed to address uncertainties or gaps in existing data. The performance assessment shall be updated to support the final facility closure. Additional iterations of the

performance assessment and composite analysis shall be conducted as necessary during the post-closure period.

(a) Performance assessments and composite analyses shall be reviewed and revised when changes in waste forms or containers, radionuclide inventories, facility design and operations, closure concepts, or the improved understanding of the performance of the waste disposal facility in combination with the features of the site on which it is located alter the conclusions or the conceptual model(s) of the existing performance assessment or composite analysis.

Objective:

The objective of these requirements is to ensure that performance assessments and composite analyses are updated as appropriate, whenever changes in their bases (assumptions, parameters, etc.) are contemplated or effected in order to maintain the validity and effectiveness of the controls which are based on the performance assessment and composite analysis.

Discussion:

As discussed in Section I.2.F.(15) of the guidance for Chapter I, General Requirements, since a low-level waste disposal facility will be in operation for many years, and waste receipts and knowledge concerning the disposal facility environs could change, maintaining the performance assessment and composite analysis through a regular schedule of evaluations is required by the manual.

The performance assessment provides a means whereby the long-term efficacy of the disposal facility is evaluated and provides input to disposal facility design, operational requirements, and waste acceptance criteria. The composite analysis is a planning tool to ensure that low-level waste disposal, in consort with other activities at the site, is not likely to compromise future radiological protection of the public. Because the performance assessment and composite analysis results are projections based on estimated waste and facility characteristics, they are technically uncertain. A maintenance program is needed to, over time, improve confidence in the results of the analysis and in the long-term plans for protecting public health and safety. Through the conduct of an assessment maintenance program, site operators can technically justify reducing the conservatism in the analysis based on acquiring data which support revising the analyses. The results of the revised performance assessment and composite analysis can result in revised waste acceptance criteria which could result in a lessening of constraints on waste receipts, less costly remediation alternatives, or in revised land-use controls.

Acquisition and consideration of field data represents a necessary component of the maintenance program. Performance assessment and composite analysis development and refinement represents a continuous process during the operational life of a disposal facility. Over the lifetime of the disposal facility, the performance assessment and composite analysis must be maintained and upgraded as additional information about the waste, environmental setting, and site is obtained. At closure of the disposal facility, a final performance assessment which analyzes all of the waste that has been disposed must be prepared and approved. During the post-closure period, it may also be necessary to revise the performance assessment and composite analysis according to the criteria stated above.

As discussed above, the improvement of performance assessments, the addition of the composite analysis to the required evaluations of low-level waste disposal facilities, and their reviews and approvals has been the aim of much of the improvements to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. Similarly, maintenance of performance assessments and composite analyses has also been modified to improve the upkeep of the analyses and controls based on the assessments. Consequently, detailed guidance on maintaining performance assessments and composite analyses is being developed for inclusion in DOE G 435.1-3, *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. The *Maintenance Guide* will need to be consulted for additional detailed discussions of the maintenance of performance assessments and composite analyses once issued.

Compliance with this requirement is demonstrated by the implementation of a site-specific performance assessment and composite analysis maintenance program that includes research projects, field studies, and the results of monitoring to update the analyses.

Supplemental References:

1. DOE, 1996. *Maintenance of US Department of Energy Low-Level Waste Performance Assessments*, U.S. Department of Energy, Washington, DC, September 1996.

2. DOE. *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses,* DOE G 435.1-3, U.S. Department of Energy, Washington, D.C. (Under preparation.)

IV.P.(4) Performance Assessment and Composite Analysis Maintenance.

(b) A determination of the continued adequacy of the performance assessment and composite analysis shall be made on an annual

basis, and shall consider the results of data collection and analysis from research, field studies, and monitoring.

(c) Annual summaries of low-level waste disposal operations shall be prepared with respect to the conclusions and recommendations of the performance assessment and composite analysis and a determination of the need to revise the performance assessment or composite analysis.

Objective:

The objective of these requirements is to ensure that the bases of the performance assessment and composite analysis (e.g., assumptions, parameters, waste inventory) remain valid and to ensure that results of testing, research, and development, and monitoring are considered in this determination and summary.

Discussion:

Because the analyses in the performance assessments and composite analyses are based on projections of waste receipts and parameter values that predict site behavior, annual summaries of actual disposal operations that include actual waste receipts and results of site research projects and monitoring, can assist in calibrating the performance assessment and composite analysis to be more accurate as the life of the facility goes on. The annual summaries are to tie the annual summaries to the conclusions of the performance assessment and composite analysis, and determine whether they continue to be the correct conclusions. As more and more of these annual summaries are factored appropriately into the maintenance of the performance assessment and composite analysis, the more the results are based on actual facility performance, and the more the conclusions can be relied on to provide a reasonable expectation that the performance objectives will continue to be met.

Performance assessment and composite analysis maintenance includes the routine review and revision, as appropriate, of the analyses. Reviews provide a mechanism for routine assessment of the controls derived from the analyses on waste disposal, source remediation, or land-use controls so that potential problems are identified and managed. The revisions ensure that there is cohesive documentation providing a reasonable expectation of meeting the performance measures. This use of the analyses is similar to the use of a safety analysis report. The assumptions and analyses in the performance assessment are used to establish a performance envelope and are translated into administrative and engineering controls (e.g., procedures, waste acceptance criteria, designs, land-use controls).

The reviews should include an assessment of relative test, research and development, and monitoring data that may have been obtained. This part of the review is two-fold. First, it ensures that the conceptual model(s), assumptions, parameters, etc. remain valid. Second, it enhances confidence in the model results and may result in a lessening of the degree of conservatism in the analyses. The annual reviews should be documented and retrievable.

As discussed above, the improvement of performance assessments, the addition of the composite analysis to the required evaluations of low-level waste disposal facilities, and the reviews and approvals for these analyses are among the improvements to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. Similarly, maintenance of performance assessments and composite analyses has also been modified to improve the upkeep of the analyses and controls based on the assessments.

Compliance with this requirement is demonstrated by a documented process that results in annual summaries of the low-level waste disposal operations and a determination of the continued adequacy of the analyses.

Supplemental References:

1. DOE, 1996. *Maintenance of US Department of Energy Low-Level Waste Performance Assessments*, U.S. Department of Energy, Washington, D.C., September 1996.

2. DOE. *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*, DOE G 435.1-3, U.S. Department of Energy, Washington, D.C. (Under preparation.)

IV. P.(5) Disposal Authorization. A disposal authorization statement shall be obtained prior to construction of a new low-level waste disposal facility. Field Elements with existing low-level waste disposal facilities shall obtain a disposal authorization statement in accordance with the schedule in the Complex-Wide Low-Level Waste Management Program Plan. The disposal authorization statement shall be issued based on a review of the facility's performance assessment, composite analysis, performance assessment and composite analysis maintenance, preliminary closure plan, and preliminary monitoring plan. The disposal authorization statement shall specify the limits and conditions on construction, design, operations, and closure of the low-level waste facility based on these reviews. A disposal authorization statement is a part of the radioactive waste management basis for a disposal facility. Failure to obtain a disposal authorization statement

by the implementation date of this Order shall result in shutdown of the disposal facility.

Objective:

The objective of this requirement is to ensure that any conditions or limitations that are required on the operations of a low-level waste disposal facility or waste accepted at the facility that result from the review and approval of the performance assessment and composite analysis maintenance plans, monitoring plans, and closure plans are included in the radioactive waste management basis for the facility.

Discussion:

As discussed in DOE M 435.1-1, Section I.2.E.(1), following the review and approval of the performance assessment and composite analysis, maintenance plan, monitoring plan, and closure plan for a low-level waste disposal facility, a disposal authorization is to be issued that sets forth any necessary conditions for the design, construction, and operation of the disposal facility in order to maintain the reasonable assurance that the disposal performance objectives of Chapter IV of DOE M 435.1-1 will be met. The guidance on DOE M 435.1-1, Section I.2.E.(1) should be consulted concerning the differences in the issuance of a disposal authorization for a low-level waste disposal facility operated under DOE O 435.1 for the Office of Waste Management and for a facility operated under CERCLA for the Office of Environmental Restoration.

As discussed above, the improvement of performance assessments, the addition of the composite analysis to the required evaluations of low-level waste disposal facilities, and their reviews and approvals are among the improvements to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. The issuance of a disposal authorization statement based on the reviews and approvals of the evaluations is considered a critical addition to these improvements. Consequently, detailed guidance on the review process and development of a disposal authorization statement is being developed for inclusion in DOE G 435.1-2, *Review Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. DOE G 435.1-2 will need to be consulted for additional detailed discussions of the review of performance assessments and composite analyses once issued and the issuance of a disposal authorization statement.

<u>Obtaining a Disposal Authorization Statement</u>. As stated in the requirement, for a new low-level waste disposal facility, the disposal authorization statement must be obtained prior to construction of the facility. Because the performance assessment and composite analysis prepared prior to construction are preliminary, and will include parameters based on some assumptions, it is recognized that modifications will occur. Conditions included in the disposal authorization statement will need to indicate when and how modifications to the performance assessment, based

on design and construction, need to be included in performance assessment maintenance cycles or in other procedures or the facility waste acceptance criteria that are prepared following construction.

> *Example: DOE Site B has decided to establish a new low-level waste disposal facility. The preliminary performance assessment is prepared using conservative assumptions, is reviewed, and is approved at the site given the assumptions. The performance assessment, composite analysis, maintenance plans, monitoring plan, and closure plan are sent to Headquarters for final approval. A disposal authorization statement is issued and the site manager authorizes construction. The conditions in the statement include a requirement that the performance assessment be resubmitted following construction and prior to operations for review, accompanied by the waste acceptance criteria based on the revised performance assessment that incorporates any changes to the evaluation brought about by construction changes or new information.*

For existing low-level waste disposal facilities, the disposal authorization statement must be obtained in accordance with the schedule in the current version of the Complex-Wide Low-Level Waste Management Plan that is required by General Requirement I.2.D.(1). This schedule reflects current program planning and scheduling concerning active disposal facilities, and provides for the time necessary to collect data and perform the assessments required by the Disposal Section of Chapter IV of DOE M 435.1-1.

<u>Basis for the Disposal Authorization Statement</u>. The requirement for issuance of a disposal authorization statement includes review of not only the performance assessment and composite analysis, but also the performance assessment and composite analysis maintenance plans, preliminary disposal facility monitoring plan and preliminary closure plan. These documents contain analysis and controls that are closely related to each other. An understanding of how monitoring and closure are to be implemented in conjunction with the siting, design, construction and the other operational aspects of the low-level waste disposal facility is required to make a judgement as to whether there is and will continue to be reasonable assurance that the performance objectives for disposal are met. Guidance on the preparation and submittal of preliminary closure plans can be found in DOE G 435.1-1, Section IV.Q.(1), and on preparation and submittal of preliminary monitoring plans can be found in DOE G 435.1-1, Section IV.R.(3).

<u>Contents of a Disposal Authorization Statement</u>. The Disposal Authorization Statement will clearly indicate the disposal facility and design that is being authorized to operate. The statement will refer to the performance assessment and composite analysis documents reviewed as the basis for the authorization and state the primary features of the disposal facility important for understanding the authorization of operations of the facility. The maintenance, preliminary monitoring, and closure plans are also referenced along with primary information from those

documents and any other documents required to understand the authorization of operations of the facility.

> *Example: The Disposal Authorization Statement for the Site Y low-level waste disposal facility states that the performance assessment analysis and conclusions were based on the use of a concrete vault, as demonstrated in Engineering Drawing Y-23, the preliminary closure plan contained as Appendix B to the performance assessment (Site Document No. Y-344555), and additional information submitted in memorandum dated October 1, 1997.*

Conditions and limitations for operations of the facility are clearly indicated in the disposal authorization statement. These include quantities, limitations, references, or codification of assumptions contained in the performance assessment, composite analysis, preliminary closure plan, and preliminary monitoring plan for emphasis and clarity. The conditions include any limitations or allowances required based on independent analysis of the disposal configuration and conditions being examined in the evaluations. The conditions also include any other limitations, responsibilities, or commitments that were needed to resolve issues during the review of the performance assessment and composite analysis or which will serve to answer questions that need to be resolved during the first years of operation of the disposal facility.

> *Example: The Disposal Authorization Statement for the Site Y low-level waste disposal facility includes the following conditions:*
>
> 1. *Waste Acceptance Criteria documentation must include the limitations on radionuclide concentrations in waste packages as indicated in Table 42 of the performance assessment (Site Document No. Y-344555).*
>
> 2. *Monitoring of disposal facility performance shall be measured in accordance with the preliminary monitoring plan submitted as Appendix G with the performance assessment (Site Document No. Y-344555), but with one change in monitoring well location YMY-5 as described in attachment 2 to this Statement.*
>
> 3. *A final disposal facility monitoring plan reflecting information in attachment 2 to this Statement shall be submitted to the Field Element Manager for approval within 18 months of the date of this Statement.*
>
> 4. *Waste received containing U-233 should be tracked in the record keeping system of the disposal facility in a way that enables these disposed containers to be easily located on a site map.*

5. *Disposal authorization is conditioned upon continual and satisfactory compliance with the above conditions.*

Compliance with this requirement can be demonstrated by the existence of disposal authorization statements for active low-level waste disposal facilities that provide approval of and conditions for operation of the facility.

Supplemental References:

1. DOE, 1996. *Interim Format and Content Guide, and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments,* U.S. Department of Energy, Washington, D.C., October 1996.

2. DOE, 1996. *Interim Review Process and Criteria for Department of Energy Low-Level Waste Disposal Facilities Composite Analyses,* U.S. Department of Energy, Washington, D.C., November 1, 1996.

3. DOE, 1996. *Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy Low-Level Waste Disposal Facilities,* U.S. Department of Energy, Washington, D.C., April 1996.

4. DOE, 1998. *Department of Energy LLW Disposal Facility Federal Review Group, Performance Assessment and Composite Analysis Review Guidance Manual,* Revision 0, U.S. Department of Energy, September 1998.

5. DOE. *Review Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses,* DOE G 435.1-2, U.S. Department of Energy, Washington, D.C. (Under preparation.)

IV. P.(6) Disposal Facility Operations. The disposal facility design and operation must be consistent with the disposal facility closure plan and lead to disposal facility closure that provides a reasonable expectation that performance objectives will be met. Low-level waste shall be disposed in such a manner that achieves the performance objectives stated in this Chapter, consistent with the disposal facility radiological performance assessment. Additional requirements include:

Objective:

The objective of this requirement is to ensure that the low-level disposal facility is operated in a manner that adheres to the requirements and limitations contained in and derived from the closure plan and performance assessment and the critical documents related to design and operational functions that provide reasonable assurance the disposal performance objectives will be met at the facility.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.E.(1), the safety and hazard analysis for management of radioactive waste conducted to develop the essential requirements for DOE O 435.1 and DOE M 435.1-1 indicated that disposal is the most critical activity requiring controls because disposal is intended to be the last function conducted on the waste, and yet, the potential hazards from disposed low-level waste will continue into the future. Thus, there are specific requirements for the protection of the public, workers, and environment that are critical to maintaining safe and effective disposal of radioactive waste management.

As already discussed, the performance assessment is considered a critical document in determining the controls that are needed for a specific disposal facility. The information evaluated in the performance assessment on closure of the facility, and the information presented in the preliminary closure plan for the facility represent the desired "end-state" of the facility that will function in a way that provides reasonable assurance the performance objectives will not be exceeded. This requirement is intended to emphasize the relationship between the assumptions in the performance assessment and closure plan concerning operation of the disposal facility and real-time activities performed at the facility.

Facility operations procedures need to be prepared to be site-specific and formally implement the design features as part of operations, along with those aspects of facility operations addressed in the performance assessment, closure plan, and other radioactive waste management basis activities and documents (e.g. waste acceptance criteria) that are derived from the performance assessment.

> *Example: The Campus Disposal Facility operating procedures includes procedure Closure-1, which requires capping of a disposal unit with a specific multi-layer cap. The procedure contains details in drawings and processes to result in placement of the cap. This cap design is derived from the preliminary closure plan for the facility, which calls for these multi-layer caps as part of surface-water control during the life of the facility to direct water away from the disposal units to preserve the integrity and stability of the disposal units for the final closure.*

Revisions of the closure plan, performance assessment, or waste acceptance criteria result in reviews of the procedures for waste operations to ensure that the radioactive waste management basis is preserved during operations, and that any updates to performance assessment assumptions that result in operational controls are reflected in an updated procedure.

> *Example: Based on a performance assessment update using new environmental data, it is decided that an area where disposal units were originally planned will be avoided. The operating procedures are updated to reflect the new locations of trenches.*

The following four subrequirements, DOE M 435.1-1, Sections IV.P.(6) (a) through (e), provide detailed requirements for specific operational functions of and procedures for a low-level waste disposal facility that the safety and hazard and requirements analysis conducted in developing DOE O 435.1 indicated were areas especially in need of controls to help achieve the goals of protecting the public and the environment that are embodied in the disposal performance objectives.

Compliance with this requirement is demonstrated by the waste disposal facility operational procedures being developed and implemented within prescribed conditions that are analyzed in and derived from the performance assessment and closure plan for the subject low-level waste disposal.

Supplemental References:

1. NRC, 1982. *Technical Position Paper on Near-Surface Disposal Facility Design and Operation*, U.S. Nuclear Regulatory Commission, Washington, D.C., November 1982.

IV. P.(6) Disposal Facility Operations.

(a) Operating procedures shall be developed and implemented for low-level waste disposal facilities that protect the public, workers, and the environment; ensure the security of the facility; minimize subsidence during and after waste emplacement; achieve long-term stability and minimize the need for long-term active maintenance; and meet the requirements of the closure/post-closure plan.

Objective:

The objective of this requirement is to ensure that operating procedures are developed, documented, and implemented for the critical functions listed in the requirement that are important to meeting the performance objectives for low-level waste disposal over the long term.

Discussion:

Waste disposal facilities are required to conduct day-to-day operations in support of the requirements contained in the manual. For waste disposal operations to achieve this goal, procedures must be developed, documented, and implemented to ensure acceptable operating conditions at the disposal facility are maintained. Provisions to be met for worker safety, protection of the public and the environment, security, minimizing the need for long-term maintenance, and meeting the closure/post-closure plan requirements are included in the radioactive waste management basis documentation. Other requirements contained in the radioactive waste management basis documentation may suggest the development and implementation of additional procedures beyond those areas identified in this requirement (e.g., monitoring plan, waste acceptance criteria). Any procedures need to be developed consistent with the requirements of DOE 5480.19, Conduct of Operations. Procedures developed and implemented for the topical areas derived from the radioactive waste management basis documentation need to be reviewed, approved, and adhered to by the management organization responsible for operating the waste disposal facility.

> *Example 1: A motorized electronic gate mechanism for access to the disposal facility fails and a manual override is actuated to open the gate for the facility. For security of the facility, which is required to have controlled access, plant security personnel are required by procedures to man the gate and control access until the gate is repaired.*

> *Example 2: Receipt of a non-standard waste package at the disposal facility is required by the operating procedures to be placed at a staging facility within the disposal facility fence until an exception for disposal of non-standard waste package is approved that includes the method for disposal. The disposal of a non-standard waste package and an approved exception are documented and filed in the record system as required by procedure.*

The operations of a waste disposal facility are described in the performance assessment for the facility. The waste management operations presented in the performance assessment form a basis for establishing procedures for facility operations. Operations performed that are not presented in the performance assessment are based on other radioactive waste management basis documentation and evaluated by the performance assessment and composite analysis maintenance program to ensure protection of the public and the environment is not likely to be compromised.

Similarly, procedures derived from the safety analysis report, closure plan, monitoring plan or other radioactive waste management basis documents should be evaluated to ensure worker safety, security, long-term active maintenance, and closure requirements are met.

Compliance with this requirement is demonstrated by operating procedures, including the procedures for exceptions and approval of exceptions, that are complete, suitable, and correct. The adherence to procedures in waste operations also demonstrates compliance with this requirement, and any deviations from documented procedures are reviewed, documented, and retained in the permanent records of the disposal facility.

Supplemental References:

1. NRC, 1982. *Technical Position Paper on Near-Surface Disposal Facility Design and Operation,* U.S. Nuclear Regulatory Commission, Washington, D.C., November 1982.

IV. P.(6) Disposal Facility Operations.

(b) Permanent identification markers for disposal excavations and monitoring wells shall be emplaced.

Objective:

The objective of this requirement is to ensure that physical identification markers are placed to locate trenches and monitoring wells so they will be able to be located in the future as an additional measure against inadvertent intrusion.

Discussion:

A two-dimensional grid system needs to be designed to locate all disposal excavations and monitoring wells on a map of the disposal site. The grid system is be referenced to a U.S. Geological Survey or National Geodetic Survey benchmark. The location of each monitoring location is recorded in a permanent locator system, such as a Geographic Information System. To facilitate use of this locator system, disposal facility operating procedures provide for orderly placement of all waste within the disposal facility, and all monitoring locations and equipment within the disposal facility are installed according to the strategy presented in the closure plan for the facility.

The location of all disposal units needs to be identified on the surface with permanent markers from which the boundaries of disposal units can be located. In order to be considered permanent, the markers should be made from materials known to withstand anticipated environmental

conditions with little to no degradation (e.g., granite), or made from materials with similar properties whose longevity can be demonstrated through test results or empirical data (e.g., stainless steel) . The markers are engraved or manufactured with significant information about the disposal unit and the waste disposed in it. These markers, along with the total area of the facility, are permanently recorded on the map of the disposal facility, and referenced to the required benchmark. Records of maps for the disposal facility are maintained as part of the permanent records required by Chapter I of the Manual. Maps of the disposal facility are also maintained with state authorities as permanent records for public use in the future.

> *Example: At the Mojo disposal facility, permanent markers are made from engraved granite and permanently installed at the head and foot of each disposal unit. Information engraved on the marker includes the disposal unit open and closing dates, the contents, and a reference to the identity of the location of records for the disposal facility.*

Monitoring wells and other monitoring stations need to also be identifiable by a surface marker located above the natural grade. For a monitoring well, markers could be the riser of the wellhead above grade or stanchions installed around the wellhead to prevent damage.

Compliance with this requirement is demonstrated by permanent markers with appropriate information being permanently installed at closed disposal units of disposal facilities, or for operating facilities, a procedure for the design and location of these markers, and other important markers, like monitoring well locations.

Supplemental References:

1. NRC, 1982. *Technical Position Paper on Near-Surface Disposal Facility Design and Operation,* U.S. Nuclear Regulatory Commission, Washington, D.C., November 1982.

IV. P.(6) Disposal Facility Operations.

(c) Low-level waste placement into disposal units shall minimize voids between waste containers. Voids within disposal units shall be filled to the extent practical. Uncontainerized bulk waste shall also be placed in a manner that minimizes voids and subsidence.

Objective:

The objective of this requirement is to enhance the integrity of the disposed waste and the disposal unit to the maximum extent practicable by elimination of voids between waste packages within the disposal unit.

Discussion:

The stability of waste disposal units is an important element of minimizing the need for site maintenance or corrective actions, and ensuring the long-term performance of the disposal facility. Voids left within the disposal unit eventually are filled by natural processes which lead to subsidence of disposal unit covers and increased infiltration of water into wastes with subsequent increases in the release of radioactive materials to the environment. The minimization of voids within waste packages needs to be addressed in the facility waste acceptance criteria, and is required by DOE M 435.1-1, Section IV.G.(1)(d)1. Voids between waste packages are filled with natural materials, such as sand or grout, which are capable of flowing into voids with the objective of making the resulting total waste mass have a compressibility similar to the undisturbed natural materials adjacent to the disposal unit.

> *Example: Drums evenly stacked in disposal unit K at Facility Y are backfilled initially with a sand and gravel mixture that is similar to the layer of sandy soil excavated from the disposal unit.*

The overall objective in eliminating voids is to enhance disposal unit stability. Methods and procedures for waste emplacement in disposal units with waste packages designed to minimize void space within the disposal unit need to be used, so as to minimize costs of corrective actions after wastes have been emplaced. Use of waste packages with identical dimensions or which form a tesselated configuration and that can be stacked to minimize voids between waste packages is also appropriate.

> *Example: The use of B-25 and similar rectangular shaped boxes is mandated for all near-surface disposal units at Disposal Facility Y to minimize the void spaces between packages that would otherwise require filling.*

Prior to operational closure of the disposal unit, void space between the side walls of below grade disposal units and the wastes need to be filled and compacted to minimize the potential for instability of the overlying cover. Likewise, for above grade disposal units, the operational cover over the wastes needs to minimize void spaces between the cover material and the emplaced wastes.

Compliance with this requirement is demonstrated by the ratio of the compressibility of the resulting waste mass once voids have been filled within the disposal unit to the compressibility of the undisturbed natural materials adjacent to the disposal unit. The ratio achieved is as close to one as can be justified when compared to the costs of future corrective actions. The operating procedures for the disposal facility include this or another reasonable measure and the process by which it is determined that this measure is being met.

Supplemental References:

1. NRC, 1982. *Technical Position Paper on Near-Surface Disposal Facility Design and Operation*, U.S. Nuclear Regulatory Commission, Washington, D.C., November 1982.

IV. P.(6) Disposal Facility Operations.

(d) Operations are to be conducted so that active waste disposal operations will not have an adverse effect on any other disposal units.

Objective:

The objective of this requirement is to enhance the integrity of the disposed waste and the disposal unit to the maximum extent practicable by ensuring that ongoing operations do not adversely affect disposal units that are already filled.

Discussion:

Operations of a disposal unit need to not disturb the structural integrity of any other disposal units. Operations could include the excavation of a disposal unit in close proximity to an existing, operating disposal unit, which could disturb the soil column between the two disposal units. Similar operations associated with the placement of an operational cover which would destroy waste packages or move emplaced wastes should be avoided. The placement of monitoring wells within waste disposal units that would compromise the integrity of disposed wastes is another example of practices to avoid.

> *Example: Excavation of a new disposal unit is to begin prior to closure of the currently used disposal unit. Therefore, the next disposal unit is not excavated in the immediately adjoining unused land, but is excavated some appropriate distance away from the current disposal unit. Monitoring locations for the disposal unit being filled are planned for this space between the disposal units.*

Waste operations procedures for minimizing adverse effects to filled disposal units need to be included into the procedures for placing wastes in disposal units. Information developed as part of the Radioactive Waste Management Basis include the necessary basis for establishing these procedures. Specific practices to be included (e.g., minimum spacing between disposal units, foundation conditions for above-grade disposal facilities) are dependent on the site geotechnical conditions, the disposal unit design, the characteristics of the waste packages disposed of in the disposal units, and the methods for waste emplacement. Designs for constructing and operating waste disposal units include packaging and waste package emplacement methods which will minimize the potential for adverse impacts to filled disposal units. Vehicle movement, backfill storage areas, waste staging within the disposal unit need to be designed to avoid waste disposal units which have been filled. Similarly, the design and construction of adjacent disposal units need to consider any potential impacts to filled disposal units.

> *Example: Backfill from excavation of disposal unit #10 is placed in a designated backfill borrow area rather than on any of the closed disposal units. Similarly, the drum lifting machinery operates on the side of the disposal unit adjoining unused land, rather than the side that adjoins closed disposal unit #9.*

Compliance with this requirement is demonstrated by information in operating procedures which has been developed and implemented at the facility including sufficient instructions and processes on avoiding adverse impact on disposal units that are already filled.

Supplemental References:

1. DOE, 1990. *Conduct of Operations Requirements for DOE Facilities,* DOE 5480.19, U.S. Department of Energy, Washington, D.C., July 9, 1990.

2. NRC, 1982. *Technical Position Paper on Near-Surface Disposal Facility Design and Operation,* U.S. Nuclear Regulatory Commission, Washington, D.C., November 1982.

IV. P.(6) Disposal Facility Operations.

(e) Operations shall include a process for tracking and documenting low-level waste placement in the facility by generating source.

Objective:

The objective of this requirement is to preserve the knowledge of the location of specific wastes in the disposal unit and the detailed characterization information about the waste in the event corrective actions are necessary.

Discussion:

Operations procedures need to include a process for identifying the location of specific wastes or containers in the disposal unit and providing for a documented correlation of this location with the characterization information about the waste. A two-dimensional grid system such as discussed in the guidance for requirement IV.P.(6)(b) can be utilized to identify the location of waste packages within disposal units, and needs to similarly be recorded in a permanent locator system, such as a Geographic Information System. The records of the facility need to correlate the locations of the waste packages with the records of the waste characterization information transferred to the disposal facility with the waste. Preserving the location of the waste and the details of its characterization in the records facilitates future remedial or corrective actions, if necessary. Likewise, if a problem is suspected with a specific generator, then each of their packages could be located within the disposal unit for more scrutiny in monitoring, if necessary.

> *Example: The Site B disposal facility uses a computerized Geographic Information System that tracks the location of waste drums in disposal units. The Geographic Information System includes links to the Site B Waste Information Network, which correlates the package location with the specific waste disposal records for each package, which have been scanned into the Network. For any package in the disposal unit, the waste manifesting information can be examined and all the characterization information about the waste, as well as receipt date, disposal date, operators disposing, and other information.*

Compliance with this requirement is demonstrated by a record keeping system at the disposal facility that includes the location of disposed waste in the disposal units and correlates the disposed waste with characterization information on the waste in a permanent, retrievable, and traceable form.

IV. P.(7) Alternate Requirements for Low-Level Waste Disposal Facility Design and Operation. Requirements other than those set forth in this Section for the design and operation of a low-level waste disposal facility may be approved on a specific basis if a reasonable expectation is demonstrated that the disposal performance objectives will be met.

Objective:

The objective of this requirement is to allow for site-specific approval of alternative methodologies for establishing the design and operation of a low-level waste disposal facility other than use of the performance assessment and composite analysis as long as the disposal performance objectives for protection of the public and the environment in the future are met.

Discussion:

The use of the performance assessment, and the composite analysis as committed to in the *Implementation Plan, Defense Nuclear Facilities Safety Board Recommendation 94-2,* are fundamental to the Department's approach to providing disposal of low-level waste in a manner that protects the public and the environment from the long-term hazards of the waste. The use of any alternative methodologies in siting, designing, operating, closing, and maintaining a low-level waste disposal facility that do not employ the performance assessment and composite analysis must still provide a reasonable expectation that the performance objectives of DOE M 435.1-1, Section IV.P.(1) are met, and provide for an analysis that accounts for all sources of radioactive material that may be left at the DOE site and may interact with the disposal facility. The process for an exemption to the DOE M 435.1-1 requirements for the submittal of a performance assessment, DOE M 435.1-1, Section IV.P.(2) and composite analysis, DOE M 435.1-1, Section IV.P.(5) in accordance with the requirements of DOE M 251.1-1A, *Directives System Manual,* is necessary to demonstrate that an alternative methodology would provide adequate controls on disposal of low-level waste.

To provide sufficient information to the Deputy Assistant Secretaries for Environmental Restoration and Waste Management for them to exempt a facility from the performance assessment and composite analysis requirements, a demonstration of reasonable expectation that the performance objectives will be protective is necessary, including accounting for all sources of radioactivity, uncertainties, protection of inadvertent intruders or waste concentration and activity limits, and protection of water resources. Any calculational methodologies must be justified and verified, and parameters and assumptions used in the analyses must be justified.

Compliance with this requirement is demonstrated by an exemption to the requirements for a performance assessment and composite analysis approved by the Deputy Assistance Secretaries for Waste Management and Environmental Restoration, and supporting an analysis of the low-level waste disposal facility design and operations that provides a reasonable expectation that the performance objectives for disposal of low-level waste will be met and that accounts for all sources of radioactive material that may be left at the DOE site and may interact with the disposal facility.

Supplemental References:

1. DOE, 1998. *Directives System* and *Directives System Manual*, DOE O 251.1A and DOE M 251.1-1A, U.S. Department of Energy, January 30, 1998.

IV. Q. Closure.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Disposal Facility Closure Plans. A preliminary closure plan shall be developed and submitted to Headquarters for review with the performance assessment and composite analysis. The closure plan shall be updated following issuance of the disposal authorization statement to incorporate conditions specified in the disposal authorization statement.

Objective:

The objective of this requirement is to ensure that critical information on low-level waste disposal facility closure analyzed in the performance assessments and composite analyses is documented in a preliminary plan that is submitted along with performance assessment and composite analysis for review and to ensure that any changes to the facility closure plan that is part of a condition of the disposal authorization statement is formally incorporated into the closure plan.

Discussion:

The safety and hazard analysis for management of radioactive waste conducted to develop the essential requirements for DOE O 435.1 and DOE M 435.1-1 indicated that disposal is the most critical activity requiring controls because the potential hazards from disposed radioactive waste continue into the future. One of the most important of controls for long term safety of disposed low-level waste is the closure plan for the facility, the elements of which represent the last line of defense against the possible interaction of buried radioactivity and the public, worker, or the environment. The development and implementation of a low-level waste disposal facility closure plan is a crucial function in assuring disposal is being conducted safely and effectively and will remain safe into the future.

As discussed in Section I.2.F.(8) of the guidance, it is the responsibility of the Field Element Manager to develop and implement closure plans for low-level waste disposal facilities. This section provides the detailed guidance on the contents and the development of closure plans for low-level waste disposal facilities.

Preliminary Closure Plan. A preliminary closure plan, containing the elements of the closure plan discussed below, must be submitted to Headquarters as part of the documentation for approving and issuing a disposal authorization statement. The preliminary closure plan includes the documentation of the closure of the disposal facility as analyzed in the performance assessment.

The closure plan has the purpose of defining the approach to be taken for ensuring the long-term protection of the public and the environment from the disposal of low-level radioactive wastes. Information gained from the performance assessment process provides a basis to be included in developing closure plans, and the results of the performance assessment process is used to revise and update the closure plan. Examples of information to be included in closure plans are the proposed covers for the disposal units, as analyzed in the performance assessment, vegetative covers over the disposal units and their long-term effectiveness, site grading and other long-term controls for minimizing erosion and infiltration, other specialized engineered features to minimize subsidence in disposal units and radionuclide migration, and long-term disposal facility monitoring.

The closure plan for a low-level waste disposal facility is reviewed and approved according to the requirements included in Chapter I, *General Requirements* of the manual. The closure plan addresses the three steps of facility closure, which are 1) operational or interim closure, 2) final facility closure, and 3) institutional control. The closure needs to address all activities to be performed following disposal operations, with those activities being selected to minimize the need for long-term maintenance and maximize the stability of the disposal facility. A period of active institutional control of 100 years is normally assumed in the analysis, however access is controlled, monitoring is performed, and custodial maintenance is performed until release of a closed disposal facility to unrestricted uses in accordance with the requirements of DOE 5400.5, *Radiation Protection of the Public and Environment*, are met. As a result, longer periods of institutional control may be assumed when justification is provided in documented plans which describe long-term site land use or site remediation. The closure plan includes the designs and approaches to be taken for each step in the closure process, and is coordinated with the monitoring plan for the disposal facility. Integration of the monitoring plan for the low-level waste disposal facility, the data to be collected, and closure planning is also discussed in the monitoring guidance associated with DOE M 435.1-1, Section IV.R.

> *Example 1: The closure plan at Oak Ridge includes the collection, monitoring, and management of leachate from the operating disposal facility and includes the commitment to continue leachate management for 100 years after final closure.*

> *Example 2: The closure plan for SRS includes the agreement between the State of South Carolina and DOE to continue institutional controls for an indefinite period of time.*

Update of the Closure Plan. An update of the closure plan, following issuance of the disposal authorization statement, is necessary to reflect the conditions included in the disposal authorization statement. Changes mandated in the disposal authorization statement that may cause a re-evaluation of the performance assessment need to also be addressed as part of the performance assessment maintenance program. The closure plan is a living document that is constantly updated through the operational life of the facility with specific information about

contents and partial closure (e.g., caps on trenches) of disposal units and other information necessary (e.g., monitoring locations) to result in the final closed state. Additionally, any information that is incorporated into the closure plan or any changes made to closure of the facility that would change assumptions used in the analysis in the performance assessment or composite analysis should be incorporated into those evaluations as part of the performance assessment maintenance program as soon as possible so that the extent of their impact on waste acceptance or other aspects of operation can be known and any required changes are made effective as soon as possible.

> *Example 1: A minimal closure plan is prepared for a new low-level waste disposal facility and incorporated into the analyses performed for the performance assessment. The review of the performance assessment and composite analysis for the disposal facility requires enhancements of the facility monitoring included in closure plan to ensure protection of the environment, because of findings presented in the composite analysis. The closure plan is updated following the issuance of the disposal authorization statement to reflect the findings of the review and the performance assessment is reviewed to evaluate the need for revision of the performance assessment. Any revisions to the performance assessment are performed through the performance assessment maintenance program.*

> *Example 2: The preliminary closure plan is prepared for an existing disposal facility that provides for interim closure of the disposal facility awaiting the completion of the CERCLA process for final closure. The performance assessment is prepared using the interim closure plan as a conservative basis for final closure. The Disposal Authorization Statement requires the revision of the closure plan after the Record of Decision is signed from the CERCLA process. The closure plan is then revised and the performance assessment is revised to reflect the CERCLA ROD as part of the performance assessment maintenance program.*

Part of Radioactive Waste Management Basis. The closure plan is part of the documentation for the radioactive waste management basis for a disposal facility. For new disposal facilities, the closure plan is approved and incorporated into the performance assessment and composite analysis prior to approval of the radioactive waste management basis for the facility. For operating disposal facilities, the closure plan is prepared and approved as part of radioactive waste management basis, but the approved closure plan does not need to be incorporated into the performance assessment and composite analysis prior to issuing the radioactive waste management basis for the facility. The approved closure plan is addressed as part of the performance assessment and composite analysis maintenance program for operating facilities. If the approved closure plan differs substantially from the assumptions for closure included in the performance assessment and composite analysis prepared for the issuance of the disposal authorization statement, a revision of the performance assessment and composite analysis may be

necessary to provide the needed assurance that the facility will meet the performance objectives included in the manual. Iterations and improvements in these documents which form the basis for facility operation need to continue throughout disposal facility operations and closure.

> *Example 1: A radioactive waste management basis statement is not prepared for a disposal facility because a preliminary closure plan was not provided with the performance assessment and composite analysis. After a preliminary closure plan is prepared and submitted to Headquarters, the Disposal Authorization Statement for the facility is issued with amendments to be included in the preliminary closure plan. Prior to the revision of the closure plan, and the review of the performance assessment and composite analysis for the need for revision, the radioactive waste management basis statement is prepared and approved, with conditions, based on the existing documentation for the facility.*

> *Example 2: The approved closure plan for an existing disposal facility includes additional requirements for stabilization of wastes prior to final closure. The performance assessment is reviewed and revisions to the performance assessment are not necessary to account for the additional stabilization requirements, because the conclusions of the performance assessment are not changed as a result of changes in the closure plan.*

Compliance with this requirement is demonstrated when preliminary closure plans are submitted to Headquarters for review with the performance assessments and composite analyses, and then revised within one year after the disposal authorization statement is issued to include the conditions specified in the disposal authorization statement.

Supplemental References:

1. DOE, 1992. *Considerations for Closure of Low-Level Radioactive Waste Engineered Disposal Facilities*, DOE/LLW-133, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1992.

2. DOE, 1990. *Guidance on Stabilization and Closure of U.S. Department of Energy Mixed And Low-Level Radioactive Waste Disposal Facilities*, DOE/LLW-82, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

IV. Q.(1) Disposal Facility Closure Plans. Closure plans shall:

(a) Be updated as required during the operational life of the facility.

Objective:

The objective of this requirement is to ensure that conditions encountered or developed during the operation of a low-level waste disposal facility that will impact long-term safety and environmental considerations when the facility is closed are incorporated into the closure plan in a timely fashion.

Discussion:

As described in the guidance for DOE M 435.1-1, Section I.2.F.(2), a radioactive waste management basis is required to document the conditions of safe and efficient management of radioactive waste. The guidance for this section addresses maintaining the radioactive waste management basis for disposal facilities. The closure plan, as part of the radioactive waste management basis can be expected to need to be updated from the preliminary closure plan to an approved final closure plan. Additional updates can also be anticipated as the disposal facility matures from design to construction to operations. Changes in facility design and operations, additional information developed from monitoring data, or improved understanding of low-level waste disposal facility performance can lead to changes in the analyses and documentation for the facility, which could lead to changes in the closure plan. Updates of the closure plan are necessary to ensure that the radioactive waste management basis is current, and protective of workers, the public, and the environment.

Example 1: A disposal facility is designed to accept radon bearing waste at a certain level, but as the facility is operated, increased levels of radon bearing wastes are directed to the disposal facility. Revisions to the performance assessment and closure plan are made to reflect the change in operations. As a result of the new analysis in the performance assessment, a design change is made to accept the radon bearing wastes that includes an increase in the thickness of the cover and a corresponding increase in the depth of excavation of the disposal unit to maintain the same disposal capacity. The changes to the facility design are also reflected in the closure plan.

Example 2: During operations, monitoring program data reveal that moisture in the vadose zone beneath a disposal unit is greater than expected from a disposal unit subject to interim closure. Analyses in the performance assessment and closure plan are modified to test the impact of additional cover materials. As a result, the closure plan is updated to add additional material layers to the cover of the interim closed disposal

units. Subsequent monitoring data indicate a reduction in the moisture content beneath the disposal unit subject to interim closure. The closure plan is updated to reflect the change in the interim closure plan.

The determination of the need to update the closure plan for a disposal facility is site-specific. While the need to update the closure plan is site-specific, the primary purposes of closure must be maintained and can be expected to drive the need for closure plan updates. Changes in waste characteristics disposed of at the facility, which require enhanced facility performance to meet the performance objectives of the manual, could result in the need to update the closure plan. Likewise, excessive costs of implementing the closure plan, which includes elements not needed for meeting the performance objectives, could result in the need to update the closure plan.

Example: The closure plan for a disposal facility called for a thick cover to minimize the potential for root penetration into wastes by trees at Savannah River Site. The development of bamboo as a long-term method for reducing soil moisture and preventing the plant succession to pine forest is successfully demonstrated. The closure plan is subsequently updated to reflect the change in the closure plan from a thick cover to a thinner cover with bamboo plantings on top.

Occurrences of disposal unit subsidence during facility operations that indicate a lack of disposal unit stability could result in the need to update the closure plan. Similarly, unexpected releases of radionuclides from disposal units could lead to the need to update the closure plan to provide additional engineered controls or features to reduce the potential for future releases of radioactive materials. The determination of the need to update the closure plan is ultimately made when there is reason to suspect that the radioactive waste management basis for the disposal facility is no longer consistent with the actual performance of the disposal facility.

Example: Disposal unit subsidence is observed at Site B to an extent that exceeds the projections presented in the performance assessment. Corrective actions are initiated to stabilize closed disposal units with soil and inject grout into closed disposal units to stabilize them from future subsidence. The disposal facility waste acceptance requirements are revised to further reduce unstabilized waste from being accepted for disposal in operating disposal units. The closure plan is updated to include the units to be stabilized.

Compliance with this requirement is demonstrated by the closure plan for a disposal facility being a current representation of the planned facility closure and that the plans are also correctly represented in the performance assessment for the disposal facility.

Supplemental References:

1. DOE, 1992. *Considerations for Closure of Low-Level Radioactive Waste Engineered Disposal Facilities*, DOE/LLW-133, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1992.

2. DOE, 1990. *Guidance on Stabilization and Closure of U.S. Department of Energy Mixed And Low-Level Radioactive Waste Disposal Facilities*, DOE/LLW-82, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

IV. Q.(1) Disposal Facility Closure Plans. Closure plans shall:

(b) Include a description of how the disposal facility will be closed to achieve long-term stability and minimize the need for active maintenance following closure and to ensure compliance with the requirements of DOE 5400.5, *Radiation Protection of the Public and the Environment*.

Objective:

The objective of this requirement is to ensure that the primary public health and environmental protection requirements are addressed in the closure plan, as well as the principal goals of achieving long-term stability and minimizing maintenance after closure.

Discussion:

The content of a closure plan should address all phases of the activities to be undertaken during the operational or interim closure, final facility closure, and institutional control. A closure plan applies to all phases of a facility's life, and is to reference monitoring activities described in the monitoring plan, data to be collected in support of the closure, and activities to be undertaken in response to the results of facility monitoring. Facility closure is to allow the disposal facility activities to cease in a way that the public and the environment is protected from the hazards from the disposed waste in accordance with DOE's requirements in its general radiation protection directive, which is currently DOE 5400.5, *Radiation Protection of the Public and the Environment*.

> *Example: The closure plan includes maps locating monitoring wells to be used throughout operations, interim closure, final closure, and institutional control. The closure plan includes the details of well construction, sampling frequencies, sampling*

methods, monitoring parameters, and methods of analysis for each monitoring well. Also included are the data management methods, data analysis methods, data reporting and remedial action plan associated with the monitoring wells for the disposal facility.

The closure plan provides the details for accomplishing the closure requirements included in the facility design. The plan is specific to the disposal facility, the characteristics of the disposal site, and wastes disposed of at the disposal site. The plan provides a discussion of applicable DOE, Federal, State, and local closure requirements, (including DOE 5400.5), a detailed discussion of each activity to be performed during each phase of the closure process, and the relationship between the activities to achieve the desired result of minimum maintenance and long-term stability and little need for maintenance. The methods to be used for each of the closure activities are provided in the plan, including the final landscape and the methods to be employed to minimize infiltration of water into the disposal units. As part of this discussion, the plan explains how contaminant migration will be controlled in the near-term and the long-term. A detailed description of the cover designs for the disposal units and their intended performance is also included. Facility features which address the minimization of erosion by wind and water and prevent intrusion into the waste by plants and animals, are to be described in the plan.

Example: The closure plan identifies the number of lifts of cover material to be placed over disposal units, the thickness of each lift, the geotechnical specifications for each lift. The specifications for geotextiles between the various layers of the cover are identified, and any vegetative or rock cover at the ground surface are also included in the closure plan. The closure plan includes a discussion of the expected performance of the cover design and provides performance indicators for the cover design. The closure plan also provides a discussion of the corrective actions to be taken if the performance indicators are exceeded.

The closure plan includes a summary description of how the activities to be performed will place the facility into a configuration which will allow the performance objectives to be met in both the short-term and the long-term. The schedule for completing facility closure accompanies this presentation and shows each phase of closure including, the preparation and approval of related documents and permits such as the final performance assessment, composite analysis, safety analysis report, other permits, or state approvals.

Example: The closure plan provides a crosswalk summary of the elements of the closure of the facility and the performance objectives for the closure of the facility. The relationship between each feature included in the closure plan and the corresponding purpose of the feature with respect to the short-term and long-term performance of the facility is explained. How the various elements of the closure plan interface with minimizing the potential for the transport of contamination is provided. The closure plan includes the schedule for facility closure and all milestones for facility closure. Steps for

completing the closure of the facility are included with the dates for completion. The closure plan lists, as part of the schedule, all permits and documents to be completed as part of the closure of the disposal facility. Milestones are established for the completion of all documents and permits. The schedule includes allowances for review and approval of all documents and permits.

The closure plan needs to specifically address how closure activities will ensure the eventual compliance of the closed facility with the requirements for public and environmental radiation protection contained in DOE 5400.5, *Radiation Protection of the Public and the Environment*, (or 10 CFR Part 834 when it is promulgated). Aspects of closure activities that will put the facility into its final disposition, transition maintenance from active to passive, commence institutional controls, perform long-term monitoring, and institute final record-keeping, should be included in this discussion. If the facility is to be released for unrestricted release (see more guidance on DOE M 435.1-1, Section IV.Q.(2).(c)), the aspects of the closure activities that will ensure an adequate level of protection can be achieved following a time for institutional control (100 years), should also be discussed. This may include a discussion about the final cover cap thickness that was chosen to provide for very long-term stability and minimization of radioactive material release at the facility.

The closure plan needs to also include potential corrective actions to be taken at each stage of the closure process. The inspection program, the inspection methods to be used, and the criteria to be used for initiating corrective actions are described. Specific corrective actions are included for the occurrence of subsidence or the indication of contaminant migration. Other corrective actions to address potential issues such as uncontrolled site access, natural phenomena, failure of monitoring equipment, ponding of water or excessive infiltration, erosion, or the presence of undesirable flora or fauna are included, if applicable. The relationship between corrective actions and the monitoring program is clearly identified.

Compliance with this requirement is demonstrated by the closure plan including a reasonable representation of the closure conditions that will achieve stability of the disposal facility and reduce the need for active maintenance, and which can be demonstrated meets the requirements of DOE O 5400.5.

Supplemental References:

1. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

2. DOE, 1992. *Considerations for Closure of Low-Level Radioactive Waste Engineered Disposal Facilities,* DOE/LLW-133, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1992.

3. DOE, 1990. *Guidance on Stabilization and Closure of U.S. Department of Energy Mixed And Low-Level Radioactive Waste Disposal Facilities*, DOE/LLW-82, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

IV. Q.(1) Disposal Facility Closure Plans. Closure plans shall:

(c) Include the total expected inventory of wastes to be disposed of at the facility over the operational life of the facility.

Objective:

The objective of this requirement is to ensure that the closure plan is updated throughout the operation of the facility to accurately reflect and consider all of the long-term hazards associated with the actual inventory of low-level waste disposed at the facility over its operational lifetime.

Discussion:

The closure plan for a disposal facility is required to provide an inventory of the wastes expected to be disposed of at the facility over its complete lifetime. This inventory includes the inventory estimates of each isotope expected to be included in waste, as well as the total inventory. The initial inventory estimates for a new disposal facility are likely to be subject to uncertainties because they are based on expected or projected waste volumes and attributes. As the facility operates and actual waste is disposed, periodic updates of the closure plan are made, as required by DOE M 435.1-1, Section IV.Q.(1)(a), to reflect the actual volumes and characteristics of the disposed waste and reduce the uncertainty in the total and isotopic inventory. The estimated inventory presented in the preliminary or initial closure plan is consistent with the inventory used in the performance assessment of the facility, and any limitations on inventory incorporated into the waste acceptance criteria. Should the inventory estimates included in the closure plan significantly exceed the inventory considered in the performance assessment, then the performance assessment and composite analysis may need to be revised in order to provide assurance the performance objectives for the disposal facility can be met.

Example: The actual inventory of the disposal facility is less than the inventory projected for the disposal facility in the original closure plan, which was approved as part of the Disposal Authorization Statement. The closure plan is updated to include the actual inventory and the new projections for the total inventory of the disposal facility. The performance assessment and composite analysis are reviewed to determine the need for revision based on the revised inventory estimates.

Compliance with this requirement is demonstrated by the inventory in the closure plan being demonstrated to be a reasonable representation of the total expected inventory of the disposal facility at the end of facility operations.

IV. Q.(2) Disposal Facility Closure. Closure of a disposal facility shall occur within a five-year period after it is filled to capacity, or after the facility is otherwise determined to be no longer needed.

Objective:

The objective of this requirement is to ensure that the disposal facility does not remain in an unmaintained state, leading to compromise of the ability of the disposal units to contribute to long-term stability and protection of the public, workers, and the environment.

Discussion:

The guidance for DOE M 435.1-1 emphasizes the importance of closure to the overall performance of disposal facilities. This requirement to promotes prompt closure of disposal facilities to minimize the exposure of wastes to natural phenomena. Five years from the time which a disposal facility is filled to capacity provides a sufficient period of time for closure to occur without having the disposal facility and the disposed wastes being allowed to degrade and become unstable.

This requirement identifies the time period allotted for disposal facility closure following the period of active disposal operations. The time period of five years is measured from the date the last waste package is emplaced in the disposal facility. Closure is considered complete when all of the activities outlined in the closure plan for disposal facility closure have been accomplished and the facility enters the institutional control phase of closure.

> *Example: A disposal unit accepts its last package of waste and interim closure of the disposal unit is completed. The remaining disposal units in the disposal facility continue to operate. Some time later, the last disposal unit accepts its last package of waste. The five year period for final closure of the disposal facility begins with the acceptance of the last waste package in the last disposal unit.*

Facility closure activities are intended to stabilize the site and minimize the need for ongoing active maintenance. Activities performed during this period include placement of intruder barriers, completion of final grading to ensure appropriate management of runoff and infiltration over the long-term, placement of erosion controls, and placement of site markers. At the end of the closure period, the facility is in a condition where only institutional control is required, which

includes site monitoring and minor custodial care. The closure activities are clearly described in the closure plan for the facility. Closure also includes the compilation and proper disposition and storage of all records in a retrievable manner in accordance with the General Requirements Chapter of the manual. Closure, as described in the closure plan, also includes the placement of permanent identification markers to locate disposal units and placement of monitoring equipment. The locations of these markers are recorded on the site maps of the disposal facility that are referenced to USGS or NGS survey control stations. The maps are filed with the facility records and with local governmental authorities (see IV.Q.(2)d)).

Example: The final closure plan includes a description of the activities to be performed for intruder protection, removal of surface facilities and debris, final grading, installation of monitoring equipment, establishment of stable vegetation, permanent marking of disposal units, and establishing and marking of the security system (e.g., fences and alarms) for the disposal facility. All of these steps for disposal facility closure are completed in the five years allowed by this requirement.

The actions taken during disposal facility closure are documented in the final closure plan. The documentation provides a comprehensive description of the facility at the end of facility closure, including monitoring activities, intruder barriers, and permanent markers.

Example: At the completion of final closure, the documentation of all of the actions taken are reviewed. All documentation is updated to include as-built drawings and specifications for the disposal facility. The final inventory of the disposal facility is updated along with the performance assessment and composite analysis for the disposal facility and included in the final closure plan.

Compliance with this requirement is demonstrated by the final closure being completed, including the required documentation, within five years after the acceptance of the last waste package at the disposal facility.

IV. Q.(2) Disposal Facility Closure.

(a) Prior to facility closure, the final inventory of the low-level waste disposed in the facility shall be prepared and incorporated in the performance assessment and composite analysis which shall be updated to support the closure of the facility.

(b) A final closure plan shall be prepared based on the final inventory of waste disposed in the facility, the plan

implemented, and the updated performance assessment and composite analysis prepared in support of the facility closure.

Objective:

The objective of these requirements is to ensure that necessary information associated with the final inventory of low-level waste disposed at the facility over its operational lifetime is incorporated into the performance assessment and composite analysis in support of the final closure of the facility, and then incorporated into the closure plan to provide protection of the workers, public, and environment from the long-term hazards posed by the disposal waste.

Discussion:

Final Inventory. Under this requirement, the expected inventory included in the closure plan must be updated to provide the final inventory of waste actually disposed of in the facility. The final inventory includes a complete listing of the total inventory, the inventory is of each radionuclide disposed, and the total volume of waste disposed. The final inventory provides a crosswalk with the waste manifests for each waste package disposed in the facility to facilitate the resolution of any specific issues related to the location, waste characteristics, waste packaging and concentrations of radionuclides present in the disposal facility. The final inventory used in updating the performance assessment to ensure the performance of the facility meets the performance objectives for low-level waste disposal following closure.

Final Closure Plan. The final closure plan incorporates all of the findings of the final update of the performance assessment and composite analysis and includes the final inventory for the disposal facility. The final closure plan clearly presents the steps to be taken to ensure long-term stability of the facility and site. The plan specifies the ongoing maintenance and monitoring activities to be performed during the period of institutional controls and the process for conducting any corrective actions that may be required.

Example 1: The final closure of the disposal facility includes the addition of one extra lift of topsoil over the disposal units. This additional lift is included in the final closure plan, and incorporated into the performance assessment for the disposal facility.

Example 2: The final inventory for the disposal facility is less than the expected inventory projected for the disposal facility in the existing documentation. The final closure plan is updated to reflect the reduced inventory. The performance assessment and composite analysis are also updated to include the reduced inventory, and the analyses and conclusions presented in the performance assessment are updated to reflect the final inventory in the disposal facility. Approval of the final documentation for the

disposal facility is obtained prior to completion of the final closure of the disposal facility.

Compliance with this requirement is demonstrated by the final closure plan documentation for the disposal facility including the final inventory of low-level waste disposed, the final inventory is incorporated into the performance assessment and composite analysis, and all analyses and conclusions are updated as appropriate.

Supplemental References:

1. DOE, 1999. *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessment and Composite Analyses,* (in preparation), U.S. Department of Energy, Washington, D.C., 1999.

IV. Q.(2) Disposal Facility Closure.

(c) Institutional control measures shall be integrated into land use and stewardship plans and programs, and shall continue until the facility can be released pursuant to DOE 5400.5, *Radiation Protection of the Public and the Environment*.

(d) The location and use of the facility shall be filed with the local authorities responsible for land use and zoning.

Objective:

The objective of these requirements is to ensure that institutional control will continue until the low-level waste disposal facility can be released for unrestricted use and that local land use records appropriately record the previous use of the land as a radioactive waste disposal facility to provide additional protection again misuse of the land and the possibility of an inadvertent intrusion.

Discussion:

Institutional Control. Institutional control, for the purposes of performance assessment, is typically assumed to last for 100 years. However, the actual period of institutional control, when DOE maintains a custodial presence and controls the use of the land, lasts until the facility can be released. A low-level waste disposal facility cannot be released until the requirements for public and environmental radiation protection of DOE 5400.5, Radiation Protection of the Public and the

Environment (or 10 CFR Part 834, when promulgated), for releasing a facility for unrestricted use are met. Institutional controls are no longer necessary for a facility released for unrestricted use.

For low-level waste disposal facilities, the period of institutional control could extend long beyond 100 years before the requirements of DOE 5400.5 are met. The closure plan includes the necessary activities to be performed during this period of institutional control to ensure the protection of the public health and the environment, such as facility monitoring, custodial maintenance, access controls, corrective actions, passive controls and restrictions, reporting requirements, and record keeping. The determination of the necessary activities to be performed during the institutional control period is based on the documentation and analysis included in the facility radioactive waste management basis, including the performance assessment, composite analysis, closure plan, and monitoring plan. Institutional control measures must be incorporated into the site's land use and stewardship plans and programs to ensure that control of the site is not compromised. Throughout the period of institutional control, the responsibility for maintaining the facility to protect the public and the environment rests with the Field Office Manager.

Location and Land Use Documentation. This requirement ensures that the previous use of the land for low-level waste disposal is a matter of public record to provide additional assurance that future generations will have knowledge of where the wastes are located. Local governmental authorities who are responsible for maintaining land use and zoning records need to be provided with maps of the disposal facility that identify the locations of all disposal units, permanent markers, monitoring locations, and the reference USGS or NGS benchmarks. These maps need to be supplemented with additional information documenting the wastes disposed of, the hazards of the waste, and the information needed to access the permanent records of the disposal facility maintained by DOE. This information is provided to the local authorities at the beginning of the institutional control period, in the unlikely event that a lapse of institutional control by DOE occurs. As advances in information technology are incorporated into the records maintained by local authorities (e.g., GIS data), the data needed to comprehensively describe the disposal facility are provided to the local authorities to ensure an accurate and complete record of land use at the facility is available to future generations.

> *Example: The DOE Field Office records the use of the land at the Z Site as a radioactive disposal facility with the local authorities responsible for land use and zoning. GIS information for the disposal facility has been developed, but the local authorities do not require GIS information to be included in the local records. DOE appends the filing of the record with the GIS information, in addition to providing maps of disposal units, permanent markers, monitoring locations, and USGS or NDA benchmarks, to provide the most complete record of the use of the land for radioactive waste disposal.*

Compliance with this requirement is demonstrated by the final closure plan including the information necessary to safely manage the disposal facility through the institutional control

period, up to and including release of the facility to the public, and the location of the disposal facility is made a part of the public record, including the maps, coordinates, reference benchmarks, and supporting documentation necessary to provide a complete understanding of the facility's location and contents.

Supplemental References:

1. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

2. DOE, 1992. *Considerations for Closure of Low-Level Radioactive Waste Engineered Disposal Facilities*, DOE/LLW-133, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1992.

3. DOE, 1990. *Guidance on Stabilization and Closure of U.S. Department of Energy Mixed And Low-Level Radioactive Waste Disposal Facilities*, DOE/LLW-82, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

IV. R. Monitoring.

The following requirements are in addition to those in Chapter I of this Manual.

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

Objective:

The objective of this requirement is to specify minimum parameters for which information will be routinely collected and analyzed for the purpose of anticipating or identifying undesirable conditions in the management of low-level waste.

Discussion:

The safety and hazards analysis, conducted in support of developing DOE O 435.1 and DOE M 435.1-1, identified timely monitoring of radioactive waste management facilities as an effective mitigation of numerous weaknesses and conditions associated with all phases of the life-cycle of waste management. An analysis of existing Departmental requirements for environmental monitoring in DOE 5400.1 and DOE 5400.5 found that they were applicable to all radioactive waste types and all radioactive waste management facilities. Many of the individual conditions that warranted monitoring evaluated in the safety and hazards analysis are already monitored due to the implementation of these Order requirements. These two DOE Orders are implemented by DOE M 435.1-1, Section I.1.E.(7).

However, while the general environmental monitoring program and the environmental monitoring plans mandated by these DOE Orders are adequate for most circumstances, they were judged to not be sufficient in requiring identification of specific warning signs of impending conditions that would lead to releases, especially for storage of liquid low-level waste. DOE M 435.1-1, Sections IV.R.(1) and IV.R.(2) address these aspects of additional monitoring for low-level waste facilities. Also, the environmental monitoring requirements did not sufficiently address monitoring of the performance of a low-level waste disposal facility, for identification of specific signs that assumptions made in evaluations of the facility (i.e., performance assessment) were incorrect or for warning signs of conditions that should be addressed in a timely fashion to prevent conditions that were not evaluated. DOE M 435.1-1, Section IV.R.(3) addresses additional monitoring needed for low-level waste disposal facilities.

Additionally, through the conduct of safety analyses, whether they are formal safety analysis reports or auditable safety analyses, facility personnel identify the quantity and form of radioactive and/or hazardous material to be handled at the facility and the operations for managing the waste. The safety analysis establishes a basis for defining the acceptable operations envelope for the facility, and provides the basis for technical safety requirements (TSRs). The technical safety requirements may include requirements for monitoring. Review of the safety analysis will determine if the analyses indicate other monitoring that would be prudent.

> *Example: An auditable safety analysis is performed as part of the startup of a waste storage facility which will store some low-level wastes with significant concentrations of alpha-emitting radionuclides. The safety analysis indicates that a monitoring and sampling system is required on the building exhaust system. Site personnel decide that alpha monitors will be installed in the waste storage bays in addition to the monitor that is on the building ventilation system.*

Parameters Specified. The minimum parameters specified in the requirement were selected based on their potential significance for anticipating and identifying undesirable conditions at low-level waste management facilities. Each facility's radioactive waste management basis should include an evaluation of the applicability and significance of the minimum parameters. This evaluation also needs to consider additional parameters to be sampled or monitored to ensure the protection of the public health, the environment, and the workers. If a minimum parameter specified in the requirement is deemed to be not applicable in any way to the active operation of that facility, then that justification should be included in the radioactive waste management basis and when approved constitutes an exemption to the manual.

The parameters need to be sampled or monitored with a frequency that is consistent with the need to detect changes in the facility performance. The precision and accuracy of measurement required is dictated by the expected variations in the parameters and the level of precision and accuracy needed to identify problems. The monitoring frequency for specific parameters is likewise determined based on the possible time variation of the parameter and the response time required to take mitigating action. For facilities that release radioactivity in effluents, frequent monitoring or continuous monitoring should be considered.

> *Example: A waste storage facility includes a storage tank that contains liquid low-level waste. The tank is equipped with an induced draft ventilation system. The tank includes monitoring capability for temperature, radioactivity in the ventilation system, and flammable or explosive mixtures of gases.*

The verification that controls and systems are functioning properly is based upon the nature of the low-level waste management activity and the potential impact resulting from a failure. Verification of active control systems for sampling and monitoring critical facility parameters may

require frequent visual inspections. Passive controls such as disposal facility caps may only require physical inspection once every year. Verification activities are part of the radioactive waste management basis as a condition for operation and documented appropriately.

> *Example 1: High activity, high hazard liquid low-level waste is stored in a single-shell tank within a subsurface vault. The volume and pressure of the waste tank are measured via remote transducers and monitored in a central control room. Verification that the tank has not leaked is deemed necessary and accomplished with routine video inspections of the vault floor.*

> *Example 2: After closure and capping of a low-level waste disposal facility, markers are placed for the purpose identifying the location of the disposal facility. Monitoring is determined to be necessary once a year to verify that the markers are in place and the facility cap has not subsided or eroded.*

All low-level waste facilities are required to apply the sampling or monitoring requirement for the specified parameters in the requirement using the graded approach. As previously noted, the methods used and the frequency should be commensurate with the significance of a change in the parameter. This graded approach can extend to determining that it is inappropriate or unnecessary to monitor or sample for the specified parameters, and the basis for such a determination documented.

> *Example: A waste storage facility includes a closed storage tank that contains liquid low-level waste. The tank includes monitoring capability for pressure only. Documentation exists that demonstrates that the contents are not capable of generating flammable or explosive mixtures of gases and the closed tank is not susceptible to changes in temperatures above or below the building's ambient temperature.*

Compliance with this requirement is demonstrated if monitoring or sampling for the stated parameters is performed for all facilities with a precision, accuracy, and frequency consistent with timely identification of developing problems and a justification exists in the approved radioactive waste management basis for those specified parameters which are not monitored or sampled.

Supplemental References:

1. DOE, 1988. *General Environmental Protection Program*, DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

2. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

IV. R.(2) Liquid Waste Storage Facilities. For facilities storing liquid low-level waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Objective:

The objective of this requirement is to mandate regular observation of parameters that indicate the quantity of liquid low-level waste stored in tanks; (1) so that unexpected changes in quantity indications can be promptly checked to determine if they are a reflection of leakage or other problems; and (2) so that liquid low-level waste input to storage tanks will be monitored to avoid overfilling. The objective of this requirement also includes tracking of the chemical characteristics of the waste to anticipate and avert undesirable storage conditions.

Discussion:

This requirement specifies additional parameters that must be monitored at facilities storing liquid low-level waste. These are additional requirements beyond the requirements in Chapter I, as already discussed and they are in addition to the parameters required in DOE M 435.1-1, Section IV.R.(1) for all low-level waste facilities.

This requirement is based on a similar requirement invoked to address a group of high hazards that was identified by the hazards analysis performed in support of the high-level waste chapter of this Manual. The hazards analysis performed to guide development of DOE O 435.1 and DOE M 435.1-1 revealed that very hazardous releases can result from containment failure of a component or from failure to stop transfer of high activity liquid waste when the receiving vessel (e.g., tank or bin) is full. Similar circumstances occurring at a high activity low-level waste liquid storage facility are similarly problematic, and a similar requirement was believed to be justified to prevent any additional exposures or workers, radioactive leaks to the environment, and costs for damage mitigation and cleanup from unanticipated liquid storage tank problems.

The requirement addresses the operation of monitoring systems to detect storage tank or transfer equipment failure that is of sufficient magnitude to cause a detectable volume change as well as to alert operators that a storage tank is approaching capacity so that overfilling can be avoided. The monitoring capability could be coupled with operational devices such as automatic shutoffs and bypasses and with alarms that will alert operators that action is needed to prevent or mitigate a release, if warranted by the risks associated with the specific wastes being stored. Regardless of the hazard of the waste being stored, leak detection equipment and inspection of diking of the contents of liquid waste storage facilities need to be included in the monitoring program consistent with the requirements in DOE 5480.22 to prevent any unplanned releases of any liquid waste in storage.

Liquid Level or Waste Volume. Some changes in liquid level or waste volume can occur normally due to slight changes in temperature or pressure. This requirement also addresses measuring liquid level or waste volume in a storage tank for the purpose of prompt detection of acute releases (releases that are detectable visually or by some other gross indicator) and more chronic releases that become apparent over a time frame of hours or days.

> *Example: A large diameter liquid low-level waste storage tank includes a mechanical level indicator that is read and recorded daily. The level indicator remained stable for six months following the last waste addition to the tank. The level indicator readings then began to show a downward trend that totaled two inches over a two week period. The level indicator change alerts operators of a potential problem that requires further investigation.*

Surface level is a relatively straightforward parameter to monitor for detection of leakage from a liquid waste storage system. In general, the surface level in a storage tank is an appropriate indicator of waste volume. However, operations and mechanisms that could change the volume in a tank must be considered to ensure all unexplainable level changes are investigated and to discount explainable level changes.

Gas generation and evaporation as well as intentional additions to and removals from the storage tanks must be accurately accounted for if the waste liquid level (or volume) is to be used to monitor for leakage. Also, consideration needs to be given to the separate monitoring of the liquid fraction and sludge or solid fraction present in the tank, if layering of the waste is present.

> *Example 1: In the tank in the example above, an unexpected chemical reaction generates gas that is trapped within the waste matrix or under a semipermeable layer of waste that retards percolation of the gas to the surface of the waste. This mechanism maintained the apparent surface level of the waste in the tank even as liquid was leaking out.*

> *Example 2: Operating personnel at a storage facility calculate the evaporation loss expected from a liquid low-level waste tank based on an assumed radionuclide inventory. The actual radionuclide inventory is much smaller than that assumed, so the actual heat generation rate is much smaller than that assumed. Overestimation of the waste volume change due to evaporation resulted in failure to detect leakage that was incorrectly assumed to be evaporative loss.*

Chemical Characteristics. Experience with situations threatening confinement of liquid radioactive waste in storage tanks led to the part of the requirement focused on monitoring chemical characteristics. Chemical characteristics of waste that are not compatible with the material of construction of waste tanks or transfer equipment often presage containment failure. The frequency of monitoring and the identification of significant tank chemistry parameters should

be determined on a facility- and tank-specific basis. Selection of parameters is based on the need to protect the public health, the environment, and workers. Monitoring is performed to provide statistically valid information of the relevant tank chemistry and any detected changes in the chemistry of the tank.

> *Example: Some very minor volumes of laboratory spill waste are planned to be added to liquid storage tank YTR. Tank YTR is made of carbon steel and has been in service since 1978. The pH of the spill waste is measured and adjusted to a pH of 12 to meet the waste acceptance requirements for waste transfers to the tank. The pH testing of tank YTR waste is part of routine monitoring.*

For liquid low-level waste tanks for which corrosion control or other structural integrity issues are indicated, the document entitled, *Guidelines for Development of Structural Integrity Program for DOE High-Level Waste Storage Tanks*, can be consulted for guidance on establishment of processes and programs to address the storage tank problems. Appropriate use of the graded approach is to be utilized when implementing corrosion control or other programs for storage tanks that will store liquid low-level waste that is less hazardous than the tanks addressed in the BNL document.

Graded Approach. A graded approach needs to be applied to implementation of this requirement for monitoring to detect acute releases promptly. The first consideration for a graded approach is that monitoring parameters and frequencies for liquid waste storage tanks should be specific for each tank. Also, the frequency of monitoring should be selected to detect changes commensurate with the potential risks of the specific waste being stored. For example, highly acidic liquid waste in a single-walled, mild steel storage tank may require continuous monitoring coupled with alarms and transfer equipment. On the other hand, mildly radioactive and chemically stable liquid waste that has been in storage for a long period of time may only need a simple mechanical liquid level reading once per week.

Compliance with this requirement is demonstrated by developing operational procedures for liquid low-level waste storage tanks to monitor waste liquid level, waste volume, and tank chemistry so that waste volume or chemistry changes are detected in a time frame that will allow implementation of corrective measures to limit public and worker doses and to prevent unplanned releases of stored liquid waste.

Supplemental References:

1. DOE, 1992. *Technical Safety Requirements*, DOE 5480.22, U.S. Department of Energy, Washington, D.C., February 25, 1992.

2. DOE, 1997. *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, BNL-UC-406, Brookhaven National Laboratory, Upton, NY, January 1997.

IV. R.(3) Disposal Facilities. A preliminary monitoring plan for a low-level waste disposal facility shall be prepared and submitted to Headquarters for review with the performance assessment and composite analysis. The monitoring plan shall be updated within one year following issuance of the disposal authorization statement to incorporate and implement conditions specified in the disposal authorization statement.

Objective:

The objective of this requirement is to ensure that critical information on disposal facility performance monitoring is documented in a preliminary plan that is submitted along with the performance assessment and composite analysis for review and approval. This information is important in establishing conditions for authorizing the disposal of low-level waste and will help ensure that any changes to the disposal facility performance monitoring that is a condition of the disposal authorization statement is formally incorporated into the documented monitoring plan in a timely manner.

Discussion:

As previously discussed, the general environmental monitoring program and the environmental monitoring plans required in the General Requirements Chapter did not sufficiently address monitoring of the performance of a low-level waste disposal facility for identification of specific signs that assumptions made in evaluations of the facility (i.e., performance assessment) were incorrect or for specific warning signs of conditions that should be addressed in a timely fashion to prevent conditions that were not evaluated. This requirement for monitoring low-level waste disposal facilities, and all of the subrequirements that follow, are additional requirements beyond the Chapter I requirements which are applicable to all facilities. This requirement calls for the inclusion of performance monitoring information in the review of the performance assessment and composite analysis for a disposal facility so that the results of the evaluations can be used to establish the monitoring plan that will become part of the radioactive waste management basis for the disposal facility.

<u>Preliminary Monitoring Plan</u>. A preliminary monitoring plan, containing the elements of the monitoring program discussed in the guidance for DOE M 435.1-1, Section IV.R.(3)(b), must be submitted to Headquarters as part of the documentation for the disposal authorization statement

(DOE M 435.1-1, Section IV.P.(5)). The preliminary monitoring plan is a documentation of the monitoring performed in support of the performance assessment and composite analysis, and any preliminary changes or additions to the monitoring that reflect the results of the evaluations as submitted. Results of the performance assessment and composite analysis could result in the identification of a specific type of performance monitoring being included in the preliminary monitoring plan (e.g., trench cap subsidence), the identification of specific monitoring locations, or a recommended frequency for monitoring. The relationship of the monitoring plan with the performance assessment and composite analysis is discussed in detail in the next section of guidance for DOE M 435.1-1, Section IV.R.(3)(a).

> *Example: A disposal facility submits a performance assessment and composite analysis along with a preliminary closure plan to Headquarters, but does not submit a preliminary monitoring plan. The disposal authorization statement is not issued until the preliminary monitoring plan is submitted.*

Monitoring Plan Contents. Several purposes are addressed in the formulation and execution of a monitoring program for a low-level radioactive waste disposal facility. To address all purposes and conduct a program which is cost-effective requires planning which takes into consideration the characteristics of the disposal site, the wastes, and the disposal technology. Monitoring programs and their plans, which include routine analysis and interpretation of data collected, can be expected to reduce life-cycle costs of disposal by early detection of unexpected events and initiation of corrective actions, and improvements in the understanding of the performance of the site and waste disposal technology.

> *Example: To ensure the monitoring at the low-level waste disposal facility at Site R is cost-effective and is effective in determining early detection of unexpected events, it does not include vadose zone monitoring because a determination is made that, due to the thinness of the vadose zone, it does not have a major role in the determination of the long-term performance of the disposal facility.*

The monitoring plan includes a tabular summary of the media to be monitored, the methods to be used, the methods for analysis of collected samples, the methods of reporting, frequency of data collection, and action levels based on the data collected. All sampling is performed according to the appropriate procedures, with those procedures clearly described in the monitoring plan.

The plan includes a schedule for implementing the monitoring plan, and estimates of the resources required for the implementation of the monitoring plan. The plan describes the conduct of the program by a multi-disciplinary team of skilled professionals representing the various components of the monitoring program (e.g., air pathway, groundwater, closure cap, etc.).

Review and Approval of Monitoring Plan. As discussed earlier, a preliminary monitoring plan for a low-level waste disposal facility must be submitted along with the performance assessment and composite analysis for review prior to issuance of a disposal authorization. Therefore, review and approval of the monitoring plan for a low-level waste disposal facility would be conducted by the Field Element Manager, and the approved monitoring plan then becomes part of the radioactive waste management basis for the disposal facility. The authors of DOE O 435.1 intended that, to the extent practicable, the documentation of the plans, their reviews and approvals, and reporting of trends and other results of the monitoring data would be incorporated into the environmental monitoring plan required under DOE 5400.1. This incorporation may not be able to be accomplished initially, as the monitoring locations, media, and frequencies will be in a state of flux until all of the low-level disposal facility radioactive waste management basis is finalized. After the basis is finalized, this incorporation into the general environmental monitoring program may be easier to accommodate, and a phasing in of the information into the general environmental program may be appropriate.

Updating the Preliminary Monitoring Plan. An update of the monitoring plan, following the issuance of the disposal authorization statement, must be prepared within one year of issuance of the disposal authorization statement and should reflect all of the conditions concerning monitoring that are in the disposal authorization statement. Conditions in the disposal authorization statement become part of the radioactive waste management basis for the disposal facility as they reflect items to be implemented to maintain a reasonable expectation that the performance objectives will continue to be met after disposal operations have ceased.

Changes in the performance assessment and composite analysis that may be necessary because of changes in the monitoring plan or data generated by the environmental monitoring program are to be addressed as part of the performance assessment and composite analysis maintenance program.

Compliance with this requirement is demonstrated if a preliminary monitoring plan including the elements of the monitoring plan discussed in the following sections is submitted to Headquarters with the performance assessment and composite analysis for review, and a process to incorporate changes to the performance monitoring program for the low-level waste disposal facility is established that will include any changes to the monitoring based on the disposal authorization statement in an updated monitoring plan within one year of issuance of the authorization statement from Headquarters.

Supplemental References:

1. DOE, 1988. *General Environmental Protection Program*, DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

2. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

IV. R.(3) Disposal Facilities.

(a) The site-specific performance assessment and composite analysis shall be used to determine the media, locations, radionuclides, and other substances to be monitored.

Objective:

The objective of this requirement is to ensure that the monitoring program is appropriately designed and administered in a way that supports the analysis and evaluations conducted in the performance assessment and composite analysis and the conditions under which the disposal facility may operate based on the review and approval of these assessments.

Discussion:

This requirement serves to tailor the disposal facility performance monitoring to reduce uncertainties in assumptions made and evaluations conducted while developing the performance assessment and composite analysis and formulating the conditions under which the facility can operate. This requirement for monitoring low-level waste disposal facilities is an additional monitoring requirement beyond the requirements in Chapter I, as discussed in the guidance for DOE M 435.1-1, Section IV.R, and is applicable to all low-level waste disposal facilities.

Site-specific performance assessments and composite analyses are required for all low-level waste disposal facilities by DOE M 435.1-1, Sections IV.P. (2) and (3). These documents have the purpose of evaluating the long-term performance of the disposal facility and providing reasonable assurance that the performance objectives for low-level waste disposal are met. Assessments of the long-term performance of natural systems often have large uncertainties, and include many assumptions of the behavior of natural systems over extended periods of time. The performance assessment and composite analysis of a disposal system identifies these uncertainties and assumptions along with the results. An effective way to verify assumptions, reduce uncertainties, and build confidence in the results and conclusions of the performance assessment and composite analysis is to monitor the performance of the disposal facility.

Thus, the performance assessment and composite analysis are used as primary tools for establishing the monitoring plan to collect data to develop an understanding of the actual performance of the disposal facility. The performance assessment and composite analysis should provide sufficient information to identify the important migration pathways for the transport of

radionuclides, primary mobile radiological and chemical constituents, logical monitoring locations, monitoring parameters, and sampling frequencies.

> *Example: The performance assessment results for a low-level waste disposal facility indicate that one geologic strata is an especially important pathway for radionuclide release via groundwater. The preliminary monitoring plan states the importance of this strata, and indicates that two principal wells will be added to the site monitoring locations in this strata when the disposal facility becomes operational.*

Likewise, data collected from the monitoring program provide needed information to refine the performance assessment and composite analysis, as part of the maintenance program for the performance assessment and composite analysis, evaluate the conservativeness of the results of the performance assessment, and provide ongoing assurance that the results contained in the performance assessment are representative of the actual performance of the facility.

> *Example: The monitoring program installed at a low-level waste disposal site includes a surveying program of disposal unit covers to detect any subsidence of disposal unit covers. More serious subsidence is occurring than was evaluated in the performance assessment. The performance assessment is re-evaluated using the results of the monitoring data, by analyzing more severe subsidence. Even more frequent subsidence monitoring is instituted while further analysis of the situation is taking place.*

Technical personnel involved in the preparation and revision of the performance assessment and composite analysis should work closely with those personnel involved in the monitoring program to evaluate the results derived from facility monitoring. Revisions to the performance assessment, should be reviewed to determine if the changes affect the monitoring plan.

> *Example: The performance assessment for a low-level waste disposal facility is revised in response to monitoring data indicating the generation of leachate more quickly than expected. As a result of the revision, additional monitoring locations close to the disposal units are added to the monitoring plan, several monitoring locations distant from the disposal units are deleted from the monitoring plan, soil monitoring is added to the monitoring plan, additional parameters are added to the monitoring plan, frequencies of sampling are increased, and advanced vadose zone monitoring methods are introduced.*

The monitoring plan also needs to be coordinated with the disposal facility closure plan and safety analysis report to ensure the data needs derived from these separate documents are incorporated into the monitoring plan, and data collected by the monitoring program are incorporated into revisions of these documents.

Example: Referring to the previous example, the closure plan is modified to provide additional lifts of clay material to reduce long-term infiltration, and additional worker monitoring is introduced at the disposal facility to ensure worker doses are ALARA.

Compliance with this requirement is demonstrated if the performance monitoring plan for the low-level waste disposal facility demonstrates that the media, locations, radionuclides, and other substances being monitored are based on performance assessment and composite analysis results.

Supplemental References:

1. NRC, 1989. *Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility*, NUREG-1388, U.S. Nuclear Regulatory Commission, Washington, D.C., 1989.

2. NRC, 1983. *Subsurface Monitoring Programs at Sites for Disposal of Low-Level Radioactive Waste*, NUREG/CR-3164, U. S. Nuclear Regulatory Commission (by U.S. Army Corps of Engineers Waterways Experiment Station), Washington, D.C., 1983.

3. DOE, 1990. *Environmental Monitoring for Low-Level Waste Disposal Sites: Low-Level Management Handbook Series*, Revision 2, DOE/LLW-13Tg, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

IV. R.(3) Disposal Facilities.

(b) The environmental monitoring program shall be designed to include measuring and evaluating releases, migration of radionuclides, disposal unit subsidence, and changes in disposal facility and disposal site parameters which may affect long-term performance.

Objective:

The objective of this requirement is to specify the minimum parameters that must be monitored at all low-level waste disposal facilities. Monitoring of these parameters can alert operators of changing conditions that could be caused by problems associated with the disposal of low-level waste at the facility. This requirement adds the specific monitoring for disposal facility performance for the long-term in addition to the monitoring requirements that are required in Chapter I.

Discussion:

This requirement identifies the elements of environmental monitoring programs for low-level waste disposal facilities. This monitoring requirement for low-level waste disposal facilities is an additional requirement beyond the requirements of Chapter I, as discussed in the guidance for DOE M 435.1-1, Section IV.R, and is applicable to all low-level waste disposal facilities.

Elements to Be Monitored. A successful performance monitoring program for low-level waste disposal facilities monitors, at a minimum, the elements described in the requirement, and monitoring is conducted through the entire life-cycle of the facility. Therefore, a successful monitoring program actually begins prior to the facility even being constructed. Since the Department has many existing facilities already, much of this guidance is moot, except if an existing facility is to be expanded. This guidance first discusses the pre-operational monitoring program that is established in order to effectively monitor for the specific elements discussed in the requirement.

Pre-Operational Monitoring. Pre-operational monitoring of a new disposal site or the expansion of an existing disposal site to determine baseline conditions will be conducted as required by DOE M 435.1-1 as part of the Site Evaluation (DOE M 435.1-1, Section IV.M.(1)). This activity needs to be performed for at least one year prior to construction of a disposal facility. Because much of the environmental data collected by monitoring programs is influenced by seasonal events, one year of data represents an absolute minimum for data collection for new disposal sites. Longer periods of baseline monitoring data collection extending to five or more years provide a better data base. Media selected for monitoring needs to be those most likely to be affected by site development and waste disposal operations. Monitoring locations for all media are selected to provide an uninterrupted stream of data throughout site development, facility operations, facility closure, and post-closure. Pre-operational monitoring provides site characterization information, site suitability information, and provide records for public information.

> *Example: A new disposal facility at INEEL is proposed. Pre-operational monitoring data are collected for a five year period to ensure the meteorologic and soil data are reflective of the long-term trends associated with the site. Since the alternative sites are widely distributed across the site, extended data records are needed to differentiate between the various alternative sites.*

For expansions of existing disposal sites, pre-operational monitoring needs may be less demanding, because of the similarity of the site expansion to the existing disposal site. Consequently, the extent of pre-operational monitoring for the expansion of existing disposal sites may be less intensive with respect to the number of monitoring locations for each media, but the duration of pre-operational monitoring is consistent with the monitoring for new disposal sites to provide a meaningful baseline for the expanded disposal facility.

Many DOE low-level waste disposal facilities may be in close proximity to other waste management facilities. These nearby waste management facilities may be associated with the release and migration of radionuclides to the disposal facility. For such cases, the importance of the baseline monitoring program is increased. The monitoring plan for such facilities may need to be more comprehensive to allow for a separation of existing contamination from any contamination which might be introduced by the low-level waste disposal facility, and address multiple sources of contamination to assure that any release from the low-level waste disposal facility would not lead to exceeding the performance objectives addressed by the performance assessment and composite analysis.

> *Example: A new disposal facility is proposed that is adjacent to an existing operating facility which includes old disposal units closed over 30 years ago. The baseline monitoring data for the new facility indicate the migration of contamination from the old disposal units. The pre-operational monitoring program is extended in time to provide a more extensive baseline data base for separating the performance of the old disposal facility from the new disposal facility.*

Operational Monitoring. Once a baseline or pre-operational characterization of the disposal facility has been established and the facility has begun operations, operational monitoring required for low-level waste disposal facilities is directed toward the specific elements identified in the requirement.

Effluent Monitoring. The primary purpose for operational monitoring is to verify compliance with applicable effluent requirements and limits (e.g., NPDES, NESHAPS), evaluate the effectiveness of effluent treatment and control, and identify environmental problems requiring mitigation or corrective action. (Also see next discussion on Evaluation of Monitoring Data). Effluent monitoring during operations typically involves routine sampling and analysis, using methods that will capture any release of contamination that might occur, such as water runoff to storm drainage systems during storms, or tritium migration within disposed waste masses. Effluent monitoring is also used to detect hydrologic failure of engineered disposal systems, such as concrete disposal vaults. This type of monitoring can be accomplished by monitoring engineered sumps, or moisture present outside the disposal vaults.

Operational monitoring that is directed toward the detection of effluents needs to be performed as close as reasonable to the waste emplacement operations, including the consideration of monitoring within the disposed waste mass. Radionuclide releases from facility operations can potentially occur to the atmosphere, soils, or water resources. Any operational effluent release from disposal facilities needs to be monitored, such as releases from leachate collection systems to the surface, groundwater, surface water, or atmosphere. These data, when compiled over a long period of time, provide indications of long-term trends and changes in operational conditions.

Radionuclide Release Detection. Monitoring equipment and location selection for radionuclide release detection is considered during facility design and construction, with emphasis on the earliest detection of migration. Operational monitoring directed toward the detection of the migration of radionuclides is intended to ensure that applicable standards and permit requirements are met, and assess potential radiation exposures to members of the public. This type of monitoring also is used to determine any effects on the environment or natural resources. The purpose of this type of monitoring is to characterize and define trends in the physical, chemical and biological condition of environmental media.

> *Example: Air sampling at the site boundary, biological monitoring of flora and fauna within the disposal facility, and analysis of groundwater in wells adjacent to the facility are performed as part of the monitoring plan to characterize and define trends in the physical, chemical, and biological condition of the environmental media at a disposal facility.*

Subsidence. While low-level waste disposal facilities are designed and operated to maximize the stability of the wastes and the disposal facility, subsidence remains a persistent problem at disposal facilities. The occurrence of subsidence is an early indication of needed corrective actions which should be performed. Monitoring for subsidence needs to be included in the monitoring plan with the schedule for implementation of subsidence monitoring following interim closure of a disposal unit and continuing throughout the closure and post-closure phases of the monitoring plan. The onset of subsidence is considered a potential failure in long-term stability and may need to be addressed by corrective action. Parameters to be considered in monitoring for subsidence include spatial surface monitoring of disposal unit covers, and may include monitoring of the moisture profile from the surface to the bottom of the disposal unit. Other disposal facility and site parameters which provide indications of long-term performance and stability of waste disposal facilities are also incorporated into the monitoring plan as interim closure is performed on filled disposal units.

Evaluation of Monitoring Data. Data collected from operational and post-operational environmental monitoring are reviewed and interpreted to identify: (1) compliance with applicable effluent requirements, limits, and/or permit conditions, or (2) changes in disposal facility or site parameters which may affect long-term performance. Analysis and interpretation of data include the identification of the changing trends in the data, identification of monitoring data requiring verification, identification of unanticipated results, and the identification of corrective actions to be taken as a result of data collected.

> *Example: A vadose zone monitoring system beneath a disposal unit provides data indicating a steady increase in moisture content. Review of the data reveals the unanticipated trend, and an investigation of the monitoring equipment identifies an*

instrument failure. The instrument is repaired and notations added to the data record of the existence of the failed instrument.

With respect to compliance, evaluation of monitoring data is used to determine if any releases from a facility are not within limits established by DOE 5400.1 and DOE 5400.5; technical safety requirements established in response to DOE 5480.22; or other release limits established by the radioactive waste management basis for the low-level waste disposal facility. Inclusion of the interpreted results from the monitoring program for this aspect of monitoring should be reported in the Annual Site Environmental Monitoring Report required by DOE 5400.1.

With respect to long-term performance of the low-level waste disposal facility to ensure the performance objectives are met, monitoring data are reviewed periodically against the action levels contained in the monitoring plan (see guidance on DOE M 435.1-1, Section IV.R.(3)(c)). This review is conducted routinely throughout the operational, closure and post-closure periods of the facility to evaluate the performance of the facility as compared to the results contained in the performance assessment and composite analysis, detect trends in the performance of the facility sufficiently in advance to allow for necessary corrective actions, and to provide justification for changes in the monitoring plan for the facility. Additional guidance on this aspect of monitoring data evaluation is provided with the discussion of Section IV.R.(3)(c).

Example: The monitoring data for the Site Q Low-Level Waste Disposal Facility were reviewed, and a need to revise the performance assessment because of the disparity between expected results and actual data was identified. Trending of data is initiated to follow future trends in the leachate generation data and corrective action plans are developed to mitigate potential releases.

Additional Guidance on Low-Level Waste Disposal Facility Monitoring. Numerous documents that contain generalized guidance on the development of environmental monitoring for low-level waste disposal facilities have been prepared (DOE/LLW-54T, DOE/LLW-13Tg, Rev. 2, NUREG-1388, NRC Reg. Guide 4.15, DOE/EH-0173T, DOE/EP-0023). This generalized guidance should be consulted for assistance with specific monitoring topics that are not addressed by this implementation guidance. It must be remembered, however, that the generalized guidance in these reference documents must be tailored to the specific site, facility, waste streams, and disposal technology being considered.

Compliance with this requirement is demonstrated if the environmental monitoring program collects and evaluates sufficient data on effluents, radionuclide releases, and subsidence to provide a sound basis for analyzing the long-term performance of the disposal facility.

Supplemental References:

1. DOE, 1988. *General Environmental Protection Program*, DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

2. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

3. DOE, 1992. *Technical Safety Requirements*, DOE 5480.22, U.S. Department of Energy, Washington, D.C., February 25, 1992.

4. DOE, 1991. *Environmental Regulatory Guide for Radiological Monitoring and Environmental Surveillance*, DOE/EH-0173T, U.S. Department of Energy, 1991.

5. DOE, 1981. *A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations*, DOE/EP-0023, U.S. Department of Energy, Washington, D.C., 1981.

6. NRC, 1989. *Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility*, NUREG-1388, U.S. Nuclear Regulatory Commission, Washington, D.C., 1989.

7. NRC, 1979. *Quality Assurance for Radiological Monitoring Programs (Normal Operations)--Effluent Streams and the Environment*, Regulatory Guide 4.15, U.S. Nuclear Regulatory Commission, Washington, D.C., February 1979.

8. NRC, 1983. *Subsurface Monitoring Programs at Sites for Disposal of Low-Level Radioactive Waste*, NUREG/CR-3164, U.S. Nuclear Regulatory Commission (by U.S. Army Corps of Engineers Waterways Experiment Station), Washington, D.C., 1983.

9. DOE, 1990. *Environmental Monitoring for Low-Level Waste Disposal Sites: Low-Level Management Handbook Series*, Revision 2, DOE/LLW-13Tg, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

10. DOE, 1986. *Experience and Improved Techniques in Radiological Environmental Monitoring at Major DOE Low-Level Waste Disposal Sites*, DOE/LLW-54T, U.S. Department of Energy, National Low-Level Radioactive Waste Management Program, Idaho Falls, ID, 1986.

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(c) The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives in this Chapter.

Objective:

The objective of this requirement is to ensure that if data collected from the monitoring program indicates the facility is not performing as expected, that corrective actions will be initiated quickly to minimize potential impacts to the environment and the public health, and to maintain the reasonable assurance that the performance objectives will continue to be met.

Discussion:

This monitoring requirement for low-level waste disposal facilities is an additional requirement beyond the monitoring requirements in Chapter I, as discussed in guidance for DOE M 435.1-1, Section IV.R, and is applicable to all low-level waste disposal facilities. This monitoring requirement is closely associated with DOE M 435.1-1, Section IV.F, *Corrective Actions.* Data collected as part of the low-level waste disposal performance monitoring program are to be used as indicators for initiating corrective actions to address problems at low-level waste disposal facilities that could lead to exposures sometime far in the future.

This requirement emphasizes those elements of the monitoring plan for low-level waste disposal facilities directed toward performance monitoring. The primary purpose for additional monitoring requirements for low-level waste disposal facilities is to determine if the facility is performing as designed and analyzed. This requirement emphasizes the need to routinely analyze and interpret monitoring data as they are collected, using the performance assessment, composite analysis, safety analysis report, closure plan and disposal facility design documentation, to evaluate the actual performance of the facility as compared to the expected performance of the facility.

Detection of Changing Trends in Data. The methods for comparing monitoring data with the expected performance of the facility include trend analysis to examine any migration of radionuclides, subsidence, or other changes in monitoring parameters which are related to the long-term performance of the disposal facility. If a trend in surface water runoff or groundwater data indicates releases of radioactive or non-radioactive materials are more rapid than expected, the need for corrective actions must be established. In general, premature releases of radionuclides or elevated concentrations of radionuclides in environmental media are sufficient to initiate evaluation of corrective actions in detail. Early response to releases of radioactive or chemical contaminants reduces the overall costs of remediation, and can be expected to restore

facility performance that will be compliant with applicable requirements and the performance objectives for low-level waste disposal.

> *Example: The monitoring data from the Tumulus I disposal facility at Oak Ridge indicates elevated releases of tritium. Corrective actions were initiated to identify the source of the contamination, which was derived from a clogged french drain during the installation of the interim cover. The drain was repaired, and tritium releases were reduced to less than the action levels included in the monitoring plan.*

Low-level waste disposal facilities that utilize several types of disposal technologies need to develop monitoring plans to segregate the performance of the different technologies within the disposal facility. By not segregating the monitoring plan for the different technologies, the capability of determining which technology is primarily contributing to monitoring data is lost, and inappropriate corrective actions, if required, could result. The monitoring plan for facilities with multiple disposal technologies is necessarily more complex than facilities with a single disposal technology.

Corrective Actions. Should the monitoring program collect data that indicate radioactive material is migrating and the performance objectives may not be met, plans must be included in the monitoring plan for corrective measures. The identification of thresholds which indicate migration of radioactive materials potentially exceeding performance objectives and requiring corrective measures need to be developed as part of the monitoring plan.

> *Example: Results of the performance assessment and the discharge limits included in DOE 5400.5 were used to establish upper release limit from a drainage system surrounding a disposal unit. The action levels for initiating corrective actions were established as 10 percent of the release limit to provide sufficient time to take action before release limits are exceeded.*

Necessary corrective actions are determined based on the statistical significance of the monitoring data collected, the potential for exceeding the performance objectives or violating applicable DOE environmental, safety, and health requirements, the potential alternative corrective actions, the present costs of remediation, and the potential future costs of remediation. Each aspect needs to be evaluated with emphasis placed on the potential costs of future remediation. The potential for exceeding the performance objectives for low-level waste disposal needs to be determined in consultation with the performance assessment and composite analysis maintenance program. Necessary corrective actions need to be initiated as quickly as possible after the actions are justified. Necessary corrective actions include major additions to the facility to collect and contain radioactive materials, amendments to the cover design for the disposal unit, and changes in disposal facility operations. Likewise, corrective actions could include little more than simple repairs of components of the facility that failed prematurely, such as valves or drains.

While necessary corrective actions are most likely to be triggered by the performance assessment, because current disposal facility designs are not intended to have releases that could exceed regulatory limits for many years after closure, adherence to all of the requirements of all DOE Orders is important for continued operations of low-level waste disposal facilities.

The description of plans for corrective actions included in the monitoring plans for low-level waste disposal facilities need to be specific for each type of release (liquid, particulate, gaseous), and utilize a graded approach dependant on the magnitude of monitoring data exceeding the action levels. A single data point which exceeds an action level by less than ten percent does not necessarily warrant as severe a response as a series of data points in excess of 100% of the action levels. Exceeding any action level(s) warrants the notification of the responsible authority of the event occurring, as defined by the procedures for facility operations.

<u>Action Levels</u>. Determination of the thresholds which would indicate migration of radionuclides, and that the performance measures may not be met, are commonly expressed as action levels, which, if exceeded, have prescribed activities that must occur. Examples of responses to exceeding an action level include immediate notification of responsible authorities, immediate evaluation and documentation of the data collected, identification of changes in operations until the data can be verified and any necessary corrective actions are taken, and the development of mitigating actions to be undertaken to restore facility performance. The actions to be performed when action levels are exceeded need to be documented as procedures and included in the monitoring plans for low-level waste disposal facilities.

The action levels indicating performance objectives may be exceeded need to be established in consultation with the performance assessment and composite analysis maintenance program. These action levels are subject to revision as data are developed from the monitoring program that provide actual data on facility performance, but need to be established initially as part of the monitoring plan to ensure facility operations are likely to meet the performance objectives of DOE O 435.1.

Action levels for liquid, particulate, and gaseous releases need to be included in the monitoring plan, with monitoring locations established close to each disposal unit and with monitoring parameters and frequencies selected based on the results of the performance assessment. Action levels need to be determined for those radionuclides considered to be critical in understanding the performance of the disposal facility, with emphasis on mobile radionuclides, which are likely to be early indicators of any migration of radioactive material. Action levels may also be established for non-radioactive parameters (e.g., pH, moisture content), which may be appropriate as early indicators of the migration of radioactive materials. The locations for monitoring and the media to be selected that are associated with the specified action levels need to be based on the results of the performance assessment.

Example: Action levels for non-radioactive parameters are identified in the monitoring plan for pH and soil moisture content. The action levels were a change in pH of two points from the baseline monitoring data, and a 10% increase in moisture content above the baseline value.

Compliance with this requirement is demonstrated if monitoring programs for disposal facilities are capable of detecting possible changes in performance based on monitoring data collection and evaluation and identify action limits which are tied to corrective actions to be taken by procedures for disposal facility operations.

Supplemental References:

1. DOE, 1990. *Environmental Monitoring for Low-Level Waste Disposal Sites: Low-Level Management Handbook Series*, Revision 2, DOE/LLW-13Tg, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

2. DOE, 1986. *Experience and Improved Techniques in Radiological Environmental Monitoring at Major DOE Low-Level Waste Disposal Sites*, DOE/LLW-54T, U.S. Department of Energy, National Low-Level Radioactive Waste Management Program, Idaho Falls, ID, 1986.

Approved: 7-09-99

APPENDIX A
Technical Basis and Considerations for DOE M 435.1-1

U.S. DEPARTMENT OF ENERGY

Distribution:
All Departmental Elements

Initiated By:
Office of Environmental Management

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TECHNICAL BASIS AND CONSIDERATIONS

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TECHNICAL BASIS AND CONSIDERATIONS

1.0 INTRODUCTION

This section outlines and summarizes the methodology used by the Department of Energy in revising its Order on radioactive waste management. The purpose of this appendix is to establish the technical basis of the order revision process and of each of the requirements included in the revised radioactive waste management order. The Department of Energy revised the Order on radioactive waste management for several reasons:

- After thorough technical reviews and analyses, both the Department of Energy and the Defense Nuclear Facilities Safety Board concluded that the existing Order, 5820.2A, did not adequately address the Department's radioactive waste management and disposal practices.

- There have been significant advances in radioactive waste management practices and changes within the Department of Energy since the Order was issued in 1988.

- Risk based and performance-based requirements are a prudent and necessary component of DOE's new directives system.

- Opportunities for stakeholder involvement, a key element of DOE decision making, needed to be provided.

- The technical basis for the Department's radioactive waste management requirements and guidance needed to be documented.

The revised Order, designated *DOE O 435.1,* establishes the requirements for management of radioactive waste consistent with the Department's *Atomic Energy Act* responsibilities to provide for radiological protection from DOE operations. The scope of DOE O 435.1 includes: (1) high-level waste, including closure of high-level waste tank systems and management of associated incidental wastes; (2) transuranic waste, including safe treatment, storage, and characterization/ certification to support disposal at the Waste Isolation Pilot Plant; and (3) low-level waste, with attention to disposal and the impacts of interacting source terms on projected public dose. The revised Order does not contain requirements for the decontamination or decommissioning of radioactively contaminated facilities. Those requirements are incorporated in a revision of DOE O 430.1A, *Life-Cycle Asset Management*. Additionally, the requirements for the management of spent nuclear fuel are not contained in this Order. The hazards analysis performed to identify requirements for high-level waste did not address the functions associated with management of spent nuclear fuel. Thus the requirements contained in DOE M 435.1-1 do not apply to this DOE-managed spent nuclear fuel.

2.0 BACKGROUND

DOE 5820.2A, Radioactive Waste Management, was issued by the Department of Energy in September 1988. As early as 1990, the Department began analyzing, assessing, and reviewing the implementability of the Order on radioactive waste management, 5820.2A. Most DOE Orders are scheduled for review every two years to determine whether they should be continued, revised, or canceled. The policy of the Department of Energy is to use a consistent and effective management system for the development, communication, implementation, and periodic review of its Orders. Objectives in revising a DOE Order include providing more effective program direction, accountability, and performance assurance. In 1991, the Department initiated efforts to revise DOE 5820.2A.

During this initial revision effort, the Defense Nuclear Facilities Safety Board (DNFSB) also began examining low-level waste management within the defense nuclear complex, including the Department’s low-level management program and practices in terms of its past, present, and future operations. In September 1994, the DNFSB issued Recommendation 94-2, *Conformance with Safety Standards at Department of Energy Low-Level Nuclear Waste and Disposal Sites*, which identified problems with the Department’s radioactive waste management specific to low-level waste.

The DNFSB's findings, as reported to DOE in Recommendation 94-2, were that: (1) DOE had not kept pace with the evolution of commercial practices for waste disposal; (2) that six years after the issuance of DOE 5820.2A, the performance assessment process had not been completed for any of DOE's low-level waste disposal facilities; (3) that the performance assessments excluded waste buried prior to September 1988 and interacting source terms; (4) that there was considerable uncertainty in the DOE projections of low-level waste volumes; (5) that DOE needed additional requirements standards, or guidance on LLW Management; and (6) that DOE needed to improve its modeling and predictive capability for assessing radionuclide migration, enhancing stability of buried waste forms, deterring intrusion, and inhibiting migration of radionuclides.

In May 1995, a revision to 5820.2A (draft DOE 5820.2B) was issued for review by DOE and the DNFSB staff. The draft revised DOE 5820.2B was an extensive, detailed set of requirements. However, the relationship of the requirements to guidance within the Order and the technical basis for each was not clear. When distributed for review, the draft revision drew 1,500 comments from within DOE and the Defense Nuclear Facilities Safety Board. DNFSB staff identified 41 significant safety concerns and eight additional observations which they determined could adversely affect the safety of DOE's management of its radioactive waste and/or which conflicted with commitments made by DOE in response to other DNFSB Recommendations, including 94-2. Based on the DNFSB's concerns and those raised by the numerous comments on the draft Order, a significant number of issues were raised internally within DOE. As a result, the Office of

Environmental Management (EM) committed to a new approach to revising the radioactive waste management Order, and also committed to issuing a draft of the revised Order.

DOE objectives in revising the Order included: (1) incorporate DOE commitments in response to 94-2 and other DNFSB Recommendations into the Order; (2) develop a clear and sound technical basis for the requirements and guidance; (3) incorporate considerations of risk, including the processes being developed under DOE's Integrated Safety Management System; (4) develop less prescriptive and more performance-based requirements; (5) address stakeholder concerns; and (6) address other emerging considerations, such as the movement toward external regulation, legislation requiring the adoption of industry consensus standards, and DOE's ongoing efforts to delegate decision-making and managerial controls from Headquarters to the Field Office level.

The Department’s approach for revising the Order on radioactive waste management involved:

- Undertaking a systematic review of DOE’s radioactive waste management activities to identify and evaluate the functions and activities necessary to manage radioactive waste effectively;

- Assessing the hazards posed by performing the functions and activities;

- Identifying the regulatory requirements and guidance to mitigate identified hazards and manage waste effectively; and

- Establishing and documenting the technical basis for the requirements and guidance.

The revised DOE radioactive Waste Management Order, as DOE O 435.1, with its accompanying Contractor Requirements Document, Manual, and Guidance Documents governs the management of DOE’s radioactive wastes: high-level waste, transuranic waste, low-level waste, and the radioactive component of mixed waste. The process of developing these documents recorded the technical basis for the general requirements common to all radioactive waste, and the waste-type specific requirements. The overall Order revision process is summarized below. Functions maps, crosswalk tables, and technical bases for waste type specific requirements are included in this Appendix.

3.0 ORDER REVISION TEAM ORGANIZATION

3.1 Order Revision Team

DOE drew on the technical expertise of its Headquarters and Field staff and contractors to assist in the analysis radioactive of waste management functions and development of requirements. Four subteams were formed, one to address each waste type, and one to address the Order's

general requirements. The revision of the Order relied on a broad spectrum of relevant talent within and beyond DOE. Many of the team members who contributed to the response to the DNFSB Recommendation 94-2 on low-level waste were recruited for this effort because of their extensive experience in the operation and regulation of radioactive waste management activities. The expertise of the DOE National Program Managers for radioactive waste types were tapped. Also, representatives from each DOE site assisted through frequent participation via conference calls, meetings, workshops, and document reviews.

The Organization Chart in Figure 4-1 reflects both the structure of the Order Revision Team and the relationships among the Team, the Executive Committee, line management, and the Senior Review Panel.

3.2 Executive Committee

The Executive Committee provided direction on major policy issues and ensured that all programmatic issues regarding the Order revision were addressed in an integrated fashion. The Committee consist upper level management representatives from the following DOE Environmental Management offices: Office of the Assistant Secretary (EM-1); Office of the Principal Deputy Assistant Secretary (EM-2); Office of Safety and Health (EM-4); Office of Management and Evaluation (EM-10); Office of Planning, Policy and Budget (EM-20); Office of Waste Management (EM-30); Office of Environmental Restoration (EM-40); Office of Science and Technology (EM-50); Office of Nuclear Material and Facility Stabilization (EM-60); and Office of Site Operations (EM-70).

3.3 Senior Review Panel

A Senior Review Panel was established to review and provide independent technical advice and comment on the technical issues, analytical approaches, conclusions, and other activities performed for revising of the Order. The Panel consisted of top-level experts from outside DOE in the field of radioactive waste management. The expertise of the Senior Review Panel and the perspectives of each member is shown in Table 3-1.

FIGURE 3-1. Organization Chart

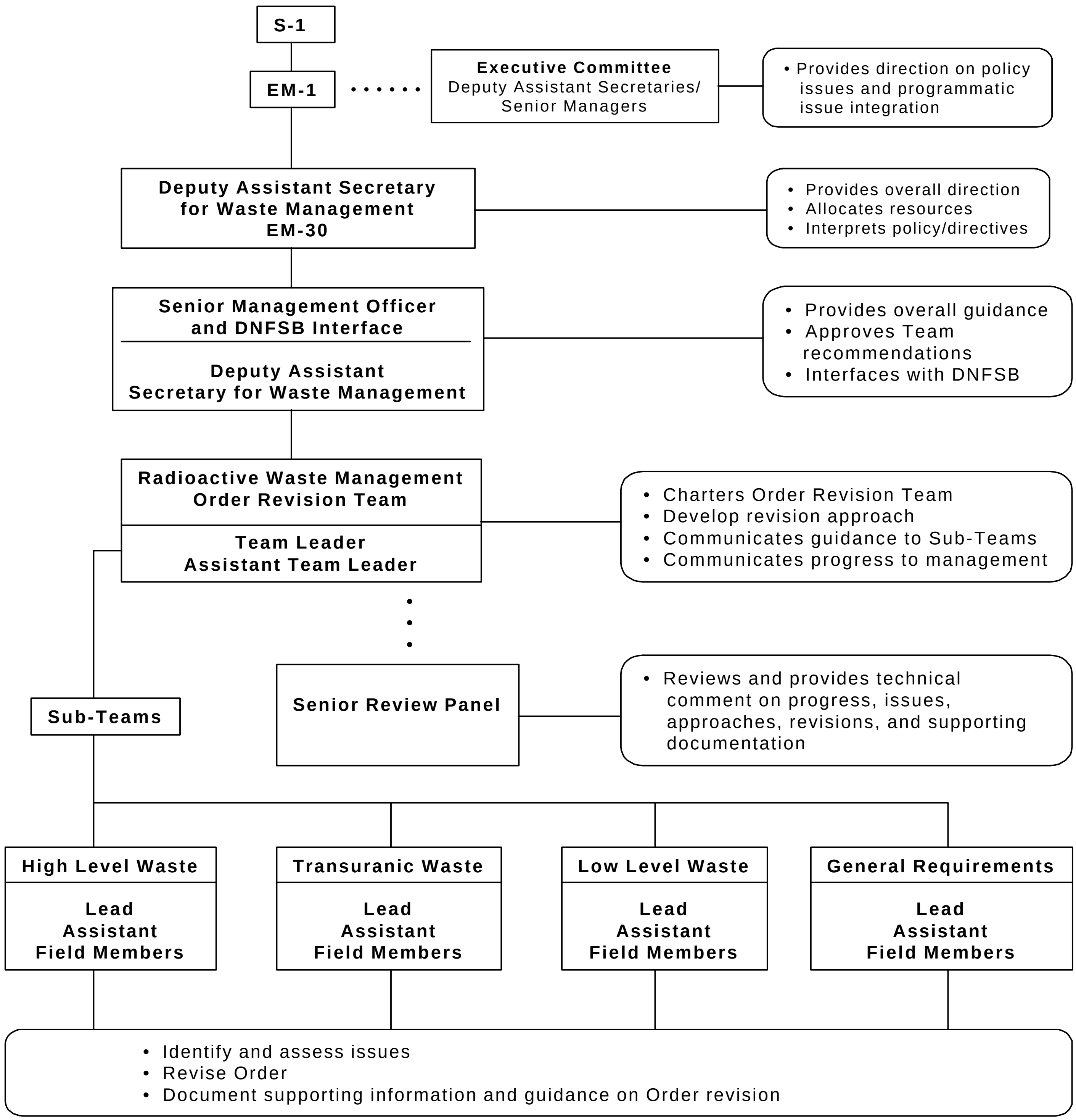


Figure 3-1: DOE Low-Level Waste (LLW) Management Essential Requirements Senior Review Panel Members

NAME	HIGHLIGHTS OF EXPERIENCE	STRENGTH
Paul L. Ziemer, Ph.D, CHP Chairman (317) 494-1435 (317) 496-1377 Fax	Adviser to DOE LLW Advisory Committee 1971; Former DOE Assistant Secretary for Environment, Safety and Health (EH); Member of the National Academy Science (NAS) BIER VI Committee Dean of School of Health Sciences, Purdue University; Past President of Health Physics Society.	Representation of professional and academic views; Familiarity with DOE practices, Order development & implementation, and political sensitivity; Established relations with DNFSB, EH, NAS, and others.
Dade Moeller, Ph.D., CHP, P.E. (919) 633-3352 (919) 633-3352 Fax	Former Chairman of NRC's Advisory Committee on Nuclear Waste (ACNW); Led DOE/Office Waste Management Disposal Site Working Group Senior Review Board.	Familiarity with Office of Waste Management; Experience with radiological performance assessments; Familiarity with NRC views and practices.
William A. Mills, Ph.D. (301) 774-0975	Former Senior Science/Policy Advisor to the Committee on Interagency Coordination on Radiation Research and Policy Coordination; Retired Public Health Service; Formerly with the Environmental Protection Agency and the Nuclear Regulatory Commission Past-President of the Health Physics Society	Representation of professional views; Familiarity with NRC policies and regulations; Familiarity with DOE practices. Familiarity with EPA policies and regulations;
Mary Birch, P.E., CHP 803 831-3310 803 831-344 Fax	Currently Engineering Supervisor, Duke Power Company Former Regulatory and Licensing Manager, U.S. DOE Civilian Radioactive Waste Management System Management and Operating Contractor Former Licensing Manager, Duke Engineering Services Former Technical System Manager, Radiation Protection, Duke Power Company Former Technical System Manager, Radioactive Waste Management Function, Duke Power Company Former Member of the North Carolina Governor's Waste Management Board Chaired the Electric Power Research Institute Advisory Committee on Below Regulatory Concern	Familiarity with NRC policies and regulations; Familiarity with DOE practices; Familiarity with EPA policies and regulations; Familiarity with State Waste Management Issues; Extensive knowledge and understanding of commercial waste management practices.
Robert Bernero 301 926-3844 301 926-1368 Fax	Currently acting as a nuclear safety consultant on projects involving spent nuclear fuel and radioactive waste management Served as a member of the Commission of Inquiry for an International Review of Swedish Nuclear Regulatory Activities to examine the effectiveness of Swedish regulations for nuclear reactor safety, radiation protection and waste management Former Director NRC's Office of Nuclear Material Safeguards and Security Former NRC Division Director for boiling water reactor licensing, reactor systems safety, and radiological safety Former NRC Division Director in Research for probablistic risk analysis and the analysis of severe reactor accidents	Representation of professional views; Familiarity with NRC policies and regulations; Familiarity with DOE practices.

4.0 ORDER REVISION PROCESS

The Order on radioactive waste management was revised using the following process which included the use of work and documents which were completed under a number of ongoing efforts, which supported the requirements and objectives of the Order revision task. The process included the following five steps:

1) Identification of radioactive waste management functions and activities based on standard systems engineering approaches.

2) Assessment of the hazards posed by performing the functions and activities.

3) Assessment of existing requirements (e.g., DOE directives, NRC regulations, EPA standards and international standards) for possible use and development of preferred language for the revised Order.

4) Development of requirements to address significant hazards and the technical basis for each requirement.

5) Solicitation of wide review and comment and resolution of comments.

This approach also corresponds to the grouping of activities used in DOE's Integrated Safety Management System (ISMS). This system establishes a logical process for integrating risk into all of DOE's activities and was used as the foundation for the next steps in the Order revision process. As noted, the ISMS outlines a simple and logical process for understanding and mitigating risks. Under this process, the development of work processes should include the following five steps: (1) identifying the functions (tasks) that must be performed to complete the work; (2) conducting a safety and hazards analysis of those functions; (3) identifying mitigating measures and controls based on that analysis; (4) applying the controls and implementing a periodic reassessment of the activities, and (5) providing for a feedback to revising the work processes as necessary. As described above, this analytical approach has been incorporated into the core of DOE's effort to revise the radioactive waste management Order, and represents the overall philosophical approach and major steps of this effort.

4.1 Identification of Radioactive Waste Management Functions and Activities

The identification of the functions associated with the management of each of the waste types was based on standard systems engineering approaches. These functions provided the framework for analysis of the tasks involved in radioactive waste management throughout the rest of the Order revision process. The identification of the functions associated with the management of low-level waste was performed as part of DOE’s response to the DNFSB Recommendation 94-2. This

effort was documented in the *Low-Level Waste Systems Description Document (reference)*. The other waste type team members used this approach as a model for developing function maps for high-level and transuranic waste management activities. The use of this systems engineering approach resulted in a consistent approach across the specific waste types. The function maps for each of the waste types are included. The functions were grouped into three basic categories: those associated with planning (formulate the program); those involving performance of work tasks (execute the program); and those which provided for review of activities and feedback (evaluate the program).

4.2 Assessment of the Hazards

Following the development of the function maps for each of the waste types, a Safety and Hazards Analysis Workshop was conducted. The workshop was attended by both DOE Headquarters and Field Element staff and support was provided by contractor personnel. At the workshop, the waste-type teams formed breakout groups and using the functional maps for all of the waste types discussed their respective functional maps to identify any omissions or inconsistencies. After the functional maps were finalized the teams identified and documented the activities that occur in each of the functions. Once the task descriptions were completed, they were used to conduct a qualitative hazards and safety analysis. Through this analysis, scenarios were developed for each task of a radioactive waste management function to identify events that could result in an exposure to a worker or the public, a release of radioactivity to the environment, or an impact on disposal facility performance. Potentially affected receptors were then identified for each scenario, and the likelihood and consequences of the postulated exposure or release was qualitatively estimated. Next, the likelihood of occurrence and consequences were used to determine risk. The last step involved identifying the weakness or condition in the work performance and managerial structures which lead to the risk and developing mitigation options to address these weaknesses or conditions. This identification of weaknesses and conditions and associated mitigation options became part of the foundation for writing the technical basis for each of the requirements in the Order, Contractor Requirement Document, and Manual. This information was used to document the need for the final requirement. A diagram of the steps in the Safety and Hazards Analysis Process is presented in Figure 4.2. Each of the steps in the Safety and Hazards Analysis Process are discussed in greater detail in the following section.

The methodology for predictive hazard evaluation of the radioactive waste management system (Safety and Hazards Analysis Process) was used to identify system weaknesses and/or conditions, qualitatively estimate risks, and develop mitigation options associated with each of the functions of the radioactive waste management system. This analysis focused on the radiological hazards associated with the management of radioactive waste. The analysis was conducted from a complex-wide perspective using a generic facility concept that drew on site/facility specific knowledge as a basis. This information was then evaluated to provide the basis for identifying and developing the requirements and implementing guidance needed to safely manage radioactive

waste from a radiological perspective. The Safety and Hazards Analysis Process was performed on the low-level, high-level, and transuranic waste management systems described in each waste-type functions map. To the extent appropriate, existing systems engineering functional analysis maps were used as a starting point. The Safety and Hazards Analysis Process involved 11 steps. A flow diagram of the 11 steps is presented in Figure 4-2. The steps are as follows:

1. Operationalize the Function. Define and describe the physical activities associated with each function to be performed in managing each waste type.

2. Identifying Initiating Event Categories. Initiating events are those in the chain of events that could affect the function as described in step 1. Initiating events were classified as either:

   - Natural Events (e.g., flood, earthquake, freezing temperatures, electrical storm);

   - Natural Processes/Passage of Time (e.g., corrosion, erosion, aging material, intrusion of plants/animals);

   - Equipment Malfunctions (e.g., instrument/sensor malfunction, process equipment malfunction);

   - External Events (e.g., fire, loss of utilities, high velocity impact); or

   - Human/Information Errors (e.g., communication error, operator error, documentation error, inadvertent intrusion by humans).

3. Identify Follow-on Event Categories. Follow-on events are those which could affect the function as described in step 1, and were classified as:

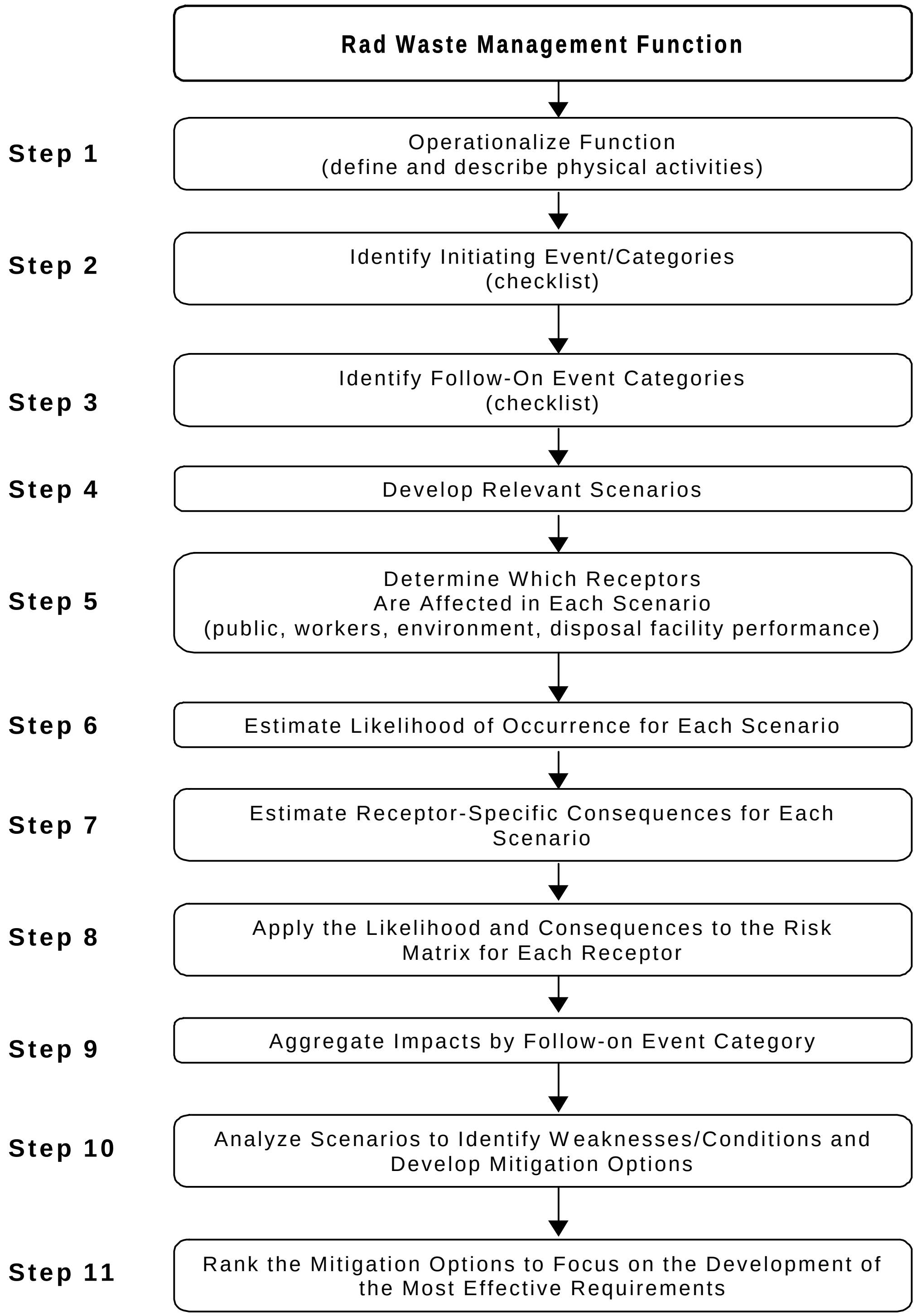
   - Structural Failure (e.g., building collapse, containment failure),

   - Infrastructure Failure (e.g., loss of water or water pipe break, loss of power or electrical surge),

   - Equipment Failure (e.g., instrument/sensor malfunction, process equipment malfunction),

   - Human Error (e.g., communication error, operator error),

STEPS IN THE SAFETY AND HAZARDS ANALYSIS



- Method/Information Failure (e.g., documentation error), or

- Other.

These categories reflect the first line of defense in preventing an initiating event from leading to exposure of a receptor.

4. Develop Relevant Scenarios. Sub-Team members developed one or more scenarios for each follow-on event category identified in step 3 that could reasonably lead to an exposure of a receptor (defined as workers, public, the environment, and disposal facility performance). The number of scenarios developed was determined by the need to address all of the activities identified in step 1. The scenarios were also used in step 10 as the basis for identifying the weaknesses and/or conditions that might exist in each scenario. The weaknesses and conditions identified were then used to focus the development of mitigation options.

5. Determine Which Receptors are Affected in Each Scenario. The scenarios developed may not have led to impacts to all four of the receptors. This step provided an opportunity for assessing which receptors were impacted under each scenario. Determining that a receptor was not impacted by a scenario eliminated the need to further evaluate that scenario/receptor combination.

6. Estimate Likelihood of Occurrence for Each Scenario. The frequency with which a scenario was expected to occur then was estimated using a set of ranges and the professional judgment of waste-type team members. The likelihood of occurrence was not meant to be a deterministic calculation, but a qualitative evaluation using experience or information on probabilities previously known or calculated (e.g., safety analysis evaluations). The likelihood of occurrence was used as one of the inputs to determine the receptor-specific qualitative risk in step 8. To determine the likelihood of the occurrence of such a scenario, each waste-type team used the process adapted from "*Risks and the Risk Debate: Searching for Common Ground "The First Step,'" Volume 1, June 1995,* and successfully employed in the *Complex-Wide Review of DOE's Low-Level waste Management ES&H Vulnerabilities.* The likelihoods of occurrence fall into categories of time:

   - < 1 year indicates a scenario whose consequence already exists or is expected to occur with a frequency of at least once per year;

   - 1 - 10 years indicates a scenario whose consequence is expected less frequently than once per year, but more frequently than once every 10 years;

- 10 - 100 years indicates a scenario whose consequence is expected less frequently than once every 10 years, but more frequently than once every 100 year); and

- > 100 years indicates a scenario whose consequence is unlikely to occur within the operating life of a facility, but is not completely precluded from occurring.

7. Estimate the Receptor-Specific Consequences for Each Scenario. The consequences for each scenario/receptor combination was estimated using broadly defined ranges of effects, allowing waste-type team members to use their professional judgement and experience. Again, information on consequences previously known or calculated (e.g., safety analysis evaluations) was applied. This information was a key input to the qualitative risk evaluation in step 8. To determine the consequences to the receptor, each waste-type team adapted the system from the *"Risks and the Risk Debate: Searching for Common Ground "The First Step"*. Consequences are receptor specific:

   - Injury/loss of life for workers;

   - Exposure/loss of life for the public;

   - Damage for the environment; and

   - Impact for the disposal facility performance.

8. Apply the Likelihood and Consequences to the Risk Matrix for Each Receptor and Aggregate the Impacts. The likelihood of occurrence (from step 6) and estimated consequence (from step 7) for each scenario was used in this step as the basis for qualitatively estimating the risk to a receptor through the standard risk matrices developed for each receptor type. This information along with the information from steps 4 through 7, was used to develop the mitigation options.

9. Aggregate Impacts by Follow-on Event Category. The risks for scenario/receptor combinations were then tabulated by follow-on event category to provide a relative measure of the potential risk associated with each category of follow-on events.

10. Analyze Scenarios to Identify Weaknesses and/or Conditions and Develop Mitigation Options. The scenarios developed in step 4 were analyzed to identify the weaknesses and/or conditions that were assumed in the operations or managerial structure of each scenario. The weaknesses and conditions identified were then used to help focus the development of mitigation options. Using the results of steps 4 through 9, the waste-type team members developed mitigation

measures that would address the weaknesses and/or conditions and that could reduce the likelihood of occurrence and/or consequences of an event. The information from steps 4 through 9 also were used to focus the development of the mitigation activities in the context of the scenarios. These mitigation options served as the basis for identification and development of the requirements and the implementing guidance for the safe management of radioactive waste.

11. Rank the Mitigation Options to Focus on the Development of the Most Effective Requirements. The tabulated risks for each scenario/receptor combination were used as the basis for ranking mitigation options for effectiveness in addressing safe management of radioactive waste. This ranking served as an input to the decision of which potential requirements and/or implementing guidance would be most effective in safely managing radioactive waste.

4.3 Requirements Analysis

Once the weaknesses and conditions and mitigation options to address these weaknesses or conditions were developed, existing requirements were evaluated to identify those which addresses the mitigation options. This was accomplished during the Requirements Analysis Workshop. The workshop was attended by both DOE Headquarters and Field Element staff and support was provided by contractor personnel. At the workshop the waste type teams formed breakout groups and using the weakness and conditions and associated mitigation options identified by all the waste types at the previous workshop they evaluated their own to identify any omissions or inconsistencies. Following this the weaknesses and conditions and associated mitigation options were finalized for each of the waste type. The process of searching through existing requirements to identify those that would address these weaknesses and conditions began. This effort was facilitated by the identification of potentially applicable requirement sources before the workshop. These sources were then readily available for the team members. This resulted in the inclusion of over 100 DOE directives (orders, manuals, guides, and policies) and other agency requirements and guides (EPA and NRC requirements and other national, international, and industry consensus standards).

The evaluation involved a determination of whether the requirement addressed the weakness or condition. If yes, did it adequately address the weakness or condition? If yes, it was adopted for use. If no, could it be modified to adequately address the weakness or condition? If yes, it was modified and adopted for use. If no, a requirement was written and adopted for use. To ensure a complete evaluation, checklists were prepared for each function which included a list of DOE directives and other requirements that might apply that were required to reviewed. If more than one requirement was identified which would address a weakness or condition, they were evaluated and the most appropriate one or a if necessary a hybrid using one or more of the requirements was adopted for use. This evaluation, modification, writing, and adoption for use

process became part of the foundation for writing the technical basis for each of the requirements in the final Order, Contractor Requirement Document, and Manual. This information was used to describe the source of the language used in the final requirement. The following describes the Requirements Analysis and each of its steps in more detail. A flow diagram of the steps in the Requirements Analysis, which includes decisions on which document is most appropriate for each requirement is depicted in Figure 5-1. The steps are as follows:

1) Operationalize Functions

For each waste type, the functions were listed along with the definition of the function and phrases representing the operationalization of the function. An example is high-level waste function 1.3.1.1.1.2 Characterize Site for Storage Facility: Recognize facility-specific characteristics and gather and review technical data from candidate sites.

2) Identify Needed Requirement Areas

For the function being analyzed, the list of items for which requirements were needed was included. This comprised a list of weaknesses and conditions from the Safety and Hazards Analysis process and a list of the vulnerabilities from the low-level waste Complex-Wide Review and similar evaluations of transuranic and high-level waste which have been identified.

3) Identified Existing and External Requirement Sources

For each function, the appropriate requirements were listed from sources that are or could be requirements for the safe and effective implementation of the function for managing radioactive waste. Each requirement was then linked to any weaknesses, conditions, or vulnerability which it could potentially address. Requirement sources included:

- DOE 5820.2A, *Radioactive Waste Management* and other DOE directives;
- Applicable Federal requirements (e.g., 40 CFR Part 190);
- A set of proposed multi-function requirements;
- Other Federal requirements (e.g., 10 CFR Part 61);
- International standards (if appropriate); and

- National standards and practices (if appropriate).

4) Evaluate Adequacy of Requirements

Each of the requirements compiled in Step 2 was evaluated to determine its adequacy in providing for safe management of radioactive waste for the function being analyzed. This evaluation was based on an analysis of the requirement against the following considerations:

- Does the requirement support an upper-level requirement?

- Does the requirement address an activity of the function as defined in the function definition and operationalization?

- Does the requirement address a weakness or condition identified through the Safety and Hazards Analysis process?

- Does the requirement address a vulnerability identified through the Complex-Wide Review for low-level and mixed low-level wastes or other assessments for transuranic or high-level wastes?

- Does the requirement address the guiding principles for establishment of specific requirements to support the upper-level requirements?

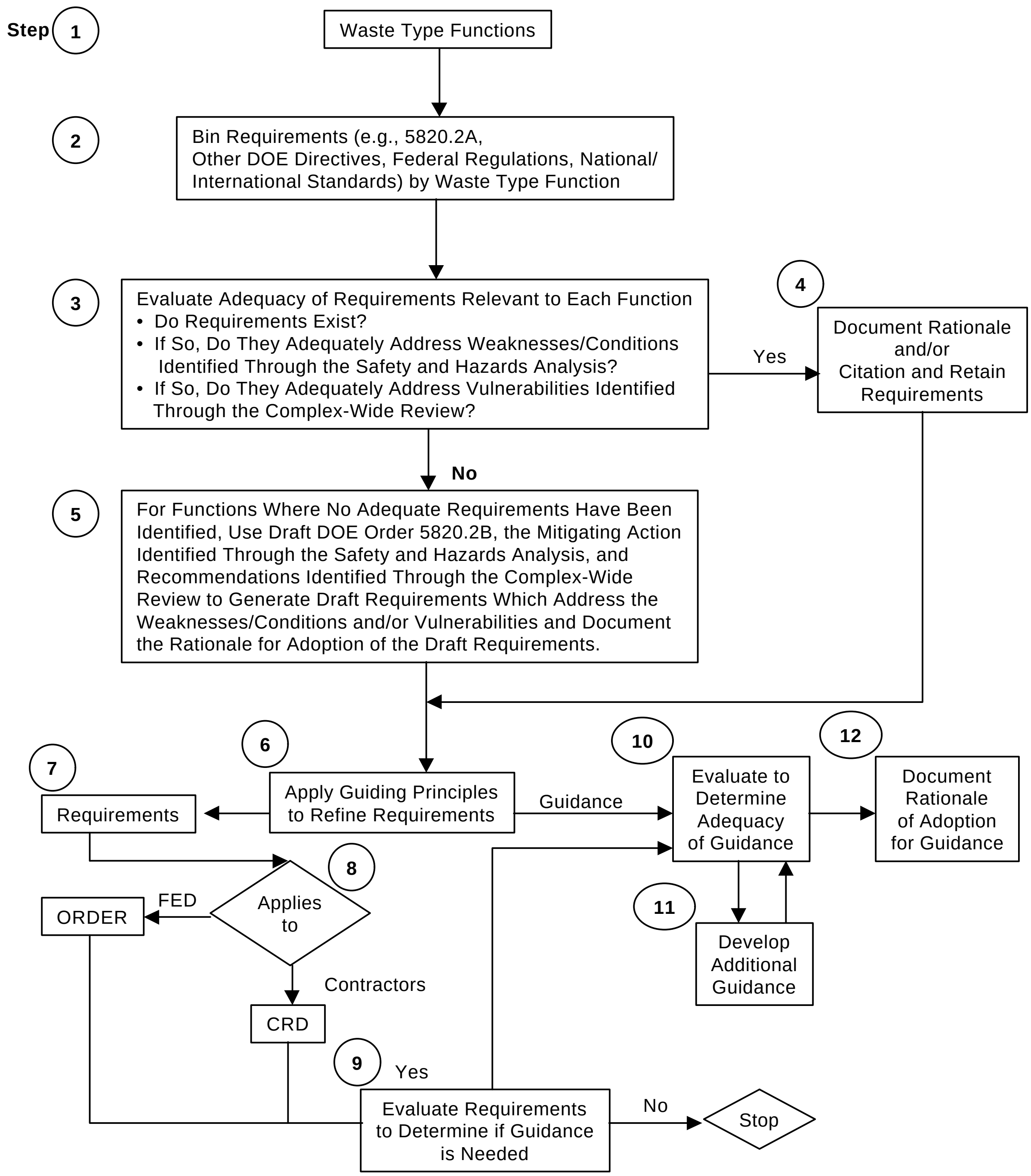
- Does the requirement describe a best management practice or a proven site-specific method?

The requirements were evaluated in the following Order. First, any proposed multi-function requirements and other applicable Federal requirements and DOE directives were evaluated. Then requirements potentially applicable from DOE 5820.2A, *Radioactive Waste Management*, were evaluated. Finally, requirements from other non-applicable sources (similar U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency regulations, and national standards), followed by any international information were evaluated.

5) Identification of Additional Requirements

When the preceding steps in the requirements analysis were completed, the lists of vulnerabilities and weaknesses or conditions, and the list of operationalized functions were examined to identify if any additional requirements were needed. Similarly, the

Requirements Analysis



proposed requirements listed were examined to see if additional requirements were needed in order to effectively implement the waste management functions of each waste type.

5.0 OTHER CONSIDERATIONS

The following areas of consideration were identified as concepts and values to be incorporated in and reflected throughout the revised radioactive waste management order.

5.1 Protection of the Public

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be conducted and shown to assure adequate protection of the public from exposure to radioactive materials during both normal operations and during reasonably foreseen off-normal events. Adequate radiation protection is defined by the exposure limits set forth in 10 CFR Part 834. In addition, the DOE Nuclear Safety Policy defines safety goals that are expressed in terms of public risk of accidental fatality and fatal cancer incidence. The risk of prompt fatality to average individual due to an accident in the vicinity of a DOE facility is to be less than 0.1% of the sum of prompt fatalities due to other accidents to which members of the public are generally exposed. The risk of cancer fatality that might result from operations at a DOE site should not exceed 0.1% of the sum of all cancer fatality risks to the public resulting from all other causes [SEN-35-91].

5.2 Protection of the Workforce

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities, shall be conducted and shown to protect the workforce from hazards to a level commensurate with comparable, safe industrial facilities and shall meet the requirements of the *Occupational Safety and Health Act* (OSHA) requirements 29 CFR Part 1910 and 29 CFR Part 1926 [DOE O 440.1A]. Facilities shall be designed, operated, decontaminated, and closed to limit radiation exposures to the workforce during normal operations and during reasonably foreseen off-normal events to levels below limits set forth in 10 CFR Part 835 as supplemented by DOE Notice 441.1

5.3 As Low as Reasonably Achievable (ALARA)

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be analyzed to show and shall be conducted in manners such that radiation exposures of the public, the workforce, and environment are kept as low as reasonably achievable (ALARA). ALARA is the approach to radiation protection to manage and control exposures, taking into account social, technical, economic, practical and policy considerations. ALARA does not identify a dose limit but is

instead a process which has the objective of attaining doses as far below the applicable limits as can be reasonably achieved. [10 CFR 835.1001 and 10 CFR 835.1002]

5.4 Defense-in-depth

The safety strategy for radioactive waste management activities at DOE sites shall be based on defense-in-depth. In this context, defense-in-depth is the practice of using systems of equipment and systems of procedures in a structure of mutual re-enforcement to avoid exposures of the public, the workforce, and the environment to nuclear radiation [DNFSB/TECH-6]. A graded approach based on risk shall be utilized to comply with the requirement [10 CFR 830.3 and 10 CFR 830.7].

5.5 Protection of the Environment

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post closure activities shall be conducted to meet statutory limits and shown to minimize contamination of the environment in a cost-effective manner and to limit exposure of aquatic animals to levels below the limits specified in 10 CFR Part 834. Contamination of land by DOE activities shall be limited to avoid permanently restricting land from beneficial use [*Atomic Energy Act of 1954*, as amended; Executive Order 11514].

5.6 Compliance

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be compliant with applicable Federal, State, and local laws and regulations, as well as Compliance Orders [10 CFR Part 820]. These activities shall also comply with applicable Executive Orders, DOE's Strategic Plan, and DOE Policies [SEN-15-90; DOE Policy P 251.1].

5.7 Authorization Basis

Radioactive waste management activities at DOE sites shall have an authorization basis. "The authorization basis establishes the safety envelop for a facility operation or activity and defines what will have to be done to control safety of the operation [or activity]. The authorization basis includes the hazards analysis, the definition of administrative and engineering controls to prevent and mitigate hazards, and the associated technical and operation limits. The type of safety documents that will constitute the authorization basis will vary with the hazard and complexity of the operation or activity." [DOE O 425.1A; DOE 5480.21; DOE 5480.22; DOE 5480.23]

5.8 Cost-Effectiveness

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be shown to be cost effective with OMB Circular A-94. The evaluation of cost effectiveness shall include:

- Quantified estimates of life-cycle cost of proposed activities and alternatives. Life-cycle cost shall include capital investment, acceptance testing, operations, maintenance, decontamination, decommissioning, disposal, closure and post-closure activities.

- Quantified estimates of the benefits of proposed activities and alternatives. The benefits shall include waste minimization, increments in the expected radiation dose to the public, the workforce, and the contamination of the environment, land use, and timely disposal of waste. The conversion of benefits to monetary values for use in comparisons to cost shall have a defensible and documented basis. Estimates of costs and benefits shall include the time cost of capital and quantification of uncertainties. Selection among alternatives shall minimize life-cycle costs and investment risk while maximizing the net benefit for the timely disposition of wastes without compromising the protection of the public, the workforce, and the environment, nor the compliance with applicable laws and regulations [SEN-35-91 Section 1; Executive Order 12780 (1991)].

5.9 Voluntary Consensus Standards

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be conducted in conformance with applicable technical standards that are developed or adapted by voluntary consensus standard bodies to the extent that these standards are appropriate and practical [Public Law 104-113; SEN-35-91, Section 2, Paragraphs 1 and 2; DOE Policy 251.1].

5.10 Waste Minimization

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall minimize the waste quantity, volume, and toxicity to an extent technically and economically practical.

5.11 Property and Facility Protection

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be conducted in manners that

minimize the threats to DOE property [*Atomic Energy Act of 1954*, as amended, Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*].

5.12 Timely Disposal of Waste

Radioactive waste management activities at DOE sites shall be prioritized to minimize with respect to life-cycle cost the time integral of risk of radiation exposure to the public and the workforce, as well as the time integral of the risk of environmental contamination.

5.13 Waste Characterization

Radioactive waste on DOE sites shall be characterized sufficiently to assure compliance with other requirements including those concerning limitations on radiation doses to the public and the workforce, possible degradation of the environmental quality, and the cost-effective management of radioactive waste, as well as to assure compliance with the waste acceptance criteria both on the site and at the eventual waste disposal site.

6.0 REQUIREMENT DOCUMENTATION AND TECHNICAL BASIS

6.1 Order Writing Process

The general requirements and waste-type teams took the requirements that resulted from applying the guiding principles and began to organize then into the draft outline of the Order and Manual. Once all of the requirements had been place into the appropriate section of the draft outline it was reviewed and modified to eliminate redundancies, provide for better flow and logic, identification of requirements common to all waste types (these requirements were then evaluated for possible inclusion in the General Requirements section), and other changes associated with consistency and wording selection. Once each of the individual waste-type chapters was completed the chapters were reviewed collectively for consistency and continuity and further revised to address suggested changes. Finally, the draft was sent out for a Department-wide review.

6.2 Documentation of Technical Basis Crosswalk

During the entire Order revision process, information needed to develop the technical basis for each of the requirements was identified and generated. The Safety and Hazards Analysis provided the technical basis for why the requirements are important and necessary for the safe management of radioactive waste. The Requirements Analysis provided the technical basis for the source and, in some cases, the wording of the requirements. The application of the guiding principles for generating requirements provided the technical basis for the wording of the requirements and, in the case of some of general requirements, also provided the technical basis for the need and

source of the requirements. The following sections provide a discussion of the approaches for the management of radioactive waste, high-level waste, transuranic waste, and low-level waste.

Additionally, a crosswalk of the requirements from DOE 5820.2A, *Radioactive Waste Management*, to Draft DOE O 435.1, *Radioactive Waste Management*, was conducted and the technical basis for each of the requirements is included for general requirements and the requirements for high-level waste management, transuranic waste management, and low-level waste management. The technical basis provides crosswalk tables (Attachment 1) depicting the revised 435.1 requirements, the 5820.2A requirements, and the technical basis for the revised requirements.

The technical basis for the revised requirement includes:

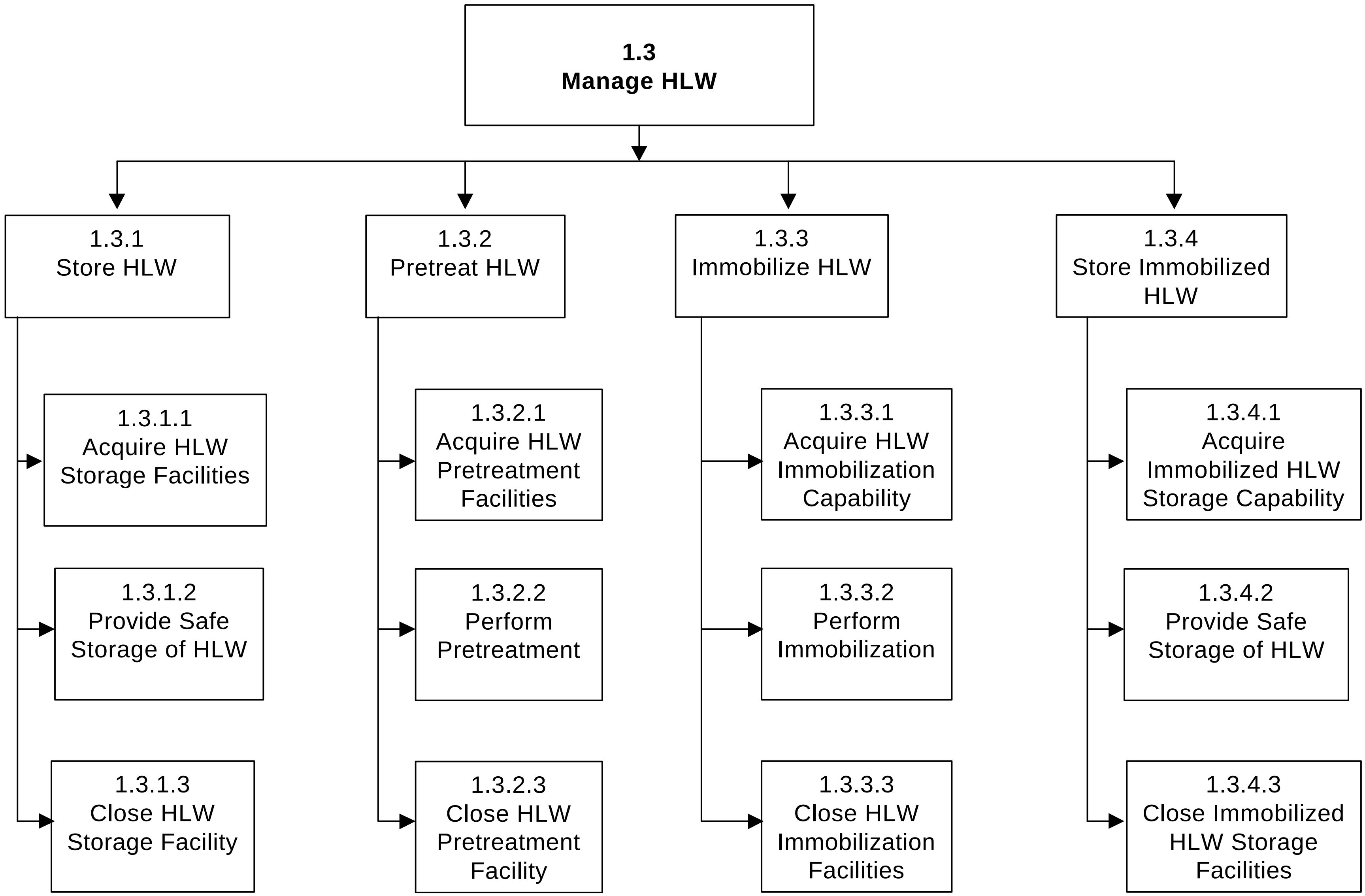
- The driver for the requirement (Safety and Hazard Analysis, Requirements Analysis, complex-wide review, etc.).

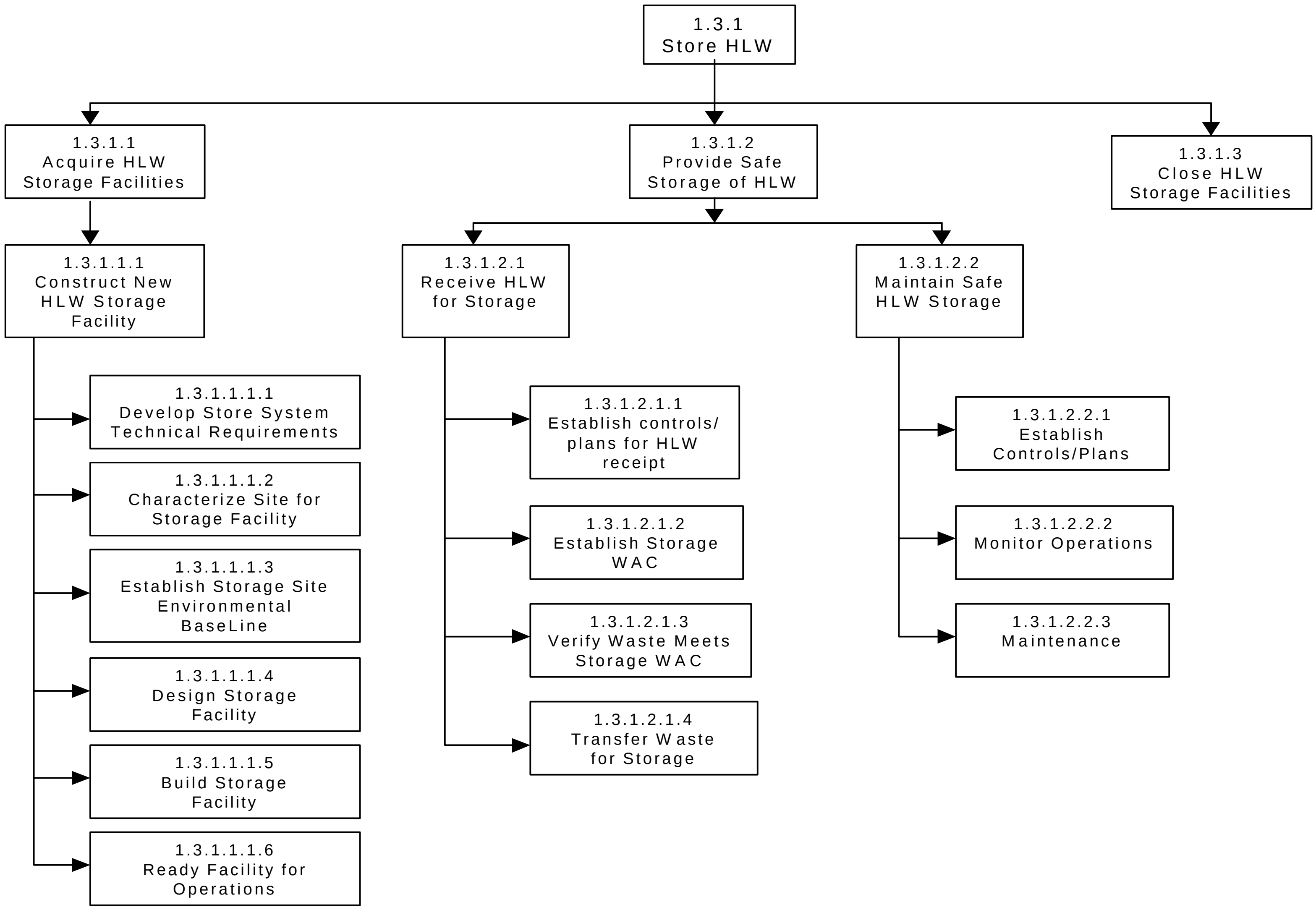
- The weakness/condition or vulnerability which the requirement addresses.

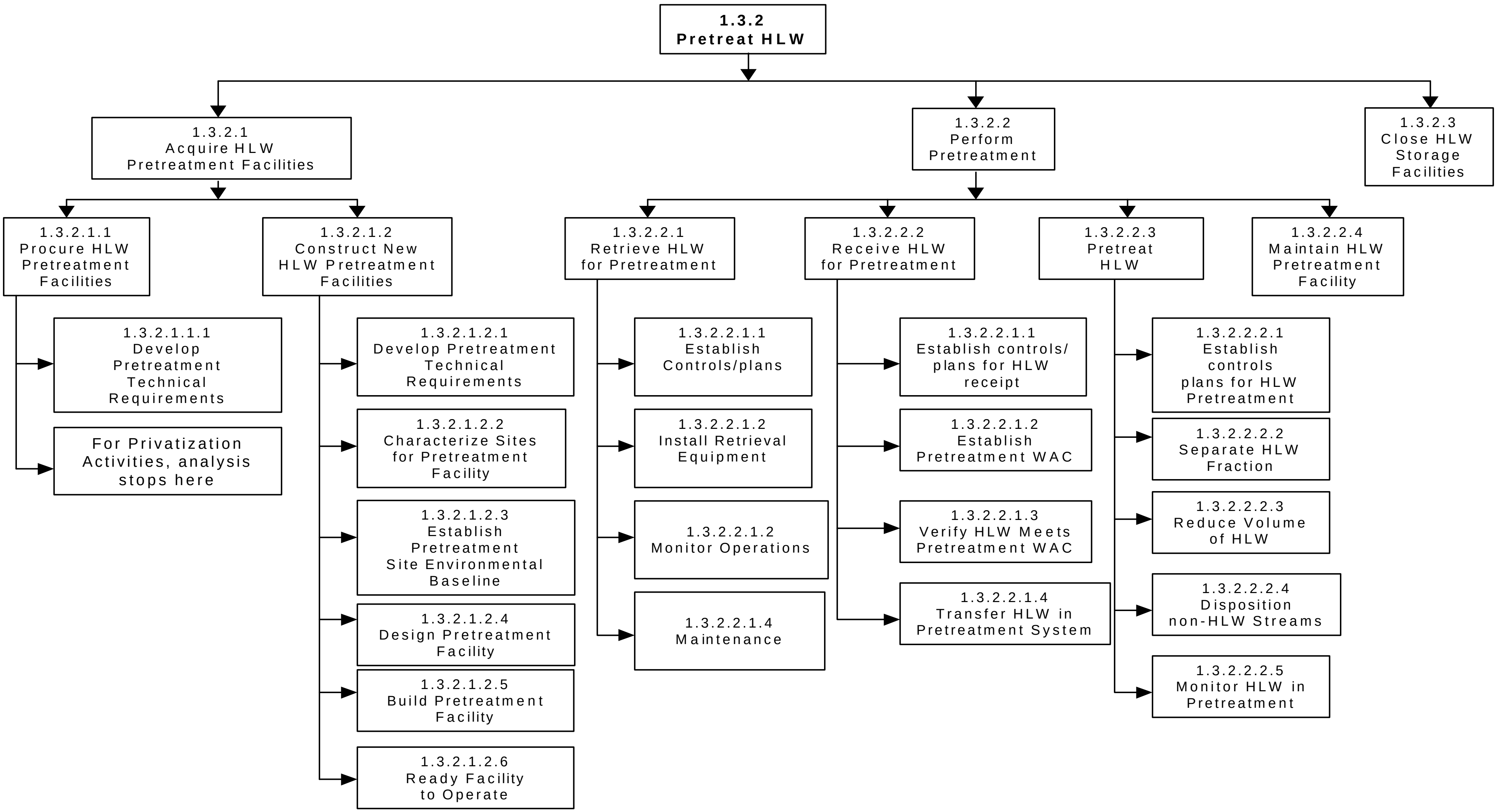
- The origin or source of the requirement.

- Other information (e.g., the requirement addresses other considerations as identified in Section 5.0, such as provides defense in depth, addresses ALARA, etc.).

Functions Maps


1.3
Manage HLW
1.3.1
Store HLW
1.3.1.1
Acquire HLW Storage Facilities
1.3.1.2
Provide Safe Storage of HLW
1.3.1.3
Close HLW Storage Facility
1.3.2
Pretreat HLW
1.3.2.1
Acquire HLW Pretreatment Facilities
1.3.2.2
Perform Pretreatment
1.3.2.3
Close HLW Pretreatment Facility
1.3.3
Immobilize HLW
1.3.3.1
Acquire HLW Immobilization Capability
1.3.3.2
Perform Immobilization
1.3.3.3
Close HLW Immobilization Facilities
1.3.4
Store Immobilized HLW
1.3.4.1
Acquire Immobilized HLW Storage Capability
1.3.4.2
Provide Safe Storage of HLW
1.3.4.3
Close Immobilized HLW Storage Facilities


1.3.1
Store HLW
1.3.1.1
Acquire HLW
Storage Facilities
1.3.1.2
Provide Safe
Storage of HLW
1.3.1.3
Close HLW
Storage Facilities
1.3.1.1.1
Construct New
HLW Storage
Facility
1.3.1.2.1
Receive HLW
for Storage
1.3.1.2.2
Maintain Safe
HLW Storage
1.3.1.1.1.1
Develop Store System
Technical Requirements
1.3.1.1.1.2
Characterize Site for
Storage Facility
1.3.1.1.1.3
Establish Storage Site
Environmental
BaseLine
1.3.1.1.1.4
Design Storage
Facility
1.3.1.1.1.5
Build Storage
Facility
1.3.1.1.1.6
Ready Facility for
Operations
1.3.1.2.1.1
Establish controls/
plans for HLW
receipt
1.3.1.2.1.2
Establish Storage
WAC
1.3.1.2.1.3
Verify Waste Meets
Storage WAC
1.3.1.2.1.4
Transfer Waste
for Storage
1.3.1.2.2.1
Establish
Controls/Plans
1.3.1.2.2.2
Monitor Operations
1.3.1.2.2.3
Maintenance


1.3.2
Pretreat HLW
1.3.2.1
Acquire HLW
Pretreatment Facilities
1.3.2.2
Perform
Pretreatment
1.3.2.3
Close HLW
Storage
Facilities
1.3.2.1.1
Procure HLW
Pretreatment
Facilities
1.3.2.1.2
Construct New
HLW Pretreatment
Facilities
1.3.2.2.1
Retrieve HLW
for Pretreatment
1.3.2.2.2
Receive HLW
for Pretreatment
1.3.2.2.3
Pretreat
HLW
1.3.2.2.4
Maintain HLW
Pretreatment
Facility
1.3.2.1.1.1
Develop
Pretreatment
Technical
Requirements
For Privatization
Activities, analysis
stops here
1.3.2.1.2.1
Develop Pretreatment
Technical
Requirements
1.3.2.1.2.2
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Facility
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1.3.2.1.2.4
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Equipment
1.3.2.2.1.2
Monitor Operations
1.3.2.2.1.4
Maintenance
1.3.2.2.1.1
Establish controls/
plans for HLW
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Establish
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1.3.2.2.1.3
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Pretreatment WAC
1.3.2.2.1.4
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1.3.2.2.2.1
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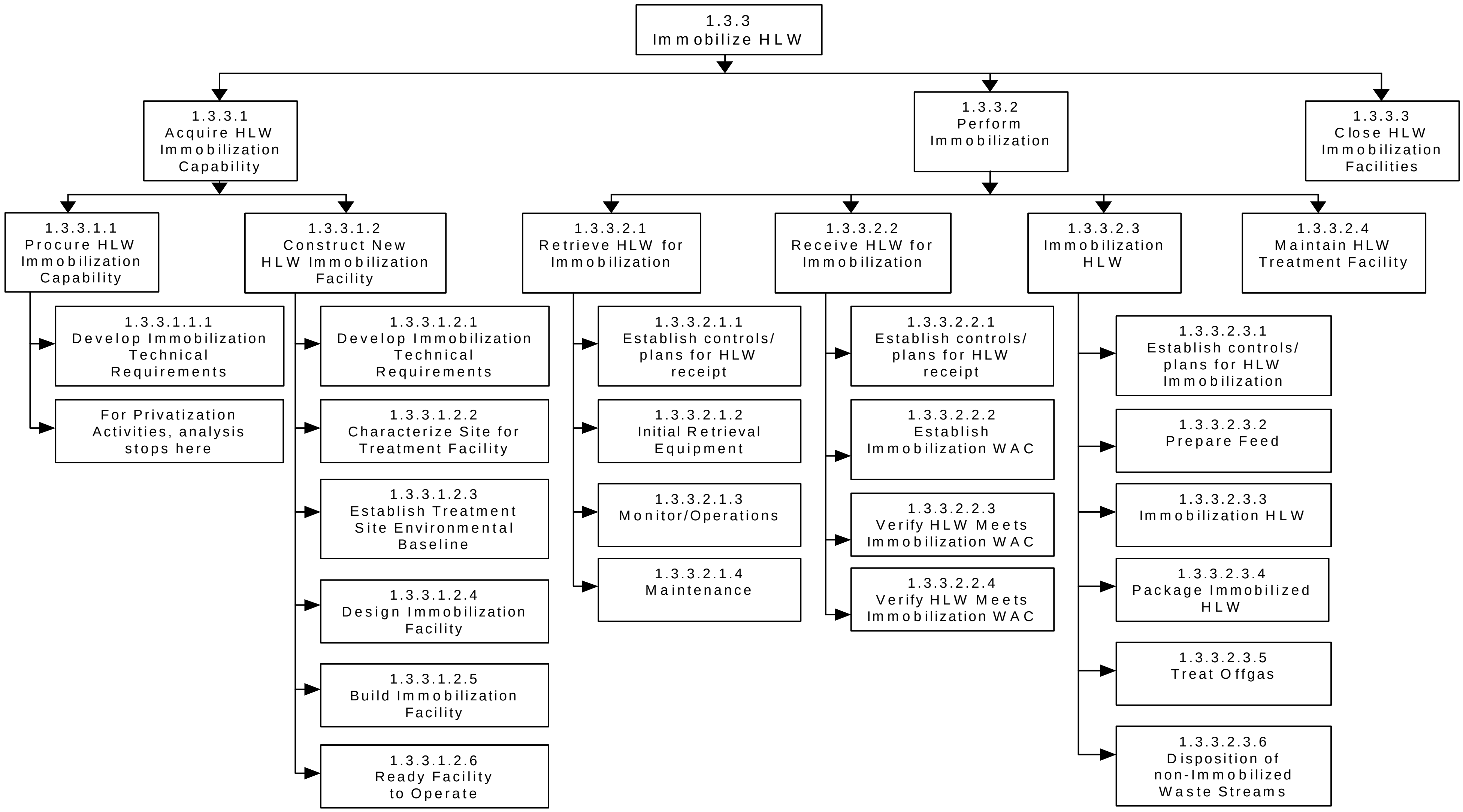
1.3.2.2.2.3
Reduce Volume
of HLW
1.3.2.2.2.4
Disposition
non-HLW Streams
1.3.2.2.2.5
Monitor HLW in
Pretreatment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Immobilize HLW
1.3.3.1
Acquire HLW Immobilization Capability
1.3.3.2
Perform Immobilization
1.3.3.3
Close HLW Immobilization Facilities
1.3.3.1.1
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1.3.3.1.2
Construct New HLW Immobilization Facility
1.3.3.2.1
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1.3.3.2.2
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1.3.3.2.3
Immobilization HLW
1.3.3.2.4
Maintain HLW Treatment Facility
1.3.3.1.1.1
Develop Immobilization Technical Requirements
For Privatization Activities, analysis stops here
1.3.3.1.2.1
Develop Immobilization Technical Requirements
1.3.3.1.2.2
Characterize Site for Treatment Facility
1.3.3.1.2.3
Establish Treatment Site Environmental Baseline
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Design Immobilization Facility
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1.3.3.1.2.6
Ready Facility to Operate
1.3.3.2.1.1
Establish controls/ plans for HLW receipt
1.3.3.2.1.2
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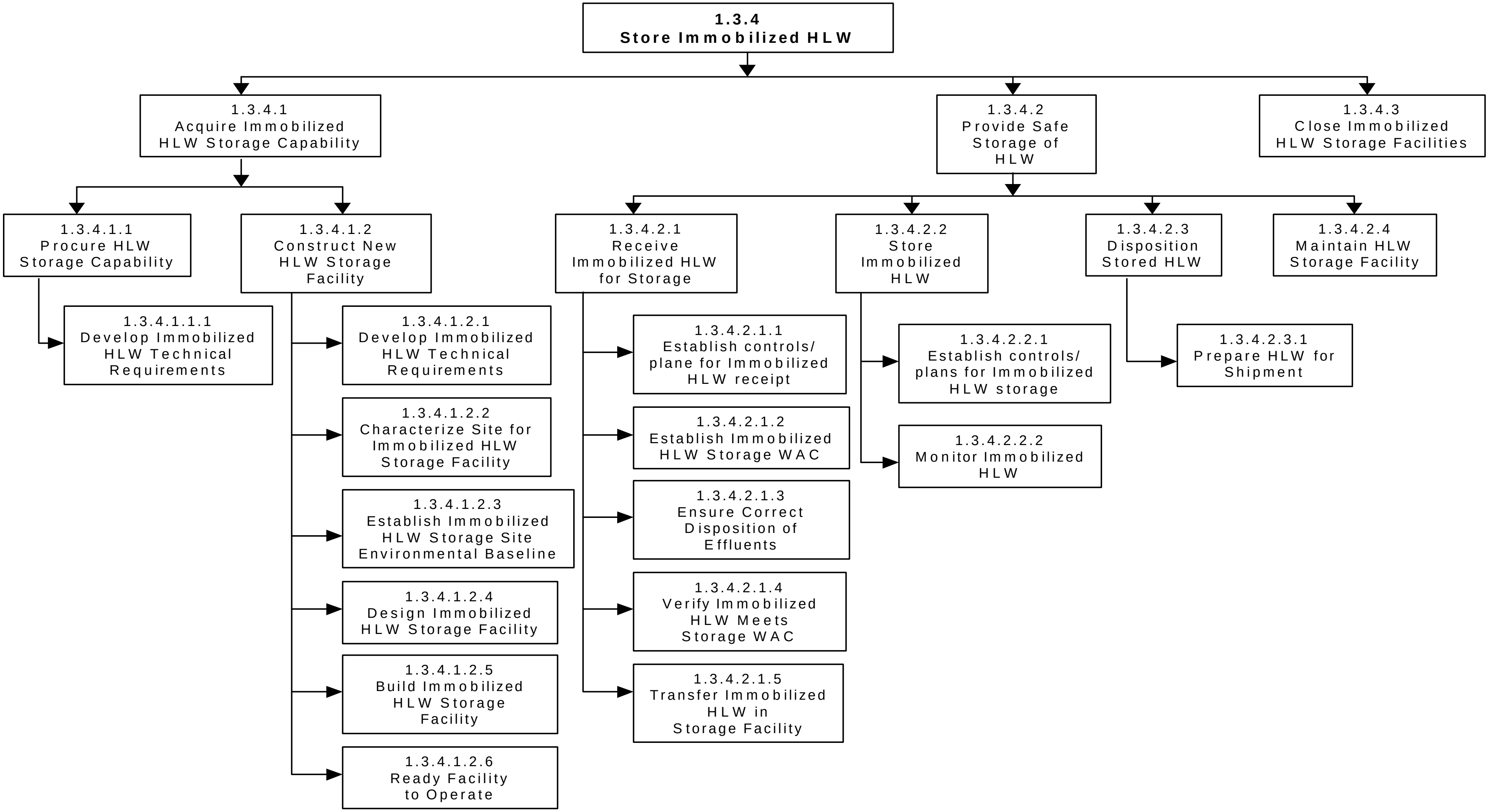
1.3.3.2.1.3
Monitor/Operations
1.3.3.2.1.4
Maintenance
1.3.3.2.2.1
Establish controls/ plans for HLW receipt
1.3.3.2.2.2
Establish Immobilization WAC
1.3.3.2.2.3
Verify HLW Meets Immobilization WAC
1.3.3.2.2.4
Verify HLW Meets Immobilization WAC
1.3.3.2.3.1
Establish controls/ plans for HLW Immobilization
1.3.3.2.3.2
Prepare Feed
1.3.3.2.3.3
Immobilization HLW
1.3.3.2.3.4
Package Immobilized HLW
1.3.3.2.3.5
Treat Offgas
1.3.3.2.3.6
Disposition of non-Immobilized Waste Streams


1.3.4 Store Immobilized HLW
1.3.4.1 Acquire Immobilized HLW Storage Capability
1.3.4.2 Provide Safe Storage of HLW
1.3.4.3 Close Immobilized HLW Storage Facilities
1.3.4.1.1 Procure HLW Storage Capability
1.3.4.1.2 Construct New HLW Storage Facility
1.3.4.2.1 Receive Immobilized HLW for Storage
1.3.4.2.2 Store Immobilized HLW
1.3.4.2.3 Disposition Stored HLW
1.3.4.2.4 Maintain HLW Storage Facility
1.3.4.1.1.1 Develop Immobilized HLW Technical Requirements
1.3.4.1.2.1 Develop Immobilized HLW Technical Requirements
1.3.4.1.2.2 Characterize Site for Immobilized HLW Storage Facility
1.3.4.1.2.3 Establish Immobilized HLW Storage Site Environmental Baseline
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1.3.4.1.2.5 Build Immobilized HLW Storage Facility
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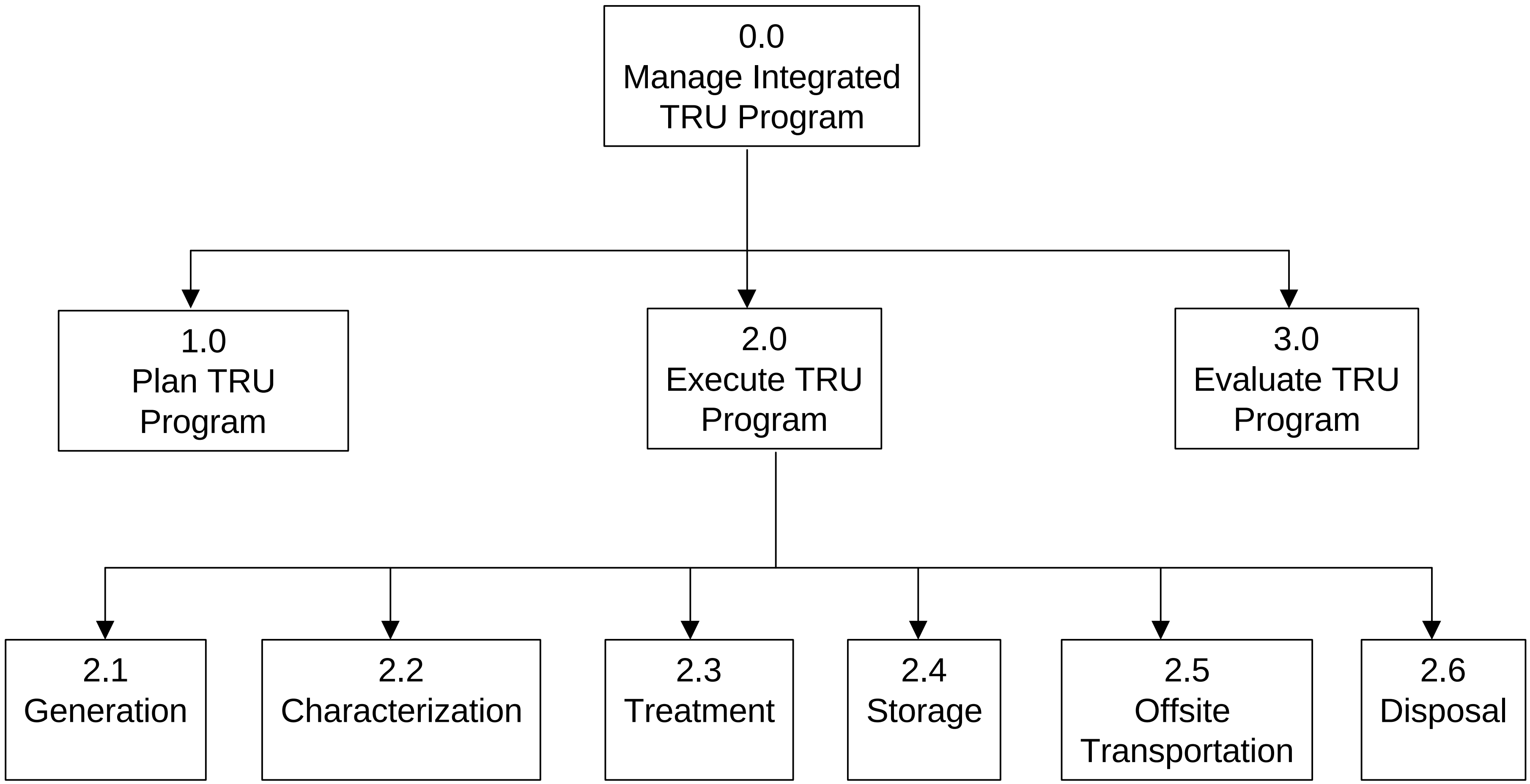
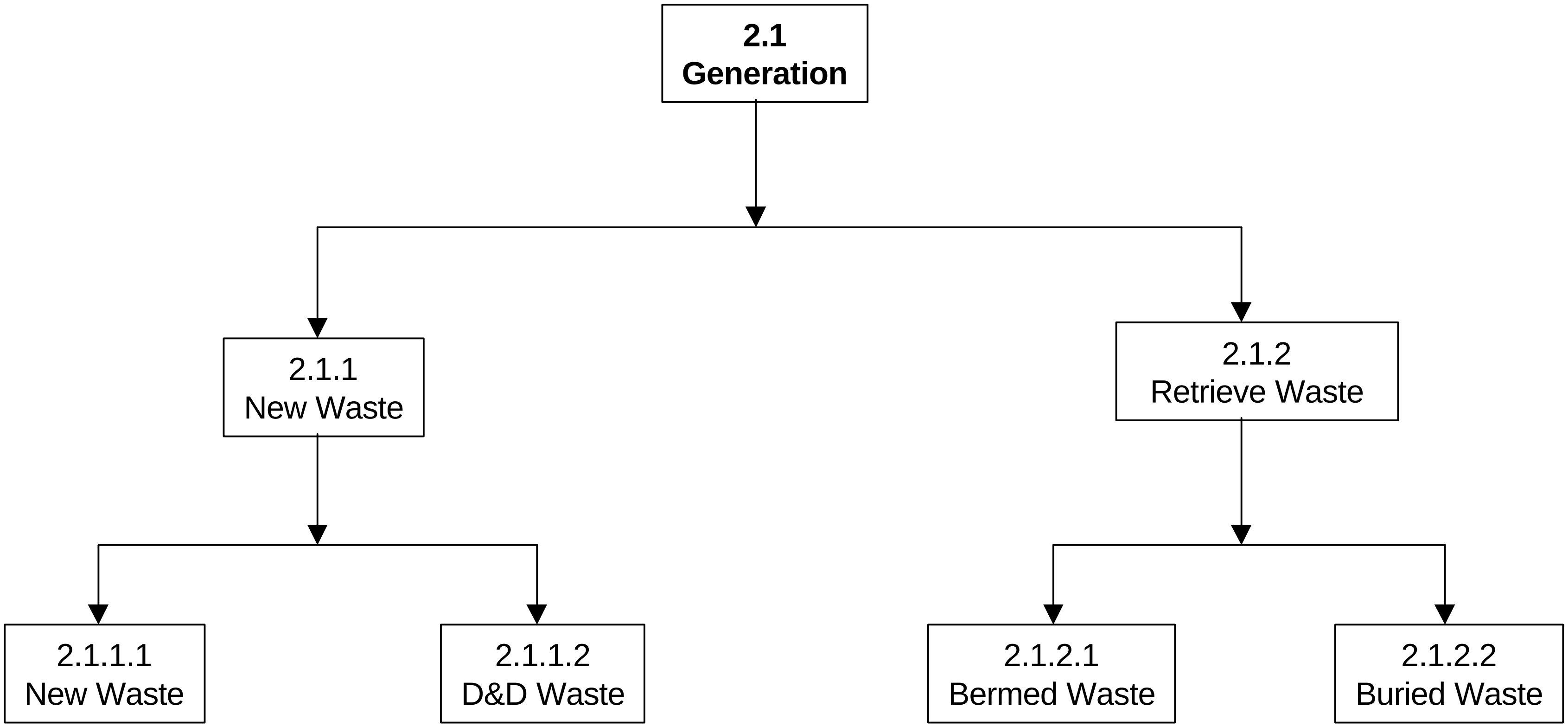
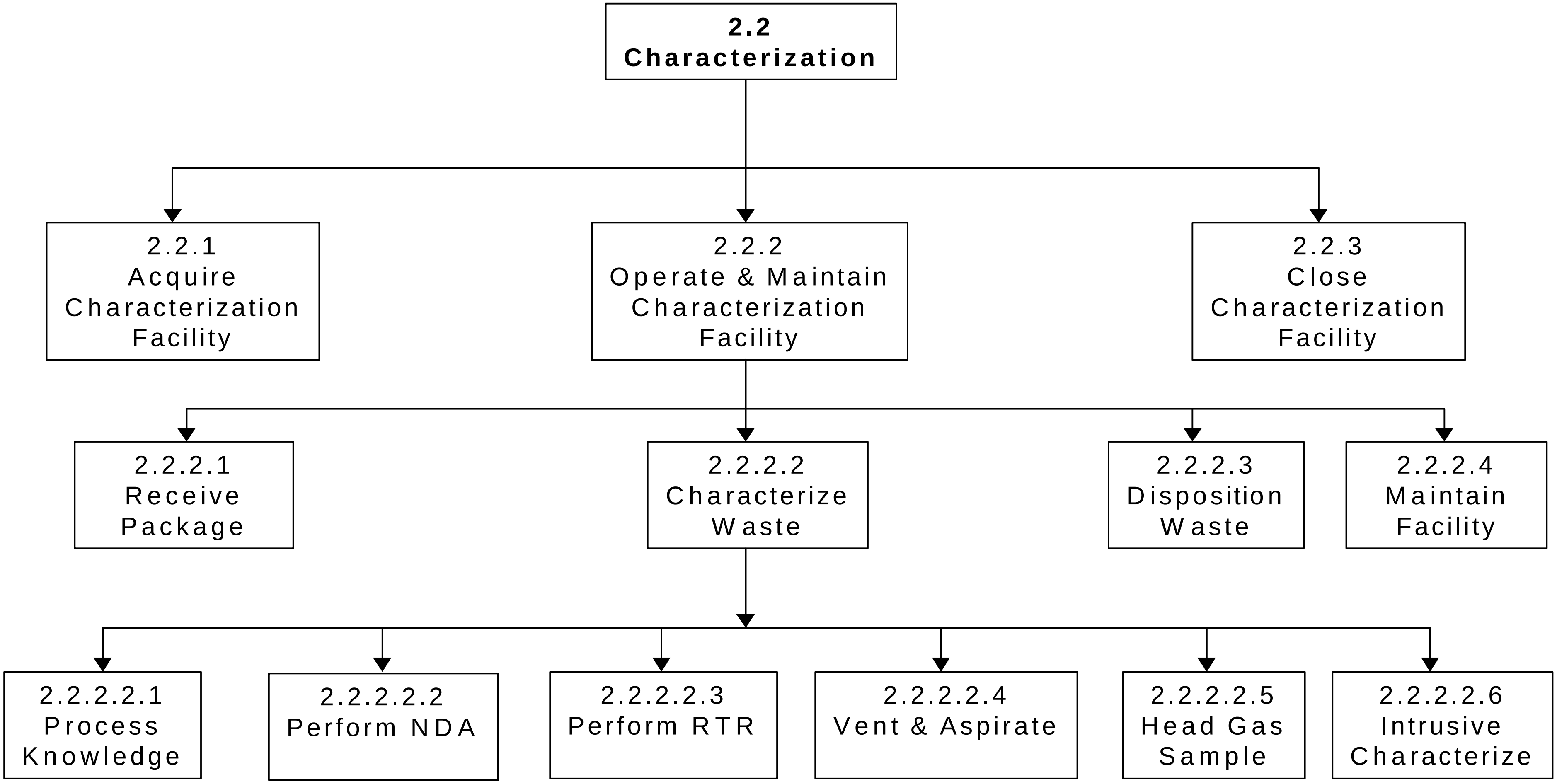
1.3.4.2.1.1 Establish controls/ plane for Immobilized HLW receipt
1.3.4.2.1.2 Establish Immobilized HLW Storage WAC
1.3.4.2.1.3 Ensure Correct Disposition of Effluents
1.3.4.2.1.4 Verify Immobilized HLW Meets Storage WAC
1.3.4.2.1.5 Transfer Immobilized HLW in Storage Facility
1.3.4.2.2.1 Establish controls/ plans for Immobilized HLW storage
1.3.4.2.2.2 Monitor Immobilized HLW
1.3.4.2.3.1 Prepare HLW for Shipment


0.0
Manage Integrated
TRU Program
1.0
Plan TRU
Program
2.0
Execute TRU
Program
3.0
Evaluate TRU
Program
2.1
Generation
2.2
Characterization
2.3
Treatment
2.4
Storage
2.5
Offsite
Transportation
2.6
Disposal


2.1
Generation
2.1.1
New Waste
2.1.2
Retrieve Waste
2.1.1.1
New Waste
2.1.1.2
D&D Waste
2.1.2.1
Bermed Waste
2.1.2.2
Buried Waste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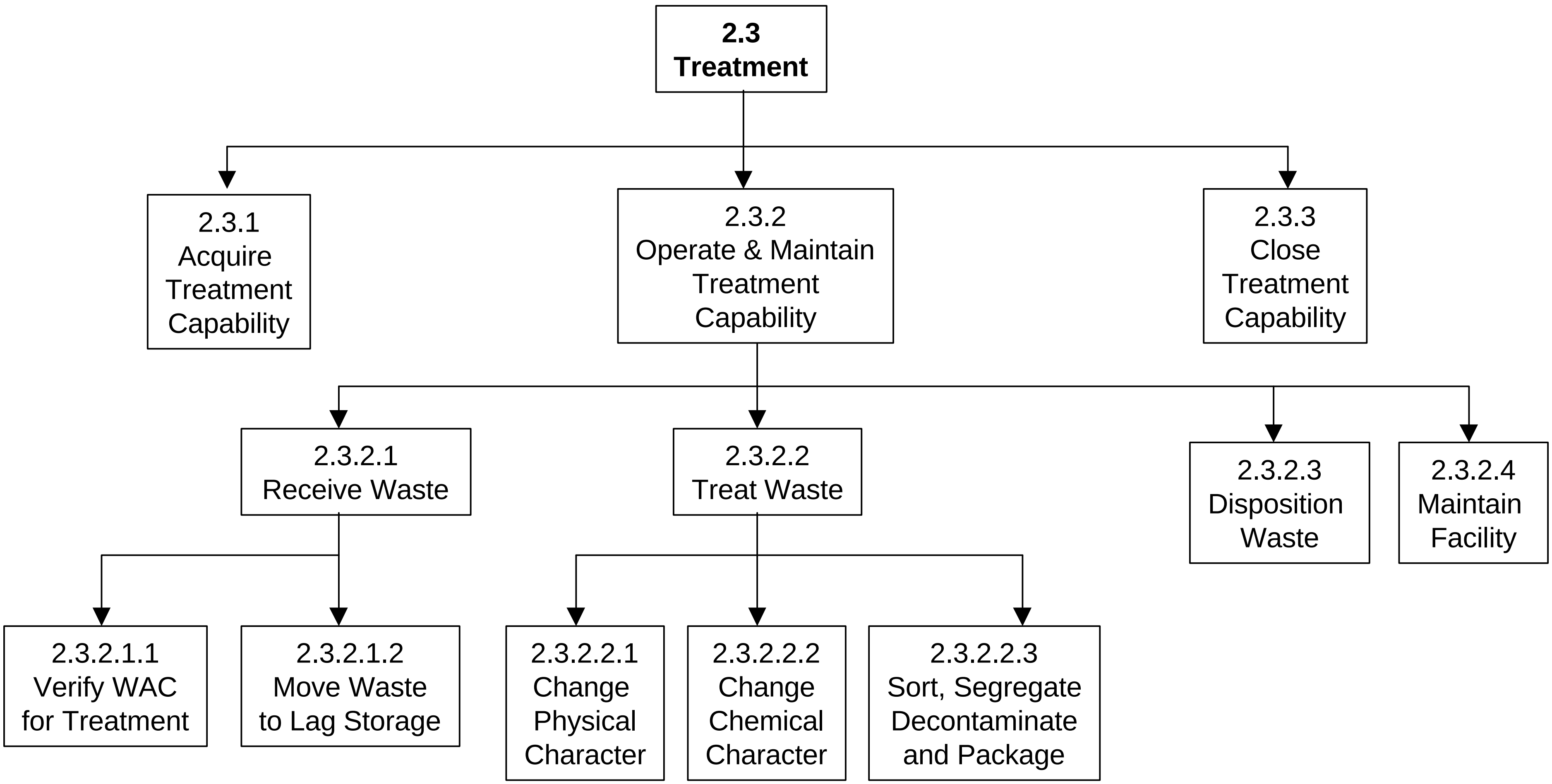
Characterization
2.2.1
Acquire
Characterization
Facility
2.2.2
Operate & Maintain
Characterization
Facility
2.2.3
Close
Characterization
Facility
2.2.2.1
Receive
Package
2.2.2.2
Characterize
Waste
2.2.2.3
Disposition
Waste
2.2.2.4
Maintain
Facility
2.2.2.2.1
Process
Knowledge
2.2.2.2.2
Perform NDA
2.2.2.2.3
Perform RTR
2.2.2.2.4
Vent & Aspirate
2.2.2.2.5
Head Gas
Sample
2.2.2.2.6
Intrusive
Characterize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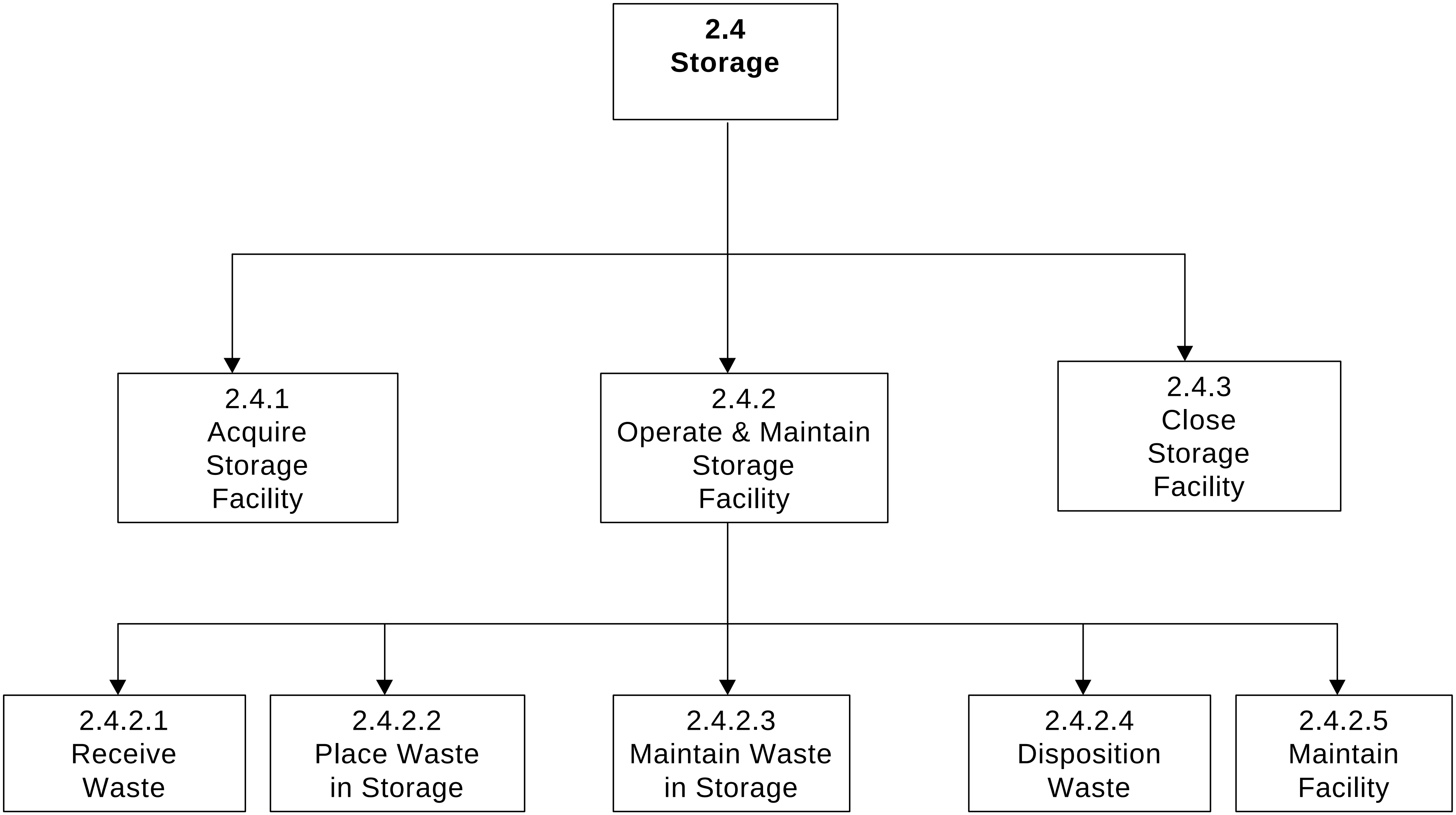
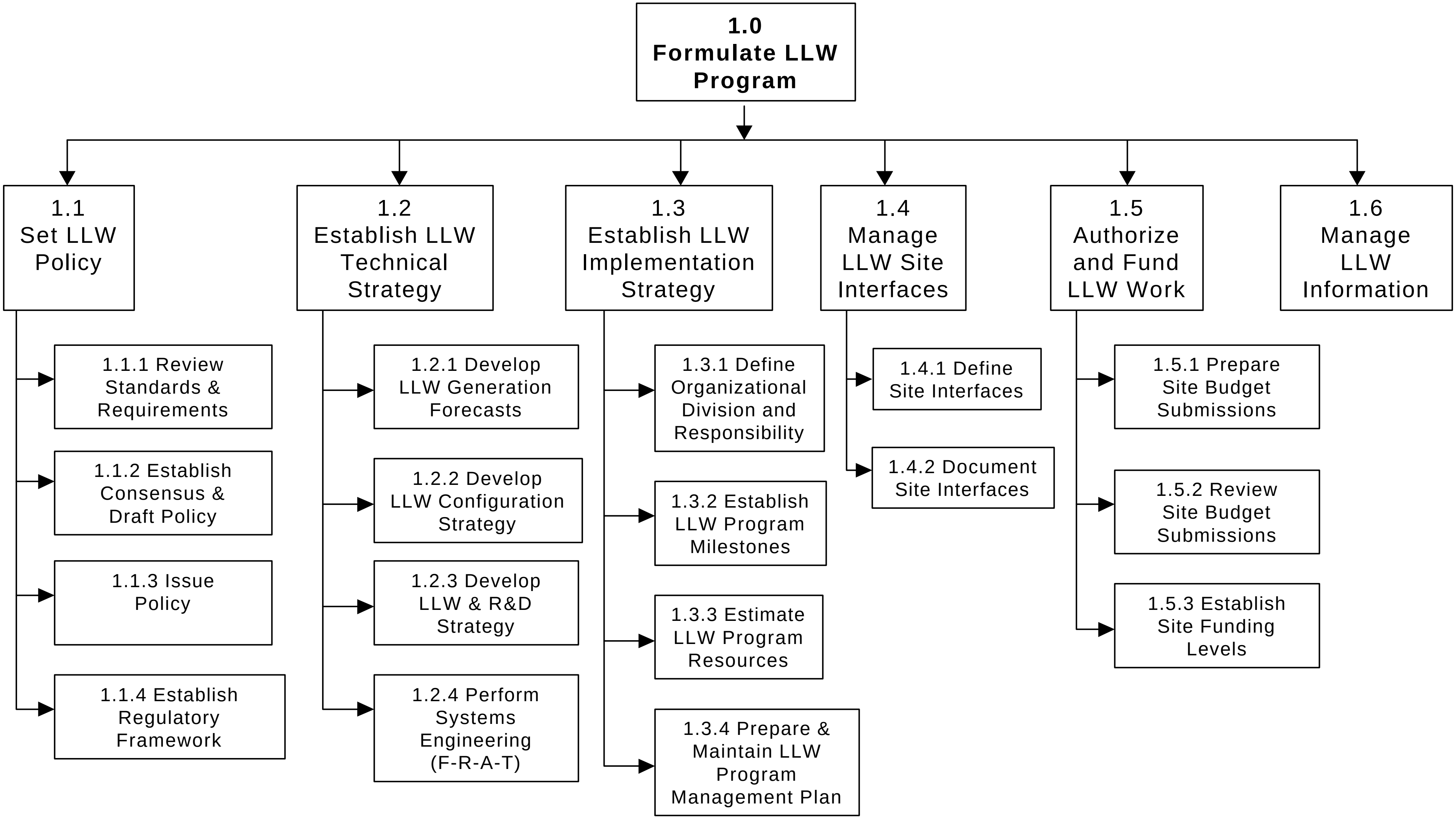
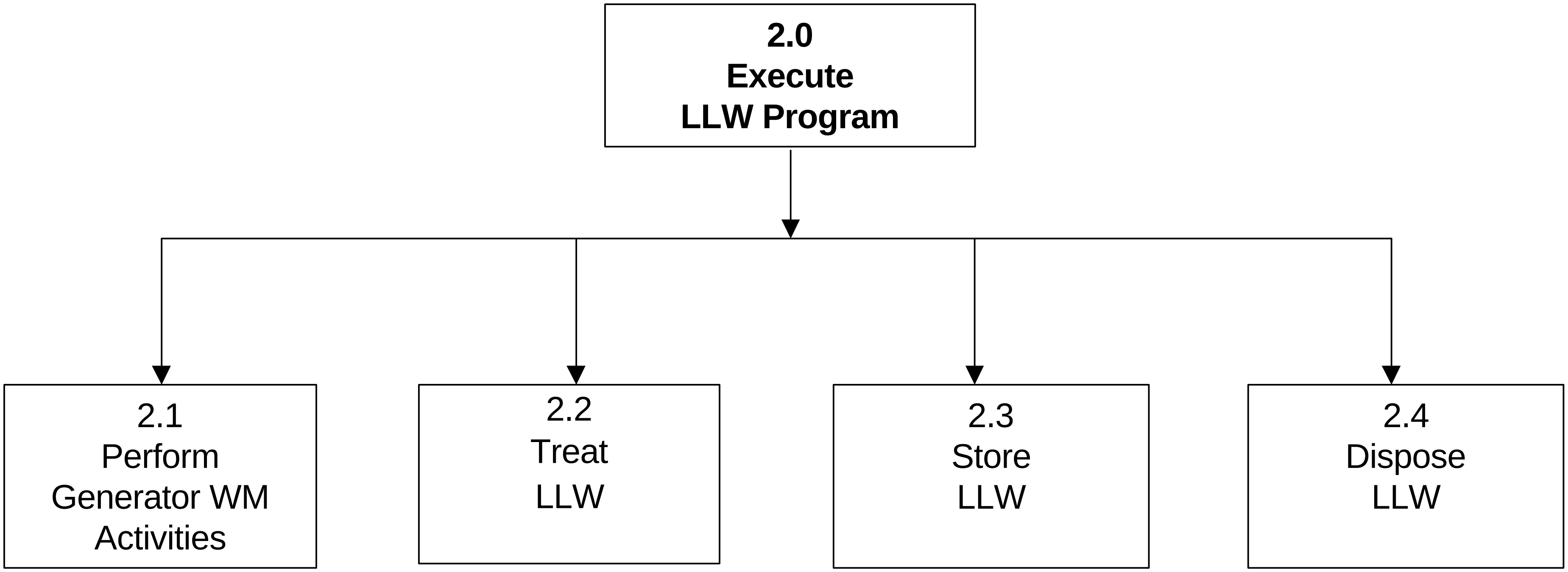
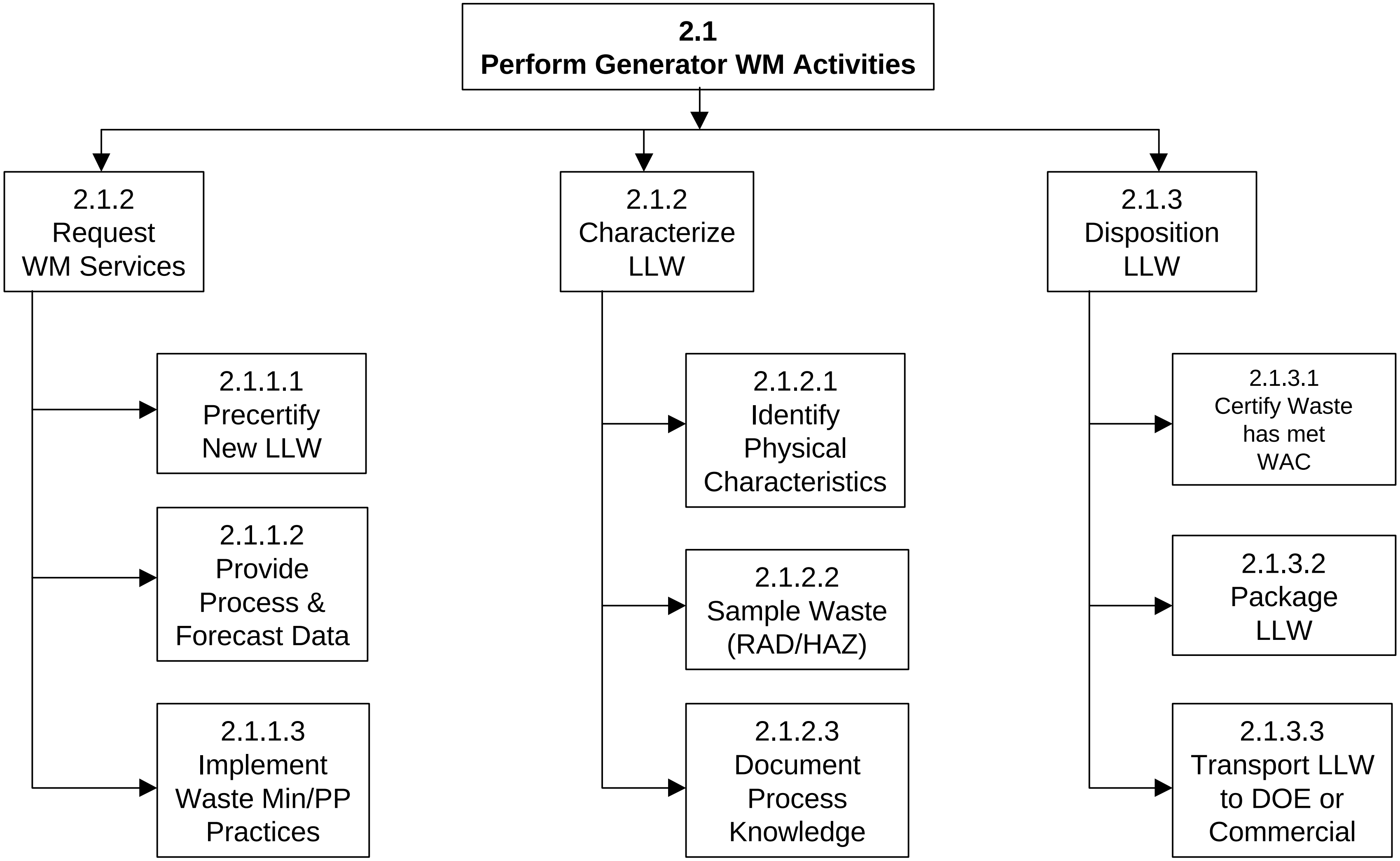
Treatment
2.3.1
Acquire
Treatment
Capability
2.3.2
Operate & Maintain
Treatment
Capability
2.3.3
Close
Treatment
Capability
2.3.2.1
Receive Waste
2.3.2.2
Treat Waste
2.3.2.3
Disposition
Waste
2.3.2.4
Maintain
Facility
2.3.2.1.1
Verify WAC
for Treatment
2.3.2.1.2
Move Waste
to Lag Storage
2.3.2.2.1
Change
Physical
Character
2.3.2.2.2
Change
Chemical
Character
2.3.2.2.3
Sort, Segregate
Decontaminate
and Package


2.4
Storage
2.4.1
Acquire
Storage
Facility
2.4.2
Operate & Maintain
Storage
Facility
2.4.3
Close
Storage
Facility
2.4.2.1
Receive
Waste
2.4.2.2
Place Waste
in Storage
2.4.2.3
Maintain Waste
in Storage
2.4.2.4
Disposition
Waste
2.4.2.5
Maintain
Facility


1.0
Formulate LLW
Program
1.1
Set LLW
Policy
1.2
Establish LLW
Technical
Strategy
1.3
Establish LLW
Implementation
Strategy
1.4
Manage
LLW Site
Interfaces
1.5
Authorize
and Fund
LLW Work
1.6
Manage
LLW
Information
1.1.1 Review
Standards &
Requirements
1.1.2 Establish
Consensus &
Draft Policy
1.1.3 Issue
Policy
1.1.4 Establish
Regulatory
Framework
1.2.1 Develop
LLW Generation
Forecasts
1.2.2 Develop
LLW Configuration
Strategy
1.2.3 Develop
LLW & R&D
Strategy
1.2.4 Perform
Systems
Engineering
(F-R-A-T)
1.3.1 Define
Organizational
Division and
Responsibility
1.3.2 Establish
LLW Program
Milestones
1.3.3 Estimate
LLW Program
Resources
1.3.4 Prepare &
Maintain LLW
Program
Management Plan
1.4.1 Define
Site Interfaces
1.4.2 Document
Site Interfaces
1.5.1 Prepare
Site Budget
Submissions
1.5.2 Review
Site Budget
Submissions
1.5.3 Establish
Site Funding
Levels


2.0
Execute
LLW Program
2.1
Perform
Generator WM
Activities
2.2
Treat
LLW
2.3
Store
LLW
2.4
Dispose
LLW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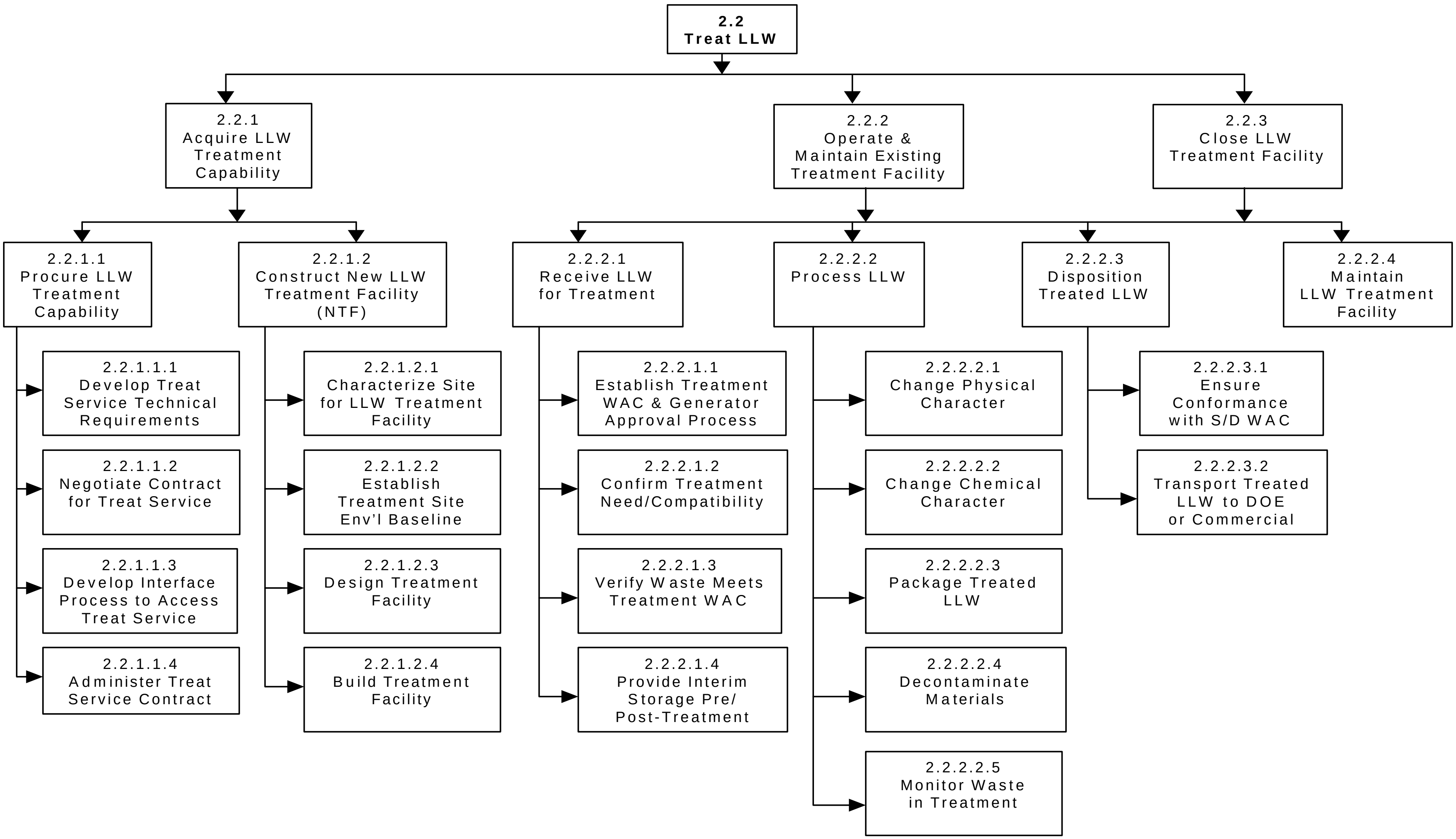
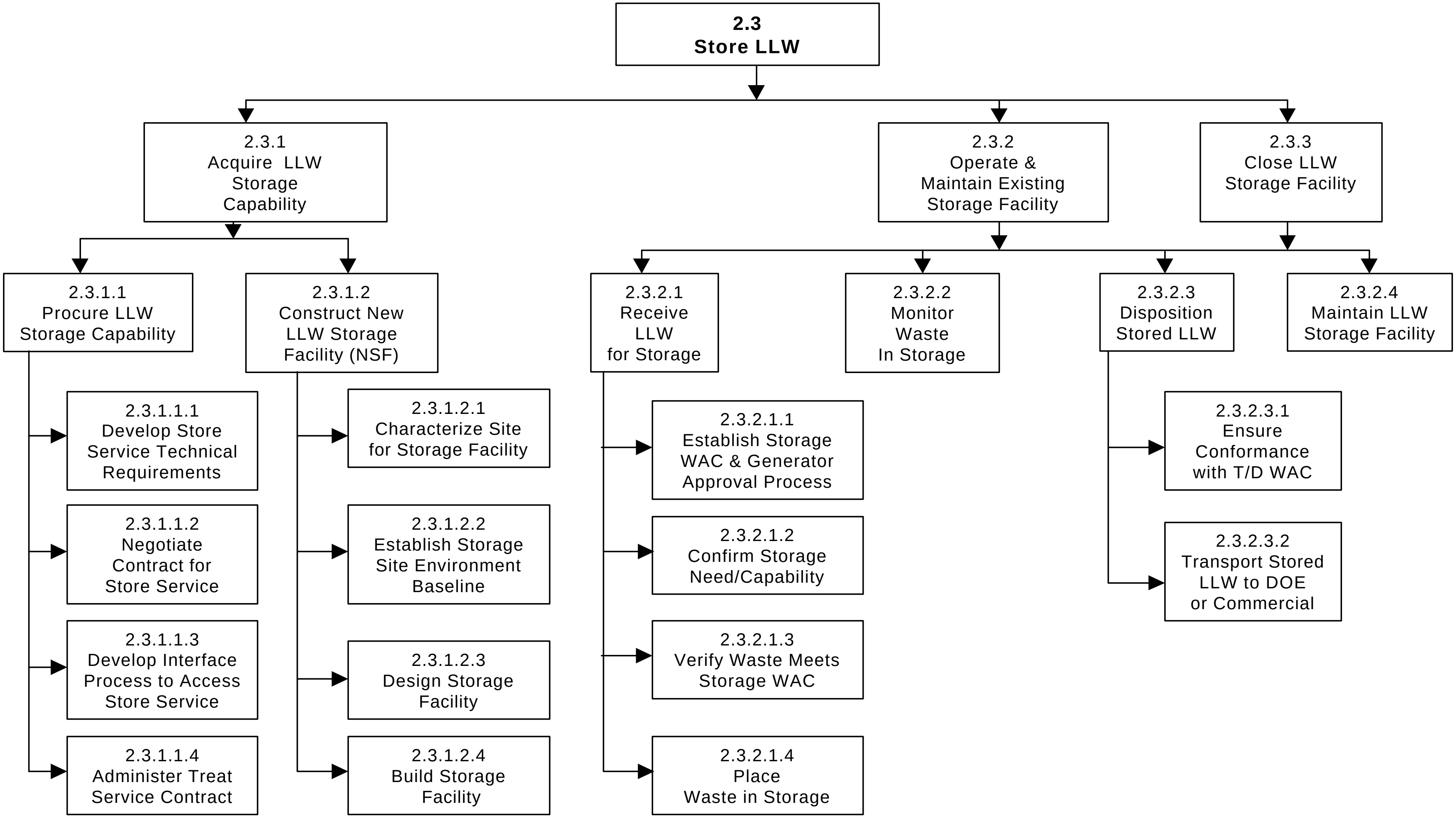
Perform Generator WM Activities
2.1.2
Request
WM Services
2.1.2
Characterize
LLW
2.1.3
Disposition
LLW
2.1.1.1
Precertify
New LLW
2.1.1.2
Provide
Process &
Forecast Data
2.1.1.3
Implement
Waste Min/PP
Practices
2.1.2.1
Identify
Physical
Characteristics
2.1.2.2
Sample Waste
(RAD/HAZ)
2.1.2.3
Document
Process
Knowledge
2.1.3.1
Certify Waste
has met
WAC
2.1.3.2
Package
LLW
2.1.3.3
Transport LLW
to DOE or
Commercial


2.2
Treat LLW
2.2.1
Acquire LLW Treatment Capability
2.2.2
Operate & Maintain Existing Treatment Facility
2.2.3
Close LLW Treatment Facility
2.2.1.1
Procure LLW Treatment Capability
2.2.1.2
Construct New LLW Treatment Facility (NTF)
2.2.2.1
Receive LLW for Treatment
2.2.2.2
Process LLW
2.2.2.3
Disposition Treated LLW
2.2.2.4
Maintain LLW Treatment Facility
2.2.1.1.1
Develop Treat Service Technical Requirements
2.2.1.1.2
Negotiate Contract for Treat Service
2.2.1.1.3
Develop Interface Process to Access Treat Service
2.2.1.1.4
Administer Treat Service Contract
2.2.1.2.1
Characterize Site for LLW Treatment Facility
2.2.1.2.2
Establish Treatment Site Env'l Baseline
2.2.1.2.3
Design Treatment Facility
2.2.1.2.4
Build Treatment Facility
2.2.2.1.1
Establish Treatment WAC & Generator Approval Process
2.2.2.1.2
Confirm Treatment Need/Compatibility
2.2.2.1.3
Verify Waste Meets Treatment WAC
2.2.2.1.4
Provide Interim Storage Pre/ Post-Treatment
2.2.2.2.1
Change Physical Character
2.2.2.2.2
Change Chemical Character
2.2.2.2.3
Package Treated LLW
2.2.2.2.4
Decontaminate Materials
2.2.2.2.5
Monitor Waste in Treatment
2.2.2.3.1
Ensure Conformance with S/D WAC
2.2.2.3.2
Transport Treated LLW to DOE or Commercial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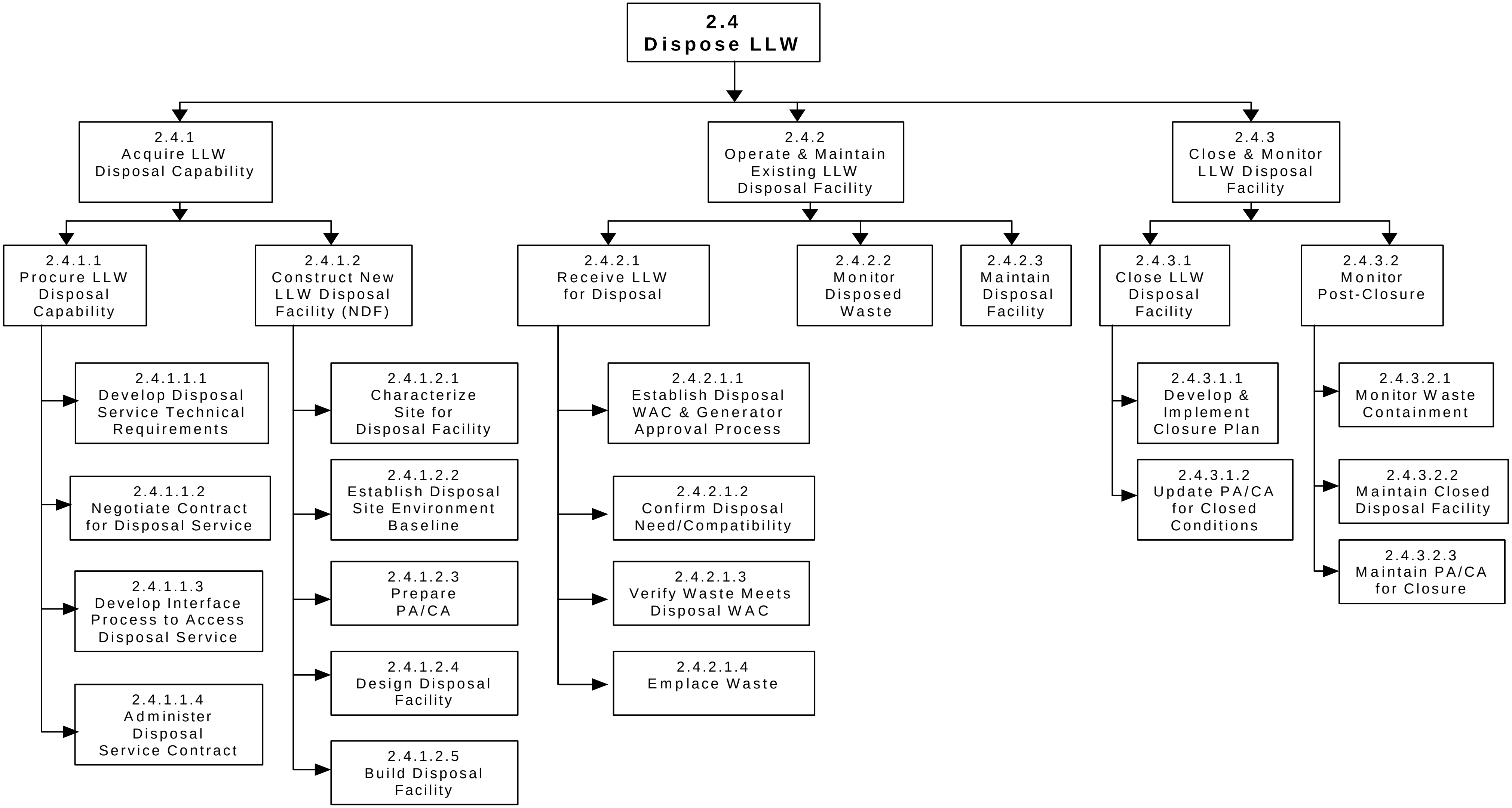
Store LLW
2.3.1
Acquire LLW
Storage
Capability
2.3.2
Operate &
Maintain Existing
Storage Facility
2.3.3
Close LLW
Storage Facility
2.3.1.1
Procure LLW
Storage Capability
2.3.1.2
Construct New
LLW Storage
Facility (NSF)
2.3.2.1
Receive
LLW
for Storage
2.3.2.2
Monitor
Waste
In Storage
2.3.2.3
Disposition
Stored LLW
2.3.2.4
Maintain LLW
Storage Facility
2.3.1.1.1
Develop Store
Service Technical
Requirements
2.3.1.1.2
Negotiate
Contract for
Store Service
2.3.1.1.3
Develop Interface
Process to Access
Store Service
2.3.1.1.4
Administer Treat
Service Contract
2.3.1.2.1
Characterize Site
for Storage Facility
2.3.1.2.2
Establish Storage
Site Environment
Baseline
2.3.1.2.3
Design Storage
Facility
2.3.1.2.4
Build Storage
Facility
2.3.2.1.1
Establish Storage
WAC & Generator
Approval Process
2.3.2.1.2
Confirm Storage
Need/Capability
2.3.2.1.3
Verify Waste Meets
Storage WAC
2.3.2.1.4
Place
Waste in Storage
2.3.2.3.1
Ensure
Conformance
with T/D WAC
2.3.2.3.2
Transport Stored
LLW to DOE
or Commercial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Dispose LLW
2.4.1
Acquire LLW
Disposal Capability
2.4.2
Operate & Maintain
Existing LLW
Disposal Facility
2.4.3
Close & Monitor
LLW Disposal
Facility
2.4.1.1
Procure LLW
Disposal
Capability
2.4.1.2
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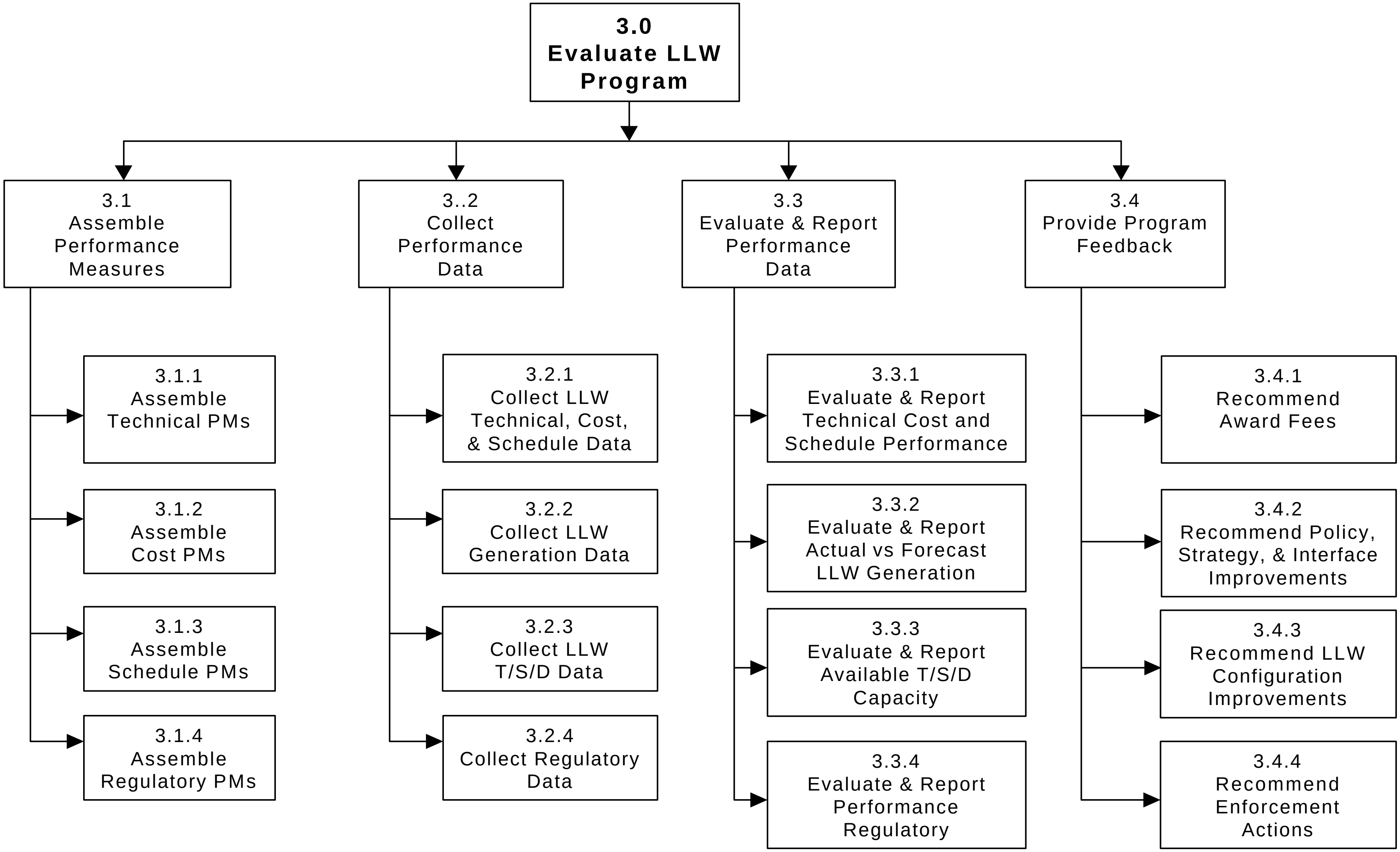
LLW Disposal
Facility (NDF)
2.4.2.1
Receive LLW
for Disposal
2.4.2.2
Monitor
Disposed
Waste
2.4.2.3
Maintain
Disposal
Facility
2.4.3.1
Close LLW
Disposal
Facility
2.4.3.2
Monitor
Post-Closure
2.4.1.1.1
Develop Disposal
Service Technical
Requirements
2.4.1.1.2
Negotiate Contract
for Disposal Service
2.4.1.1.3
Develop Interface
Process to Access
Disposal Service
2.4.1.1.4
Administer
Disposal
Service Contract
2.4.1.2.1
Characterize
Site for
Disposal Facility
2.4.1.2.2
Establish Disposal
Site Environment
Baseline
2.4.1.2.3
Prepare
PA/CA
2.4.1.2.4
Design Disposal
Facility
2.4.1.2.5
Build Disposal
Facility
2.4.2.1.1
Establish Disposal
WAC & Generator
Approval Process
2.4.2.1.2
Confirm Disposal
Need/Compatibility
2.4.2.1.3
Verify Waste Meets
Disposal WAC
2.4.2.1.4
Emplace Waste
2.4.3.1.1
Develop &
Implement
Closure Plan
2.4.3.1.2
Update PA/CA
for Closed
Conditions
2.4.3.2.1
Monitor Waste
Containment
2.4.3.2.2
Maintain Closed
Disposal Facility
2.4.3.2.3
Maintain PA/CA
for Closure


3.0
Evaluate LLW Program
3.1
Assemble Performance Measures
3..2
Collect Performance Data
3.3
Evaluate & Report Performance Data
3.4
Provide Program Feedback
3.1.1
Assemble Technical PMs
3.1.2
Assemble Cost PMs
3.1.3
Assemble Schedule PMs
3.1.4
Assemble Regulatory PMs
3.2.1
Collect LLW Technical, Cost, & Schedule Data
3.2.2
Collect LLW Generation Data
3.2.3
Collect LLW T/S/D Data
3.2.4
Collect Regulatory Data
3.3.1
Evaluate & Report Technical Cost and Schedule Performance
3.3.2
Evaluate & Report Actual vs Forecast LLW Generation
3.3.3
Evaluate & Report Available T/S/D Capacity
3.3.4
Evaluate & Report Performance Regulatory
3.4.1
Recommend Award Fees
3.4.2
Recommend Policy, Strategy, & Interface Improvements
3.4.3
Recommend LLW Configuration Improvements
3.4.4
Recommend Enforcement Actions

BASIS FOR REGULATION OF RADIOACTIVE WASTE

The revised Order, designated DOE O 435.1, *Radioactive Waste Management*, establishes the requirements for management of radioactive waste consistent with the Department's *Atomic Energy Act of 1954*, as amended, responsibilities to provide for radiological protection from DOE operations. The scope of DOE O 435.1 includes: (1) high-level waste, including closure of high-level waste tank systems and management of associated incidental wastes; (2) transuranic waste, including safe treatment, storage, and characterization/certification to support disposal at the Waste Isolation Pilot Plant; and (3) low-level waste, with attention to disposal and the impacts of interacting source terms on projected public dose. The revised Order does not contain requirements for the management of the decontamination or decommissioning of radioactively contaminated facilities. Those requirements are incorporated in a revision of DOE O 430.1, *Life-Cycle Asset Management*. Additionally, the requirements for the management of spent nuclear fuel are not contained in this Order. The hazards analysis performed to identify requirements for high-level waste did not address the functions associated with management of spent nuclear fuel. Thus the requirements contained in DOE M 435.1-1 do not apply to this DOE-managed spent nuclear fuel.

<u>Risk</u>

The focus of the *Radioactive Waste Management Order* revision effort provided numerous challenges and opportunities to DOE for addressing risk. These opportunities and challenges operated at several different levels. As sources for understanding the overall scope of risk throughout the DOE complex and its operations, the DOE Risk Report to Congress and the findings of the Complex-Wide Review on low-level waste implemented under Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-2 were invaluable. Through these sources, DOE was able to conceptualize both the breadth and causes of the major risks within DOE's operations at the complex-wide and site-specific managerial levels.

DOE's *Integrated Safety Management System* (ISMS) establishes a logical process for integrating consideration of risk into all of DOE's planning and activities, and provides a uniform and common process for thinking about the problems of risk and developing solutions. In particular, the ISMS dictates a simple but logical process for understanding and mitigating risks. Under ISMS, the development of work processes follows a simple five-step approach: (1) identify the functions that must be performed to complete the work; (2) conduct a safety and hazards analysis of those functions; (3) develop the appropriate mitigating measures and controls based on that analysis; (4) apply the controls and implement a periodic reassessment of the activities, and (5) provide for a feedback to revising the work processes as necessary. This analytical approach has been incorporated into the heart of DOE's effort to revise the Radioactive Waste Management Order and represents the overall philosophical approach and major steps of this effort.

Performance-Based Requirements

One of the factors that contributed heavily to the shaping of the efforts to revise DOE's radioactive waste management requirements is the emphasis on performance-based requirements. Through the Department's system for revising and issuing directives there has been a strong movement away from detailed prescriptive requirements toward higher-level and more performance-based requirements. The implementation of performance-based requirements requires methods of measurement or demonstration in order to determine effective implementation and/or compliance. Such requirements are difficult to implement if the requirements are not clearly written, complete guidance is not provided, or the technical basis of the requirements is not known or understood. A particular challenge to this effort, therefore, was to develop not only the appropriate level of performance-based requirements, but to also develop the appropriate level of associated guidance and technical basis. Notably, these key elements of an effective performance-based requirements system have also been some of the key areas of failure with DOE's past requirements, especially with regard to DOE's radioactive waste management requirements.

When both the goals of performance-based and risk-based requirements are considered, an approach is necessary, which if developed and used properly, can provide the avenue for implementing such requirements effectively. One method of achieving this balance and allowing for a graded approach in the application of the requirements is to implement the requirements at the site level through the development of operation-specific authorization basis documentation. Under the concept of authorization basis documentation, each site-specific waste management operation develops its own vehicle for demonstrating methods of compliance, documenting implementation-level procedures and requirements, and providing the baseline for measurement of performance. The authorization basis is developed based on site-specific conditions and the particular risks and performance needs for the facility, and is approved by the cognizant DOE manager.

An example of such authorization basis documentation is the process that DOE currently uses for developing Safety Analysis Reports (SARs) and authorizing facilities to operate. Under this approach, each operation or facility is required to analyze the key hazards of the facility's operations and processes, describe them, develop the controls to mitigate the hazards and the technical basis for such, and provide an overall framework for the operation of the facility. When authorized, the facility then operates to the procedures and operational envelope identified in the authorization basis documentation. Events or occurrences which deviate from the authorization basis trigger re-evaluation and development of additional work process and requirements as necessary.

The requirements developed under the General Requirements Chapter of DOE M 435.1-1 provide the umbrella which incorporates the considerations of risk, performance, and authorization basis

documentation into DOE's radioactive waste management system. The technical basis and crosswalk tables presented in this document address both the waste-type specific requirements and the general requirements of DOE M 435.1-1, and where appropriate, references across chapters of the Manual have been included.

CHAPTER I

GENERAL REQUIREMENTS AND RESPONSIBILITIES

1. REQUIREMENTS

A. Delegation of Authority. Managers charged with responsibilities within this Manual may delegate authority for these tasks to another manager. All delegations of authority shall be documented.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need for there to always be a DOE manager with direct responsibility for ensuring activities are conducted in a fashion that protects the public, workers, and the environment. This requirement specifically addresses several weaknesses and conditions associated with lack of management and lack of documentation of decisions.

Requirements Analysis. New requirement derived for the Manual.

Other Considerations. The requirement implements a best management practice in place at most Departmental levels, and is included to emphasize the importance of accountability for ensuring radioactive waste management activities conducted by the Department are done so safely.

B. Use of Guidance. Additional information supporting the requirements in this Manual is contained in the Implementation Guide for use with DOE M 435.1-1, *Radioactive Waste Management Manual*. This Guide, DOE G 435.1-1, *Implementation Guide for DOE M 435.1-1*, shall be reviewed when implementing the requirements of this Manual. The Guide provides additional information and acceptable methods for meeting the requirements. Other methods may be used but must ensure an adequate level of safety commensurate with the hazards associated with the work and be consistent with the radioactive waste management basis.

Basis:

Functions Evaluated. This requirement derives from the analysis of most Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. This requirement derives from the vetting process used in the safety and hazards analyses. Mitigating activities were identified to control the weaknesses and conditions identified, and in many cases, better guidance was recognized as the most effective mitigating action, especially in cases where there was a longstanding requirement that was considered sufficient. The preparation of effective implementation guidance for all requirements was indicated as a result of the safety and hazards analyses.

Requirements Analysis. The requirement partially derives from the evaluation of DOE O 251.1A, *Directives System*, DOE M 251.1-1A, *Directives System Manual*, and its implementation guidance.

Other Considerations. The use of guidance to explain the intention of requirements, along with acceptable ways of meeting the requirements, is a well developed regulatory method used by the NRC. The use of guidance as described in the requirement implements this best management practice for DOE management of radioactive waste. Also, some of the acceptable ways for meeting requirements included in the guidance are there due to the vetting process used in development of performance-based requirements. The source of these acceptable methods is often another requirements document (e.g., WIPP Waste Acceptance Criteria). They may represent the only acceptable way to meet the requirement right now, but the level of specificity is not appropriate for the Manual and the activities to which it applies. The requirement includes the need to document the use of alternative methods, and a rationale if one is used.

C. Radioactive Waste Management. All radioactive waste subject to DOE O 435.1, *Radioactive Waste Management*, and the requirements of this Manual shall be managed as high-level waste, transuranic waste, low-level waste, or mixed low-level waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level functions for all three waste types: Formulate, Execute, and Evaluate.

Safety and Hazard Analyses. The safety and hazards analyses conducted for determining the essential requirements for radioactive waste management assumed that all radioactive waste was either high-level waste, transuranic waste, or low-level waste, based on the definitions assumed for the three waste types (The definitions in DOE 5820.2A were assumed). Special case waste, non-defense transuranic waste, and other wastes that have been management problems in the past were included in the analysis for the purposes of determining technical requirements needed to manage them, and the essential requirements included in the manual are believed to be sufficient for managing all of the Department's radioactive waste as one of the three waste types.

Requirements Analysis. New requirement derived for the Manual.

Other Considerations. Because of the special needs of management of mixed low-level waste, the Department has established and manages a mixed low-level waste program independent of the low-level waste management program. The requirement includes consideration of the effectiveness of this program by recognizing that all DOE radioactive waste could be managed within one of these four programs.

D. Analysis of Environmental Impacts. Existing and proposed radioactive waste management facilities, operations, and activities shall meet the requirements of 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures*; and DOE O 451.1A, *National Environmental Policy Act Compliance Program*. All reasonable alternatives shall be considered, as appropriate. Nothing in this Order is meant to restrict consideration of alternatives to proposed actions.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions in all three waste types associated with siting, designing, and constructing new waste management facilities. It also partially derives from the analysis of the Develop the program functions for all three waste types

Safety and Hazard Analyses. The requirement partially addresses some weaknesses and conditions associated with poor siting of facilities, and inadequate site characterization data. The requirement also partially addresses the need to involve stakeholders in decision making, a need identified in some of the program development requirements.

Requirements Analysis. The requirement is essentially equivalent to and updates the reference in DOE 5820.2A, 6.10. to DOE 5440.1C, *National Environmental Policy Act.*

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives. The following requirements and DOE directives are required for all DOE radioactive waste management facilities, operations, and activities as applicable. Any of the requirements for the following Departmental directives may be waived or modified through application of a DOE-approved requirements tailoring process, such as the "Necessary and Sufficient Closure Process" in DOE P 450.3 and DOE M 450.3-1 and DOE P 450.4, *Safety Management System Policy*, or by an exemption processed in accordance with the requirements of that directive or DOE M 251.1-1A, *Directives System Manual*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. During the safety and hazard analysis, numerous weaknesses and conditions and needs for controls for radioactive waste management were identified as potentially covered by requirements or DOE directives already in place. Some examples of these weaknesses and conditions are safety documentation, personal protective equipment, and effluent monitoring. The safety and hazards analysis identified the controls and mitigating actions included in these other requirements and directives.

Requirements Analysis. The requirements and directives identified in the safety and hazard analyses that contained necessary mitigating actions and controls were evaluated for their adequacy in addressing the weaknesses and conditions identified for radioactive waste management. Many of these requirements and directives were found to provide controls that were essential to the protection of the public, workers, and the environment. These are listed below to ensure that the requirements they invoke are followed for radioactive waste management facilities. The directives that are listed under this requirement represent those that addressed weaknesses and conditions that; were associated with high hazard scenarios, were associated with numerous accident scenarios, or are known to be significant in management of one of the radioactive waste types. More discussion appears about the specific weaknesses and conditions addressed by the requirement or directive in the following sections. The requirement also imposes the Department's Integrated Safety Management System as required under DOE P 45.4, *Safety Management System Policy*. This ensures that if any of these essential requirements and directives are modified or waived, that the hazard associated with the requirement is being adequately controlled.

Other Considerations. The requirement includes allowing waivers or modifications to requirements in these directives through any of the accepted processes for doing so within the Department. This is included to implement the Department's integrated safety management system. The principle allows that alternative requirements are acceptable if a similar process as the one followed in developing the Order demonstrates the controls are the correct set for the situation.

E. <u>Requirements of Other Regulations and DOE Directives</u>.

(1) Analysis of Operations Information. Data that measure the environment, safety, and health performance of radioactive waste management facilities, operations, and activities shall be identified, collected, and analyzed as required by DOE O 210.1, *Performance Indicators and Analysis of Operations Information*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Evaluate top-level function for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need to perform evaluations of the performance of radioactive waste management facilities in protecting the public, workers, and the environment, and improving performance in critical activities if indicated.

Requirements Analysis. Analysis of DOE O 210.1, *Performance Indicators and Analysis of Operations Information*, indicates that it provides the essential requirements necessary for radioactive waste management facilities to implement an effective analysis of operations information.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(2) Classified Waste. Radioactive waste for 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*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The safety and hazards analyses assumed that classified waste was included in the radioactive wastes for which essential requirements were being developed.

Requirements Analysis. Analysis of DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*, and DOE 5633.3B, *Control and Accountability of Nuclear Materials*, indicate that they provide the essential requirements necessary for the national security protections needed for management of classified radioactive waste at DOE waste management facilities.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(3) Conduct of Operations. Radioactive waste management facilities, operations, and activities shall be conducted in a manner based on consideration of the associated hazards. Waste management facilities, operations, and activities shall meet the requirements of DOE 5480.19, *Conduct of Operations Requirement for DOE Facilities*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate procedures to be developed and implemented for all radioactive waste management operations and activities important to protection of the public, workers, and the environment. Weaknesses and conditions associated with lack of or poor procedures were identified repeatedly in the safety and hazards analysis.

Requirements Analysis. Analysis of DOE 5480.19, *Conduct of Operations Requirement for DOE Facilities*, indicates that it provides the essential requirements necessary for effective development of procedures and other conduct of operations at DOE radioactive waste management facilities. Meeting of these requirements is emphasized by this DOE M 435.1-1 requirement because the weaknesses and conditions associated with poor or lack of procedures was repeatedly identified as potentially contributing to management problems with radioactive waste.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(4) Criticality Safety. Radioactive waste management facilities, operations, and activities shall be covered by a criticality safety program in accordance with DOE O 420.1, *Facility Safety*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for criticality to be considered in the management of wastes containing fissile or fissionable materials. Potentially

catastrophic consequences were identified in the safety and hazard analyses for storage, treatment, and disposal scenarios involving weaknesses involving criticality concerns.

Requirements Analysis. Analysis of DOE O 420.1, *Facility Safety*, indicates that it provides the essential requirements necessary for an effective criticality safety program at DOE radioactive waste management facilities. Meeting of these requirements is emphasized by this DOE M 435.1-1 requirement because of the potential for large consequences indicated in the safety and hazards analyses if criticality safety programs are not carefully adhered to.

Other Considerations. The requirement is included for emphasis based partially on comments of the Senior Review Panel on draft versions of the Manual.

E. Requirements of Other Regulations and DOE Directives.

(5) Emergency Management Program. Radioactive waste management facilities, operations, and activities shall maintain an emergency management program in accordance with DOE O 151.1, *Comprehensive Emergency Management System*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate emergency management to respond to accident scenarios and potentially hazardous situations involving radioactive waste management. The need for emergency management was identified as a very important mitigating action for situations involving high hazard activities, especially weaknesses and conditions associated with storage of high-level waste, and treatment and pre-treatment of high-level waste, and transportation of all wastes.

Requirements Analysis. Analysis of DOE O 151.1, *Comprehensive Emergency Management System* indicates that it provides the essential requirements necessary for development of an effective emergency management program for DOE that will include radioactive waste management facilities, operations, and activities. Meeting of these requirements is emphasized by this DOE M 435.1-1 requirement to ensure that the high hazard activities involved in the management of some radioactive wastes has the necessary mitigating activities to ensure protection of the public, workers, and the environment.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(6) Environmental and Occurrence Reporting. Radioactive waste management facilities, operations, and activities shall meet the reporting requirements of DOE O 231.1, *Environment, Safety and Health Reporting*, and DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions and the Evaluate the program functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide reporting of environmental monitoring and operational data for radioactive waste management operations and activities to ensure the protection of the public, workers, and the environment continues to meet regulatory and stakeholder requirements. The requirement also addresses the need to implement an effective feedback system within an integrated safety management system to effectively evaluate radioactive waste management facilities, operations, and activities.

Requirements Analysis. The requirement is essentially equivalent to and updates the reference in DOE 5820.2A, 6. References to the environmental monitoring order which has been canceled, DOE 5484.1, and the occurrence reporting order which has been canceled, DOE O 231.1, *Environment, Safety, and Health Reporting*, and DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information* were evaluated and found to be adequate in implementing environmental monitoring reporting requirements and occurrence reporting requirements for radioactive waste management. This is included to implement the Department's integrated safety management system, as invoked in the introductory requirement to this section of the Manual, Requirements of Other Regulations and DOE Directives.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(7) Environmental Monitoring. Radioactive waste management facilities, operations, and activities shall meet the environmental monitoring requirements of DOE 5400.1, *General Environmental Protection Program;* and DOE 5400.5, *Radiation Protection of the Public and the Environment*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide monitoring of radioactive waste management operations and activities to ensure the protection of the public, workers, and the environment continues to meet regulatory and stakeholder requirements. The requirement also partially addresses the need to involve stakeholders in decision making, a need identified in some of the program development requirements.

Requirements Analysis. The requirement is essentially equivalent to and updates the reference in DOE 5820.2A, 6. References to several environmental compliance orders which have been canceled that required environmental and effluent monitoring. DOE 5400.1, *General Environmental Protection;* and DOE 5400.5, *Radiation Protection of the Public and Environment* were evaluated and found to be adequate in implementing environmental monitoring requirements for radioactive waste management facilities. (Some additional monitoring requirements appear in the waste type chapters where specific waste management situations warrant.)

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(8) Hazard Analysis Documentation and Authorization Basis. Radioactive waste management facilities, operations, and activities shall implement DOE Standards, DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23, Nuclear Safety Analysis Reports,* and/or DOE-EM-STD-5502-94, *DOE Limited Standard: Hazard Baseline Documentation,* and shall, as applicable, prepare and maintain hazard analysis documentation and an authorization basis as required by DOE O 425.1A, *Startup and Restart of Nuclear Facilities*, DOE O 5480.21, *Unreviewed Safety Questions*, DOE 5480.22, *Technical Safety Requirements*, and DOE 5480.23, *Nuclear Safety Analysis Reports*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for constructing a new facility for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need for the analysis of the specific hazards associated with a specific radioactive waste management facility, operation, or activity to be considered in the determination of whether the public, workers, and environment are adequately protected. Poor or lack of hazard analysis has been identified repeatedly by the Defense Nuclear Facilities Safety Board as a weakness requiring correction for many Departmental programs.

Requirements Analysis. DOE O 425.1A, *Startup and Restart of Nuclear Facilities*, DOE O 5480.21, *Unreviewed Safety Questions,* DOE 5480.22, *Technical Safety Requirements,* and DOE 5480.23, *Nuclear Safety Analysis Reports* contain the Department's requirements for implementing appropriate safety and hazards documentation for those facilities which warrant it. The requirement is emphasized here because of the potential for large consequences indicated in the safety and hazards analyses if this process is carefully adhered to.

Other Considerations. The requirement is included to implement one of the top-level requirements established for the Order revision, the use of the authorization basis concept. It was recognized during the development of essential requirements that some radioactive waste management facilities activities, and operations already function under the authorization basis system established in the Directives that are invoked by this requirement. This situation is addressed in the guidance on DOE M 435.1-1 under the General Requirement for a radioactive waste management basis.

E. Requirements of Other Regulations and DOE Directives.

(9) Life-Cycle Asset Management. Planning, acquisition, operation, maintenance, and disposition of radioactive waste management facilities shall be in accordance with DOE O 430.1A, *Life-Cycle Asset Management*, and DOE 4330.4B, *Maintenance Management Program*, including a configuration management process to ensure the integrity of physical assets and systems. Corporate physical asset databases shall be maintained as complete, current inventories of physical assets and systems to allow reliable analysis of existing and potential hazards to the public and workers.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all functions for all three radioactive waste types.

Safety and Hazard Analyses. Several effective mitigating actions were identified in the safety and hazard analyses that were assumed to be potentially covered by the implementation of a couple of newer DOE directives. These mitigating activities included improved planning for waste management activities, operations, and facilities, better maintenance of radioactive waste management facilities, equipment, and assets, and a configuration management process for controlling changes to facilities, activities, and requirements important to protection of the public, workers, and the environment. Numerous weaknesses and conditions in many functions were addressed by one of these mitigating actions.

Requirements Analysis. DOE O 430.1A, *Life-Cycle Asset Management*, and DOE 4330.4B, *Maintenance Management Program*, were evaluated and found to be adequate in implementing

improved life-cycle asset planning, project management, configuration control, and maintenance for radioactive waste management. Implementation of DOE O 430.1A essentially updates the reference in DOE 5820.2A, 6. References, to the canceled DOE Orders, DOE 4700.1 *Project Management System*, and DOE 4300.1B, *Real Property and Site Development Planning*. (Some additional life-cycle planning requirements appear in the waste type chapters where specific waste management situations warrant.)

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(10) Mixed Waste. Radioactive waste that contains both source, special nuclear, or by-product material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component is also subject to the *Resource Conservation and Recovery Act* (RCRA), as amended.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all functions for all three radioactive waste types.

Safety and Hazard Analyses. Mixed waste was included in the radioactive wastes that required management in the safety and hazard analyses for all three waste types. Needs for specific controls and specific weaknesses and conditions, if any, were addressed for the management of mixed waste. It was determined that, with a few exceptions, the hazardous constituents were probably sufficiently controlled by any hazardous waste requirements in place.

Requirements Analysis. The requirement implements the longstanding Department policy, reflected in the requirement DOE O 435.1, 4.b.(4) that radioactive waste management facilities, operations, and activities will comply with all applicable Federal, State, and local laws and regulations. This is consistent with and essentially continues the DOE 5820.2A Policy O.5, references to 10 CFR Part 962, in DOE 5820.2A, 6. References.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(11) Packaging and Transportation. Radioactive waste shall be packaged and transported in accordance with DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all Execute functions in all three radioactive waste type analyses that involve transport of radioactive waste to another facility. The requirement also derives from the packaging functions in the treatment, storage, and disposal functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide adequate controls on the packaging of radioactive waste, and transportation of radioactive waste management from facility to facility, to ensure the protection of the public, workers, and the environment. Transportation of radioactive waste has long been recognized as one of the most hazardous activities associated with radioactive waste management, and also, the activity is conducted with regularity, increasing the chances of a mishap. The requirement also addresses the weaknesses and conditions associated with poorly packaged radioactive waste, leaking waste packages, repackaging of waste, waste that must be returned to the generator, and waste that does not contribute to the performance of a disposal facility. The requirement also partially addresses the need to consider stakeholders in development of requirements or in decision making, a need identified in some of the program development requirements.

Requirements Analysis. The requirement is essentially equivalent to and updates the references in DOE 5820.2A, 6. References to several Departmental directives on transportation which have been canceled. DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management* were evaluated and found to be adequate in implementing packaging and transportation requirements for radioactive waste. (Some additional packaging and transportation requirements appear in the waste type chapters where specific waste management situations warrant.)

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(12) Quality Assurance Program. Radioactive waste management facilities, operations, and activities shall develop and maintain a quality assurance program that meets the requirements of 10 CFR 830.120, *Quality Assurance Requirements*, and DOE O 414.1, *Quality Assurance*, as applicable.

Basis:

Functions Evaluated. This requirement derives from the analysis of most of the Execute functions of all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for radioactive waste management facilities, operations, and activities that are important to protection of the public, workers, and the environment to adhere to a controlled process for contracting, production, record keeping, auditing, labeling, and other elements that are addressed in quality assurance programs implemented in nuclear facilities. The requirement addresses the weaknesses and conditions of poor quality materials, workmanship, documentation, training, and evaluations.

Requirements Analysis. This requirement implements requirements promulgated since DOE 5820.2A, 6. References, referred to DOE 5700.6B, *Quality Assurance*. 10 CFR 830.120, *Quality Assurance Requirements and Responsibilities*, and DOE O 414.1, *Quality Assurance*, provide Departmental approved quality assurance programs and processes adequate for radioactive waste management. They are emphasized in DOE M 435.1-1 because adherence to the requirements in Quality Assurance Programs was identified as an extremely effective mitigating factor for many weaknesses and conditions identified in the safety and hazard analyses .

Other Considerations. Following the requirements of the quality assurance directives also addresses the needs for conducting effective evaluations of radioactive waste management facilities, operations, and activities which were identified in the analysis of the Evaluate functions for all three waste types.

E. Requirements of Other Regulations and DOE Directives.

(13) Radiation Protection. Radioactive waste management facilities, operations, and activities shall meet the requirements of 10 CFR Part 835, *Occupational Radiation Protection,* and DOE 5400.5, *Radiation Protection of the Public and the Environment.*

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide the protection of the public, workers, and the environment from radioactive waste management operations and activities.

Requirements Analysis. The requirement is essentially equivalent to and updates the DOE 5820.2A, 6. References to several environmental compliance orders which have been canceled that required protection of the workers, public, and the environment for radioactive waste management operations and activities. These requirements are also consistent with the Policy of DOE 5820.2A contained in that Order at paragraph 5. 10 CFR Part 835, *Occupational Radiation Protection*, and DOE 5400.5, *Radiation Protection of the Public and Environment* are the

fundamental Departmental directives that provide these protection requirements. This requirement implements three of the top-level requirements of the Department for providing controls on the management of radioactive waste, and also implements in the Manual, the fundamental requirements of DOE O 435.1, O.4, Requirements.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(14) Records Management. Radioactive waste management facilities, operations, and activities shall develop and maintain a record-keeping system, as required by DOE O 200.1, *Information Management Program*, and DOE O 414.1, *Quality Assurance*. Records shall be established and maintained for radioactive waste generated, treated, stored, transported, or disposed. To the extent possible, records prepared in response to other requirements may be used to satisfy the documentation requirements of this Manual. Additional records may be required to satisfy the regulations applicable to the hazardous waste components of mixed waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all of the functions of all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for radioactive waste management facilities, operations, and activities to provide effective record keeping on information and data are important to protection of the public, workers, and the environment. The requirement addresses significant weaknesses and conditions associated with poor or lack of effective record keeping in storage, treatment, and disposal of waste. Particular concerns were identified when waste was left in storage longer than anticipated, during any transfers of waste and information, and for long-term considerations such as disposal.

Requirements Analysis. This requirement implements requirements promulgated since DOE 5820.2A, 6. References, referred to DOE 5700.6B, *Quality Assurance*. DOE O 200.1, *Information Management Program*, and DOE O 414.1, *Quality Assurance*, were evaluated and found to provide adequate record keeping controls for radioactive waste management. The requirement specifically calls out record keeping for the activities of generation, storage, treatment, transportation, and disposal because some significant consequences were identified if record keeping was not sufficient, and because poor record keeping practices had already contributed to known problems in the complex.

Other Considerations. This general requirement contains additional requirements beyond a reference to another DOE directive or a requirement due to consolidation of some similar requirements in the individual waste type chapters, and in response to comments on draft versions of the Manual.

E. Requirements of Other Regulations and DOE Directives.

(15) Release of Waste Containing Residual Radioactive Material. The process for determining and documenting that waste is suitable to be released and managed without regard to its radioactive content shall be in accordance with the criteria and requirements in DOE 5400.5, *Radiation Protection of the Public and the Environment.*

Basis:

Functions Evaluated. This requirement derives from the analysis of the Develop the program functions for low-level waste management.

Safety and Hazard Analyses. The requirement addresses the need to recognize that some low-level waste contains so little radioactivity that it is more appropriate to manage it without regard for its radioactive content, and still provide adequate protection to the public, workers, and the environment.

Requirements Analysis. The requirement is a new requirement that further implements policies established by the Office of Environment and Health for release of property containing residual radioactive material, including waste. Guidance for the policy, implemented under DOE 5440.5, entitled *Application of DOE 5400.5 Requirements for Release and Control of Property Containing Residual Radioactive Material,* is the source of the requirement statement. The Order and guidance are considered sufficient to implement a program and process for managing some radioactive waste without regard to its radioactivity.

Other Considerations. This requirement addresses the upper level criterion of achieving cost-effective operations for radioactive waste management. The final wording of the requirement is consistent with the policy direction of the Office of Environment and Health.

E. Requirements of Other Regulations and DOE Directives.

(16) Safeguards and Security. Appropriate features shall be incorporated into the design and operation of radioactive waste management facilities, operations, and activities to prevent unauthorized access and operations, and for purposes of nuclear materials control and accountability, where applicable; and shall be consistent with DOE O 470.1, *Safeguards and Security Program*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate security and safeguards of special nuclear material to be implemented and conducted for all radioactive waste management operations and activities. Weaknesses and conditions associated with lack of or poor security and safeguards were identified repeatedly in the safety and hazards analysis

Requirements Analysis. Analysis of DOE O 470.1, *Safeguards and Security Program*, indicates that the essential requirements necessary for effective deployment of safeguards and security at DOE radioactive waste management facilities are in that directive. Meeting these requirements is emphasized by this DOE M 435.1-1 requirement because the weaknesses and conditions associated with poor or lack of security and safeguards for special nuclear material were repeatedly identified as potentially contributing to management problems with radioactive waste.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(17) Safety Management System. Radioactive waste management facilities, operations, and activities shall incorporate the principles of integrated safety management as described in DOE P 450.4, *Safety Management System Policy*, and DOE P 450.5, *Line Environment, Safety and Health Oversight*, and meet the requirements of the safety management systems sections of 48 CFR Chapter 9, *Department of Energy Acquisition Regulations* and DOE M 411.1-1, *Manual of Safety Management Functions, Responsibilities, and Authorities*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Evaluate functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for the Department's integrated Safety Management System's policies and procedures to be implemented for all radioactive waste management facilities, operations, and activities. Weaknesses and conditions associated with lack of or poor oversight and evaluations of radioactive waste management functions were identified repeatedly in the safety and hazards analysis. The need for systematic evaluation of radioactive waste management programs, facilities, and operations was identified during development of the Implementation Plan in response to Defense Nuclear Facilities Safety Board Recommendation 94-2, and is included as a commitment to the Board in that document.

Requirements Analysis. During the requirements analysis, the Department's integrated Safety Management System was still in a developmental stage, and the benefits of full implementation of it were not recognized. Even though some elements of the system were used in the development of the Order and Manual, the original set of requirements did not include a citation for radioactive waste management facilities, operations, and activities to follow the Safety Management System requirements (see Other Considerations). Only a few requirements were cited in the Manual concerning evaluations of programs, facilities, operations, and activities and how to utilize the results of evaluations for improvement.

Other Considerations. In response to comments on the draft versions of the Order and Manual by DOE-EH, the citation for following the Department's integrated Safety Management System was added. Effective evaluations and oversight of radioactive waste management facilities, operations, and activities will result from following the Safety Management System Directives. Improvements from feedback systems, such as internal safety audits, will result from full implementation of the Safety Management System.

E. <u>Requirements of Other Regulations and DOE Directives</u>.

(18) Site-Evaluation and Facility Design. New radioactive waste management facilities, operations, and activities shall be sited and designed in accordance with DOE O 420.1, *Facility Safety*, and DOE O 430.1A, *Life-Cycle Asset Management*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute function for constructing new facilities in all three radioactive waste type analyses.

Safety and Hazard Analyses. The requirement addresses the need to provide adequate site characteristics to the facility design process, and for adequately designing the facility to address protection of the public, workers, and the environment. The requirement addresses numerous weaknesses and conditions associated with problems that could potentially develop from poor design, especially in terms of processing waste in treatment, and in the need for long-term performance of a disposal facility. The requirement partially addresses some scenarios in the safety and hazards analyses that have high consequences associated with an accident involving the facility.

Requirements Analysis. The requirement is essentially equivalent to and updates the references in DOE 5820.2A, 6. <u>References</u> to DOE 6430.1A, which is canceled. DOE O 420.1, *Facility Safety*, and DOE O 430.1A, *Life-Cycle Asset Management* were evaluated and found to be mostly adequate in implementing site evaluation and facility design requirements for radioactive waste management facilities. However, some weaknesses and conditions significant to

management of radioactive waste are not specifically addressed in these two Orders. They are still invoked because they do address a large number of weaknesses and conditions, and also establish administrative and program elements that are necessary to control site evaluation and facility design. To address the specific weaknesses and conditions not addressed in the two Orders, additional site evaluation and facility design requirements appear in the waste type chapters where specific waste management situations warrant.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(19) Training and Qualification. A training and qualification program shall be implemented for radioactive waste management program personnel, and shall meet the requirements of DOE O 360.1, *Training*, and DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate training and qualification of personnel to be implemented and conducted for all radioactive waste management operations and activities important to protection of the public, workers, and the environment. Weaknesses and conditions associated with lack of or poor training and personnel qualifications were identified repeatedly in the safety and hazards analysis

Requirements Analysis. Analysis of DOE O 360.1, *Training*, and DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*, indicates that they provide the essential requirements necessary for effective development of training procedures and programs and qualification of personnel procedures at DOE radioactive waste management facilities. Meeting these requirements is emphasized by this DOE M 435.1-1 requirement because the weaknesses and conditions associated with poor or lack of training and qualification of personnel was repeatedly identified as potentially contributing to management problems with radioactive waste.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(20) Waste Minimization and Pollution Prevention. Waste minimization and pollution prevention shall be implemented for radioactive waste management facilities, operations, and activities to meet the requirements of Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements*, and Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, and DOE 5400.1, *General Environmental Protection Program*.

Basis:

Functions Evaluated. This requirement derives from the analysis of specific functions identified in the analysis of all three waste types for minimization of waste generation.

Safety and Hazard Analyses. The safety and hazard analyses identified that waste minimization, pollution prevention, and where appropriate, volume reduction, were effective mitigating actions against many of the hazards associated with radioactive waste management.

Requirements Analysis. The requirement is consistent with the policy implemented at DOE 5820.2A, paragraph 5. The existence of several executive level positions that are called out in the requirement provided the necessary controls that were needed to flow down to appropriate waste minimization techniques at the actual activity level, and were found to be sufficient.

Other Considerations. Implementation of waste minimization and pollution prevention was one of the top-level principles formulating the basic requirements for the Order and Manual.

E. Requirements of Other Regulations and DOE Directives.

(21) Worker Protection. Radioactive waste management facilities, operations, and activities shall meet the requirements of DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide the protection of the workers from radioactive waste management operations and activities that involve hazards not solely associated with the radioactive characteristic of material being used, but which are required to be conducted. Because of the need to provide protection from the radioactive hazard, workers

may be subjected to other hazards, such as working in confined spaces, or with complex machinery, that involve their own hazards for which workers must be protected.

Requirements Analysis. The requirement is consistent with the Policy of DOE 5820.2A contained in that Order at paragraph 5. for protecting workers. DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* is the Departmental directive that provides the basic protection requirements for workers. This requirement implements the top-level requirement of the Department for providing controls on the management of radioactive waste, and also implements in the Manual, the requirements of DOE O 435.1, O.4 Requirements, paragraph (3), *Protect the work force.*

Other Considerations. None.

2. RESPONSIBILITIES

A. Program Secretarial Officers. Program Secretarial Officers with radioactive waste management facilities, operations, or activities are responsible within their respective programs for ensuring that the Field Element Managers meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

B. Assistant Secretary for Environmental Management. The Assistant Secretary for Environmental Management is responsible for:

(1) Complex-Wide Radioactive Waste Management Programs. Establishing and maintaining integrated Complex-Wide Radioactive Waste Management Programs for high-level, transuranic, low-level, and mixed low-level waste. These programs shall use a systematic approach to planning, execution, and evaluation to ensure that waste generation, storage, treatment, and disposal needs are met and coordinated across the DOE complex.

(2) Changes to Regulations and DOE Directives. Ensuring changes to regulations and DOE directives are reviewed and, when necessary, incorporated into revisions of this Manual to ensure the basis for safe radioactive waste management facilities, operations, and activities is maintained.

C. Assistant Secretary for Environment, Safety, and Health. The Assistant Secretary for Environment, Safety and Health is responsible for providing an independent overview of DOE radioactive waste management and

decommissioning programs to determine compliance with DOE environment, safety, and health requirements and applicable Environmental Protection Agency (EPA) and state regulations, including:

(1) Advising the Secretary of the status of Departmental compliance with the requirements of DOE O 435.1, this Manual, and applicable provisions of other DOE Orders.

(2) Conducting independent appraisals and audits of DOE waste management programs.

(3) Reviewing site Waste Management Plans with regard to compliance with DOE environment, safety, and health requirements.

D. <u>Deputy Assistant Secretary for Waste Management</u>. The Deputy Assistant Secretary for Waste Management is responsible for:

(1) Complex-Wide Radioactive Waste Management Program Plans. Developing, implementing, and maintaining integrated Complex-Wide Radioactive Waste Management Program Plans for high-level, transuranic, low-level, and mixed low-level waste. Each plan shall, at the DOE complex-wide level, describe the functional elements, organizations, responsibilities, and activities that comprise the system needed to store, treat and dispose of radioactive waste in a manner that is protective of the public, workers, and the environment. In addition, the plans shall:

(a) Present a waste management strategy that integrates waste projections and life-cycle waste management planning into complex-wide facility configuration decisions; and

(b) Describe the approach to research and technology development being pursued to improve safety and/or efficiency in managing radioactive waste.

(2) Waste Management Data System. Establishing and maintaining a system to compile waste generation projection data and other information concerning radioactive waste management facilities, operations, and activities across the complex.

E. <u>Deputy Assistant Secretaries for Waste Management and Environmental Restoration</u>. The Deputy Assistant Secretary for Waste Management and the Deputy Assistant Secretary for Environmental Restoration are responsible for:

(1) Disposal. Reviewing and approving, along with EH-1, transuranic waste disposal facility performance assessments and other disposal documents as required in waste specific chapters for which DOE is responsible for making compliance determinations. Reviewing and approving performance assessments and composite analyses, or appropriate CERCLA documentation, for low-level waste disposal facilities, and issuing disposal authorization statements.

(a) The Deputy Assistant Secretaries shall establish a review panel consisting of DOE personnel to review low-level waste disposal facility performance assessments and composite analyses, review appropriate CERCLA documentation, recommend low-level waste disposal facility compliance determinations to the Deputy Assistant Secretaries, and develop disposal authorization statements.

(b) The Deputy Assistant Secretaries shall issue disposal authorization statements containing conditions that low-level waste disposal facilities must meet in order to operate with an approved radioactive waste management basis.

(2) Site Closure Plans. Reviewing and approving closure plans and other closure documentation for deactivated high-level waste facilities/sites and issuing authorization for closure activities to proceed.

Basis:

Functions Evaluated. Generally the Responsibilities do not derive from the analysis of radioactive waste management functions. The specific responsibilities reflected in the above requirements are derived from the analysis of the top-level functions of Develop, Execute, and Evaluate the Program evaluated for all three radioactive waste management types.

Safety and Hazard Analyses. Generally, the Responsibilities do not derive from the safety and hazards analyses of radioactive waste management. These requirements address the Low-Level Waste Complex-Wide Review Vulnerabilities on Waste Forecasting, Disposal Facility Capacity, and Approval of Radiological Performance Assessments for low-level waste disposal facilities. The responsibility concerning changes to regulations did derive from the safety and hazards analyses. Existing regulations and directives were found to provide controls which mitigated weakness and conditions identified during the safety and hazards analysis, so any changes in these existing regulations need to be analyzed for their impact on the safety of radioactive waste management activities.

Requirements Analysis. These requirements are essentially equivalent to the assignments of Responsibilities in DOE 5820.2A. The specific responsibilities reflect updates to the responsibilities in DOE 5820.2A to reflect the current organizations, revisions to remove any responsibility discussions of organizations that do not implement any essential radioactive waste management functions or requirements, the implementation of the principle of a radioactive waste management basis for operating a facility, and the implementation of the majority of radioactive waste management functions integral to protecting the public, the workers, and the environment by DOE field operations. Commitments made in response to Defense Nuclear Facilities Safety Board Recommendation 94-2 provide the basis for the review and approval of performance assessments and composite analyses, and the issuance of a disposal authorization statement (see Other Considerations). The low-level waste chapter technical basis contains additional discussions about these requirements.

Other Considerations. The final wording and the elements that appear in the Responsibilities section result from achieving consistency between waste type chapters and from responses to comments on the draft versions of the Manual. The specific discussions on the review panel for low-level waste disposal facilities' performance assessments and composite analyses are included in response to comments made by the Defense Nuclear Facilities Safety Board so that DOE M 435.1-1 would be consistent with commitments made and review methods implemented in response to Recommendation 94-2.

2. RESPONSIBILITIES

F. Field Element Managers. Field Element Managers are responsible for:

(1) Site-Wide Radioactive Waste Management Programs. Developing, documenting, implementing, and maintaining a Site-Wide Radioactive Waste Management Program. The Program shall use a systematic approach for planning, executing, and evaluating the site-wide management of radioactive waste in a manner that supports the Complex-Wide Radioactive Waste Management Programs and ensures that the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Radioactive Waste Management Basis. Ensuring a radioactive waste management basis is developed and maintained for each DOE radioactive waste management facility, operation, and activity; and ensuring review and approval of the basis before operations begin. The Radioactive Waste Management Basis shall:

(a) Reference or define the conditions under which the facility may operate based on the radioactive waste management documentation;

(b) Include the applicable elements identified in the specific waste-type chapters of this Manual; and

(c) Be developed using the graded approach process.

(3) Waste Minimization and Pollution Prevention. Ensuring implementation of waste minimization and pollution prevention programs.

(4) Approval of Exemptions for Use of Non-DOE Facilities. DOE radioactive waste shall be treated, stored, and in the case of low-level waste, disposed of at the site where the waste is generated, if practical; or at another DOE facility. If DOE capabilities are not practical or cost effective, exemptions may be approved to allow use of non-DOE facilities for the storage, treatment, or disposal of DOE radioactive waste based on the following requirements:

(a) Such non-DOE facilities shall:

1. Comply with applicable Federal, State, and local requirements;

2. Have the necessary permit(s), license(s), and approval(s) for the specific waste(s); and

3. Be determined by the Field Element Manager to be acceptable based on a review conducted annually by DOE.

(b) Exemptions for the use of non-DOE facilities shall be documented to be cost effective and in the best interest of DOE, including consideration of alternatives for on-site disposal, an alternative DOE site, and available non-DOE facilities; consideration of life-cycle cost and potential liability; and protection of public health and the environment.

(c) DOE waste shall be sufficiently characterized and certified to meet the facility's waste acceptance criteria.

(d) Appropriate *National Environmental Policy Act* (NEPA) review must be completed. For actions taken under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), it is DOE's policy to incorporate NEPA values into the CERCLA documentation.

(e) Headquarters shall be notified of any exemption allowing use of a non-DOE facility and the Office of the Assistant Secretary for Environment, Safety and Health (EH-1) shall be consulted prior to the exemption being executed.

(f) Host States and State Compacts where non-DOE facilities are located shall be consulted prior to approval of an exemption to use such facilities and notified prior to shipments being made.

(5) Environmental Restoration, Decommissioning, and Other Cleanup Waste. Ensuring the management and disposal of radioactive waste resulting from environmental restoration activities, including decommissioning, meet the substantive requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual. Environmental restoration activities using the CERCLA process (in accordance with Executive Order 12580) may demonstrate compliance with the substantive requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual (including the Performance Assessment and performance objectives, as well as the Composite Analysis) through the CERCLA process. However, compliance with all substantive requirements of DOE O 435.1 not met through the CERCLA process must be demonstrated. Environmental restoration activities which will result in the off-site management and disposal of radioactive waste must meet the applicable requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual for the management and disposal of those off-site wastes. Field Elements performing environmental restoration activities involving development and management of radioactive waste disposal facilities under the CERCLA process shall:

(a) Submit certification to the Deputy Assistant Secretary for Environmental Restoration that compliance with the substantive requirements of DOE O 435.1 have been met through application of the CERCLA process; and

(b) Submit the decision document, such as the Record of Decision, or any other document that serves as the authorization to dispose, to

the Deputy Assistant Secretary for Environmental Restoration for approval.

(6) Radioactive Waste Acceptance Requirements. Ensuring development, review, approval, and implementation of the radioactive waste acceptance requirements for facilities that receive waste for storage, treatment, or disposal. Radioactive waste acceptance requirements shall establish the facility's requirements for the receipt, evaluation, and acceptance of waste.

(7) Radioactive Waste Generator Requirements. Ensuring development, review, approval, and implementation of a program for waste generation planning, characterization, certification, and transfer. This program shall address characterization of waste, preparation of waste for transfer, certification that waste meets the receiving facility's radioactive waste acceptance requirements, and transfer of waste.

(8) Closure Plans. Ensuring development, review, approval, and implementation of closure plans for radioactive waste management facilities in accordance with the applicable requirements in the waste-type chapters of this Manual.

(9) Defense-In-Depth. Ensuring defense-in-depth principles are incorporated where potential uncertainties or vulnerabilities warrant their use when reviewing and approving radioactive waste management activities and documents. These principles advocate the use of multiple levels of engineered and administrative controls to provide protection to the public, workers, and the environment.

(10) Oversight. Ensuring oversight of radioactive waste management facilities, operations, and activities is conducted. Oversight shall ensure radioactive waste management program activities are conducted in accordance with a radioactive waste management basis and meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(11) Training and Qualification. Ensuring a training and qualification program is implemented for designated radioactive waste management program personnel, and the training is commensurate with job duties and responsibilities. Only those personnel who have been trained and qualified shall design or operate safety (safety class and safety significant) structures, systems, and components.

(12) As Low As Reasonably Achievable (ALARA). Ensuring ALARA principles for radiation protection are incorporated when reviewing and approving radioactive waste management activities.

(13) Storage. Ensuring all radioactive waste is stored in a manner that protects the public, workers, and the environment in accordance with a radioactive waste management basis, and that the integrity of waste storage is maintained for the expected time of storage and does not compromise meeting the disposal performance objectives for protection of the public and environment when the waste is disposed.

(14) Treatment. Ensuring all radioactive waste requiring treatment is treated in a manner that protects the public, workers, and the environment and in accordance with a radioactive waste management basis.

(15) Disposal. Ensuring radioactive waste is disposed in a manner that protects the public, workers, and the environment and in accordance with a radioactive waste management basis. Reviewing specific transuranic or low-level waste documentation including the performance assessment and composite analysis, or appropriate CERCLA documentation, prior to forwarding them to Headquarters for approval, and obtaining and ensuring the facility is operated in accordance with the disposal authorization statement. Conducting performance assessment and composite analysis maintenance.

(16) Monitoring. Ensuring monitoring is conducted for all radioactive waste management facilities as required. Ensuring that disposal facilities are monitored, as appropriate, for compliance with conditions of the disposal authorization statement.

(17) Material and Waste Declassification and Waste Management. Ensuring, to the extent practical, radioactive material and waste generated under a program that is classified for national security reasons is declassified or rendered suitable for unclassified radioactive waste management.

(18) Waste Incidental to Reprocessing. Ensuring that waste incidental to reprocessing determinations are made by either the "citation" or "evaluation" process described in Chapter II of this Manual. Ensuring consultation and coordination with the Office of Environmental Management for waste determined to be incidental to reprocessing through the "evaluation" process.

(19) Waste With No Identified Path to Disposal. Ensuring a process is developed and implemented for identifying the generation of radioactive waste with no identified path to disposal, and reviewing and approving conditions under which radioactive waste with no identified path to disposal may be generated. Headquarters shall be notified of the decisions to generate a waste with no identified path to disposal.

(20) Corrective Actions. Ensuring a process exists for proposing, reviewing, approving, and implementing corrective actions when necessary to ensure that the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual are met, and to address conditions that are not protective of the public, workers, or the environment. The process shall allow workers, through the appropriate level of management, to stop or curtail work when they discover conditions that pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Basis:

Functions Evaluated. Generally the Responsibilities for the Field Element Manager do not derive from the analysis of any specific radioactive waste management functions. However, the specific responsibility of the Field Element Manager to develop and implement a site-wide radioactive waste management program is derived from the analysis of the top-level functions of Develop, Execute, and Evaluate the Program evaluated for all three radioactive waste management types.

Safety and Hazard Analyses. Generally, the Responsibilities do not derive from the safety and hazards analyses of radioactive waste management. These requirements do address the Complex-Wide Review Vulnerabilities on Waste Forecasting, Disposal Facility Capacity, Storage of Low-Level Waste, Waste Characterization, and No Path Forward Waste.

Requirements Analysis. These requirements are basically equivalent to the assignment of Responsibilities in DOE 5820.2A to the heads of field organizations. These specific responsibilities reflect updates to the responsibilities in DOE 5820.2A to reflect the current facilities, functions, operations, organizations, and activities associated with radioactive waste management, the implementation of the principle of a radioactive waste management basis for operating a facility, and the implementation of the majority of radioactive waste management functions integral to protecting the public, the workers, and the environment by DOE field operations. Commitments made in response to Defense Nuclear Facilities Safety Board Recommendation 94-2 provide the basis for several specific Field Element Manager responsibilities. The language for some of these is derived from the DNFSB 94-2 deliverable, “Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management

and Disposal," (letter from A. Alm, July 31, 1996), and the DNFSB 94-2 deliverable, "Guidance for Complying with DOE 5820.2A, *Radioactive Waste Management,* for Onsite Management and Disposal of Low-Level Waste (LLW) Resulting from Environmental Restoration Activities." Language for the use of non-DOE facilities requirement is derived from, "Delegation of Authority to Grant Exemptions to Department of Energy Order 5820.2A to Allow for the Use of Commercial Facilities for Disposal of Department of Energy Low-Level Waste."

Other Considerations. Implementation of waste minimization and pollution prevention, defense-in-depth, a radioactive waste management basis, ALARA, and corrective actions reflect implementation of top-level criteria for the Order and Manual requirements development. Also, some of the requirements implement specific responsibilities of the Department's Integrated Safety Management System. (The implementation of the top-level criteria and the Department's integrated safety management system continues through the specification of some waste type chapter requirements. The waste type chapter technical bases should be consulted for additional discussions to find those contributions to meeting the upper level criteria). The final contents of some of the Field Element Manager responsibilities is due to achieving consistency among the waste types. This included consolidating elements of a requirement common to all three waste types into one general requirement, and responding to comments on draft versions of the Manual, especially from field personnel.

G. All Personnel. All personnel are responsible for:

(1) Problem Identification. Identifying and reporting radioactive waste management facilities, operations, or activities that do not meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual, or that pose a threat to the safety of the public, workers, or the environment.

(2) Shutdown or Curtailment of Activities. Stopping or curtailing work, through the appropriate level of management, to prohibit continuation of conditions or activities which pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Basis:

Functions Evaluated. Generally the Responsibilities do not derive from the analysis of radioactive waste management functions. These responsibilities of all personnel involved with radioactive waste management derive from the analysis of the top-level function of Evaluate the Program for all three radioactive waste management types.

Safety and Hazard Analyses. Generally, the Responsibilities do not derive from the safety and hazards analyses of radioactive waste management.

Requirements Analysis. New requirement derived for the Manual. DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees,* was evaluated and this essential set of requirements was derived from the requirements of that Order.

Other Considerations. Implementation of responsibilities for identification of problems and implementing corrective actions through appropriate levels of management implements the Department's integrated safety management system, as invoked in the introductory requirement to this section of the Manual, Requirements of Other Regulations and DOE Directives.

BASIS FOR REGULATION OF HIGH-LEVEL WASTE

The Department of Energy (DOE) O 5820.2A, *Radioactive Waste Management,* issued in September 1988, established the policies and guidelines for managing the Department's high-level waste and any other materials which, because of their highly radioactive nature (level of health risk, longevity of health risk and thermal activity) require similar handling. The Order assumed that unless demonstrated to the contrary, all high-level waste shall be considered to be radioactive mixed waste and subject to the requirements of the *Atomic Energy Act of 1954,* as amended, and the *Resource Conservation and Recovery Act*. In addition, the Order did not apply to the management by the Department of commercially generated high-level radioactive waste nor did it apply to the geologic disposal of high-level waste produced by the Department's activities and operations. Such materials were to be managed by the Office of Civilian Radioactive Waste Management under the requirements of the *Nuclear Waste Policy Act of 1982*, as amended.

The basic assumptions made in DOE 5820.2A for the management of high-level waste are still valid for DOE O 435.1. However, since the issuance of DOE 5820.2A the need to comply with a series of regulatory requirements has contributed to the focus and content of the revised *Radioactive Waste Management* Order, DOE O 435.1. For example, since 1988 the Office of Civilian Radioactive Waste Management has issued DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD), that describes the technical requirements and functions to be satisfied by high-level waste form producers in order that their spent nuclear fuel and high-level radioactive waste can be accepted into the Civilian Radioactive Waste Management System. The waste acceptance requirements contained in this document are derived from a number of documents, including statutes, regulations, and DOE directives with a primary driver being the Nuclear Regulatory Commission's 10 CFR Part 60 regulation, *Disposal of High-Level Radioactive Wastes in Geologic Repositories.* In response to the WASRD the DOE Office of Environmental Management has developed, and implemented, DOE-EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS), which serve as the technical specifications which the high-level waste form producers are required to meet in order to ensure acceptance of their vitrified waste form into the Civilian Radioactive Waste Management System.

In 1992, Congress passed amendments to the *Solid Waste Disposal Act*, entitled the *Federal Facility Compliance Act*, which required DOE to prepare plans for the developing treatment capacities and technologies for mixed waste. Pursuant to this Act, DOE prepared site-specific treatment plans, and consent orders or agreements that were reached with the affected States and EPA. These consent orders and agreements typically specify how and when high-level wastes which also exhibit hazardous characteristics or contain RCRA-regulated hazardous components are to be retrieved, characterized, treated, and stored for shipment to the geologic repository. This process has involved many stakeholder groups and different regulatory entities.

The High-Level Waste Requirements chapter of the *Radioactive Waste Management Manual*, DOE M 435.1-1, is consistent with the legislation and requirements associated with the disposal of high-level waste at a geologic repository. In addition, to requirements contained in DOE 5820.2A, the current requirements for the management of high-level waste have been prepared to apply to a broad range of management functions, from generation through storage, pretreatment, treatment, and post-treatment storage. The previously detailed requirements related to managing and preparing waste for disposal are now replaced by a higher-level, performance-based set of requirements.

The following pages explain the basis for the high-level waste management requirements included in DOE M 435.1-1.

CHAPTER II

HIGH-LEVEL WASTE REQUIREMENTS

II.A. Definition of High-Level Waste.

High-level waste is the highly radioactive waste 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 other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

Basis:

Functions Evaluated. Requirement is not based on functions.

Safety and Hazard Analyses. Requirement is not based on safety and hazard analyses.

Requirements Analysis. The requirement is based on the definition of high-level waste contained in the *Nuclear Waste Policy Act of 1982*, as amended, and implemented by 10 CFR Part 60, *Disposal of High-Level Radioactive Waste in Geologic Repositories.* Slight revisions to the *Nuclear Waste Policy Act* definition for high-level waste were directed by DOE General Counsel for the definition contained in DOE M 435.1-1. These revisions include a deletion of the reference to the Nuclear Regulatory Commission. This is replaced by the wording "consistent with existing law," and remains a mechanism for determining a waste is high-level waste. The wording in DOE M 435.1-1 is fundamentally the same as the definition contained in DOE 5820.2A. However, this latter definition, contained in an attachment to the Order titled, *Definitions*, did not include the authority for other waste to be determined to be high level that require permanent isolation.

Other Considerations. This definition reflects DOE application of the statutory definitions to the scope of this Order. High-level waste, as defined in DOE M 435.1-1, does not include DOE-managed spent nuclear fuel since, at the time of the preparation of the Manual, DOE had not declared this material a waste.

II.B. Waste Incidental to Reprocessing.

Waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not high-level waste, and shall be managed under DOE's regulatory authority in accordance with the requirements for transuranic

waste or low-level waste, as appropriate. When determining whether spent nuclear fuel reprocessing plant wastes shall be managed as another waste type or as high-level waste, either the citation or evaluation process described below shall be used:

(1) Citation. Waste incidental to reprocessing by citation includes spent nuclear fuel reprocessing plant wastes that meet the description included in the Notice of Proposed Rulemaking (34 FR 8712) for proposed Appendix D, 10 CFR Part 50, Paragraphs 6 and 7. These radioactive wastes are the result of reprocessing plant operations, such as, but not limited to: contaminated job wastes including laboratory items such as clothing, tools, and equipment.

(2) Evaluation. Determinations that any waste is incidental to reprocessing by the evaluation process shall be developed under good record-keeping practices, with an adequate quality assurance process, and shall be documented to support the determinations. Such wastes may include, but are not limited to, spent nuclear fuel reprocessing plant wastes that:

(a) Will be managed as low-level waste and meet the following criteria:

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

3. Are to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*; or will meet alternative requirements for waste classification and characterization as DOE may authorize.

(b) Will be managed as transuranic waste and meet the following criteria:

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

2. Will be incorporated in a solid physical form and meet alternative requirements for waste classification and characteristics, as DOE may authorize; and

3. Are managed pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, in accordance with the provisions of Chapter III of this Manual, as appropriate.

Basis:

Functions Evaluated. This requirement is not based on functions.

Safety and Hazard Analyses. This requirement is not based on safety and hazard analyses.

Requirements Analysis. The Citation process is based on the cited Federal Register Notice, Notice of Proposed Rulemaking (34 FR 8712) for Appendix D, 10 CFR Part 50. The Evaluation process is based on the NRC response to the petition regarding disposal of waste at the Hanford site, the NRC (States of Washington & Oregon): Denial of Petition for Rulemaking, 58 FR 12342-12347, March 4, 1993; and the NRC previous determination that similar operations at SRS (separation of the low-activity fraction) should be characterized as incidental waste and not high-level waste (*52 FR 5992-6001*). DOE 5820.2A did not contain a requirement regarding a waste incidental to reprocessing determination process.

Other Considerations. Requirement reflects input from discussions with the NRC staff and the DOE Office of General Counsel and DOE Office of Environment, Safety, and Health (EH). Discussions with NRC staff resulted in their offer to review, on macro basis, DOE Evaluation Process determinations, if DOE decided their participation was needed. DOE General Counsel's review of draft versions of the Evaluation process agreed with the NRC, NRC participation is not required and that DOE clearly has the authority to review and accept Evaluation process determinations. DOE EH review resulted in clarifying the differences in evaluation process criteria for low-level waste and transuranic waste. This requirement formalizes a determination process that has been used by DOE high-level waste sites.

II.C. Management of Specific Wastes.

The following provide for management of specific wastes as high-level waste in accordance with the requirements in this Chapter:

(1) Mixed High-Level Waste. Unless demonstrated otherwise, all high-level waste shall be considered mixed waste and is subject to the requirements of both the *Atomic Energy Act of 1954*, as amended, the *Resource Conservation and Recovery Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. High-level waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Basis:

Functions Evaluated. Requirement is not based on functions.

Safety and Hazard Analyses. Requirement is not based on safety and hazards analyses.

Requirements Analysis. This requirement is based on DOE policy to ensure conservatism in complying with the requirements of the *Resource Conservation and Recovery Act*, as amended, and the *Toxic Substances Control Act*, as amended. DOE 5820.2A, paragraph I.1., also required that all high-level waste be considered mixed waste unless demonstrated otherwise.

Other Considerations. Since high-level waste may contain hazardous constituents, this requirement contributes to defense-in-depth and protection of workers and the environment, and is a best management practice.

II.D. <u>Complex-Wide High-Level Waste Management Program</u>.

A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level high-level waste management functions: formulate, execute, and evaluate the high-level waste program.

Safety and Hazard Analyses. This requirement addresses the need for a complex-wide integrated program that is necessary for planning, executing, and evaluating the high-level waste program. The requirement addresses the needs for a description of functional elements, organizations, responsibilities and activities that comprise the system needed to manage high-level waste. It also addresses the need to develop a waste management strategy that integrates waste

projections and life-cycle waste management planning into complex-wide facility configuration decisions.

Requirements Analysis. The requirement for a high-level waste management program has no predecessor requirements in DOE 5820.2A. A site-wide radioactive waste program is established in Chapter I of the Manual to accomplish appropriate flow of information between the sites and the complex-wide program. The requirement for a high-level waste management program plan is an improvement to the requirement for a waste management plan in Chapter VI of DOE 5820.2A. The high-level waste management program plan is an integrated, complex-wide, plan developed using input from the site-wide radioactive waste management programs required in Chapter I of the Manual.

Other Considerations. Facility optimization, configuration management, cost-savings, and the other goals of the high-level waste management program are best accomplished by an integrated program that includes documented milestones and measures of accomplishment.

II.E. Site-Wide Radioactive Waste Management Program.

In addition to the items in Chapter I of this Manual, documentation of the Site-Wide Radioactive Waste Management Program shall include a description of the High-Level Waste Systems Engineering Management Program to support decision-making related to nuclear safety, including high-level waste requirements analysis, functional analysis and allocation, identification of alternatives, and alternative selection and system control.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level high-level waste management functions: formulate, execute, and evaluate the high-level waste program.

Safety and Hazard Analyses. This requirement addresses the need for a documented logical basis for making significant high-level waste programmatic decisions that are important to nuclear safety that are reflected in the site-wide radioactive waste management program. This site-wide integrated program that is necessary for planning, executing, and evaluating the high-level waste program at each site becomes an input to the complex-wide plan required by section II.D.

Requirements Analysis. The content of this requirement is based on interim technical standard, EIA/IS-632 *System Engineering* dated December 1994, published by the Electronic Industries Association. This same interim standard is also cited in DRAFT DOE G 420.1-X *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria,* Rev. G dated September 1995. Standards Proposal No. 3537-A has been issued which proposes to upgrade and revise EIA/IS-632. When the proposed upgrade and revision is approved, the

standard will be published as ANSI/EIA-632, and EIA-IS-632 will be CANCELED. DOE 5820.2A did not specifically require systems engineering to support decision making related to nuclear safety.

Other Considerations. This requirement is included in DOE O 435.1 based on DOE's Implementation Plan in response to DNFSB Recommendation 92-4, which proposed a systems engineering approach to construct a rational and integrated program at the Hanford site. No specific weakness from the hazard and risk analysis is cited to justify this requirement. However, the Order Revision Team used a systems engineering approach to identify the functions and conduct the hazards analyses.

II.F. Radioactive Waste Management Basis.

High-level waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Pretreatment and Treatment Facilities. The waste acceptance requirements and waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level high-level waste management functions: formulate, execute, and evaluate the high-level waste management program.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions due to the lack of, or poor integration of programs, documentation, and controls considered important for the safe operation of high-level waste management facilities.

Requirements Analysis. The requirement for a radioactive waste management basis for high-level waste management facilities has no predecessor requirements in DOE 5820.2A. As described in M 435.1-1, Section I.2.F.(2), the radioactive waste management basis references, or defines, the conditions under which a facility may operate based on radioactive waste management documentation, using the graded approach process. It also specifically includes certain elements identified in the specific waste-type chapters of the Manual. For high-level waste, the waste

certification program and the waste acceptance requirements are specifically identified. However, the identification of these two specific requirements does not preclude the inclusion of other requirements from the high-level waste Manual. For instance, the controls for maintaining a safe operating envelope under which the use of tanks that are known or suspected to have leaked previously for continued storage of high-level waste may very well be included as part of the authorization basis. The radioactive waste management basis employs the principles of the Authorization Basis for radioactive facilities, as required by DOE 5480.21, *Unreviewed Safety Questions,* and DOE 5480.23, *Nuclear Safety Analysis Reports,* and extends them to facilities and operations that are not subject to the requirements of these Orders.

Other Considerations. The radioactive waste management basis concept being employed is performance-based and employs the graded approach process, i.e., the rigor of documentation is commensurate with the hazards of the activities being carried out at a given facility. The concept also supports the defense-in-depth philosophy for added worker protection.

II.G. Quality Assurance Program.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Product Quality. The requirements of RW-0333P, *Quality Assurance Requirements and Description,* shall apply to those high-level waste items and activities important to waste acceptance/product quality.

(2) Audits and Assessments. The evaluation and assessment requirements of RW–0333P, *Quality Assurance Requirements Document and Description*, and associated implementing procedures shall be met for high-level waste acceptance and product quality activities, in addition to the assessment requirements of other DOE directives and requirements identified in Chapter I of this Manual.

Basis:

Functions Evaluated. The requirement is based on the analysis of treating high-level waste and storing immobilized high-level waste

Safety and Hazard Analyses. This analysis identified low range probabilities and consequences that resulted from a weakness in inspection of immobilized high-level waste and the treatment (immobilization) of high-level waste.

Requirements Analysis. The requirement invokes the requirements contained in RW-0333P, *Quality Assurance Requirements Document and Description.* DOE 5820.2A contained QA requirements but did not cite DOE/RW-0333P.

Other Considerations. These requirements are also included based on statutory (*Nuclear Waste Policy Act of 1982*, as amended), regulatory (10 CFR Part 60) and DOE Policy (DOE/RW-0333P) directives. For the purpose of activities within the scope of DOE O 435.1, the statute, requirement, and policy apply to development, production and acceptance of the solidified high-level waste form. The statute supports the DOE longstanding planning that DOE high-level waste be disposed in a geologic repository regulated by NRC, for which the Quality Assurance requirements are published in 10 CFR Part 60, Subpart G. Compliance with NRC's quality assurance requirements must be demonstrated before DOE can dispose high-level waste at the repository.

To prepare for that demonstration, as well as to meet its own quality standards, DOE's Office of Civilian Radioactive Waste Management (OCRWM), published DOE/RW-0333P, *Quality Assurance Requirements Document and Description* (QARD). DOE/RW-0333P states that its provisions "… apply to every level of every organization performing work for, or to be accepted by, OCRWM."

DOE 5820.2A cited the quality assurance requirements in DOE 5700.6B and appropriate national consensus standards. However, DOE 5820.2A did not include the high-level waste specific quality assurance requirements related to the development, production and acceptance of immobilized high-level waste at the repository.

II.H. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving high-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of waste contained in any one storage vessel, pretreatment facility, or treatment facility. Tanks or other facilities that are designated for high-level waste contingency storage shall be maintained in an operational condition when waste is present and shall meet all the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Basis:

Functions Evaluated. This requirement is based on analyses of the following functions: operate, monitor and maintain high-level waste storage systems; maintain safe storage envelope; and transferring high-level waste to storage.

Safety and Hazard Analyses. The analyses identified potential significant consequences from leaking storage tanks without adequate spare capacity and adequate transfer equipment.

Requirements Analysis. This requirement is based on that contained in DOE 5820.2A, paragraph 1.3.b.(4)(d), and draft DOE 5820.2B, Chapter II paragraph 3.c.(3)(g). However, the requirement in DOE M 435.1-1 goes further than that contained in DOE 5820.2B, in that it also invokes the requirements for design requirements for structural integrity for new tanks, should they be constructed for use as contingency storage. The new requirement also invokes the storage requirement for structural integrity for existing double and/or single shell tanks in order to use such tanks for contingency storage. Should it be necessary to use tanks that have, or are suspected to have, leaked in the past for contingency storage, the requirement provides in Section II.Q.(2), Structural Integrity Program, for the conditions under which such tanks could be used in emergency situations only, and is to include the identification of a safe operational envelope and the controls necessary to maintain that envelope.

Other Considerations. The readily available capability to respond to emergency situations involving loss of confinement supports the defense-in-depth concept, protection of workers and the environment, and the radioactive waste management basis.

II.I. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Basis:

Functions Evaluated. The requirement is derived from the analysis of the top-level functions: formulate, execute, and evaluate the high-level waste management program.

Safety and Hazard Analyses. The requirement addresses the need for conducting evaluations, e.g., inspections, reviews, of high-level waste management activities associated with the protection of the public, workers, and the environment, and for correcting situations which are not in accordance with requirements of DOE O 435.1, or M 435.1-1. The requirement addresses a normal management function, i.e., to follow-up to see that directives are carried out in a disciplined manner, and to evaluate the effectiveness of the order to establish the overall requirements to mitigate the hazards posed by DOE radioactive waste management activities. The requirement also addresses the potential weaknesses and conditions due to poor, or non-existent documentation that demonstrates the implementation of an approved radioactive waste management basis for an operation and the need to limit the operation of waste management activities to the constraints/bounds identified in the facility's radioactive waste management basis.

Requirements Analysis. The requirement for corrective actions has no predecessor requirements in DOE 5820.2A. The authorization basis concept of DOE 5480.21, and DOE 5480.23, and their implementation, was utilized as a basis for the implementation of the radioactive waste management basis. Corrective actions are used by the NRC in reactor licensing for dealing with situations that could be inimical to public health and safety, however, no additional essential requirement language was derived from those requirements.

Other Considerations. The use of the corrective actions requirement, in conjunction with the radioactive waste management basis requirement, provide feedback mechanisms which are necessary to make measurable improvements to the high-level waste management program and is considered a best management practice.

II.J. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all high-level waste storage, pretreatment, or treatment facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form that ensures the chemical and physical stability of the waste under conditions that might be encountered during transfer, storage, pretreatment, or treatment;

(c) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each

exception request shall be documented, including its disposition as approved or not approved; and

(d) Pretreatment, treatment, storage, packaging, and other operations shall be designed and implemented in a manner that will ultimately comply with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

Basis:

Functions Evaluated. The requirement is derived from the safety and hazards analysis that addressed the following functions: transferring and receiving high-level waste for pretreatment, treatment, and storage activities and maintaining safe storage of high-level waste.

Safety and Hazard Analyses. The requirement addresses the need for the establishment of waste acceptance requirements by pretreatment, treatment, and storage facilities receiving waste and for ensuring the waste acceptance requirements are met at the receiving facility. The requirement also addresses the weaknesses and conditions identified by the safety and hazards analyses concerning the receipt of incompatible high-level waste streams in high-level waste management facilities. In addition, the requirement ensures that no high-level waste management activity jeopardizes compliance with the EM *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS) or the *Civilian Radioactive Waste Management System Requirements Document* (DOE/RW-0406).

Requirements Analysis. The high-level waste acceptance requirements have no predecessor requirements in DOE 5820.2A, however, waste acceptance requirements (criteria) were a requirement in the Order for low-level waste. Part of the requirement was derived from specific criteria for exceptions that appear in DOE site-specific waste acceptance criteria documents. Exception provisions are common in performance-based requirements documents, as long as the basis for the exception is identified and the authorizing process to avoid unjustified exceptions is provided.

Other Considerations. Effective waste acceptance experience at DOE facilities establishes this requirement as a best management practice, supportive of the principle of defense-in-depth, and the DOE M 435.1-1 principle of radioactive waste management basis.

II.J.(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and

administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Basis:

Functions Evaluated. This requirement is derived from the safety and hazards analysis that addressed the following functions: transferring and receiving high-level waste for pretreatment, treatment, and storage activities and maintaining safe storage of high-level waste.

Safety and Hazard Analyses. The requirement addresses the need for establishing a confirmation step for assuring that generators meet waste acceptance requirements of storage, pretreatment, and treatment facilities and that the receiving facility verifies that the acceptance requirements are met before the waste is accepted. The requirement addresses potential weaknesses and conditions that could arise from a storage, pretreatment, or treatment facility receiving poorly characterized waste or waste containing unacceptable constituents. The requirement also addresses the weaknesses and conditions identified with the acceptance of waste that does not conform with the requirements of the facility that received it.

Requirements Analysis. The requirement has no predecessor requirement in DOE 5820.2A, however, waste acceptance requirements (criteria) were a requirement in the Order for low-level waste. Specifically, DOE 5820.2A, Requirement III.3.e.(4) required audits of waste certification programs. Current waste acceptance documents and practices were evaluated for the essential requirements to address the weaknesses and conditions identified

Other Considerations. The requirement adds defense-in-depth to the waste acceptance and waste certification processes by adding an evaluation and acceptance step by the receiving facility. The language was developed from best management practices of current DOE facilities and allows for flexibility in implementation and use of the graded approach.

II.K. Waste Generation Planning.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all high-level waste streams.

(2) Waste With No Identified Path to Disposal. High-level waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste (compliance with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*).

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions for certifying waste, providing waste forecast data, and approval of generator processes by the receiving facility.

Safety and Hazard Analyses. The requirement addresses the need for generators, and pretreatment, treatment, and storage facilities management to identify and acquire as much information as possible about a waste stream prior to its generation; to prevent the generation of waste streams that may not have a path forward to disposal; and to implement an authorization process for managing no path forward wastes. Specific weaknesses and conditions addressed are the generation of waste streams that can not be certified or accepted at high-level waste management facilities because they have no path forward through disposal, or they challenge the capacity of existing waste management facilities.

Requirements Analysis. The requirements have no direct predecessor requirements in DOE 5820.2A, however, Chapter VI does require a Waste Management Plan. This requirement, and the concepts it embodies, have been significantly modified in DOE M 435.1-1 to clarify that the focus of these activities is on the life-cycle management of high-level waste streams and not on information about managing facilities and their achievements. The requirements in DOE M 435.1-1 emphasize life-cycle planning and the resolution of issues that may prevent the disposal of high-level waste in accordance with the provisions of the *Nuclear Waste Policy Act of 1982*, as amended.

However, this requirement must be viewed in the context of the related requirements in DOE M 435.1-1, Chapter I. These requirements assign to the Field Element Manager the responsibility to approve conditions under which radioactive waste with no path to disposal may be generated, and to notify DOE HQ of any decision to generate such waste. The objective is to bring issues associated with the potential generation of high-level waste with no identified path to disposal to the attention of appropriate DOE Managers before such waste is generated to resolve problems that preclude its disposal. The requirement and guidance establishes a Departmental position to avoid the generation of such waste. The guidance also expressly elicits the development of plans for resolving issues that prevent disposal.

Other Considerations. The concepts of life-cycle planning and approval, prior to generation, support the defense-in-depth philosophy. The objective of resolving issues that prevent disposal before the waste is generated addresses the need for waste management personnel to ensure that a high-level waste stream is not generated unless there is evidence to support confidence that the waste can ultimately comply with the Office of Environmental Management *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS).

II.L. Waste Characterization.

High-level waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any solidification media;

(c) Radionuclides or source information sufficient to describe the approximate radionuclide content of the waste; and

(d) Any other information which may be needed to demonstrate compliance with the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

(3) Hazardous Characteristics. Waste characterization processes shall yield sufficient chemical and physical data to clearly identify any hazardous characteristics that may degrade the ability of structures, systems, and components to perform their radioactive waste management function.

Basis:

Functions Evaluated. The following functions were evaluated to support this requirement: transfer high-level waste to storage (slurry); transfer high-level waste to storage (calcine); disposition of non-high-level waste streams; maintain a safe storage envelope; and disposition of non-immobilized high-level waste.

Safety and Hazard Analyses. The analyses identified weakness related to characterization that included record-keeping errors and inadequate analysis equipment.

Requirements Analysis. This requirement is based on the requirements contained in DOE 5820.2A at paragraphs 1.3.b.(1)(a), 1.3.b.(1)(b), and DOE Draft O 5820.2B, paragraph 3.b.(3).

Other Considerations. Characterization of waste is necessary to determine compatibility when wastes from different processes or tanks are combined, and to support determinations of structural integrity, all of which are necessary to maintain a safe storage envelope. Characterization is also necessary to ensure that waste accepted for storage can be processed to meet the requirements of DOE/EM-0093, *Waste Acceptance Specifications for Vitrified High-Level Waste Forms.* Characterization data to support safe storage and meeting vitrified waste acceptance specifications contribute to defense-in-depth and protection to workers, the public and the environment. The data quality objective process invoked for characterization provides a structured, industry-accepted process approach to determining specific characterization requirements.

II.M. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving high-level waste for storage, pretreatment, treatment, and disposal are met.

(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

(2) Certification Before Transfer. High-level waste shall be certified as meeting the waste acceptance requirements before it is transferred to the facility receiving the waste.

(3) Maintaining Certification. High-level waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, pretreatment, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Basis:

Functions Evaluated. This requirement is based on the functions of transferring high-level waste to storage, pretreatment, or treatment facilities prior to immobilization, and comparing the high-level waste characteristics to the waste acceptance criteria of the receiving facility.

Safety and Hazard Analyses. This requirement resulted, in part, from the hazard of combining incompatible waste streams in a waste storage tank, pretreatment facility, or treatment facility. The consequences could result in a tank being placed in a condition that is outside the receiving facility's radioactive waste management basis, or loss of confinement due to a deleterious chemical/thermal reaction.

Requirements Analysis. This requirement is considered necessary to ensure a facility or operation's radioactive waste management basis, or authorization basis, is identified and maintained. This requirement did not appear in DOE 5820.2A.

Other Considerations. This requirement, together with the requirement for Waste Acceptance (Section II.J.) provides defense-in-depth by requiring that both the generator and the receiver implement a program that documents that the waste to be transferred meets the receiving facility's waste acceptance requirements. Implementing such a program reduces the likelihood that transferred wastes contain unacceptable materials or characteristics, thereby avoiding hazards that would occur from the unnecessary transportation and handling of waste streams which do not meet waste acceptance requirements. A certification program also contributes to waste minimization and is a best-management practice.

II.N. Waste Transfer.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Authorization. High-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Basis:

Functions Evaluated. The requirement derives from the analysis of the functions to transfer waste to storage, pretreatment and treatment facilities.

Safety and Hazard Analyses. The hazards are that safe storage will not be maintained and that waste will be received or generated for which there is no path forward to disposal. The hazards are created by the receipt of waste without the cognizance or approval of personnel at the receiving facility, or because the receiving facility personnel failed to properly determine the acceptability of the waste. The receipt of waste prior to authorization may preclude instituting the controls necessary for its safe management. The waste may be incompatible with the receiving tank materials and/or the contents of the tank, leading to loss of containment via overflows, degradation of its structural integrity, or by chemical /criticality reactions. The receipt of waste which is incompatible with that already contained in the receiving tank could also result in generating a waste with no path forward for disposal.

Requirements Analysis. This requirement addresses the need for establishing a process for assuring that personnel at the receiving facility verify the acceptance of the waste to be received, including its compatibility with the receiving tank and its contents, and have authorized the transfer. The requirement that high-level waste shall not be transferred until personnel responsible for the facility receiving the waste authorizes the transfer has no predecessor in DOE 5820.2A. The requirement provides for appropriate controls to ensure safe management of high-level waste during transfers.

Other Considerations. This requirement provides an additional level of defense in depth to avoid the receipt of incompatible wastes and/or wastes with no path forward for disposal. Authorization by receiving facilities for transfer provides this defense-in-depth when waste is transferred, a vulnerable period in the life cycle of the waste.

II.N.(2) Data. Waste characterization data and generation, storage, pretreatment, treatment, and transportation information for high-level waste shall be transferred with or be traceable to the waste.

Basis:

Functions Evaluated. The requirement derives from the analysis of the function to maintain safe storage, and from the functions to verify the waste meets the acceptance criteria at storage pretreatment and treatment facilities.

Safety and Hazard Analyses. The hazards are that safe storage will not be maintained and that waste will be received or generated for which there is no path forward to disposal. The hazard arises because of the potential for losing the characterization data for specific wastes, which in turn could lead to situations in which waste will be received that is incompatible with the tank or the contents of the tank; or waste will be received or generated for which there is no path for disposal. Data supporting the acceptability of canistered waste forms are also important to preclude the receipt of waste which might not be acceptable at a geologic repository. Specific

weaknesses and conditions include losing knowledge about waste at any step of the waste management process. Particularly vulnerable stages of the process include transfer operations, and when pretreatment or treatment changes the waste form, and when storage lasts longer than anticipated.

Requirements Analysis. The requirement addresses the need for maintaining and being able to access accurate characterization data on which transfer authorization will be based, and for the maintenance of that data at all stages of the waste management process for high-level waste, from generation through post-treatment storage. This requirement has no predecessor in DOE 5820.2A, since the EM-WAPS and WASRD were published subsequent to the issuance of DOE 5820.2A.

Other Considerations. The principle of ALARA is supported by this requirement in preventing re-certification or re-characterization of waste, or doing unnecessary sampling and analysis, if all characterization data are properly maintained and transferred. Similarly, the principle of waste minimization is supported by this requirement through reducing unnecessary samples that must be dispositioned.

II.N.(3) Records and Transfer Reporting. The records and transfer requirements for canistered high-level waste forms shall comply with DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste

Basis:

Functions Evaluated. The requirement in part responds to the high-level waste functional analysis requirements for waste acceptance criteria and receipt of immobilized waste.

Safety and Hazard Analyses. The requirement is based on the need for documentation that demonstrates the compliance of each canistered waste form with the requirements of DOE/EM-0093 or DOE/RW-0351P, not on the safety and hazards analysis.

Requirements Analysis. The undesirable outcome that this requirement seeks to preclude is that the records and transfer requirements for canistered high-level waste forms will not comply with applicable specifications. The requirement addresses the need to ensure high-level waste activities generate and maintain records that demonstrate immobilized high-level waste meets the requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, or DOE/RW-0406, *Civilian Radioactive Waste Management System Requirements Document*, for non-vitrified, immobilized high-level waste. This requirement has

no predecessor in DOE 5820.2A, since the EM-WAPS and WASRD were published subsequent to the issuance of DOE 5820.2A.

Other Considerations. None.

II.O. Packaging and Transportation.

The following requirement is in addition to those in Chapter I of this Manual.

(1) Canistered Waste Form. Immobilized high-level waste shall meet the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

Basis:

Functions Evaluated. The requirement in part responds to the high-level waste functional analysis requirements for waste acceptance criteria and receipt of immobilized waste.

Safety and Hazard Analyses. This requirement is focused on the need for documentation that demonstrates the compliance of each canistered waste form with the requirements of DOE/EM-0093 or DOE/RW-0406, not on the safety and hazards analysis.

Requirements Analysis. The undesirable outcome that this requirement seeks to preclude is that the canistered high-level waste form will not meet the requirements for acceptance into the Civilian Radioactive Waste Management System, and/or that documentation is not available to so demonstrate. The requirement addresses the need to ensure that, before packaging and transporting, each immobilized high-level waste form meets the requirements specified by DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0406, *Civilian Radioactive Waste Management System Requirements Document*, for non-vitrified, immobilized high-level waste. This requirement has no predecessor requirement in DOE 5820.2A since the EM-WAPS and the WASRD were published subsequent to the issuance of DOE 5820.2A.

Other Considerations. None.

II.P. Site Evaluation and Facility Design. The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for high-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new high-level waste facility or expansion of an existing high-level waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, or human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Basis:

Functions Evaluated. These requirements are based on the outcome of safety and hazard analyses that addressed the functions: construct new facilities (storage); construct new facilities (pretreatment); construct new facilities (immobilization); and construct new facilities (storage of immobilized waste).

Safety and Hazard Analyses. There are numerous hazards involved in the construct new facilities functions stemming from inadequate siting, the most critical being the loss of containment. Scenarios examined included those in which the risk posed by natural phenomena as well as man-induced events could not be solely offset by facility design and construction, or the site evaluation failed to identify certain hazards to be incorporated into the design. Similarly, design and construction cannot always offset the potential effects of the facility on the population and sensitive environmental issues associated with the region in which the facility is proposed to be sited.

Requirements Analysis. This performance-based requirements is based on the siting evaluation requirements of 10 CFR Part 72, Sub-Part E, *Siting Evaluation Factors.* DOE 5820.2A, Section I.3.a.(1)(a), did require that the design requirements for new facilities protect against the effects of natural phenomena. There were no explicit requirements in DOE 5820.2A for site evaluation to consider other critical factors as a precursor to design and construction of new facilities.

Other Considerations. This requirement supports the defense-in-depth concept and can be expected to lead to selection of sites that result in reduced risk.

II.P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(a) Safety (Safety Class and Safety-Significant) Structures, Systems, and Components. Safety structures, systems, and components for high-level waste storage, pretreatment, and treatment facilities shall be designated and designed consistent with the provisions of DOE O 420.1, *Facility Safety;* DOE 5480.22, *Technical Safety Requirements*; and DOE 5480.23, *Nuclear Safety Analysis Reports*.

Basis:

Functions Evaluated. These requirements are based on analyses of the following functions: construct new facilities (storage); construct new facilities (pretreatment); construct new facilities (immobilization); construct new facilities (storage of immobilized waste); compare high-level waste to receiving facility waste acceptance criteria; prepare feed; and package immobilized high-level waste.

Safety and Hazard Analyses. There are numerous hazards involved in the construct new facilities functions stemming from inadequate design, the most critical being the loss of containment due to an initiating event of a deflagration or detonation of flammable and explosive gases. The weaknesses identified in the construct new facilities functions were inadequate identification of design requirements and inadequate incorporation of requirements into the design. Other weaknesses identified were failure to identify hazards, waste stationary in unshielded lines, and personnel in unauthorized areas.

Requirements Analysis. This requirement is based on the requirements in current DOE Orders (420.1 *Facility Safety*; 5480*.22 Technical Safety Requirements*; 5480.23*, Nuclear Safety Analysis Reports)* and on DOE-STD-3009.94, *Preparation Guide for U. S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports.* DOE 5820.2A addresses the design of new facilities in requirement 1.3.a.(1)(a) in which design objectives for new facilities were required to assure the protection of the public, worker and to comply with DOE policies regarding nuclear safety, safeguards and security, but did not require the identification of Safety Class and Safety Significant systems, structures, and components. Because several high hazard scenarios were identified in the safety and hazards analysis, it was decided to invoke these specific requirements in this Order to provide an enhanced safety posture.

Other Considerations. This requirement supports defense-in-depth and is a best management practice. This requirement is consistent with the thrust of the DOE 5820.2A citation regarding nuclear safety but adds the requirement for a systematic assessment of functions to identify safety class and safety significant structures, systems and components. The additional rigor that is required by this 435.1 requirement is expected to lead to a higher degree of safety in the design and construction of new high-level waste facilities.

II.P.(2) Facility Design.

(b) Confinement. High-level waste systems and components shall be designed to maintain waste confinement. The following requirements apply to new or modifications to existing high-level waste systems, ancillary systems, and components:

1. Secondary confinement systems shall be designed to prevent any migration of wastes or accumulated liquid out of the waste system; shall be capable of detecting, collecting, and retrieving releases into the secondary confinement; and shall be constructed of, or lined with, materials that are compatible with the waste(s) to be placed in the waste system.

2. Tank and piping systems used for high-level waste collection, pretreatment, treatment, and storage shall be welded construction, except where remote configurations or periodic rerouting of high-level waste streams require non-welded construction.

Basis:

Functions Evaluated. This requirement is based on analyses of the functions: construct new HLW facilities (storage, pretreatment/treatment, and immobilization storage), prepare facility/site for closure as LLW disposal site, transfer calcine to storage, maintain safe storage envelope, and transfer waste to storage (slurry).

Safety and Hazard Analyses. The analyses identified potential weaknesses in the design process (failure to identify or incorporate correct and accurate design parameters into the design), as well as operational weaknesses. The operational weaknesses included failures due to aging, erosion, corrosion, and mechanical damage.

Requirements Analysis. The requirements are based on canceled DOE 6430.1A, Section 1323-5.2, 40 CFR Part 264, Subpart J and 40 CFR Part 265, Subpart J. DOE 5820.2A contained a number of citations related to, but not encompassing all of the elements of this requirement. For instance, DOE 5820.2A, Section I.3.b.(2)(a) required double containment for all new high-level waste facilities.

Other Considerations. The specific cited RCRA requirements extracted from 40 CFR Part 264 and 40 CFR Part 265 are invoked in this requirement solely to provide control and containment of the radioactive component of the waste. The double containment requirements that result from invoking the RCRA provisions also address the radiation hazard present in managing high-level waste.

II.P.(2) Facility Design.

(c) Lifting Devices. The design of hoisting and rigging devices shall comply with the following specific requirements.

1. Lifting devices that are designated as safety class or safety significant shall be designed to prevent free fall of loads.

2. Loading and unloading systems for lifting devices that are designated as safety class or safety significant shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

Basis:

Functions Evaluated. This requirement is based on the analyses of the following functions: maintain a safe storage envelope; package immobilized high-level waste; operate and maintain a high-level waste immobilization facility; operate, monitor and maintain high-level waste storage systems; and install retrieval equipment.

Safety and Hazard Analyses. The analyses identified the potential accidental release of large objects (e.g. shielding blocks, canister of vitrified high level waste; tank pump assembly) which could result in deflagrations or conflagrations, uncontrolled releases of radioactivity, and injuries/exposures to workers.

Requirements Analysis. These requirements are based on those contained in 10 CFR Part 60, paragraph 60.131 (b)(10). This requirement has no predecessor requirement in DOE 5820.2A.

Other Considerations. This requirement supports defense-in-depth, ALARA, performance-based requirements, and waste authorization basis concepts.

II.P.(2) Facility Design.

(d) Ventilation.

1. Design of high-level waste pretreatment, treatment, and storage facilities shall include ventilation through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the applicable requirements.

Basis:

Functions Evaluated. The requirement is based on the weaknesses identified during the safety and hazard analyses of the following functions: operate and monitor retrieval systems from storage; operate and monitor retrieval system from pretreatment; transfer high-level waste to storage; and maintain safe storage.

Safety and Hazard Analyses. The hazard is the release of radioactive material in airborne effluents that exceed the criteria established in 10 CFR Part 835, *Occupational Radiation Protection*, DOE 5400.5, *Radiation Protection of the Public and the Environment*, and 40 CFR Part 61 *National Emission Standards for Hazardous Air Pollutants*, which promulgates standards to implement the *Clean Air Act.* Filtration may be required during both normal and off-normal operations to meet these requirements, and a specific determination should be made through the facility safety analysis process. However, the safety and hazard analysis performed in support of DOE O 435.1 assumed ventilation to be required and identified the failure of the HEPA filter due to moisture, either from tank washing or failure to shut off steam jets, as a weakness requiring special attention during design.

Requirements Analysis. DOE 5820.2A, paragraph 1.3.b.2.f, required ventilation systems to maintain radionuclide release within published guidelines. The requirement in DOE M 435.1-1 for ventilation systems to control the release of radionuclides is essentially the same as that in DOE 5820.2A

Other Considerations. This requirement is also based on requirements in 10 CFR Part 835, *Occupational Radiation Protection*, DOE 5400.5 *Radiation Protection of the public and Environment, and* 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*. It also promotes ALARA and defense-in-depth principles.

II.P.(2) Facility Design

(d) Ventilation.

2. When conditions exist for generating gases in flammable and explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Basis:

Functions Evaluated. This requirement is based on an analysis of the function to maintain a safe storage envelope, both in storage tanks and high-level waste pretreatment/treatment facilities.

Safety and Hazard Analyses. The safety and hazards analyses identified the generation, accumulation and ignition of flammable, explosive and oxidizer gases in the high-level waste storage tank headspace as one of the highest risk scenarios resulting in uncontrolled releases, of radioactive material to the public, workers and the environment.

Requirements Analysis. This requirement is an expansion of that contained in DOE 0 5820.2A, paragraph 1.3.b.2.f. which also requires means to prevent deflagration or detonation of explosive vapors.

Other Considerations. This requirement and its accompanying guidance supports defense-in-depth by reducing the possibility of dangerous accumulations of gases, and by precluding the potential ignition of the gases. The DOE M 435.1-1 requirement and its guidance provides this greater margin of safety by requiring measures, in addition to the ventilation system itself, when conditions exist for the concentrations of gases which have accumulated in the headspace to approach the lower flammability/explosivity limits. The guidance suggests that these additional measures may consist of ventilation systems that employ a spark proof technology to preclude sources of ignition from within the ventilation system, or measures to control the concentration of the oxidant/oxygen.

II.P.(2) Facility Design

(e) Considerations of Decontamination and Decommissioning. Areas in new and modifications to existing high-level waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage, pretreatment, and treatment functions for constructing a new facility; the treatment function for closure of a pretreatment or treatment facility; and the decommissioning of all high-level waste facilities.

Safety and Hazard Analyses. The requirement addresses the need for incorporating waste generation reduction and minimization features or other design techniques, such as modular

approaches, into the design of new high-level waste management facilities. The condition identified in the safety and hazards analyses addressed by this requirement is managing the residuals from a pretreatment or treatment facility.

Requirements Analysis. The consideration of decontamination and decommissioning activities in the design of new facilities and modifications to existing facilities is an improvement to Chapter V, DOE 5820.2A, the requirement in DOE 5820.2A, Section I.3.a.(1)(b), and the requirement included in canceled DOE 6430.1A, *General Design Criteria*.

Other Considerations. This requirement was also added to promote best management practices for the entire life-cycle management of waste that will be generated from operating a high-level waste management facility. Preventing or minimizing the generation of waste is a top-level principle incorporated into DOE M 435.1-1.

II.P.(2) Facility Design

(f) Maintenance Exposure Reduction. Remote maintenance features and other appropriate techniques to maintain as low as reasonably achievable (ALARA) personnel exposures shall be incorporated into each high-level waste facility.

Basis:

Functions Evaluated. The functions evaluated which support this requirement are: operate monitor and maintain a waste storage system; transfer high-level waste to storage; transfer high-level waste to pretreatment; transfer high-level waste to treatment/immobilization facility; transfer calcined high-level waste to storage; transfer calcined high-level waste to pretreatment; transfer calcined high-level waste treatment; and prepare the facilities for closure as a low-level waste disposal site.

Safety and Hazard Analyses. The hazard and safety analyses identified numerous opportunities requiring maintenance personnel to enter high-radiation areas for operations, maintenance and inspections. The potential frequency and duration of access dictate that remote maintenance or other features necessary to minimize personnel exposures be incorporated in the design of high-level waste storage, treatment and pretreatment facilities where frequent access and/or long durations of access pose potential hazards to workers.

Requirements Analysis. This requirement is essentially the same as that contained in DOE 5820.2A, paragraph 1.3.c.(2)(g).

Other Considerations. This requirement supports the ALARA concept, and is considered a best management practice. The guidance points out that these design features must address both

internal and external sources of radiation, and that they must be controlled and tested to assure proper function.

II.P.(2) Facility Design

(g) Facilities for Receipt and Retrieval of High-Level Waste.

1. Designs for storage facilities shall incorporate features to facilitate retrieval capability.

2. High-level waste receipt and retrieval systems shall be designed to complement the existing storage facilities for safe storage and transfer of high-level waste.

Basis:

Functions Evaluated. This requirement is derived from the analyses for the following functions: operate and monitor retrieval system for pretreatment, and operate and monitor retrieval system for immobilization.

Safety and Hazard Analyses. The weakness in the analyses of both functions was an incorrect design specification that resulted in loss of confinement during retrieval.

Requirements Analysis. The origin of the requirement is taken from DOE 5820.2A, paragraph 1.3.a.(1)(c), which was expanded to include consideration of the integrity of the storage system. DOE 5820.2A, paragraph 1.3.a.(1)(c), required new storage facilities to incorporate features to facilitate retrieval capability, however, it did not require the retrieval systems to be operated and maintained for system integrity.

Other Considerations. This requirement addresses the need for a planned and integrated retrieval strategy prior to design, the design of new storage facilities to accommodate the structural loads necessary to implement the planned retrieval strategy, and the need to consider those loads in evaluating the integrity of individual storage systems. This requirement is a consideration in establishing the authorization basis for a specific storage facility, and is consistent with the requirement to employ systems engineering for decisions related to safety. These safety decisions involve containment, compatibility with interfacing equipment, structural integrity, and safe transfer operations. The requirement also supports defense-in-depth for protection of workers.

II.P.(2) Facility Design

(h) Structural Integrity. Designs for new tanks shall contribute to the confinement requirement at Section II.P.(2)(b) of this Manual by:

1. Incorporating features to avoid critical degradation modes at the proposed site where practicable, or minimize degradation rates for the critical modes; and

2. Incorporating features to facilitate execution of the Structural Integrity Program required by Section II.Q.(2) of this Manual.

Basis:

Functions Evaluated. This requirement was identified subsequent to the analysis of functions; however it is consistent with the function to maintain a safe storage envelope.

Safety and Hazard Analyses. The scenarios developed for use during the analyses did not identify medium range (or higher) consequences resulting from the loss of structural integrity, and producing minor leaks (as opposed to a more catastrophic loss of containment). Subsequently, however, actual events in the field indicated that long term releases at relative minor rates from underground storage tanks may have reached site groundwater. This would have increased the assigned risk if this information would have been known during the time the safety and hazard analyses were performed.

Requirements Analysis. This requirement and accompanying guidance are based on the work performed by Brookhaven National Laboratory and documented in their report, BNL-UC-406, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, January 1997. DOE 5820.2A, paragraphs 1.3.b.(3)(c), and 1.3.c.(3)(b) required that "a method for periodically assessing waste storage system integrity (e.g., coupons for corrosion testing, photographic and periscopic inspections, leak detectors, liquid level devices) shall be established, documented and reported as required in the management plan", but did not address design considerations to support structural integrity.

Other Considerations.

The DOE M 435.1-1 requirement in Section II.Q.(2) and the implementing guidance envisions a more quantitative analysis than that required by DOE 5820.2A. The new requirements require corrosion modes and rates to be identified, the remaining thickness of the tank wall to be assessed as well as the structural strength and stiffness of the concrete tanks or vaults, along with the steel shells and liners against collapse or failure from postulated normal (e.g., soil) and credible accident (e.g., earthquake, explosion) loads. Those activities are carried out after construction;

however, a knowledge of these activities are necessary to incorporate features into the design of new tanks to facilitate the in-service structural integrity program. This requirement contributes to defense-in-depth and is a best management practice.

II.P.(2) Facility Design

(i) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of high-level waste treatment, storage, pretreatment, and treatment facilities to provide volume inventory data and to prevent spills, leaks and overflows from tanks or confinement systems

Basis:

Functions Evaluated. Requirements for engineering controls stem from analyses of the following functions: transfer high-level waste to storage (slurry); and separate /reduce high-level waste fraction.

Safety and Hazard Analyses. The analyses identified two weaknesses: (1) absence of siphon break equipment, and (2) transfer line failure due to stress from expansion leading to a loss of confinement.

Requirements Analysis. This requirement is essentially the same as contained in DOE 5820.2A at paragraph 1.3.b.(2)(h), except that DOE O 435.1 also requires that these controls be part of the design of new facilities.

Other Considerations. The guidance for this requirement gives as examples of instrumentation and controls "...flowmeters, level sensing devices...anti-siphoning devices, overflow prevention features and any other ...controls that maintain sufficient freeboard within the storage unit". In addition, the guidance to this requirement states that it is invoked to support prompt detection and prevention of conditions which could lead to release of radioactive material. Thus, the requirement addresses implementation of controls that prevent the loss of confinement whereas the monitoring requirement in Section II.P.(2)(j), Volume Monitoring Systems, is intended to address detection of a loss of confinement. This requirement provides defense-in-depth for protection of workers, supports the ALARA principle, and supports the radioactive waste management basis.

II.P.(2) Facility Design

(j) Volume Monitoring Systems. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of high-

level waste storage, pretreatment, and treatment facilities to provide rapid detection of failed confinement and/or other abnormal conditions.

Basis:

Functions Evaluated. This requirement stems from an analysis of the following functions: maintain a safe storage envelope; operate, monitor, and maintain a high-level waste storage system; and maintain high-level waste pretreatment/treatment facility safe envelope.

Safety and Hazard Analyses. The analyses identified weaknesses involving failure to detect flammable gas build up in the tank dome headspace, failure to sample and test waste to establish ignition limits, and inadequate tank level monitoring. These are all weaknesses that lead to loss of confinement, and/or loss of confinement resulting from high-energy release scenarios, the most significant hazard identified in the safety and hazard analyses for high-level waste management functions.

Requirements Analysis. The requirement is based on the requirements in DOE 5820.2A at paragraph 1.3.b.(3)(a), and DRAFT DOE 5820.2B, Chapter II, paragraph 3.c.(5).

Other Considerations. The examples cited in the DOE 5820.2A requirement were deleted in keeping with the performance-based requirements concept. Examples were provided in guidance. This requirement addresses <u>detection</u> of system failures that could lead to the most significant consequences involving high-level waste management functions. This early detection capability is essential to mitigate the hazards and contributes to the defense-in-depth concept.

II. Q. <u>Storage</u>.

The following requirements are in addition to those in Chapter I of this Manual and also apply to facilities intended for management of high-level waste awaiting pretreatment, treatment or disposal, unless stated otherwise.

(1) Operation of Confinement Systems.

(a) Confinement systems shall be operated and maintained so as to preserve the design basis.

(b) Secondary confinement systems, where provided, shall be operated to prevent any migration of wastes or accumulated liquid out of the waste confinement systems.

Basis:

Functions Evaluated. This requirement is based on analyses of the following functions: prepare high-level waste facility/sites for closure as low-level waste disposal site; transfer calcined high-level waste to storage; maintain a safe storage envelope; and transfer high-level waste to storage (slurry).

Safety and Hazard Analyses. The analyses identified operational weaknesses that included failures due to aging, erosion, mechanical damage and other degradations due to failure to maintain the effectiveness of design capabilities, that could lead to loss of confinement.

Requirements Analysis. The requirements were developed, in part, from the DOE 5820.2A requirement in Section I.3.b.(2)(d), which requires secondary confinement systems to be capable of containing waste that leak in them, and, in part, to ensure the design basis for confinement systems are protected and also to maintain the radioactive waste management basis of the waste system.

Other Considerations. The key to maintaining the effectiveness of the features incorporated into the design of the confinement systems, is a knowledge of the operational assumptions incorporated into the design, and the development and use of operational procedures based on those assumptions. The guidance provides further details and examples. This requirement supports the defense-in-depth concept for worker protection.

II.Q.(2) Structural Integrity Program.

(a) **Leak-Tight Tanks In-Service. A structural integrity program shall be developed for each high-level waste storage tank site to verify the structural integrity and service life of each tank to meet operational requirements for storage capacity. The program shall be capable of:**

1. **Verifying the current leak-tightness and structural strength of each tank in service;**

2. **Identifying corrosion, fatigue, and other critical degradation modes;**

3. **Adjusting the chemistry of tank waste, calibrating cathodic protection systems, wherever employed, and implementing other necessary corrosion protection measures;**

4. Providing credible projections as to when structural integrity of each tank can no longer be assured; and

5. Identifying the additional controls necessary to maintain an acceptable operating envelope.

(b) In-Service Tanks that Have Leaked or Are Suspect. For each high-level waste storage tank in-service that is known to have leaked, or is suspect, a modified structural integrity program shall be developed and implemented to identify the safe operational envelope. The modified program shall be capable of:

1. Verifying the structural strength of each tank in-service which has leaked or is suspect;

2. Identifying corrosion, fatigue and other critical degradation modes;

3. Adjusting the chemistry of tank waste, calibrating cathodic protection systems, wherever employed, and implementing other necessary corrosion protection measures;

4. Determining which of the tanks that have leaked or are suspect may remain in service by identifying an acceptable safe operating envelope;

5. Providing credible projections as to when the acceptable safe operational envelope can no longer be assured; and

6. Identifying the additional controls necessary to maintain the acceptable safe operational envelope.

When physical activities, as part of a structural integrity program, pose additional vulnerabilities, alternative measures shall be implemented to provide an acceptable storage operational envelope.

(c) Other Storage Components. The structural integrity of other storage components shall be verified to assure leak tightness and structural strength.

Basis:

Functions Evaluated. This set of requirements is derived, in part, from the weaknesses identified during safety and hazard analyses of the following functions: transfer high-level waste to storage (slurry); transfer high-level waste (calcine); and maintain a safe storage envelope.

Safety and Hazard Analyses. The hazard is loss of confinement, and the weaknesses identified were aging due to corrosion, erosion and fatigue of the confinement structures.

Requirements Analysis. The requirement is based, in part, on several citations in DOE 5820.2A. These include:

> Section I.3.b.(3)(c), periodic assessments of system integrity;
> Section I.3.b.(7)(c), adjustment of waste chemistry to control corrosion;
> Section I.3.b.(2)(d), limits on the concentration of radionuclides in waste that could be transferred in singly contained pipelines;
> Section I.3.b.(2)(c), conditions for continued use of leaking storage tanks;
> Section I.3.b.(2)(g), requirements for facilities that employ cathodic protection;
> Section I.3.b.(4)(a), actions regarding tanks that have leaked;
> Section I.3.c.(2)(a), restrictions on the use of single shell tanks to receive fresh waste; and a number of complementary requirements in DOE 5820.2A under section I.3.c. for doubly contained storage systems.

The expanded set of requirements in DOE M 435.1-1 is based on the work performed by Brookhaven National Laboratory (BNL), and published in BNL-UC-406 *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks,* January, 1997. However, a significant number of high-level waste storage tanks are known to, or are suspected to leak, and cannot meet the requirements for leak tightness for the entire volume of the storage tank as envisioned in the BNL guidelines. Further, there are very limited alternatives to continuing to use some of these tanks. Therefore, the BNL derived program requirements were modified to apply to tanks that have leaked in the past, leak now, or are suspected to leak, to identify a safe operating envelope for these tanks; and to identify the controls necessary to maintain that envelope, as conditions for their continued limited use.

The authors of the BNL Document were consulted regarding the requirements for ascertaining the structural integrity for underground piping systems. They concurred that the program outlined in their report was not applicable to underground piping systems that could not be accessed. They agreed that since the piping systems are not continually in use, pressurization of the piping systems prior to each transfer provided an adequate means for implementing a structural integrity program for such systems.

The need for the requirement is based on actual occurrences where structural integrity (leak tightness, only) was lost for certain tanks. In most, if not all instances, the time period for which structural integrity of the tank could be assured was not predicted based on a formal structural integrity assessment program. Consequently, loss of containment was determined after the loss occurred, and/or the consequences were noticed. In those instances, management was placed in a reactive position to respond to a double crisis--correct the leaking situation and remediate the consequences.

The DOE M 435.1-1 requirement at Sections II.Q.(2)(a) and (b), and the implementing guidance envisions a more quantitative analysis than that required by DOE 5820.2A, in which corrosion modes and rates will be identified, tank waste chemistry is adjusted, and the time-point when structural integrity can no longer be assured is predicted. This projection affords an opportunity for management to be pro-active. In addition, the new requirement and its guidance includes an assessment of structural strength and stiffness of the concrete tanks or vaults, along with the steel shells and liners against collapse or failure from postulated normal (e.g., soil, operational, etc.,) and credible accident (e.g., earthquake, explosion, etc.) loads.

Finally, verification of leak-tightness and making credible projections as to when the acceptable safe operating envelope can no longer be assured for suspect leaking, single-shell tanks may be problematic at some sites due to their configuration, waste levels, or the risks posed in trying to do so. The requirement provides for the equivalent, necessary controls, e.g., periodic pumping to remove as much of the pumpable liquids as possible, until the waste can be removed.

Other Considerations. This requirement contributes to defense-in-depth and is a best management practice.

II.Q.(3) Waste Form Canister Storage. Canisters of immobilized High Level Waste awaiting shipment to a repository shall be:

(a) Stored in a suitable facility;

(b) Segregated and clearly identified to avoid commingling with low-level, mixed low level, or transuranic wastes; and

(c) Monitored to ensure that storage conditions are consistent with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-level Waste Forms,* or DOE/RW-0351, *Waste Acceptance System Requirements Document,* for non-vitrified immobilized high-level waste. Facilities and operating procedures for storage of vitrified high-level waste shall maintain the integrity of the canistered waste form.

Basis:

Functions Evaluated. This requirement is based on an analysis of the following functions: operate and maintain immobilized high-level waste storage systems, and prepare immobilized high-level waste for shipment.

Safety and Hazard Analyses. The hazard is that the canistered waste will be determined to be unacceptable for shipment to the repository because it was exposed to storage conditions that would result in noncompliance with DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified Waste Forms* or with DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for nonvitrified waste forms. The weakness is failure to store and maintain the canistered waste form properly, due either to equipment failure, environmental conditions or personnel errors. The safety and hazard analysis assumed that there was no facility to remediate canisters that were damaged during storage. Under this assumption the weakness also results in the creation of waste with no path forward to disposal**.**

Requirements Analysis. The origin of the requirement was section 3.c.(2)(b), Draft DOE 5820.2B.

Other Considerations. DOE 5820.2A, paragraph 1.3.d.1.b., also required the interim storage facility to comply with the requirements of DOE 5820.2A, paragraph 3b, which covers a variety of requirements related to design and construction of new facilities as well as operational requirements. However, the thrust of paragraph 3.b was not specifically to preserve the quality of the vitrified waste form. The DOE M 435.1-1 requirement supports the performance-based regulatory approach and supports EM capability to maintain the product so as to preserve its certification as meeting waste acceptance specifications contained in DOE/EM-0093.

II. R. Treatment.

> **Treatment shall be designed and implemented in a manner that will ultimately comply with DOE/EM–0093, *Waste Acceptance Product Specifications for Vitrified High-level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.**

Basis:

Functions Evaluated. This requirement is not based on functional analyses.

Safety and Hazard Analyses. This requirement is not based on safety and hazard analyses.

Requirements Analysis. This requirement is based on DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* and DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified, immobilized high-level waste. Meeting the requirements contained in these two documents ensures the final waste form will be acceptable for disposal in the geologic repository managed by the Office of Civilian Radioactive Waste Management. DOE 5820.2A, paragraph 1.3.d.(1)(a), specified acceptance requirements based on 10 CFR Part 60, 10 CFR Part 71, and 40 CFR Part 191. Subsequent to the publication of DOE 5820.2A DOE/EM-0093 and DOE/RW-0351P were published. This requirement was invoked to ensure that any interim treatment step would be considered so as not to preclude the ability of the final treated waste form to comply with DOE/EM-0093 or DOE/RW-0351P.

Other Considerations. NRC has not published guides on how to interpret its waste product requirements contained in 10 CFR 60.113 or draft 10 CFR Part 63 in terms that can be applied to contracts. DOE has made its interpretation for use by the DOE high-level sites and its contractors in DOE/EM-0093 and DOE/RW-0351P. The external requirements and other DOE Orders necessary to ensure safety of treatment facilities and operations are identified and invoked in Chapter I, General Requirements and Responsibilities, of DOE M 435.1-1.

II. S. Disposal.

Disposal of high-level waste must be in accordance with the provisions of the *Atomic Energy Act of 1954,* as amended, the *Nuclear Waste Policy Act of 1982,* as amended, or any other applicable statutes.

Basis:

Functions Evaluated. This requirement is not based on functional analysis.

Safety and Hazard Analyses. This requirement is not based on weaknesses identified during safety and hazard analyses. Disposal of high-level waste in a geologic repository is outside the scope of DOE O 435.1.

Requirements Analysis. This requirement is based on the provisions of the *Atomic Energy Act of 1954*, as amended, and the Nuclear *Waste Policy Act of 1982,* as amended. DOE 5820.2A, paragraph I.3.D., required disposal to be in accordance with the provisions of the *Nuclear Waste Policy Act of 1982*, as amended.

Other Considerations. It is recognized that onsite disposal of high-level waste may be possible under the provisions of the *Atomic Energy Act of 1954,* as amended. However, the safety analysis and requirements analysis conducted to support DOE O 435.1 and M 435.1-1 did not evaluate disposal activities for high-level waste at a DOE site. DOE currently plans that high-

level waste be treated to meet the specifications for acceptance for disposal at a geologic repository. Onsite disposal of high-level waste is not considered consistent with that policy.

The repository is to be sited and operated by DOE, and regulated by NRC through 10 CFR Part 60. Draft 10 CFR Part 63, which will implement requirements of draft 40 CFR 197, is expected to replace 10 CFR Part 60. The NRC will license the disposal of such waste so additional requirements were not necessary.

II. T. <u>Monitoring.</u>

> **High-level waste pretreatment, treatment, storage, and transportation facilities shall be monitored for chemical, physical, radiological, structural, and other changes that could indicate failure of system confinement, integrity, or safety, and which could lead to abnormal events or accidents. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, flammable or explosive mixtures of gases, level and/or waste volume, and significant waste chemistry parameters for non-immobilized high-level waste. Facility monitoring programs shall also include physical inspections to verify that control systems have not failed.**

Basis:

Functions Evaluated. The requirement is derived from the safety and hazards analysis that addressed the following functions: maintaining safe high-level waste pretreatment and storage envelopes, and operating, monitoring, and maintaining high-level waste storage systems.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of failing to detect flammable gas buildup in waste storage tanks, failing to sample and test waste storage tank contents to establish ignition limits, and inadequate waste tank level monitoring.

Requirements Analysis. The requirement is similar to the DOE 5820.2A, paragraph I.3.b.(3.)(a.), with the addition of a requirement to provide monitoring to prevent fires and explosions in pretreatment, treatment, storage and transportation facilities and the monitoring of related parameters, such as temperature and pressure, to prevent loss of confinement.

Other Considerations. These requirements address the risks of releasing radioactive materials to the environment by monitoring the conditions of the waste as well as contributing to worker protection by supporting the defense-in-depth concept. In addition, the requirement invokes RCRA requirements, for tank systems and ancillary equipment, to provide similar confinement, leak detection, and monitoring features as are required for hazardous waste. This requirement is

the operational aspect of monitoring. Specific design features that are to be incorporated in high-level waste facilities are contained in Section II.P.(2)(i).

II. U. Closure

The following requirements for closure of deactivated high-level waste sites are in addition to those in Chapter I of this Manual.

(1) Decommissioning. Deactivated high-level waste facilities/sites shall meet the decommissioning requirements of DOE O 430.1A, *Life-Cycle Asset Management* and the requirements of DOE 5400.5, *Radiation Protection of the Public and the Environment*, for release; or

(2) CERCLA Process. Deactivated high-level waste facilities/sites shall be closed in accordance with the CERCLA process as described in Section I.2.F.(5); or

(3) Closure. Deactivated high-level waste facilities/sites shall be closed in accordance with an approved closure plan as specified below. Residual radioactive waste present in facilities to be closed shall satisfy the waste incidental to reprocessing requirements of this Chapter.

(a) Facility/Site Closure Plans. A closure plan shall be developed for each deactivated high-level waste facility/site being closed that defines the approach and plans by which closure of each facility within the site is to be accomplished. This plan shall be completed and approved prior to the initiation of physical closure activities, and updated periodically to reflect current analysis and status of individual facility closure actions. The plan shall include, at a minimum, the following elements:

1. Identification of the closure standards/performance objectives to be applied from Chapter III or IV, as appropriate;

2. A strategy for allocating waste disposal facility performance objectives from the closure standards identified in the closure plan among the facilities/units to be closed at the site;

3. An assessment of the projected performance of each unit to be closed relative to the performance objectives allocated to each unit under the closure plan;

4. An assessment of the projected composite performance of all units to be closed at the site relative to the performance objectives and closure standards identified in the closure plan; and

5. Any other relevant closure controls including a monitoring plan, institutional controls, and land use limitations to be maintained in the closure activity.

Basis:

Functions Evaluated. The requirement is based, in part, on an analysis of the following functions: closure of deactivated high-level waste facilities/site as low-level waste disposal sites; and closure of deactivated high-level waste facilities/site for decontamination and decommissioning.

Safety and Hazard Analysis. The weaknesses and conditions associated with preparation of deactivated high-level waste facilities for closure include: spills of waste being removed, shipping containers leak due to poor sealing, worker exposure to high radiation while removing equipment, and release of contaminated air while backfilling systems and facilities, for closure in place. This requirement is based on the consideration that some wastes can be classified as non-high-level waste through the use of the waste incidental to reprocessing process (Section II.B). Waste that is found to be non-high-level waste can be managed and disposed in a manner that is more cost effective than management and disposal as high-level waste. While not analyzed in the hazards analysis and requirements analysis, the closure of deactivated high-level waste facilities, managed as transuranic waste disposal sites, is considered to be similar in operations and hazards.

Requirements Analysis. The first two requirements, decommissioning and use of the CERCLA process for closing deactivated high-level waste facilities, are already available and in use within the DOE Complex. The concept underlying the third requirement, Closure, is built on a related requirement that appears in DOE 5820.2A, Section I.3.d.(2), Disposal. That requirement addressed options for permanent disposal of wastes from reprocessing, such as single shell tank wastes (thought to be relatively low activity waste) by methods including in-place stabilization, especially for single tank waste that is not easily retrievable. In addition, DOE 5820.2A, Section I.3.b.(7)(b), discusses the need to develop programs that support the disposal of the separated waste from high-level waste as other waste categories, such as transuranic waste or low-level waste. In contrast, the new requirement in DOE M 435.1-1 is specifically focused on identifying waste incidental to reprocessing (DOE M 435.1-1, Section II.B) and providing for the management and disposal of those materials using processes appropriate to the relative hazard of the waste.

Other Considerations. These requirements recognize that closure of deactivated high-level waste facilities is an integral part of planning and operating a high-level waste facility and adds

defense-in-depth by providing minimal requirements for the closure actions and plans that support stability and minimization of maintenance activities. In addition, the use of the waste incidental to reprocessing determination process to allow certain waste streams to be managed as either transuranic waste or low-level waste, conserves disposal capacity for high-level waste. This requirement also supports the radioactive waste management basis requirement at Section II.F.

II.V. Specific Operations.

Specific requirements are provided for the operation of lifting devices and facilities for receipt and retrieval of high-level waste.

(1) Operation of Lifting Devices. Hoisting and rigging activities shall be conducted in accordance with the guidance provided in the DOE Standard "Hoisting and Rigging" (DOE-STD-1090-96).

Basis:

Functions Evaluated. This requirement is based on the analyses of the following functions: maintain a safe storage envelope; package immobilized high-level waste; operate and maintain a high-level waste immobilization facility; operate, monitor and maintain waste storage systems; and install retrieval equipment.

Safety and Hazard Analyses. The analyses identified the potential hazards to workers associated with the lifting and manipulation of heavy loads in areas with restricted space and reduced visibility in the presence of high-level radioactive waste, where collisions, and upset (tip-over of crane) could result in serious consequences to workers.

Requirements Analysis. These requirements are based on those contained in DOE-STD-1090-96, "Hoisting and Rigging", particularly those associated with the critical lift determinations (Section 2 of the Standard). This requirement has no predecessor requirement in DOE 5820.2A. They are mandated by this Order and Manual for high-level waste management facility operations.

Other Considerations. This requirement supports defense-in-depth, ALARA, and performance-based requirements, and waste authorization basis concepts.

II.V.(2) Operation of Facilities for Receipt and Retrieval of High-Level Waste. High-level waste receipt and retrieval systems shall be operated and maintained consistent with high-level waste system features incorporated in the facilities. Strategies for retrieval of waste shall be analyzed to ensure that structural and radiological impacts are consistent with the facility design basis.

Basis:

Functions Evaluated. The requirement is based on an analysis of the following functions: prepare facility/sites for closure as a low-level waste disposal site; transfer calcined high-level waste to storage; maintain a safe storage envelope; and transfer high-level waste to storage (slurry).

Safety and Hazard Analyses. The hazard is the potential loss of confinement. The analyses identified operational weaknesses that included failures due to aging, erosion and mechanical damage.

Requirements Analysis. The requirement is complementary to that contained in DOE M 435.1-1 Section II.P.(2)(b), and is intended to assure that features and operability capabilities incorporated into the design of confinement systems are maintained during the operational period. This requirement incorporates the requirement in DOE 5820.2A section I.3.b.(2)(d)**.**

Other Considerations. This requirement contributes to defense in depth, and supports ALARA, performance-based requirements, and waste authorization basis concepts.

BASIS FOR REGULATION OF TRANSURANIC WASTE

The Department of Energy DOE 5820.2A, *Radioactive Waste Management,* issued in September 1988, assumed that transuranic waste would be disposed at the Waste Isolation Pilot Plant (WIPP), except for the buried transuranic waste which would be managed in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* and the *Superfund Amendments and Reauthorization Act*. Since the issuance of DOE 5820.2A, the need to comply with a series of regulatory requirements has contributed to the focus and content of the revised Radioactive Waste Management Order, DOE O 435.1. The primary paradigm shifts from 1988 to the present DOE O 435.1 requirements are the addition of significant external oversight and regulation, and a broader view of DOE transuranic waste management program rather than primarily on the WIPP.

In September 1988, the opening of WIPP for receipt of transuranic waste was assumed to be imminent. The WIPP had been authorized by Congress in 1979 for the purpose of providing a research and development facility to demonstrate the safe disposal of transuranic radioactive wastes resulting from defense program activities. The law specifically referred to defense wastes, thereby exempting involvement by the Nuclear Regulatory Commission in the project. In 1988, the WIPP facility had been constructed, procedures written, and waste was expected to be shipped to WIPP at that time.

DOE 5820.2A was written with a clear focus on WIPP requirements and on WIPP as the primary disposal facility for transuranic waste. It indicated that DOE would be the regulator to decide for or against permanent disposal at the end of the WIPP operations demonstration period. If the decision were against using WIPP as the permanent repository, the stored waste would be retrieved, repackaged, and handled as directed by DOE. The Order was very detailed in describing how the waste is to be packaged, characterized, certified, stored, and shipped to WIPP for disposal.

At the time the DOE order was issued in 1988, the WIPP was being delayed primarily because of issues regarding the *Federal Land Policy and Management Act* (FLPMA). The FLPMA of 1976 had been established to ensure that public lands are managed in a way that protects the quality of the environment. The WIPP site is on public land that at that time was under the jurisdiction of the Bureau of Land Management (BLM). The site validation investigations and construction of the WIPP were conducted by the DOE under two successive administrative land withdrawals, neither of which permitted the receipt and storage of transuranic waste or transuranic mixed wastes at WIPP. In 1987, the first of many bills that would permanently withdraw the WIPP site from the operations of the public land laws and transfer the administrative authority for the land from the Department of Interior (DOI) to DOE was introduced into Congress. However, as described below, the legislation required for land withdrawal became complicated by issues associated with compliance with the *Resource Conservation and Recovery Act* requirements (40 CFR Parts 260-280); Environment Radiation Protection Standards for Management and Disposal

of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes (40 CFR Part 191); and other issues. As a result, the *WIPP Land Withdrawal Act* enacted in 1992 became a vehicle establishing the regulatory framework for transportation and disposal of transuranic waste at WIPP.

The *Resource Conservation and Recovery Act* (RCRA), enacted in 1976, was to address the growing problems associated with solid waste disposal, specifically those wastes that are hazardous to public health and the environment. Until the mid 1980s, it had been believed that RCRA did not apply to radioactive wastes contaminated with hazardous constituents. The wastes destined for WIPP were not considered regulated under RCRA due to the byproduct material exemption. Under the definition of byproduct material in the *Atomic Energy Act of 1954*, as amended, both the hazardous and the radioactive components of transuranic waste were considered as a whole, to be byproduct material. In 1987, the DOE issued an interpretive rule that byproduct material includes only the radioactive portion of the wastes, thereby subjecting the hazardous waste components to RCRA requirements. The aspect of this decision that had the most impact on WIPP was the land disposal restrictions (40 CFR Part 268), enacted in 1980 through the *Hazardous and Solid Waste Amendments Act,* which prohibits the land disposal of hazardous waste unless the wastes meet treatment standards or if the owner/operator can demonstrate to a reasonable degree of certainty that there will be no migration of hazardous constituents from the disposal unit.

As a result of the *Nuclear Waste Policy Act of 1982*, as amended, the EPA promulgated 40 CFR Part 191, *Environment Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes*, in 1985. These requirements govern the performance of a repository for transuranic waste disposal. In 1987, the U.S. Court of Appeals for the First Circuit struck down a portion of the requirements because EPA had not adequately explained certain inconsistencies between the disposal standards and the agency's safe drinking water standards.

Since DOE 5820.2A, *Radioactive Waste Management,* was issued in 1988, the regulatory requirements for management of transuranic waste have significantly changed because of the resolution of these regulatory issues. In 1992, Congress passed the *WIPP Land Withdrawal Act* to withdraw the land for WIPP. Among other important features, the law transferred the land from the DOI to the DOE, established a test phase, required compliance with 40 CFR Part 191, and required the EPA Administrator to determine compliance with the disposal requirements. The Act mandated that EPA issue criteria for evaluating DOE's compliance demonstration with 40 CFR Part 191. The EPA met this requirement on February 9, 1996, with the publication of 40 CFR Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations.*

In 1992, Congress passed amendments to the *Solid Waste Disposal Act*, entitled the *Federal Facility Compliance Act,* which required DOE to prepare plans for developing treatment

capacities and technologies for mixed waste. Pursuant to this Act, DOE prepared site-specific treatment plans, and consent orders or agreements have been reached with the affected states and the EPA. These consent orders and agreements typically specify how and when transuranic wastes which also contain a RCRA-regulated hazardous component are to be retrieved, characterized, treated, certified to the WIPP waste acceptance criteria, and then stored or shipped for disposal at WIPP. This process has involved many stakeholder groups and different regulatory entities.

In 1996, Congress passed amendments to the 1992 *WIPP Land Withdrawal Act* which primarily deleted the test phase and removed the hazardous waste land disposal prohibitions of RCRA (no migration variance and treatment requirements). Consequently, transuranic waste containing hazardous waste constituents does not need to be treated in accordance with the treatment standards to allow its disposal. However, WIPP must still comply with the RCRA requirements of the state of New Mexico pursuant to the *New Mexico Hazardous Waste Act of 1978*.

The Transuranic Waste Requirements chapter of the *Radioactive Waste Management Manual*, DOE M 435.1-1, is consistent with the legislation and requirements associated with the certification and operation of WIPP. However, unlike DOE 5820.2A, the current requirements do not unduly focus on the details and requirements of WIPP-specific operations. Instead, the requirements for management of transuranic waste have been prepared to apply to a broader range of management functions, from generation, through treatment and storage, to disposal. The previously detailed requirements related to preparing and disposing of waste at WIPP are now addressed by higher level, performance-based requirements.

The following pages explain the basis for the transuranic waste management requirements included in DOE M 435.1-1.

CHAPTER III

TRANSURANIC WASTE REQUIREMENTS

III. A. Definition of Transuranic Waste.

Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) 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 the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or

(3) Waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Basis:

Functions Evaluated. This requirement relates to the very top level function, that is, manage transuranic waste. All of the other functions, and therefore all of the transuranic waste management requirements apply only to the management of waste determined to meet the definition of transuranic waste.

Safety and Hazard Analyses. Although no specific safety or hazard was associated with identifying waste as transuranic waste, accurate determination of the waste type is necessary to ensure that it is managed and disposed of in accordance with the applicable requirements which are based on an analysis of safety and hazards associated with subordinate functions.

Requirements Analysis. The definition of transuranic waste was taken from the *Waste Isolation Pilot Plant Land Withdrawal Act*, as amended, and is consistent with the definition in 40 CFR Part 191, *Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*. The current definition is consistent with the basic elements of the definition in DOE 5820.2A, but differs in a couple of details. The previous definition specified that the determination of whether a waste was transuranic waste was made at the time of assay, but did not specify when the assay was to be performed. As a consequence, there was ambiguity regarding the type of waste if treatment changed the concentration after an assay had been performed. The current definition does not specify when the determination is to be made, but the supporting guidance clarifies that it is to be

made when the waste is certified as meeting the waste acceptance criteria of a facility to which it is being transferred. The past definition also allowed Heads of Field Elements to determine that other alpha contaminated wastes must be managed as transuranic waste. This provision no longer exists for the reason explained below.

Other Considerations. The Department is legislatively constrained by the *Waste Isolation Pilot Plant Land Withdrawal Act* to disposing only defense transuranic waste at the Waste Isolation Pilot Plant. The term transuranic waste is defined in the legislation, so there is no latitude for disposing of waste in the Waste Isolation Pilot Plant if it does not meet that definition. Since the legislation removes disposal at the Waste Isolation Pilot Plant as an option for Field Element Manager-proclaimed transuranic wastes, there is no waste management benefit of declaring them to be transuranic waste.

III. B. Management of Specific Wastes.

The following provide for management of specific wastes as transuranic waste in accordance with the requirements in this Chapter:

(1) Mixed Transuranic Waste. Transuranic waste determined to contain both a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, and a radioactive component subject to the *Atomic Energy Act of 1954*, as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. Transuranic waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(3) Pre-1970 Transuranic Wastes. Transuranic waste disposed of prior to implementation of the 1970 Atomic Energy Commission Immediate Action Directive regarding retrievable storage of transuranic waste is not subject to the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Basis:

Functions Evaluated. This requirement does not derive from the analysis of any specific functions. Mixed transuranic waste is a subset of transuranic waste and is thereby included in all of the waste management functions analyzed.

Safety and Hazard Analyses. The regulation of mixed transuranic waste in accordance with the applicable requirements of the *Resource Conservation and Recovery Act* (RCRA) was an underlying assumption in the safety and hazard analysis. Part of this assumption was that the applicable Federal or State requirements which implement RCRA provide adequate protection from the hazardous waste components. Similarly, the controls provided by *Toxic Substances Control Act* (TSCA) requirements for the management of polychlorinated biphenyls and other materials regulated by TSCA were assumed to be adequate.

Requirements Analysis. The Mixed Transuranic Waste requirement is comparable to the policy stated in DOE 5820.2A, Chapter II.1 with respect to management of mixed transuranic waste. Additional language has been added that specifies transuranic waste mixed with TSCA-regulated materials shall also be managed in accordance with the requirements implementing TSCA. The Pre-1970 Transuranic Waste requirement is consistent with how EPA applies disposal requirements in 40 CFR Part 191. The disposal standards do not apply to previously disposed waste unless it is retrieved.

Other Considerations. The additional language regarding management of certain wastes in accordance with TSCA was added as a result of a review identifying this as a gap in the requirements. The additional language was therefore added to the transuranic, high-level, and low-level waste management chapters of the Manual.

III. C. Complex-Wide Transuranic Waste Management Program.

A complex-wide program and plan shall be developed as described under *Responsibilities,* 2.B and 2.D, in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level functions of transuranic waste management, i.e., formulate, execute, and evaluate the transuranic waste management program.

Safety and Hazard Analyses. This requirement addresses the need for an integrated and documented complex-wide program for planning, executing, and evaluating the activities necessary to safely manage transuranic waste. The requirement addresses the potential

weaknesses and conditions associated with failure to prepare and document program assumptions and uncertainties, prepare a strategic plan, identify organizational roles and responsibilities, identify and provide a point of coordination for research and development, and evaluate program progress. All of these activities promote protection of the public, workers and the environment by enabling the Department to make the most effective use of its waste management resources.

Requirements Analysis. The requirement for a complex-wide transuranic waste management program and program plan has no equivalent requirement in DOE 5820.2A. Inclusion of a requirement for a complex-wide program and program plan is an improvement over DOE 5820.2A which assigned individual Program Secretarial Officers responsibility for managing waste under their purview, but required no coordination across the DOE sites and Headquarters Offices.

Other Considerations. Establishing a requirement for central coordination of the Transuranic Waste Management Program is consistent with the Department's present practice for managing transuranic waste. Under the current practice, Headquarters has delegated responsibility for planning and implementing the transportation to and disposal of waste at WIPP to a central organization, the Carlsbad Area Office. Consistent with this responsibility, the Carlsbad Area Office has prepared a Transuranic Waste Management Program Plan that focuses on the disposal of defense transuranic waste. Inclusion of this requirement will perpetuate the maintenance of a plan addressing this key element of the transuranic waste management program and ensure that the plans are developed for management of the balance of the transuranic waste.

III. D. Radioactive Waste Management Basis.

Transuranic waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, disposal authorization statement, waste acceptance requirements, and monitoring plan.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level waste management functions of Formulate, Execute, and Evaluate a waste management program.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions associated with a lack of or poor integration of documents, programs, and controls important to radioactive waste management (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or accountability at the highest management positions for ensuring the most important requirements for the safe management of waste will be met.

Requirements Analysis. The requirements for a radioactive waste management basis for transuranic waste management facilities and activities have no comparable requirements in DOE 5820.2A. The radioactive waste management basis for a facility or activity includes formal approval at the site level of transuranic waste management operations, and ensures that programs and activities established to meet other requirements are being coordinated and integrated as necessary with activities needed to meet DOE O 435.1 requirements. The radioactive waste management basis concept employs the same principles as the authorization basis for DOE facilities carried out under DOE 5480.21, facility licensing carried out by the NRC, facility permitting done by the EPA and state agencies. Whereas an EPA permit or NRC license application would be required to compile all necessary information in a single summary document, documentation of the controls which constitute the radioactive waste management basis do not need to be assembled in a single document. The intent is that the controls are documented and that the site personnel know what they are, where they are, and how they work together to provide protection of the public, workers, and the environment, but, it was decided that additional work for the sole purpose of compiling the information into a single, license application-like document was unwarranted.

Other Considerations. The concept for the radioactive waste management basis derives in part from the weaknesses or vulnerabilities identified as a result of the Defense Nuclear Facilities Safety Board Recommendation 94-2 addressing low-level waste management. The Board commented on the failure of the Department to complete the performance assessment review process for low-level waste disposal facilities. In addition, the Department performed a Complex-Wide Review of low-level waste management activities and identified conditions that would be improved (e.g., poor storage conditions) by requiring that a formal confirmation that the controls necessary for safe operations are in place. The concept of the radioactive waste management basis was extended to the other waste types as a best management practice. The radioactive waste management basis also provides a degree of defense in depth in the administration of waste management by requiring a confirmation that a facility or operation is adhering to applicable requirements. The radioactive waste management basis concept being employed is performance

based and uses the graded approach, so the rigor of documentation is commensurate with the hazards and safety implications of activities carried out at a given facility.

III. E. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving liquid transuranic waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated transuranic waste contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of liquid waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Basis:

Functions Evaluated. This requirement was derived from hazards identified in the high-level waste safety and hazard analyses, and is based on evaluations of the functions to operate, monitor, and maintain storage systems.

Safety and Hazard Analyses. The analyses identified a weakness associated with the inability to take mitigative actions in the event of a leak from a facility processing or storing liquid potentially significant consequences from leaking storage tanks without adequate spare capacity and adequate transfer equipment.

Requirements Analysis. This requirement is based on high-level waste requirements contained in 5820.2A, paragraph 1.3.b.(4)(d), and draft 5820.2B, chapter II paragraph 3.c.(3)(g).

Other Considerations. During the review of draft DOE O 435.1, requirements were identified from other waste types that were considered relevant to the management of transuranic waste. The readily available capability to respond to emergency situations involving loss of confinement supports the defense-in-depth concept, protection of workers and the environment, and the radioactive waste management basis.

III. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Basis:

Functions Evaluated. These requirements derive from the analysis of the top-level functions of Plan, Execute, and Evaluate the Transuranic Waste Management Program.

Safety and Hazard Analyses. The requirement addresses the need for conducting evaluations (oversight, inspections, reviews, etc.) of the transuranic waste management activities that are important to protection of the public, workers, and the environment, and for correcting situations which are not being conducted in accordance with Order and/or Manual requirements. This first subrequirement addresses a weakness of any requirement where lapses in attention result in a failure to implement requirements intended to provide protection of the public, workers, and the environment. The second subrequirement addresses the hazards associated with failure to operate facilities and conduct activities in accordance with an established set of controls, the radioactive waste management basis. Curtailing or shutting down operations provides interim controls of potential hazards until the corrective actions can be fully implemented. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor documentation or integration of documentation of the evaluations that demonstrate radioactive waste management controls are sufficient which collectively make up the radioactive waste management basis for a facility.

Requirements Analysis. Corrective actions were not explicitly required in DOE 5820.2, however, the Order did invoke DOE O 414.1, Quality Assurance which does have requirements for corrective actions. Similarly, existing requirements for corrective actions in quality assurance directives serve as a model for the current requirements. The authorization basis concept of DOE 5480.21 and its implementation were utilized as a basis for the concept of radioactive waste management basis. Corrective actions are used by the NRC in reactor licensing for dealing with situations that could be inimical to public health and safety, however, no additional essential requirement language was derived from those requirements.

Other Considerations.

The radioactive waste management basis, and the use of corrective actions to correct situations where the basis is not being met is partially derived from system engineering which was done for the low-level waste management program which showed the need for accountability to demonstrate requirements are being met. The requirement was invoked for transuranic waste management as a best management practice. The use of corrective actions is consistent with implementation of the Integrated Safety Management System and the use of feedback mechanisms to determine measurable improvement of programs.

III. G. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all transuranic waste storage, treatment, or disposal facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal;

(c) Restrictions or prohibitions on waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance;

(d) Requirement to identify transuranic waste as defense or non-defense, and limitations on acceptance; and

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Basis:

Functions Evaluated. This requirement derives from the functions for receiving waste for storage, treatment and disposal, and functions for establishing waste acceptance criteria and ensuring compliance with waste acceptance criteria.

Subrequirement (d) derives from the analysis of characterization and disposal functions related for transuranic waste.

Safety and Hazard Analyses. The requirement addresses the need for establishment of waste acceptance criteria by treatment, storage, and disposal facilities and it ensures that the requirements of the waste acceptance criteria are met at the receiving facility. The requirement was developed to mitigate hazards associated with receiving incompatible or unexpected waste types either through human error or method/information failure which could lead to exposure or injury to workers, loss of containment of waste, or operation of the facility beyond its authorization basis.

The subrequirement (d) reduces the potential for redundant handling of waste packages resulting from the inability to easily determine whether the waste is defense (eligible for disposal at WIPP) or non-defense waste.

Requirements Analysis. There are no similar requirements for developing waste acceptance criteria for transuranic waste in 5820.2A, however similar requirements are in the low-level waste section of 5820.2A, Chapter III.3.e.(1) through (5). Current DOE radioactive waste management facility waste acceptance criteria were evaluated for additional essential waste acceptance criteria.

There is no requirement in 5820.2A that specifically correlates with subrequirement (d) referring to defense or non-defense transuranic waste. However, 5820.2A, Chapter II.3.e.2 requires that certified waste not be commingled with noncertified waste. The requirement is similar since transuranic waste from defense related activities can be certified for disposal at WIPP, and non-defense waste cannot be certified for disposal at WIPP.

Other Considerations. The requirements found in 5820.2A and current DOE facility WAC were made performance-based and consolidated into requirements for acceptable waste. Implementation guidance includes discussions of the specific restrictions and allowances found in those other sources of requirements that were evaluated. Effective waste acceptance experience at DOE facilities establishes these criteria as best management practice for waste acceptance requirements.

Subrequirement (d) is derived from the *WIPP Land Withdrawal Act* limitation that WIPP only accept transuranic waste from defense related activities. The requirement is based on General

Counsel's review of Congressional legislation affecting WIPP and is referenced in the DOE G 435.1 guidance corresponding to this requirement.

III. H. <u>Waste Generation Planning</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all transuranic waste streams.

(2) Waste With No Identified Path to Disposal. Transuranic waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for pre-certifying waste, providing forecast data, and approval of generator processes by the receiving facility.

Safety and Hazard Analyses. The requirement addresses the need for generators, and treatment, storage, and disposal facilities to know more about wastes requiring management prior to their generation, to prevent the generation of waste streams that may not have a path forward to disposal, and to implement an authorization for generation of no path forward waste. Specific weaknesses and conditions addressed are the generation of waste that cannot be certified or accepted at a management facility, with no disposal option, or that taxes the capacity of a waste management facility. The requirement addresses a weakness that parallels a vulnerability identified in the *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities*.

Requirements Analysis. The requirements have no direct predecessor transuranic waste requirements in DOE 5820.2A. DOE 5820.2A low-level waste requirement III.3.b.(2) calls for an overall waste management systems performance assessment and Chapter VI calls for a waste

management plan. These requirements and the concepts they embody have been significantly modified in DOE M 435.1-1 to clarify the focus of these activities on the life-cycle of transuranic waste streams rather than on information about facilities managing and achievements in characterization, treatment, storage, and disposal as separate activities. These requirements in DOE M 435.1-1 emphasize planning rather than an assessment of the system performance. The requirements of DOE O 430.1A were evaluated and determined to be adequate for life-cycle planning for radioactive waste management facilities and other assets, but not adequate with respect to planning for the management of the waste streams themselves.

Other Considerations. The concepts of life-cycle planning prior to generation and approval to generate provide defense-in-depth by ensuring that a generation process will be designed and/or modified such that the waste generated can be certified and can be managed at appropriate storage, treatment, and disposal facilities. The requirement addressing waste with no path to disposal is included to ensure that such waste is generated only after careful consideration and an explicit acknowledgment that the waste will be stored safely pending resolution of the issues preventing disposal.

III. I. Waste Characterization.

> **Transuranic waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.**

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions in the receipt, storage, treatment, and disposal of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of receiving poorly or un-characterized waste, waste requiring additional management as mixed or remotely-handled waste, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility because of its containment breach potential, and waste that would adversely affect the performance of a disposal facility.

Requirements Analysis. This requirement expands and improves on the requirement in 5820.2A, Chapter II.3.b.2, with the allowance that waste characteristics may be determined by non-destructive methods as long as positive correlation can be established between the non-destructive methods and the intrusive or direct methods. This requirement was derived from authors and comments on the draft which specified that the cost saving approach of non-destructive examination ought to be allowed and encouraged for characterization of waste.

Other Considerations. Use of indirect methods to characterize the waste significantly reduces the cost of any sites' certification program. This is a best management practice to reduce the overall cost to DOE and the generator. Correlation of indirect to direct methods is a measure of defense-in-depth for certification of waste to the acceptance criteria of the receiving facility.

III. I.(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Basis:

Functions Evaluated. This requirement is based on an analysis of generator functions as they relate to the receipt, storage, treatment, and disposal of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of receiving poorly characterized waste, waste requiring additional management as mixed waste, waste exceeding waste acceptance criteria limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, and waste that would adversely affect the performance of a disposal facility. The requirement addresses potential weaknesses in transuranic waste characterization that are similar to those identified in the Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities.

Requirements Analysis. This requirement expands on the requirement in DOE 5820.2A, II.3.b.2, with the addition of the data quality objective (DQO) or a similar process to correctly establish a waste characterization program. Application of the DQO process yields data that are appropriate and commensurate with the decisions that are being made using the data. Guidance from the Environmental Protection Agency was used as a source for the elements of a DQO or similar process.

Other Considerations. The additional language is derived from language provided by commenters on draft versions of the requirements. Application of a data quality objectives or similar process is supportive of ALARA since the characterization design is established and optimized before effort is expended in acquiring characterization data. This avoids having to re-characterize waste or spend additional time in collecting unneeded information. It also provides a mechanism for ensuring information necessary to support the performance assessment evaluations that are used to demonstrate that disposal facility performance objectives are expected to be met. At DOE-complex sites where characterization requirements have been developed and refined, the use of data quality objectives and an appropriate quality assurance program were essential to its success.

III. I.(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any stabilization or absorbent media;

(c) Weight of the container and contents;

(d) Identities, activities, and concentrations of major radionuclides;

(e) Characterization date;

(f) Generating source;

(g) Packaging date; and

(h) Any other information which may be needed to prepare and maintain the disposal facility performance assessment or demonstrate compliance with applicable performance objectives.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions in the receipt, storage, treatment, and disposal of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of receiving poorly or un-characterized waste, waste requiring additional management as mixed or remotely-handled waste, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility because of its containment breach potential, and waste that would adversely affect the performance of a disposal facility.

Requirements Analysis. This requirement expands on the requirement in 5820.2A, Chapter II.3.b.2, with the addition of specific minimum waste characteristics needed to manage transuranic waste during its life cycle.

Other Considerations. Specific minimum waste characteristics are provided by authors and commenters on drafts of the requirements that are interested in applying best management practices and in keeping radiation exposure as low as reasonably achievable. At DOE-complex sites where these life cycle phases of transuranic waste management are being executed or

planned, the waste characteristics listed have been determined to be the most important and useful to the successful management of the waste.

III. J. Waste Certification.

> **A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving transuranic waste for storage, treatment, or disposal are met.**

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to ship only waste certified to meet the waste acceptance criteria of the receiving treatment, storage, or disposal facility. The requirement addresses weaknesses and conditions of receiving uncharacterized waste, waste exceeding WAC limitations, waste requiring additional management due to mis-certification, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility.

Requirements Analysis. The requirement is similar to part of the requirements in 5820.2A, Chapter II.3.C.1 and II.3.C.3., calling for waste to be certified to a prepared waste certification program. Specific reference to the Waste Isolation Pilot Plant (WIPP) has been removed and placed in guidance as a representative example. Current requirements established in the WIPP waste certification plan were used in the evaluation for essential requirements in waste certification.

Other Considerations. None.

> **III. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.**

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions that could arise from uncertified waste, poorly characterized waste, or waste containing unacceptable materials, particularly caused by poor certification documentation and recordkeeping.

Requirements Analysis. The requirement replaces authority and auditability requirements established in DOE 5820.2A, Chapter II.3.C.4 through II.3.C.10. The requirement removes specific involvement of the Waste Acceptance Criteria Certification Committee at WIPP, and the Environmental Evaluation Group with the State of New Mexico, as final certification authority for shipment of waste to WIPP. The requirement establishes recordkeeping requirements considered essential for waste certification activities.

Other Considerations. The requirement was derived from best management practices utilized in successful waste certification programs at DOE generator facilities, and from experience of DOE facilities receiving waste from many differing generators. The requirement provides defense-in-depth for waste certification documentation. Best management practices entail the identification of a single official and an alternate, who have the authority to certify that transuranic waste meets the acceptance criteria of the receiving facility. To ensure that proper documentation and recordkeeping are in place to retain waste characterization data at its origin is considered defense-in-depth.

III. J.(2) Certification Before Transfer. Transuranic waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions that could arise from allowing receipt of uncertified waste, poorly characterized waste, or waste containing unacceptable materials.

Requirements Analysis. This requirement did not originally exist in DOE 5820.2A for transfer of transuranic waste. The requirement was added from generator comments on the draft of DOE O 435.1. Comments specified that generators' waste be certified as meeting the receiving facility's waste acceptance criteria and that this certification take place prior to its transfer to the receiving facility.

Other Considerations. This requirement adds defense-in-depth to the controls over the most vulnerable part of the waste management system, namely when waste is transferred. This requirement appropriately places the burden on the generator to ensure that the waste meets the receiving facility waste acceptance criteria.

III. J.(3) Maintaining Certification. Transuranic waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses weaknesses and conditions of failing to manage the waste at a treatment or storage facility such that it will lose its certification prior to transfer to the next phase in its life cycle. These actions include: failing to monitor and inspect the waste such that release of radioactive or hazardous materials is allowed; abusive handling such that the containment boundary of the waste package is compromised and must be replaced; and failing to manage certification documentation such that records are lost or destroyed.

Requirements Analysis. The requirement is an expansion of 5820.2A, Chapter II.3.e.2., calling for management of transuranic waste in such a fashion that certified waste is not commingled with uncertified waste. In addition, the waste must be controlled, inventoried and records maintained such that its original certification may be preserved.

Other Considerations. None.

III. K. Waste Transfer.

A documented process shall be established and implemented for transferring responsibility for management of transuranic waste and for ensuring availability of relevant data. The following requirements are in addition to those in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement is based on analyses of all functions associated with waste management. All of these functions require an individual to have responsibility for knowing what is in a waste container and maintaining control over what happens to the container.

Safety and Hazards Analysis. The requirement addresses the weakness or condition of maintaining inadequate controls over waste containers for which one is responsible. This can result in unallowable materials being introduced into a waste container and not being acknowledged on the information passed along when the container is transferred. The result is a potential hazard from receiving and managing containers with unknown waste contents. This could result in excess exposure to workers or in releases which could affect workers, the public, or the environment.

Requirements Analysis. This requirement is one of several which improve on DOE 5820.2A, Chapter II.3.e.3. This requirement, along with I.1.E.(16) and III.J.(3) of DOE M 435.1-1, more thoroughly address the need to prevent unauthorized access to transuranic waste when in storage.

Other Considerations. None.

III.K.(1) Authorization. Transuranic waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a process for assuring that generators meet waste acceptance criteria of storage, treatment, and disposal facilities and that receiving facilities verify that the acceptance criteria are met before the waste is

received. Specific weaknesses and conditions addressed are receipt of uncertified waste, poorly characterized waste, or waste containing unacceptable materials.

Requirements Analysis. The requirement is an improvement to DOE 5820.2A Chapter II.3.c.5. which addresses specific authorization by the Waste Acceptance Criteria Certification Committee for waste transfers to WIPP. This requirement no longer specifies WIPP but generically identifies the generator and receiving facility.

Other Considerations. Authorization by receiving facilities for transfer provides defense-in-depth when waste is transferred, which is the most vulnerable period in the waste's life cycle.

III. K.(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for transuranic waste shall be transferred with or be traceable to the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of all functions in the transuranic waste management system. Waste data were required input into every subsequent function from the previous function.

Safety and Hazard Analyses. The requirement addresses the need for maintaining accurate characterization data at all stages of the waste management process for transuranic waste from generation through post-disposal. Specific weaknesses and conditions include losing knowledge about waste at any step of the waste management process. Particularly vulnerable stages of the process include transfers, transportation, when treatment changes the waste form, when repackaging occurs, and when storage lasts longer than anticipated.

Requirements Analysis. The requirement is one of several which improve the requirement identified in DOE 5820.2A, Chapter II.3.f.(3), on shipping papers and waste manifests. The analysis of the waste manifest requirement indicated that it was too restrictive (language limited use of manifests to when there was a package). The requirement needed to ensure that maintaining characterization and packaging data, applies to all functions. The manifesting requirements of 10 CFR Part 20 were evaluated, and found to be too restrictive since it was limited to offsite disposal of transported waste.

Other Considerations. The requirement reflects a change to a performance based requirement that applies to all functions rather than a limited set. The principle of ALARA is supported by this requirement in preventing re-certification or re-characterization of waste, or doing unnecessary sampling and analysis, if all characterization data are properly maintained and transferred.

III. L. <u>Packaging and Transportation</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging.

(a) Transuranic waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste is removed from the container.

(b) Vents or other mechanisms to prevent pressurization of containers or generation of flammable or explosive concentrations of gases shall be installed on containers of newly-generated waste at the time the waste is packaged. Containers of currently stored waste shall meet this requirement as soon as practical unless analyses demonstrate that the waste can otherwise be managed safely.

Basis:

Functions Evaluated. These requirements are based on evaluations of the packaging and transportation functions (called waste disposition in the functions analysis) associated with waste generation, characterization, treatment, storage, off-site transportation, and disposal.

Safety and Hazard Analyses. In the safety and hazards analyses the loss of container integrity and the subsequent exposure of workers or the public and releases to the environment are associated with using an inappropriate container for the type of waste being packaged. These hazards could result from weaknesses or conditions associated with lack of systematic processes, lack of personnel training, and radiological decomposition of materials within waste containers.

Requirements Analysis. The requirements for packaging are improvements, updates, consolidations, and additions to packaging requirements in DOE 5820.2A, requirement II.3.d.3. This DOE M 435.1-1 requirement refers to Chapter I, General Requirements and Responsibilities, which invokes DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management*, which address transportation of radioactive materials. These two DOE orders in turn refer to the Department of Transportation requirements addressing packaging and labeling of materials (including radioactive materials) for transport on public roadways. Through the safety and hazards analysis, requirements analysis, and subsequent analyses in the development of DOE M 435.1-1, the packaging requirements were identified as either not adequately covered in existing requirements or warranting emphasis in the Manual.

Other Considerations. The final language in the requirement is partially in response to comments received on draft versions of DOE O 435.1 and DOE M 435.1-1. Venting of transuranic waste packages is required for transportation in TRUPACT II. However, DNFSB comments on the draft Manual noted that the hazards associated with pressurization during transportation can also occur in storage or other waste management steps. Therefore, venting of containers was added as a requirement with the allowance that a facility may, through a technical evaluation such as its safety analysis report, demonstrate that vents are not necessary for safe storage of the waste.

III. L.(1)(c) When transuranic waste is packaged, defense waste shall be packaged separately from non-defense waste, if feasible.

Basis:

Functions Evaluated. This requirement is based on the analysis of storage functions as they related to final disposition of transuranic waste.

Safety and Hazard Analyses. The requirement reduces the potential for redundant handling of waste packages resulting from unclear markings as to being defense (eligible for disposal at WIPP) or non-defense waste.

Requirements Analysis. There is no requirement in DOE 5820.2A specifically referring to segregation of defense or non-defense transuranic waste. However, DOE 5820.2A, requirement II.3.e.2 requires that WIPP-certified waste not be commingled with noncertified waste. The requirement is similar since transuranic waste from defense related activities can be certified for disposal at WIPP, and non-defense waste cannot be certified for disposal at WIPP.

Other Considerations. A key source of requirements affecting transuranic waste management is the *Waste Isolation Pilot Plant Land Withdrawal Act*, as amended. This legislation authorizes WIPP, upon receiving the necessary certification, to dispose of defense transuranic waste. Consistent with this legislation, a requirement was added to the Manual to require that defense and non-defense waste be packaged separately when waste is packaged. This requirement is consistent with the DOE Office of General Counsel's review and interpretation of Congressional legislation affecting WIPP (Memorandum, R.R. Nordhaus to A. Alm and G. Dials, *Interpretation of the Term "Atomic Energy Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, September 9, 1996). This interpretation was distributed to DOE sites by a memorandum from S. Cowan to Distribution, *Implementation Guidance Concerning "Atomic Energy Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, October 17, 1996.

III. L.(1)(d) Containers of transuranic waste shall be marked such that their contents can be identified.

Basis:

Functions Evaluated. This requirements is based on an evaluation of the functions for generation, treatment, storage, off-site transportation, and disposal of transuranic waste. Proper marking of containers is necessary for safe handling of transuranic waste during all phases of the waste management life cycle.

Safety and Hazard Analyses. The requirement addresses the conditions and weaknesses of having inaccurate or incomplete information about a waste container at essentially any stage of waste management. The condition may be the inability to discern information directly from marking or labeling on a container or may be that marking or labeling does not support correlation to records regarding the container contents. As a result of not being able to ascertain information about a waste, workers are potentially exposed to unexpected high dose rates, airborne contamination, or other hazards associated with a waste.

Requirements Analysis. The requirement for marking and labeling reflects improvements, updates, consolidations, and additions to packaging requirements in DOE 5820.2A, requirement II.3.d.3. The current DOE M 435.1-1 requirement refers to DOE O 460.1A and DOE O 460.2, DOE orders covering transportation of radioactive materials, which in turn detail or refer to specific DOT, DOE, and NRC requirements necessary to ensure proper packaging and labeling of transuranic waste packages. This requirement expands on the transportation requirements for marking and labeling such that they apply at any stage in waste management.

Other Considerations. Marking and labeling are considered ALARA and best management practices and are employed for radioactive and hazardous waste. Proper marking and labeling also encourages a graded approach to the handling and management of mixed and non-mixed transuranic waste by providing information that allows safety features and controls to be commensurate with the hazard associated with each waste container.

III. L.(2) Transportation. To the extent practical, the volume of waste and number of transuranic waste shipments shall be minimized.

Basis:

Functions Evaluated. This requirement relates primarily to the transuranic waste generation function, but is also relevant to transporting waste to and managing waste at storage, treatment, and disposal facilities.

Safety and Hazard Analyses. The requirement addresses the condition of loading and unloading transport vehicles, securing waste on transport vehicles, and transporting waste. Hazards associated with radiological exposure, industrial accidents, and highway accidents are expected to be proportional to the number of waste containers handled. This is supported by other studies (e.g., Waste Management Programmatic Environmental Impact Statement) that indicate that transportation is a relatively high hazard activity in radioactive waste management. Consequently, reducing the amounts of waste and the number of containers is expected to result in a lower incidence of the above-mentioned hazards.

Requirements Analysis. This requirement did not previously exist in the transuranic waste chapter of DOE 5820.2A, and is similar to a DOE 5820.2A low-level waste requirement and to the more general requirements for waste minimization. However, because of the documented increased risk associated with transportation, this requirement was added to minimize risk to workers, the public and the environment by consolidating and reducing the number of radioactive materials shipments.

Other Considerations. The requirement adds defense-in-depth to the requirements of 460.1A (invoked in the General Requirements and Responsibilities Chapter) for transportation of transuranic waste. It accounts for possible consequences associated with transportation as identified during the safety and hazard analysis. The requirement was developed in support of the guiding principles for minimizing numbers of shipments to result in ALARA total radiation doses and the best management practice of making the most cost-effective use of the shipment.

III. M. **<u>Site Evaluation and Facility Design</u>. The following requirements are in addition to those in Chapter I of this Manual.**

(1) Site Evaluation. Proposed locations for transuranic waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new transuranic waste facility or expansion of an existing transuranic waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Basis:

Functions Evaluated. This requirement relates to the functions of acquiring storage or treatment facilities and/or capabilities for management of transuranic waste.

Safety and Hazard Analyses. This requirement addresses the need for site characteristics to be appropriately incorporated into the design of transuranic waste management facilities (storage, treatment, and disposal). The requirement addresses the weaknesses and conditions associated with poor facility siting, inadequate designs of facilities, and inadequate data for performance assessment calculations for disposal facilities. Some of the consequences resulting from failures evaluated in this part of the analysis were high because of catastrophic failures of radioactive material containment that could occur due to environmental and geotechnical characteristics such as flooding, earthquakes, and severe weather events.

Requirements Analysis. This requirement is a combination of DOE 5820.2A requirements II.3.e.(5) and II.3.g.(2), with significant modifications and expansion. The wording is modified such that it addresses characterization of all transuranic waste management facilities rather than focusing only on site selection for a potential new transuranic waste storage or interim storage facility. This requirement supplements those in DOE O 420.1 *Facility Safety* and DOE O 430.1A, *Life Cycle Asset Management*. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced. Additional information is contained in DOE G 435.1-1, which details portions 6430.1A as guidance.

Other Considerations. This requirement is based the safety and hazard analyses performed for low-level waste, but are applicable to transuranic waste.

III. M.(2) Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Transuranic waste systems and components shall be designed to maintain waste confinement.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions for placing and monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need for some transuranic waste management facilities to provide additional confinement barriers in addition to packaging. The requirement addresses the specific weaknesses and conditions of managing liquid transuranic

waste, and containers in storage leaking or breaking during handling, and waste being in storage longer than planned. Weaknesses identified in the high-level waste safety and hazard analyses included failures due to aging, corrosion and mechanical damage.

Requirements Analysis. The requirement is partially derived from the DOE 5820.2A Requirements I.3.b.(2)(a) requiring double containment for all new high-level waste facilities, but is improved and applied to transuranic waste treatment and storage facilities. The requirement is also based on an evaluation of *Resource Conservation and Recovery Act* requirements at 40 CFR Part 264, Subpart J and 40 CFR Part 265 Subpart J, and evaluation of DOE 6430.1A.

Other Considerations. This requirement is based the safety and hazard analyses performed for high-level waste, but are applicable to transuranic waste.

III. M.(2)(b) Ventilation.

1. **Design of transuranic waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.**

2. **When conditions exist for generating gases in flammable or explosive concentrations in treatment or storage facilities, ventilation or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.**

Basis:

Functions Evaluated. This requirement derives from the analysis of the storage function for monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need to include ventilation systems as appropriate in facilities that treat and store transuranic waste due to the receipt of waste in gaseous form, or waste which degrades and creates gases in the container. The requirements address the weaknesses of receiving waste with incorrect characterization information or which contains an unknown material and of having to open containers to verify the contents. Requirement (d)2. specifically addresses the weakness associated with the receipt of a container that includes a gas or an explosive agent. Processing a container of transuranic waste with a gas

or an explosive was identified as a high hazard activity due to potentially large consequences in the safety and hazard analysis conducted on transuranic waste treatment.

Requirements Analysis. The requirements are similar to the requirement in 5820.2A, I.3.b.(2)(f) requiring ventilation systems to maintain radionuclide release within published guidelines at high-level waste tanks, but it is applied to transuranic waste management treatment and storage facilities. The requirement is partially derived from requirements in 10 CFR Part 835 *Occupational Radiation Protection, DOE Order 5400.5 Radiation Protection of the Public and Environment,* and 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

Other Considerations. This requirement is based the safety and hazard analyses performed for high-level waste, but are applicable to transuranic waste.

III. M.(2)(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing transuranic waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage and treatment functions for constructing a new facility and the treatment function for closure of a treatment facility.

Safety and Hazard Analyses. The requirement addresses the need for incorporating waste generation reduction and minimization into the design of new management facilities. The condition identified in the safety and hazards analyses being addressed by this requirement is managing the residuals from a treatment facility.

Requirements Analysis. This requirement improves on DOE 5820.2A requirements III.3.c on waste generation minimization and reduction, and on the policies in III.2.a. and 2.b. that no legacies requiring remedial action should remain after transuranic waste operations are terminated and that transuranic waste should be managed in a systematic way that includes waste generation reduction. DOE O 430.1A was evaluated during the development of planning requirements for radioactive waste, and it was found to be sufficient for management of radioactive waste management facilities and other assets of the transuranic waste management system, but it did not adequately discuss planning of waste streams to be generated by facilities, including radioactive waste management facilities.

Other Considerations. This requirement was added to promote best management practices to include consideration of the entire life-cycle of the management of waste that will be generated from operating a transuranic waste management facility. Preventing or minimizing the generation of waste is a top-level principle that is incorporated into DOE M 435.1-1 wherever possible.

III. M.(2)(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of transuranic waste treatment and storage facilities to provide volume inventory data and to prevent spills, leaks, and overflows from tanks or confinement systems.

III. M.(2)(e) Monitoring. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of transuranic waste storage, treatment, and disposal facilities to provide rapid identification of failed confinement and/or other abnormal conditions.

Basis:

Functions Evaluated. These requirements derive from the analysis of storage functions for monitoring waste in storage and maintaining the storage facility, and treatment functions for providing interim storage at the treatment facility, processing waste, and maintaining the facility.

Safety and Hazard Analyses. Requirement (b) addresses the need to detect system failures that could lead to significant consequences such as a leak in a tank containing liquid transuranic waste. Requirement (c) addresses the need to provide instrumentation and other engineered items to allow for control of the storage and transfer of waste in tanks and processing lines to prevent loss of containment of liquid transuranic waste. The requirements address the weaknesses and conditions of liquid transuranic waste tanks breaching or being overfilled, containers in storage leaking or breaking during handling, or liquid transuranic waste lines in treatment facilities breaching. Potentially high hazards were identified due to large consequences of an undetected liquid transuranic waste storage tank breach or overfill, or of a treatment facility process line breaking without detection or because adequate controls were not designed in the facility. The high-level waste safety and hazard analyses identified weaknesses involving failure to detect flammable gas build up, failure to sample and test waste to establish ignition limits, inadequate storage tank level monitoring, and waste transfer line failure.

Requirements Analysis. The requirements are based on the DOE 5820.2A requirements I.3.b.(3)(a) and I.3.b.(2)(h) for high-level waste tanks. The requirements are expanded to apply to transuranic waste treatment and storage facilities and the controls are required to be part of the design of new facilities. This requirement supplements those in DOE O 420.1 *Facility Safety* and

DOE O 430.1A, *Life Cycle Asset Management*. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities,* that were canceled when DOE 6430.1A was replaced. Additional information is contained in DOE G 435.1-1, which details portions DOE 6430.1A as guidance.

Other Considerations. This requirement is based the safety and hazard analyses performed for high-level waste, but are applicable to transuranic waste.

III. N. Storage.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Transuranic waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Basis:

Functions Evaluated. This requirement is based on analyses of functions associated with the storage of transuranic waste. The specific functions affecting this requirement include developing waste acceptance criteria for receiving waste for storage and placing waste into storage.

Safety and Hazard Analyses. The safety and hazards analysis identified weaknesses or conditions associated with a lack of thorough analysis or a failure to integrate all pertinent data (e.g., safety analysis report) in the development of waste acceptance criteria for the storage facility. The resultant hazard is that containers with incompatible materials or energy sources (e.g., explosives, reactive material) are received that can cause releases that endanger workers or release radioactivity to the environment.

Requirements Analysis. This requirement is similar to DOE 5820.2A requirement, II.3.g.(2)(e) requiring incompatible wastes to be packaged and stored separately. A number of existing internal and external requirements require consideration of hazards that need to be considered in decisions about what can be safely put into a container and placed in storage. These requirements are included in RCRA, DOE 5480.21, *Unreviewed Safety Questions,* 5480.22, *Technical Safety Requirements,* 5480.23, *Nuclear Safety Analysis Report*s, and 420.1, *Facility Safety*. These more general requirements are encompassed in the Manual requirements for developing waste acceptance requirements and for establishing a radioactive waste management basis.

Other Considerations. Based on DNFSB comments on the draft DOE M 435.1-1, specific requirements for prohibiting certain types of material from storage were added to the Manual. Incorporation of language that specifically identifies materials that are not to be stored mitigates the weaknesses related to not conducting a sufficiently rigorous analysis when developing waste acceptance requirements. The current requirement is a best management practice which will prevent practices which have been reported or observed in waste management or materials management at DOE sites.

III. N(2) Storage Integrity. Transuranic waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Basis:

Functions Evaluated. This requirement is derived from the transuranic waste function of placing waste into storage and a similar function for low-level waste of placing waste in storage and monitoring waste while in storage.

Safety and Hazard Analyses. The safety and hazards analysis for transuranic waste identified weaknesses and conditions associated with storing incompatible wastes together and of waste containers in storage being damaged by outside forces (e.g., damaged by a forklift). These weaknesses and conditions can lead to releases to the environment and present an inhalation hazard to workers, and to a lesser extent, the public. In the low-level waste safety and hazards analysis, weaknesses and conditions associated with waste being in storage for longer periods of time than planned, of poor emplacement of waste within a storage facility, and of inadequate storage containers were identified. This requirement also addresses vulnerabilities similar to those for Low-Level Waste in Storage and Inadequate Low-Level Waste Storage Conditions as identified in the *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities*.

Requirements Analysis. The requirement has a predecessor requirement in DOE 5820.2A requirements II.3.e.(7) and II.3.g.(2)(f). RCRA storage requirements for hazardous waste were evaluated for assistance in defining a storage approach, with associated time frames, if appropriate, for protecting the integrity of waste in storage.

Other Considerations. The current performance-based requirement to provide protection of the integrity of waste containers in storage was derived independently from any existing requirements. Early draft language for this requirement included protecting stored waste from prolonged exposures to the elements, such as rain and sun, and suggested that covers, temperature controls, and secondary containment were acceptable ways to do this. The final wording resulted partially from ensuring the requirement did not include items which were more appropriately addressed in

guidance, and partially from ensuring consistency between waste type chapters. It also addresses a concern raised in DNFSB comments that waste storage should not result in exposure to workers involved in activities unrelated to maintaining the stored waste, i.e., workers involved in other activities should not have waste stored in their work area.

III. N.(3) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of transuranic waste to ensure container integrity is not compromised.

Basis:

Functions Evaluated. This requirement is derived from the analysis of the storage functions of maintaining waste storage and monitoring waste containment and configuration.

Safety and Hazard Analyses. The safety and hazards analysis identified a potential hazard associated with the failure of a waste container and the subsequent release of radioactivity. The hazard was associated with weaknesses associated with undetected degradation of containers while in storage. The identified weaknesses were in supervision, operator performance, and failure to detect problems.

Requirements Analysis. The requirement is essentially the same as the DOE 5820.2A requirement II.3.e.4. In evaluating requirements, a worker training program developed in accordance with DOE O 360.1, *Training*, was determined to be adequate to address the one aspect of the operator performance weakness. The DOE M 435.1-1 requirement to establish a radioactive waste management basis, which would include operating procedures for the storage facility also addresses the weaknesses. This requirement makes inspection of the containers a necessary part of those procedures.

Other Considerations. In addition to the DOE 5820.2A requirement to monitoring the condition of waste containers, in the development of DOE M 435.1-1 it was recognized that it was also necessary to take action when a problem was identified. Consequently, this requirement includes a process for maintaining containers so that deficiencies are corrected if they are found during inspections.

III. N.(4) Retrievable Earthen-Covered Storage. Plans for the removal of transuranic waste from retrievable earthen-covered storage facilities shall be established and maintained. Prior to commencing waste retrieval activities, each waste storage site shall be evaluated to determine relevant information on types, quantities, and location of

radioactive and hazardous chemicals as necessary to protect workers during the retrieval process.

Basis:

Functions Evaluated. This requirement is based on the analysis of generator functions for retrieval of buried waste, but was also applied to retrieval from earth-covered or bermed transuranic waste storage sites since the hazards would be similar.

Safety and Hazard Analyses. The requirement addresses conditions or weaknesses associated with recovering waste that has been stored in earth-covered configurations. Information on the stored waste may be incomplete and conditions in the storage configuration may have resulted in container degradation and release of radioactive or hazardous materials. This situation present an unknown hazard to the environment and to workers involved in recovering the waste for characterization, processing, and disposal.

Requirements Analysis. DOE 5820.2A did not have an equivalent requirement addressing waste in earth-covered storage. However, DOE 5820.2A requirements II.3.i.(2) and II.3.i.(3), addressing buried transuranic-contaminated waste were similar in that they required characterization and development of a closure plan.

Other Considerations. In 1970, the Department established a policy that waste meeting the definition of transuranic waste was to be stored pending a decision on appropriate disposal. A number of DOE sites established earth-covered storage configurations, some with an intended 20-year service life. Many of these facilities have waste in storage well beyond the originally-planned 20 years. This requirement was written to encourage the development of plans and retrieval of waste from these facilities since it is recognized that greater numbers of containers will fail the longer they remain in earth-covered storage. The requirements of DOE 5820.2A were modified to apply to earth-covered storage instead of buried transuranic waste (which is addressed under CERCLA and is outside the scope of the current order). Therefore, rather than addressing the preparation of a closure strategy, the requirement calls for the development and maintenance of a plan for retrieval of the waste.

III. O. Treatment.

Transuranic waste shall be treated as necessary to meet the waste acceptance requirements of the facility receiving the waste for storage or disposal.

Basis:

Functions Evaluated. This requirement derives from the analysis of treatment functions which change the physical or chemical characteristics of liquid or solid, contact-handled or remote-handled transuranic waste.

Safety and Hazard Analyses. The requirement addresses the condition where operator error, procedural error, or equipment/system failure leads to fire or explosion in a treatment facility, loss of containment of waste, exposure to workers, public and environment.

Requirements Analysis. There are numerous existing requirements which will mitigate the hazards associated with treating transuranic waste such as RCRA (for mixed waste), the 5480 series of DOE orders, and safety and design requirements in DOE O 420.1, *Facility Safety*, and 430.1A, *Life Cycle Asset Management*. DOE 5820.2A, Chapter II.3.b.3 required that mixed waste be treated where feasible and practical, to destroy the hazardous component. The requirement is now performance based to allow treatment to the receiving facility waste acceptance criteria, which are selected based on a facility safety analysis report among other requirements.

Other Considerations. The external requirements and other DOE Orders necessary to ensure safety of treatment facilities and operations are identified and invoked in the General Requirements section of DOE O 435.1.

III. P. Disposal.

> **Transuranic waste shall be disposed in accordance with the requirements of 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*.**

Basis:

Functions Evaluated. This requirement is based on the analysis of the disposal performance requirements necessary to protect the public and the environment.

Safety and Hazard Analyses. This function was not specifically analyzed during the Safety and Hazard Analysis process since external requirements exist which address the performance requirements for transuranic waste disposal.

Requirements Analysis. There was no similar disposal requirement in 5820.2A. The EPA disposal and ground water protection requirements of 40 CFR Part 191 address the performance requirements for transuranic waste disposal.

Other Considerations. The *WIPP Land Withdrawal Act* authorized EPA to certify WIPP's compliance with the requirements of 40 CFR Part 191. The EPA issued criteria for the certification of compliance under 40 CFR Part 194. For other transuranic waste disposal (e.g. Greater Confinement Disposal at Nevada Test Site), DOE retains the authority to approve compliance with 40 CFR Part 191.

III. Q. Monitoring.

The following requirements are in addition to those in Chapter I of this Manual.

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

(2) Stored Wastes. All transuranic wastes in storage shall be monitored, as prescribed by the appropriate facility safety analysis, to ensure the wastes are maintained in safe condition.

(3) Liquid Waste Storage Facilities. For facilities storing liquid transuranic waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions, maintaining transuranic waste in storage, monitoring waste containment and configuration.

Safety and Hazard Analyses. The requirement addresses the condition where failure to monitor waste results in a release of waste due to a human, equipment or method/information failure. Additionally, during the review of the order, requirements were identified in other waste type chapters that were considered relevant to the management of transuranic waste. The requirements address the weaknesses and conditions of failing to detect flammable gas buildup in waste storage tanks, failing to sample and test waste storage tank contents to establish ignition limits, and inadequate waste tank level monitoring.

Requirements Analysis. A similar requirement exists in 5820.2A, Chapter II.3.g.2.(c) for having environmental monitoring systems in place to detect any release of radioactive and hazardous components, with the addition of a requirement to provide monitoring to prevent fires and explosions in pretreatment, treatment, storage and transportation facilities and the monitoring of related parameters, such as temperature and pressure, to prevent loss of confinement. General Requirements invokes compliance with DOE 5400.1 and DOE 5400.5 which provide environmental monitoring requirements.

Other Considerations. The requirement allows a performance based approach utilizing the facility safety analysis so that the monitoring system will be based on the hazards pertinent to that facility. These requirements address the risks of releasing radioactive materials to the environment by monitoring the conditions of the waste as well as contributing to worker protection by supporting the defense-in-depth concept. In addition, the requirements invoke RCRA requirements, for tank systems and ancillary equipment, to provide similar confinement, leak detection, and monitoring features as for hazardous waste.

BASIS FOR REGULATION OF LOW-LEVEL WASTE

DOE O 435.1 establishes a performance-based system for the regulation of low-level waste. A waste management systems analysis was performed to establish the functions involved in all phases of waste management from generation to disposal. With the Complex-Wide Review and Vulnerability Assessment having been completed previously, a safety and hazards evaluation of each function was performed that identified those activities with safety and health significance in need of requirements. Weaknesses and conditions warranting attention in developing requirements were also identified. Each function was considered for its potential impact on workers, the public, and the environment using health-based limits as measures. Following the safety and hazards analyses, the requirements to be incorporated into DOE O 435.1 were identified by examining all existing orders, rules, requirements and policies which relate to the management of low-level waste. Requirements were identified which addressed the needs, weaknesses, and conditions determined from the safety and hazards analyses, and the justification for each requirement was documented. The requirements for DOE O 435.1 and DOE M 435.1-1 were then written with the intent of setting overall requirements and criteria for developing a performance envelope for each facility on a site-specific basis. Each field element is required by DOE M 435.1-1 to perform an appropriate level of analysis (e.g., performance assessment and composite analysis for a disposal facility) to establish facility specific limits and requirements for design, construction, startup, operation, monitoring, and closure.

The results of the Complex-Wide Review and Vulnerability Assessment, waste management systems analysis, safety and hazards analyses, and requirements analysis established that short-term risks and issues related to near-term worker safety and protection of public health and the environment were being addressed with only a few important exceptions. However, long-term risks and issues related to protecting public health and the environment had not been fully addressed in the implementation of DOE 5820.2A. The results of the analyses performed for DOE O 435.1 clearly identified that the predominant impact to public health and the environment in the future is associated with the disposal of low-level wastes. Also, the actions taken in the generation, treatment, and storage of wastes prior to disposal are the predominant contributors to potential impacts from disposal in the future. The requirements included in the DOE O 435.1 and DOE M 435.1-1 are written with the recognition of these findings and with the intent of requiring sites to develop site-specific criteria and procedures which lead to acceptable disposal facility performance.

The regulation of low-level waste at DOE facilities, as developed in DOE O 435.1, differs from the more generic but prescriptive approach taken by the NRC in developing requirements for commercial facilities in 10 CFR Part 61 and other rules. 10 CFR Part 61 was developed with several known conditions that are specific to commercial waste and are not necessarily appropriate for DOE low-level waste. These differences include (1) NRC has a formal licensing process while DOE uses the Directives process; (2) NRC requirements are for generic but unknown facilities and locations; (3) commercial waste streams are well defined; (4) DOE

processed spent fuel for spent nuclear material; (5) DOE disposes of low-level waste onsite, where practical, at facilities which have been operating for many years; (6) land use controls for DOE low-level waste disposal facilities are likely to extend into the distant future; and (7) the management structure for DOE complex-wide low-level waste management is well established. These factors lead to differences in waste management regulation and practices for DOE and NRC low-level waste disposal; however, the required level of health protection is essentially identical.

One specific result of the differences in the process used by DOE to regulate low-level waste is the approach to waste classification. The NRC developed a generic waste classification system for application to all facilities and all locations, which was based on a well-developed understanding of the characteristics of commercial low-level waste. The waste classification limits were developed from a performance assessment of generic low-level waste disposal facilities in various locations that was included in the Environmental Impact Statement for 10 CFR Part 61. The DOE approach places greater emphasis on site-specific decisions for site-specific conditions, and requires a site-specific performance assessment to develop limits, on the basis of criteria for radiation protection (dose limits) that are similar to the NRC. This approach recognizes that the locations for the disposal of wastes are well known, but the waste characteristics are not as well understood. DOE M 435.1-1 requires the development of waste acceptance criteria for each waste management facility to ensure justified limitations are placed on wastes to be disposed of. Sites may establish waste classifications as needed for operation of specific facilities, but they must establish waste acceptance criteria. This approach leads to the development of site-specific systems which take into account the environmental characteristics of the site and the characteristics of the wastes being disposed of, such as the Category 1 and 3 designations at Hanford, which are similar to the NRC classes A and C.

1. FORMAL LICENSING AS COMPARED TO DIRECTIVES FOR FACILITIES

The NRC process includes formal rulemaking to establish requirements and licensing directly by NRC or through agreement states as appropriate. This process involves publication and formal reviews, and sometimes judicial intervention. The requirements must anticipate what might be done in unspecified facilities and locations and must provide a means to control future actions through rules and license conditions, which can be changed (but not easily) when updating, corrections, and expansion are needed.

The DOE process includes DOE Orders and Manuals and local operating policies and procedures, which can be updated and expanded within the DOE system. If expansions are needed, a directive can simply be issued from DOE-HQ to the Operations Office, or from the Operations Office to the contractor, whereas the NRC might have to go through a detailed process of amending the license. Thus the DOE system has less anticipatory information regarding future conditions that might or might not be needed. In addition, Operations Offices have substantial local authority,

which can simplify changes that may become necessary. Because missions, environmental conditions, and waste characteristics vary widely within the DOE system, the Orders give generally applicable requirements that recognize the need to consider site-specific conditions in setting requirements for specific facilities by the Operations Offices. Consequently, specific requirements for a given low-level waste management facility are likely to vary across the DOE system, but reasonable assurance is provided that the generally applicable requirements for the protection of workers, public health, and the environment are met.

2. NRC AND DOE FACILITIES AND LOCATIONS

The NRC rules for low-level waste disposal were developed for nationwide application at a wide variety of facilities which have geological and environmental settings that are largely unknown until a specific facility is proposed. In contrast, DOE disposal sites are already known and owned by the federal government; and extensive descriptions of the geology, hydrology, ecology, and other environmental conditions are available. The NRC rules have been developed to guide the selection of disposal sites to areas that meet the basic siting criteria in 10 CFR Part 61. As a result of sites being selected to meet criteria associated with prescribed site characteristics, the rules include a minimum of specific facility and waste form requirements. These generally amount to a waste classification system, waste form stability requirements for Classes B and C, and extra disposal depth for Class C waste. These requirements apply to all sites, including both humid and arid sites. The rules provide for the advantages of arid disposal sites for the disposal of low-level waste by setting site-specific limits under 10 CFR 61.41 for protection from releases, but any advantages associated with arid sites are not included in the waste classification system. Additional basic criteria for waste disposal have to be met, along with the requirement to provide reasonable assurance that performance objectives will be met.

The DOE approach, where the disposal sites are known but the waste characteristics are not as well known, is to set basic performance objectives, which are substantially the same as those of the NRC. Each site is then required to prepare a site-specific performance assessment of the total disposal system (site, design features, waste form, radionuclide content, and operating practices, and closure plans) to provide reasonable assurance the performance objectives will be met. The basic difference is that the DOE system allows for more consideration of site-specific characteristics in siting, design, waste form, and radionuclide limits in the demonstration of reasonable assurance the performance objectives are met. Engineered features (vaults, caissons, tumuli, containers, and multi-layer surface barriers) are important contributors to performance at DOE facilities, especially at humid sites.

DOE regulation of low-level waste also must take into account that DOE facilities are frequently co-located with reactors, fuel cycle facilities, historical disposal facilities, and facilities which are in the process of being remediated or decommissioned. Commercial low-level waste disposal sites are typically isolated from other nuclear facilities. Thus, commercial low-level disposal sites

are relatively small (waste disposal zone plus a buffer zone), while the DOE disposal sites can range up to many square miles and may include several disposal facilities. As a result, interactions between disposal facilities may become an important consideration in regulating low-level waste, as well as interactions with other nuclear facilities, in order to ensure overall radiation protection of workers, the public health and the environment.

Every DOE site presents a large and complex physical and environmental setting for the disposal of low-level waste that is not readily comparable to the physical and environmental settings associated with the disposal of commercial low-level waste. Some of the NRC siting requirements, while very appropriate for relatively small disposal facilities, are not appropriate for the entire area of a DOE site. Furthermore, the combination of site-specific analyses, procedures, engineered design features, waste acceptance criteria, and waste treatment used by DOE for the regulation of low-level waste has been demonstrated to provide reasonable assurance that rigorous performance objectives can be achieved at disposal facilities which may not be ideal with respect to the siting requirements in 10 CFR Part 61.

3. NRC COMMERCIAL WASTES ARE MORE EASILY DEFINED

Commercial reactor and fuel-cycle waste comes almost entirely from two similar types of water-cooled reactors. This leads to a relatively small number of waste streams, with relatively well-known and consistent compositions. The typically uniform characteristics of these waste streams supported the development of a waste classification system based on inadvertent intrusion scenarios that resulted in relatively large volumes of low-activity waste (Class A), and a small volumes of higher-activity waste (Classes B and C). A review of the set of waste classification limits demonstrated the commercial waste streams segregated relatively easily into the waste classes, and most of the variations in the composition of commercial waste streams did not lead to major changes in classification of wastes or waste volumes.

Wastes generated by DOE nuclear activities are much more variable than commercially generated wastes in all respects. The distribution of radionuclides and their concentrations in DOE-generated wastes is almost continuous, with no natural breakdowns into specific waste classes or concentration ranges. Thus, waste classification of DOE wastes for the entire complex is somewhat arbitrary at best. Waste characteristics of wastes generated by individual DOE sites vary widely from site to site. For DOE sites engaged in production-like operations (e.g., weapons production, isotope production), the wastes generated do have relatively uniform characteristics and can be classified into specific waste streams for the purpose of waste management and disposal. However, the uniformity of production-like waste streams at one DOE site is not likely to be shared with other DOE sites. For DOE sites engaged in research and development, the characteristics of the wastes generated are highly variable and often change as research programs begin and end. For research and development sites, the identification of generated wastes with a fixed waste classification system does not lead to the optimal use of resources in waste

management either for the DOE complex or individual research and development facilities. As a result, the adoption of site-specific waste acceptance criteria, supported by site-specific analyses, is the most appropriate and effective method for regulating the disposal of DOE low-level wastes.

4. REPROCESSING OF SPENT FUEL BY DOE

Spent fuel generated by commercial nuclear activities is not reprocessed. Consequently, commercially generated radioactive wastes consist of spent fuel and several low-level waste streams from non-reprocessing sources. Most of the volumes of low-level wastes generated by commercial activities are relatively low in radionuclide concentrations.

Spent fuel generated by DOE nuclear activities was assumed to be reprocessed. Reprocessing of spent fuel generates additional waste streams which are difficult to manage and dispose of. The first solvent extraction cycle waste generated by reprocessing spent fuel is defined as high-level waste, but wastes from other cycles are not defined as high-level waste, unless sufficiently concentrated so that they become the equivalent of the wastes generated by the first solvent extraction cycle. Although the concentrations of radionuclides in wastes generated from other solvent extraction cycles of reprocessing spent fuel may be less than first solvent extraction cycle waste, the concentrations of radionuclides can be very high, and require special handling in management and disposal.

DOE also produces transuranic (TRU) waste from cladding removal of spent fuel rods, further reprocessing of plutonium as a product, isotope production, and high-energy neutron research and development. TRU wastes are not typically produced in commercial nuclear activities licensed by NRC, as they are in DOE nuclear activities. Consequently, the NRC waste classification system does not have a separate class for TRU waste. Any TRU waste which may be generated by NRC-licensed facilities is simply included as a subclass of greater-than-Class C (GTCC) waste.

The discussion in this section and the previous section illustrates that commercial wastes licensed by the NRC consist of (1) very high-concentration, low-volume high-level wastes associated with spent fuel; (2) several low-concentration waste streams of low-level waste which can be subdivided into Class A, B, and C waste; and (3) a few high-concentration, low-volume waste streams associated with non-fuel core components, resins, sludge, and sealed sources that are subdivided as GTCC waste. This segregation of concentration and volume ranges of wastes provides a very natural division of disposal technologies into repository disposal for spent fuel and near-surface disposal for almost all other waste as low-level waste. GTCC waste can be considered separately as waste appropriate for disposal in a repository or some other type of engineered disposal system that provides a greater degree of isolation than near-surface disposal.

In contrast, reprocessing of DOE spent fuel has resulted in a substantial increase in generated low-level waste volumes as inert chemicals become part of the liquid waste stream. These

additional waste streams have a wide range of radionuclide concentrations. In addition, the liquid waste is frequently subjected to further processing for radionuclide separation of uranium and other useful byproducts and for volume reduction by evaporation. Thus, DOE low-level wastes consist of a wide range of radionuclides, concentrations, and volumes that are not naturally segregated as waste streams which correspond to disposal technologies.

5. DISPOSAL OF DOE WASTE ONSITE

The disposal of low-level waste by DOE and its predecessors has always been at the site where the waste is generated if practicable. This practice for DOE disposal of low-level waste was adopted to reduce the hazard and cost of packaging, handling, and shipping low-level waste. The disposal of nearly all commercially generated low-level waste, however, is performed after the waste is shipped a substantial distance to a few centralized disposal facilities. This practice of shipping across public roads prior to disposal at NRC-licensed facilities results in more robust waste forms and packages for shipping, with shielding oftentimes needed for the shipment of higher-activity wastes.

The disposal of low-level waste generated by DOE nuclear activities at the site where the waste is generated is a matter of long standing policy. This policy has led large DOE sites to develop disposal practices and requirements tailored to specific waste characteristics, and to the capabilities of each site. The onsite DOE disposal facilities are limited to six disposal sites across the DOE complex, with small DOE sites shipping low-level wastes a relatively short distance for disposal at the larger DOE sites. Each DOE site with a low-level waste disposal facility is required to prepare a performance assessment of the onsite disposal system and a composite analysis for pre-1988 waste and other interacting source terms.. Based on the analysis presented in the performance assessment and other required documents (e.g., safety analysis report), each site is then required to develop waste acceptance criteria, design and build engineered features, and utilize operating procedures to provide protection of workers, the public, and the environment. This approach makes optimal use of the capacity of the disposal facility to accept waste and of the available knowledge of the disposal facility, site characteristics, and waste characteristics.

Because the disposal of commercial wastes using 10 CFR Part 61 applies to all NRC-licensed sites anywhere, the procedures to be followed for the disposal of low-level wastes are derived from a generic systems analysis and environmental impact statement that were prepared as part of the rulemaking. As a result of being necessarily much more generic, the NRC requirements tend to be more restrictive in order to provide the same degree of reasonable assurance the performance objectives in the rule are met. This system does not accommodate site-specific variations in site characteristics, waste characteristics, or disposal facility characteristics as easily.

6. DIFFERENT PLANS FOR FUTURE CONTROL

Commercial waste disposal facilities licensed by NRC are intended to be closed once the disposal capacity at the facility has been filled. Following closure of the disposal facility, only minor custodial care and monitoring are required. Additionally this care is anticipated to last for only a relatively short period of 100 years of active institutional control. Disposal sites which have been closed are to be owned by the Federal or a State government, with state sites eventually transferred to the Federal government.

In contrast, a DOE disposal facility may be closed once the disposal capacity has been filled, and a new disposal facility may be opened on the same site. Consequently, low-level waste disposal may be a continuous process for a DOE site, rather than a one-time activity with a specific period of operations. Institutional control of a DOE disposal facility may continue for an extended period of time beyond the relatively short period of institutional control associated with commercial low-level waste disposal facilities.

Since DOE low-level waste disposal facilities are associated with DOE sites having stated missions and objectives that are intended to be long lasting, the duration of future control of DOE disposal facilities may extend well beyond the license period for any commercial disposal facility, particularly if the DOE site continues to be used for nuclear activities. Commercial disposal facilities received from the states would also be under Federal control, but would be less likely to be part of a site with continuing nuclear activities. Consequently, decisions regarding the disposal of low-level waste at DOE sites need to consider the possibility of extended periods of Federal control, providing justified commitments for future control of DOE sites have been made.

7. EXISTING MANAGEMENT STRUCTURE

The formal licensing process used by NRC and the agreement states for the disposal of low-level radioactive waste is intended for private corporations, but could be applied to public consortiums or other organizations. The management structure of an applicant for a license is closely scrutinized in the licensing process and is reviewed periodically. Ultimately, the financial and custodial responsibilities of an NRC-licensed low-level waste disposal facility are transferred to the Federal government. The periodic review of the license by the NRC ensures the licensee operates the disposal facility according to the conditions incorporated into the license. Reports, inspections, and audits are included in the operation of low-level waste disposal facility by NRC to provide additional assurance the requirements for the disposal of low-level waste are met.

The authorization basis concept used by DOE for the disposal of low-level radioactive waste in DOE O 435.1 and DOE M 435.1-1 takes advantage of the formalized management structure of DOE with responsibilities for oversight at DOE Headquarters and responsibilities for operations at DOE Field Offices. The existing system of checks and balances between DOE Headquarters,

DOE Field Offices, and DOE contractors is a structured management system which is subject to review and oversight as part of normal operations. This existing management system has a division of responsibilities and authority that can be relied upon to fulfill the responsibilities associated with low-level waste disposal providing a documented record and basis for operations is maintained. This system provides assurance that the necessary conditions for the proper disposal of low-level waste will be performed with the protection of workers, the public health, and the environment.

8. SUMMARY

This discussion addresses the regulation of low-level waste by DOE, and compares the approach contained in DOE O 435.1 and DOE M 435.1-1 to the approach taken in 10 CFR Part 61. The discussion identifies seven significant points of contrast between DOE and NRC regulation of low-level waste. The discussion of these points of contrast includes the justification for the approach taken by DOE. While there are differences between 10 CFR Part 61, DOE O 435.1/DOE M 435.1-1, the performance objectives for protection of workers, the public, and the environment for both are justified and adequate.

CHAPTER IV

LOW-LEVEL WASTE REQUIREMENTS

IV. A. Definition of Low-Level Waste.

Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or byproduct material (as defined in section 11e.(2) of the *Atomic Energy Act of 1954*, as amended), or naturally occurring radioactive material.

Basis:

Functions Evaluated. This requirement does not derive from the analysis of any specific functions. The definition of low-level waste was included as an assumption in the Functions Analyses.

Safety and Hazard Analyses. The definition of low-level waste was also included as an assumption in the Safety and Hazard Analyses.

Requirements Analysis. The definition of low-level waste is essentially equivalent to the first sentence of the low-level waste definition in Attachment 2 of DOE 5820.2A. (The 5820.2A definition was the definition assumed in the Functions Analysis and Safety and Hazard Analyses). The wording of the definition is from the *Nuclear Waste Policy Act of 1982*, as amended, in order that definitions are consistent with current legislative drivers for DOE radioactive waste management.

Other Considerations. Additional language is included that was derived from language provided by commenters on draft versions of the requirements that ensures it is clear that naturally - occurring radioactive material is not included in the definition of low-level waste.

IV. B. Management of Specific Wastes.

The following provide for management of specific wastes as low-level waste in accordance with the requirements in this chapter:

(1) Mixed Low-Level Waste. Low-level waste determined to contain both source, special nuclear, or byproduct material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. Low-level waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(3) Accelerator-Produced Waste. Radioactive waste produced as a result of operations of DOE accelerators is low-level waste and shall be managed in accordance with DOE O 435.1, *Radioactive Waste Management*, and this Manual, and all applicable Federal or State requirements.

(4) 11e.(2) and Naturally Occurring Radioactive Material. Small quantities of 11e.(2) byproduct material and naturally occurring radioactive material may be managed as low-level waste provided they can be managed to meet the requirements for low-level waste disposal in Section IV.P of this Manual.

Basis:

Functions Evaluated. This requirement does not derive from the analysis of any specific functions. Mixed low-level waste was assumed to be an interface to the management of low-level waste in the Functions Analyses.

Safety and Hazard Analyses. The inclusion of mixed low-level waste was an assumption in the Safety and Hazard Analyses, consistent with its role of interface in the Functions Analysis. The Analysis considered all wastes managed currently as low-level waste in the evaluations of scenarios and weaknesses and conditions that could occur in managing radioactive waste, including some accelerator-produced, naturally-occurring, and byproduct materials.

Requirements Analysis. The inclusion of managing mixed low-level waste in accordance with the low-level waste requirements of the Order is equivalent to the policy stated in Requirement III.2.d of DOE 5820.2A. The inclusion of managing small quantities of 11e.(2) and naturally occurring radioactive materials in accordance with the low-level waste requirements of the Order is equivalent to the policy stated in Requirement IV.2 of DOE 5820.2A. Additional language is added that specifies low-level waste mixed with polychlorinated biphenyls shall also be managed in accordance with the *Toxic Substances Control Act* to distinguish the requirements it must meet from RCRA requirements. The inclusion of managing accelerator-produced radioactive materials in accordance with the low-level waste requirements of the Order is also equivalent to the policy stated in Requirement IV.2 of DOE 5820.2A.

Other Considerations. The additional language is derived from language provided by commenters on draft versions of the requirements and through ensuring that waste type chapters were consistent. The additional language ensures that certain radioactive wastes will be managed as low-level waste that are the responsibility of the Department but which have not been sufficiently accounted for in current legislative drivers for management of DOE's radioactive waste.

IV. C. Complex-Wide Low-Level Waste Management Program.

> **A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.**

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level functions of low-level waste management; Formulate, Execute, and Evaluate the low-level waste management program.

Safety and Hazard Analyses. This requirement addresses the need for a documented complex-wide integrated program for planning, executing, and evaluating the activities necessary to safely manage low-level waste. The requirement addresses the potential weaknesses and conditions of lack of, or poor: strategic planning; identification of needed research and development; data collection and management; review of other low-level waste regulatory programs, and; development of necessary management requirements, guidance, and procedures, and lack of or poor: strategic planning documentation; identification of roles and responsibilities; documentation of program assumptions and uncertainties; documentation of facility utilization and plans; process for issue identification and resolution; and documentation of program evaluation activities. The requirement for a complex-wide low-level waste management program also addresses the need for integration of program activities as demonstrated by the results of the Complex-Wide Review and the recommendations made in Defense Nuclear Facilities Safety Board Recommendation 94-2.

Requirements Analysis. The requirement for a complex-wide low-level waste management program has no predecessor requirements in DOE 5820.2A. The requirement is considered an improvement to the requirement for a waste management plan in Chapter VI of DOE 5820.2A because it provides for integration and coordination at the Headquarters level of the planning done at the site-level (Site-wide radioactive waste planning is still required by Chapter I of the Manual).

Other Considerations. Facility optimization, configuration management, cost-savings, and other goals of the low-level waste management system evaluated in the system engineering of low-level waste conducted in response to Defense Nuclear Facilities Safety Board Recommendation 94-2

are best accomplished by an integrated program at the headquarters level that includes documented milestones and measures of accomplishment. The Department has been operating with a waste type manager for low-level waste, and this requirement improves on that practice by assigning the duties and responsibilities of managing the low-level waste program to the Deputy Assistant Secretary for Waste Management.

IV.D. Radioactive Waste Management Basis.

Low-level waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, composite analysis, disposal authorization statement, closure plan, waste acceptance requirements, and monitoring plan.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level low-level waste management functions: Formulate, Execute, and Evaluate a low-level waste management program.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions lack of or poor integration of documents, programs, and controls important to radioactive waste management (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or accountability at the highest management positions for ensuring the most important requirements for the safe management of waste will be met. This requirement partially addresses the Complex-Wide Vulnerability concerning performance assessments not being approved by including the performance assessment and composite analysis as part of the radioactive waste management basis requiring approval for a low-level waste disposal facility.

Requirements Analysis. The requirements for a radioactive waste management basis for low-level waste management facilities have no predecessor requirements in DOE 5820.2A. DOE 5820.2A did include review of performance assessments, but only implied that performance assessments required approval, and did not include any kind of authorization for generation, treatment, or disposal of low-level waste. The radioactive waste management basis for a facility or activity includes formal approval at the site level of low-level waste management operations and ensures that programs and activities established to meet other requirements are being coordinated and integrated as necessary with activities needed to meet DOE O 435.1 and DOE M 435.1-1 requirements. The Department's System Engineering of the Low-Level Waste Management System, conducted in response to Recommendation 94-2, indicated the need for facility evaluations to demonstrate requirements are being met. The radioactive waste management basis concept employs the same principles as the authorization basis for DOE facilities carried out under DOE 5480.23, and facility licensing carried out by the U.S. Nuclear Regulatory Commission and facility permitting done by the U.S. Environmental Protection Agency and state agencies. (Based on DOE M 435.1-1 and other Directive's documentation requirements, information will not need to be pulled together into a summary document, such as a license or permit application, as required by NRC and EPA).

Other Considerations. The radioactive waste management basis concept is implementation of the Department's system engineering of low-level waste management, which indicated the need for facility evaluations to demonstrate requirements are being met. The radioactive waste management basis concept being employed is performance based and uses the graded approach, so the rigor of documentation is commensurate with the hazards and safety implications of activities carried out at a given facility. The radioactive waste management basis is also consistent with the Department's integrated Safety Management System, as this allows tailoring of specific requirements to specific hazards at a certain facility that gets reviewed and approved, as opposed to a rigid approach that implements requirements that might not be needed, but are enforced because review and approval of a basis is not conducted. Final wording of the requirement results from specific comments on draft versions of the requirement, and ensures that it is clear that the radioactive waste management basis includes both physical and administrative controls to provide protection of the public, workers, and the environment.

IV. E. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual:

(1) Contingency Storage. For off-normal or emergency situations involving high activity or high hazard liquid low-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated low-level waste contingency storage shall be maintained in an operational condition when waste is present

and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of high activity or high hazard liquid low-level waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Basis:

Functions Evaluated. These requirements were derived from the analysis of Treatment functions for providing interim storage at the treatment facility, processing waste, and maintaining the treatment facility. The requirements are also partially derived from analysis of the high-level waste storage functions for operating, monitoring, and maintaining storage systems.

Safety and Hazard Analyses. The requirement addresses the need for spare capacity in tanks storing liquid low-level waste and keeping transfer lines operational in treatment facilities. The specific weaknesses and conditions addressed were management of high activity or other high hazard liquid low-level waste at treatment facilities, a breach of an interim storage at treatment, breach of transfer lines for liquid waste at treatment facilities, and the need for contingency storage space if operations cease abruptly. The safety and hazard analyses indicated a potential high hazard to workers associated with treatment of high activity liquid low-level waste if an accident occurred. The high-level waste safety and hazard analyses identified potential significant consequences, particularly to the environment, from leaking storage tanks without adequate spare capacity and adequate transfer equipment.

Requirements Analysis. This requirement is partially derived from high-level waste tank requirements contained in DOE 5820.2A, paragraph I.3.b.(4)(d), with improvements and with changes so it applies to low-level waste storage tanks.

DOE O 420.1 was evaluated and found insufficient to cover all essential design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is consistent with requirements in DOE 6430.1A, Section D13, *Special Facilities,* that were canceled when DOE 6430.1A was replaced.

Other Considerations. This requirement was partially derived from the efforts to ensure DOE M 435.1-1 requirements were consistent across the waste type chapters. The high hazards associated with treatment of high activity or other high hazard liquid low-level waste were addressed by the requirements developed by the high-level waste requirements analysis, so these were adopted for the low-level waste situation. The readily available capability to respond to emergency situations involving loss of confinement supports the defense-in-depth concept. The

final wording of the requirement addresses a specific concern of the Defense Nuclear Facilities Safety Board that the contingency storage and transfer equipment must not just be available, but that it also must meet the applicable requirements of DOE O 435.1 and DOE M 435.1-1.

IV. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual:

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Basis:

Functions Evaluated. These requirements derive from the analysis of the top-level functions, Develop, Execute, and Evaluate the low-level waste program.

Safety and Hazard Analyses. The requirement addresses the need for conducting evaluations (inspections, reviews, etc.) of the most important activities of low-level waste management associated with the protection of the public, workers, and the environment, and for correcting situations which are not being conducted in accordance with Order and/or Manual requirements. This addresses the weaknesses and conditions of reliance on performance based requirements (rather than design and operations specifications, for example) and the use of assumptions in calculations used to determine the necessary radioactive waste management controls, especially for disposal which relies on calculations over long times for establishment of necessary controls. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor documentation or integration of documentation of the evaluations that demonstrate radioactive waste management controls are sufficient which collectively make up the radioactive waste management basis for a facility. Hazards that were identified included potential for detrimental effects on the long-term performance of a disposal facility.

This requirement partially addresses the Complex-Wide Review Vulnerability on Lack of Approved Site Performance Assessments. The Defense Nuclear Facilities Safety Board Recommendation 94-2 also pointed out the lack of approved performance assessments as an integral problem in DOE low-level waste management. These concerns are addressed by requiring operations to be consistent with an approved radioactive waste management basis, which in the case of disposal, includes controls derived from an approved performance assessment, and allowing operations to be curtailed or ceased if there is not an approved basis.

Requirements Analysis. The requirement for corrective actions has no predecessor requirements in DOE 5820.2A. The authorization basis concept of DOE 5480.21 and its implementation was utilized as a basis for the concept of radioactive waste management basis. Corrective actions are used by the NRC in reactor licensing for dealing with situations that could be inimical to public health and safety, however, no additional essential requirement language was derived from those requirements.

Other Considerations. The radioactive waste management basis, and the use of corrective actions to correct situations where the basis is not being met, is partially derived from the system engineering of the low-level waste management system, which showed the need for accountability to demonstrate requirements are being met. The use of Corrective Actions is consistent with implementation by the Department of an integrated Safety Management System and the use of feedback mechanisms to determine measurable improvement of programs.

IV. G. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all low-level waste storage, treatment, or disposal facilities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides.

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal.

(c) Restrictions or prohibitions on low-level waste, materials, or containers that may adversely affect low-level waste handlers or compromise facility or waste container performance.

Basis:

Functions Evaluated. This requirement derives from the analysis of treatment, storage, and disposal functions for establishing waste acceptance criteria and ensuring waste acceptance criteria are complied with.

Safety and Hazard Analyses. The requirement addresses the need for establishment of waste acceptance criteria by receiving treatment, storage, and disposal facilities and for ensuring that the requirements of the waste acceptance criteria are met at the receiving facility and weaknesses and conditions of receiving poorly characterized waste, waste requiring additional management as a

mixed waste, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. Also, the waste acceptance criteria for disposal facilities is the document in which limitations or other requirements are imposed as a result of the Performance Assessment, linking the waste to the long-term performance of the facility and ensuring the disposal performance objectives are met. Specific hazards identified include high-hazards to the workers and the environment in the short-term from acceptance of waste containing unacceptable materials, and potential for impacts in the long-term to the disposal facility performance. This also addresses the Complex-Wide Review Vulnerability for Generation of No-Path Forward Waste because with all storage, treatment, and disposal waste acceptance criteria specified and available, generators will know all management options available and what process steps to add at the generator site to make acceptable waste. These requirements also partially address the Complex-Wide Review Vulnerability on Waste Characterization by establishing the receiving facility as the determinator of specific radionuclide concentrations and other characterization requirements.

Requirements Analysis. The requirements are improvements to 5820.2A Requirements III.3.e.(5)(a) through (5)(e). 10 CFR Part 61 waste acceptance requirements and current DOE radioactive waste management facility waste acceptance criteria were evaluated for additional essential waste acceptance criteria.

Other Considerations. The requirements found in 5820.2A, 10 CFR Part 61, and current DOE facility WAC were made performance-based and consolidated into these three essential requirements for acceptable waste. Implementation guidance includes discussions of the specific restrictions and allowances found in those other sources of requirements that were evaluated. Effective waste acceptance experience at DOE facilities establishes these criteria as best management practice for waste acceptance requirements.

IV.G.(1) Technical and Administrative.

(d) The following are additional waste acceptance requirements that shall be specified in low-level waste disposal facility waste acceptance requirements:

1. Low-level waste must contribute to and not detract from achieving long-term stability of the facility, minimizing the need for long-term active maintenance, minimizing subsidence, and minimizing contact of water with waste. Void spaces within the waste and, if containers are used, between the waste and its container shall be reduced to the extent practical.

2. Liquid low-level waste or low-level waste containing free liquid must be converted into a form that contains as little freestanding liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the container volume when the low-level waste is in a disposal container, or 0.5 percent of the waste volume after it is processed to a stable form.

3. Low-level waste must not be readily capable of detonation or of explosive decomposition or reaction at anticipated pressures and temperatures, or of explosive reaction with water. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

4. Low-level waste must not contain, or be capable of generating by radiolysis or biodegradation, quantities of toxic gases, vapors, or fumes harmful to the public or workers or disposal facility personnel, or harmful to the long-term structural stability of the disposal site.

5. Low-level waste in a gaseous form must be packaged such that the pressure does not exceed 1.5 atmospheres absolute at 20 C.

Basis:

Functions Evaluated. This requirement derives from the analysis of treatment and storage functions for ensuring disposal WAC are complied with, Treatment functions for packaging waste for storage and disposal, and for Disposal of low-level waste.

Safety and Hazard Analyses. This requirement addresses the need for waste accepted at disposal facilities from generators, treatment, and storage facilities to contribute to the long term performance of the disposal facility. The specific hazard identified was the potential impact to the long-term performance of the disposal facility. The requirement addresses the potential conditions and weaknesses of receiving waste that has poor stability properties, that requires special handling or treatment, or that would adversely affect the performance of the disposal facility. Specific weaknesses of disposed low-level wastes addressed by these requirements include: liquid wastes or wastes containing significant amounts of liquid; waste disposed with voids in the package; waste containing explosives, reactives and pyrophorics; gaseous waste, and; waste in weak packages. The requirement partially addresses Defense Nuclear Facilities Safety

Board Recommendation 94-2 that DOE implement more requirements, guidance, and standards based on the requirements covering commercial low-level waste disposal facilities.

Requirements Analysis. The requirements are improvements to the DOE 5820.2A, Chapter III.3.i.(5) Requirements. The requirements are updates to 5820.2A requirements, and they are cast as minimum waste acceptance criteria for disposal facilities as opposed to minimum waste form requirements. They are also enhancements to the 5820.2A requirements by including protection of the public and the environment into the goals of the requirements rather than limiting it to protection of workers and consideration of long-term stability of disposal site. The criteria are derived from 10 CFR Part 61 and contain only minor changes to be consistent with DOE low-level waste management and disposal conditions and operations.

Other Considerations. These criteria promote significant defense-in-depth for protecting the performance of the disposal facility by eliminating known detrimental conditions of disposed waste which have been determined from years of experience in both commercial and DOE low-level waste management.

IV. G.(1) **Technical and Administrative. Waste acceptance requirements for all low-level waste storage, treatment, or disposal facilities shall specify, at a minimum, the following:**

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

Basis:

Functions Evaluated. The requirement derives from the analysis of treatment, storage, and disposal functions for establishing WAC and ensuring WAC are complied with.

Safety and Hazard Analyses. The requirement addresses the need for establishment of waste acceptance criteria by receiving treatment, storage, and disposal facilities and for ensuring that the requirements of the waste acceptance criteria are met at the receiving facility. This requirement partially addresses the Complex-Wide Review Vulnerability on No Disposal Path Forward Waste by allowing a mechanism for approval for disposal of low-level wastes that have special considerations not covered in the waste acceptance criteria, but for which additional analysis can demonstrate that disposal can be done safely. The potential impacts to the long-term performance of the disposal facility is the critical hazard area addressed by this requirement concerning receipt and disposal of waste not covered in the waste acceptance criteria.

Requirements Analysis. This requirement for exceptions to waste acceptance criteria has no predecessor requirement in DOE 5820.2A. The requirement was derived from specific criteria for exemptions that appear in DOE site-specific waste acceptance criteria documents. Exception provisions are common in performance-based requirements documents, as long as the basis for exceptions is identified and the authorizing process to avoid unjustified exceptions is provided. The NRC performance-based disposal requirement, 10 CFR Part 61, permits exceptions to many parts of the rule, where justified (61.6 and elsewhere). For the waste characteristics requirements of Part 61, exceptions are allowed, based on a case-by-case evaluation. Of specific significance to this DOE M 435.1-1 requirement, 10 CFR 61.7.(b)(5) and 61.55(a)(2)(iv) indicate that waste above Class C may be acceptable for near-surface disposal with special processing or design.

Other Considerations. This requirement is a performance based requirement that institutes a best management practice for accepting wastes for treatment, storage, and disposal used at commercial and DOE low-level waste disposal facilities providing the reasons the waste does not meet the acceptance criteria are known and evaluated, and adequate additional controls are in place to protect the public, workers, and the environment based on the knowledge and evaluation of the waste.

IV. G <u>Waste Acceptance</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Basis:

Functions Evaluated. This requirement derives from the analysis of Waste Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a confirmation step for assuring that generators meet waste acceptance criteria of storage, treatment and disposal facilities and that the receiving facility inspects the waste to verify that the acceptance criteria are met before the waste is accepted. The requirement addresses hazards especially to workers, and the potential weaknesses and conditions that could arise from the storage, treatment, or disposal facility receiving poorly characterized waste, waste containing unacceptable materials, waste that was packaged incorrectly or which has paperwork problems, or waste damaged in transport. The requirement also partially addresses the Complex-Wide Review

Vulnerability on weaknesses in Waste Characterization by providing additional evaluations and acceptance determinations by receiving facilities on top of certification by generators.

Requirements Analysis. The requirement for receiving facility evaluation and acceptance is an improvement to DOE 5820.2A Requirement III.3.e.(4) which required audits of waste certification programs. Current waste acceptance documents and practices were evaluated for essential requirements to address the weaknesses and conditions identified.

Other Considerations. The requirement adds defense-in-depth to the waste certification and waste acceptance process by adding an evaluation and acceptance step by the receiving facility. The language was developed from the Best Management Practices of current DOE and commercial disposal facilities and is performance-based. The wording allows for flexibility in implementation and the use of the graded approach to address the different controls needed for simple waste storage facilities handling a few waste streams to multi-site and multi-program waste management facilities, such as regional disposal facilities.

IV. H. <u>Waste Generation Planning</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all low-level waste streams.

(2) Waste With No Identified Path to Disposal. Low-level waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for pre-certifying waste, providing forecast data, and approval of generator processes by the receiving facility.

Safety and Hazard Analyses. The requirement addresses the need for generators, and treatment, storage, and disposal facilities to know more about wastes requiring management prior to their generation, to prevent the generation of waste streams that may not have a path forward to disposal, and to implement an authorization for generation of no path forward waste. Specific weaknesses and conditions addressed are the generation of waste that can not be certified or accepted at a management facility, with no disposal option, or that taxes the capacity of a waste management facility. The requirement directly addresses the Complex-Wide Vulnerability of Generation of No Path Forward Waste.

Requirements Analysis. The requirements have no direct predecessor requirements in DOE 5820.2A. DOE Order Requirement III.3.b.(2) calls for an overall waste management systems performance assessment and Chapter VI calls for a waste management plan. These requirements and the concepts they embody have been significantly modified in DOE M 435.1-1 to clarify the focus of these activities on the life-cycle of low-level waste streams rather than on information about facilities managing and achievements in characterization, treatment, storage, and disposal as separate activities. These requirements in DOE M 435.1-1 emphasize planning rather than an assessment of the system performance. The requirements of DOE O 430.1A were evaluated and determined to be adequate for life-cycle planning for radioactive waste management facilities and other assets, but not adequate with respect to planning for the management of the waste streams themselves.

Other Considerations. The concepts of life-cycle planning prior to generation and approval to generate provide defense-in-depth by ensuring that a generation process will be designed and/or modified such that the waste generated can be certified and can be managed at appropriate storage, treatment, and disposal facilities. The requirement for no path forward waste directly addresses the Complex-Wide Vulnerability be providing upper management with the responsibility for approving the generation of waste which cannot be directly disposed. The final requirement language results from comments on draft versions of the requirements by specifying the four elements of the planning for no path forward waste that must be addressed in order for its generation to be approved.

IV. I. Waste Characterization.

Low-level waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for characterizing waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to only ship properly characterized waste to treatment, storage, and disposal facilities. The requirement addresses the potential conditions and weaknesses of receiving poorly characterized waste, waste requiring additional management as a mixed waste, waste exceeding WAC limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. Hazards of particular concern for waste characterization weaknesses include potential impacts to workers and the environment in the short term, and to the long-term performance of the disposal facility. The requirement also addresses the Complex-Wide Review Vulnerability on Waste Characterization.

Requirements Analysis. The requirement is essentially equivalent to the requirements at DOE 5820.2A, Chapter III.3.d.(1) and 3.d.(3) calling for waste to be characterized for proper segregation, treatment, storage and disposal, and that this characterization can be done using direct or indirect methods. The wording is modified to clarify that waste should be characterized so it can be properly handled at all times and for the purpose of meeting the receiving facilities' acceptance criteria, and that this information is to be properly documented.

Other Considerations. The final wording of this requirement is partially derived from addressing comments on previous drafts of the Manual. The requirement adds defense-in-depth by including characterization to support safe handling at all times, and not just for meeting a receiving facilities acceptance requirements. Draft versions of the characterization requirements named specific indirect methods of characterization that could be used (scaling factors, accountability, and process knowledge), and that correlations had to be derived that would tie the indirect measurements to results of direct measurements. These discussions were moved to guidance as acceptable and correct methods of the use of indirect characterization. The use of indirect methods for characterization is consistent with best management practices in commercial industry, especially at nuclear power plants, and the use of correlations to tie indirect measurements to results of direct measurements is also best management practice. These topics are addressed in the USNRC Technical Position on Waste Classification, which is referred to in guidance. This requirement is performance based to allow for flexibility in providing correlations, and the use of indirect methods for characterization supports the principle of ALARA.

IV. I.(1) Data Quality Objectives.

The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for characterizing waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to ship properly characterized waste in accordance with needs of treatment, storage, and disposal facilities. The requirement addresses the potential conditions and weaknesses of receiving poorly characterized waste, waste requiring re-characterization, waste exceeding WAC limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. The requirement also addresses the Complex-Wide Review Vulnerability on Waste Characterization.

Requirements Analysis. The requirement is an improvement to the first sentence of Requirement 5820.2A, III.3.d.(1) which required waste to be characterized "with sufficient accuracy to permit proper segregation, treatment, storage, and disposal." The use of the data quality objectives process implements a known and tested process for defining the acceptable accuracy of characterization data. The use of the data quality objectives process has been directed in policy from the Office of Environmental Management for some radioactive waste management problems, and this requirement maintains this policy.

Other Considerations. The final wording of the requirement to allow for the use of a comparable process to the data quality objectives process is derived from responses to comments. Best management practices utilized at some DOE facilities are similar to the data quality objectives process, and this wording allows for flexibility in continuing to implement those processes.

IV. I.(2) Minimum Waste Characterization.

Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) **Volume, including the waste and any stabilization or absorbent media;**

(c) **Weight of the container and contents;**

(d) **Identities, activities, and concentrations of major radionuclides;**

(e) **Characterization date;**

(f) **Generating source; and**

(g) **Any other information which may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with applicable performance objectives.**

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for characterizing waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to only ship properly characterized waste to treatment, storage, and disposal facilities and specifies the minimum requirements for that characterization. Specific hazards of concern included impacts to the long-term performance of the disposal facility, and impacts in the short term to workers from unplanned exposures. The requirement addresses potential conditions and weaknesses of receiving poorly characterized waste, waste requiring additional management as a mixed waste, waste exceeding WAC limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. The requirement also addresses the Complex-Wide Review Vulnerability on Waste Characterization.

Requirements Analysis. These requirements are improvements to requirements in 5820.2A, Chapter III.3.d.(2)(a) through 3.d.(2)(e). An additional requirement is included which requires that other characterization information needed for preparing or maintaining the performance assessment or otherwise demonstrating the performance objectives are met is also to be provided. NRC minimum waste characterization requirements in Appendix F of 10 CFR Part 20 were evaluated for essential requirements, and these are similar to the requirements of Part 20. The NRC rules specifically require the activities of H-3, C-14, Tc-99, I-129, and masses of uranium, thorium, and plutonium be reported on all low-level waste manifests. However, the variability of

DOE waste streams compared to those analyzed in development of Part 61 requires determination of safety-significant nuclides to be done through the safety analysis and performance assessment on a facility-specific basis, rather than by providing a list of specific radionuclides derived from a generic analysis. Such a list could be either too restrictive or too lenient to achieve its purpose in the DOE system with its diverse waste streams.

Other Considerations. The minimum characterization information needs are partially derived from best management practices and experiences with waste acceptance at DOE sites, and the requirements provide for defense-in-depth by ensuring minimum characterization data is developed on all waste generated, including waste with uncertain future management steps (which cannot use a facility-specific set of waste acceptance criteria to determine the exact characterization requirements to meet).

IV. J. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving low-level waste for storage, treatment, and disposal are met.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to only ship certified waste and for treatment, storage, and disposal facilities to accept only waste certified to meet the waste acceptance criteria. The requirement addresses weaknesses and conditions of receiving uncharacterized waste, waste exceeding WAC limitations, waste requiring additional management steps, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. Specific hazards identified in the analysis of concern with this activity are unplanned exposures of workers, potential impacts to the environment from acceptance of waste that does not meet WAC, and a potential for long-term impacts to the performance of the disposal facility. The requirement also partially addresses the Complex-Wide Review Vulnerability for weaknesses in Waste Characterization due to inadequate waste certification.

Requirements Analysis. The requirement is an improvement to part of the requirements in 5820.2A, Chapter III.3.e.(3) calling for a waste certification program. The parts of the 5820.2A, III.3.e.(3) requirements for joint responsibility for performing waste certification and generator

financial responsibility have been moved to guidance. Current waste certification requirements in existing DOE facility waste acceptance programs were evaluated for essential requirements in waste certification.

Other Considerations. None.

IV. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions that could arise from uncertified waste, poorly characterized waste, or waste containing unacceptable materials, especially from poor certification documentation and record keeping. This requirement addresses hazards identified impacting the long-term performance of the disposal facility. The requirement also partially addresses the Complex-Wide Review Vulnerability in Waste Characterization due to inadequate waste certification programs.

Requirements Analysis. The requirement has no predecessor requirement in DOE 5820.2A. The requirement improves on the recordkeeping requirements that are in DOE 5820.2A, Chapter III, Section M, specifically for waste certification activities.

Other Considerations. The requirement was derived from best management practices utilized at successful waste generator certification programs at DOE generator facilities, and from experience of DOE facilities receiving waste from many differing generators. The requirement provides for defense-in-depth for waste certification by ensuring: the officials who have the authority to state that low-level waste is properly certified and meets the waste acceptance criteria of the facility to which it is being sent is specifically identified and: proper documentation and recordkeeping are in place in order to retain important waste characterization data at its place of origin, the generator.

IV. J.(2) Certification Before Transfer. Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a process that ensures generators meet waste acceptance criteria of storage, treatment, and disposal facilities. The requirement addresses the weaknesses and conditions that could arise from uncertified waste, poorly characterized waste, or waste containing unacceptable materials. The requirement also partially addresses the Complex-Wide Review Vulnerability in Waste Characterization due to inadequate waste certification programs.

Requirements Analysis. This requirement is a modification of part of 5820.2A, Chapter III.3.g.(3) that waste must be certified to meet the receiving facilities acceptance criteria and that certification must take place prior to transfer to the receiving facilities.

Other Considerations. This requirement adds defense-in-depth to the controls over the most vulnerable part of the waste management system, namely when waste is transferred. This requirement places the main burden on the generator to ensure that the waste meets the waste acceptance criteria of the facility to which it is being transferred.

IV. J.(3) Maintaining Certification. Low-level waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal and Treatment, Storage and Disposal functions that the waste must be verified that it meets waste acceptance criteria evaluated in the transuranic waste analysis

Safety and Hazard Analyses. The requirement addresses weaknesses and conditions, identified in the transuranic waste safety and hazard analyses, of failing to manage the waste at a treatment or storage facility such that it will lose its certification prior to transfer to the next phase in its life cycle. These actions include: failing to monitor and inspect the waste such that release of

radioactive or hazardous materials is allowed; abusive handling such that the containment boundary of the waste package is compromised and must be replaced; and failing to manage certification documentation such that records are lost or destroyed. The hazards identified included potential impacts to workers due to damaged or degraded containers. The requirement also partially addresses the Complex-Wide Review Vulnerability in Waste Characterization due to inadequate waste certification programs.

Requirements Analysis. The requirement is an expansion of part of the transuranic waste requirement at DOE 5820.2A, II.3.e.(2) to the management of low-level waste. The transuranic waste requirement is improved by expanding the control of certified waste to all activities rather than restricting it to just storage.

Other Considerations. This requirement is included in the low-level waste chapter as a result of achieving consistency across the waste type chapters. The requirement was not originally identified as an essential requirement in the analysis of low-level waste management, but was recognized as good management practice in transuranic waste that should be adopted for management of low-level waste. The requirement supports the ALARA concept by trying to protect certified waste so that no additional characterization or packaging must take place at a later time to re-certify waste.

IV. K. Waste Transfer.

> **A documented process shall be established and implemented for transferring responsibility for management of low-level waste and for ensuring availability of relevant data.**

Basis:

Functions Evaluated. This requirement derives from the analysis of all functions in the low-level waste management system, as information about waste was identified as an input into every function from the previous function.

Safety and Hazard Analyses. The requirement addresses the need for maintaining accurate characterization data at all stages of the waste management process for low-level waste from generation through post-disposal. Specific weaknesses and conditions being addressed include losing knowledge about waste at any step of the waste management process where particularly vulnerable stages of the process include transfers and transportation, and loss of container integrity during transfer. Hazards of particular concern included impacts to workers from exposures due to loss of knowledge of waste characteristics and the long-term impact on the disposal facility performance. This requirement also partially addresses the Complex-Wide Review Vulnerability concerning Waste Characterization.

Requirements Analysis. This DOE M 435.1-1 requirement is a significant modification and improvement to requirements in DOE 5820.2A, Chapter III.3.m(1) on record keeping and III.3.h.(2) and III.3.f.(4)(d) regarding records for storage and treatment facilities. The DOE M 435.1-1 requirement consolidates the concept of the three requirements to ensure that records are kept for all low-level waste management steps and functions, and expands it to include the concept of maintaining the integrity of the waste package as well as the information on the waste. Requirements used for chain-of-custody of waste management samples at DOE and commercial facilities were evaluated to help derive this essential requirement. Record keeping requirements of DOE O 200.1 were evaluated and found to be adequate for the maintenance of written records such as waste manifests and transfer papers and are invoked in the General Requirements chapter of the Manual.

Other Considerations. Proper maintenance of information and integrity of waste packages contributes to cost-effectiveness and ALARA by minimizing the need for re-certification, re-characterization, repackaging, or doing unnecessary sampling and analysis.

IV. K. <u>Waste Transfer</u>.

The following requirements are in addition to those listed in Chapter I of this Manual.

(1) Authorization. Low-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a process for assuring that generators meet waste acceptance criteria of storage, treatment, and disposal facilities and that these receiving facilities verify that the acceptance criteria are met before the waste is received. Specific weaknesses and conditions addressed are from the possible receipt of uncertified waste, poorly characterized waste, or waste containing unacceptable materials. This requirement addresses a specific hazard to workers from exposures from receipt of waste without proper notifications and authorizations. The requirement also addresses the Complex-Wide Review Vulnerability for weaknesses in Waste Characterization which may be due to inadequate waste certification programs.

Requirements Analysis. The requirement is an improvement to DOE 5820.2A Requirement III.3.g.(3) This requirement is a modification and improvement to part of 5820.2A, Chapter III.3.g.(3) that waste must be certified to meet the receiving facilities acceptance criteria and that this must take place prior to transfer to the receiving facilities.

Other Considerations. Authorization by receiving facilities for transfer provides defense-in-depth at the most vulnerable time for radioactive waste management, when waste is transferred.

IV. K. Waste Transfer.

The following requirements are in addition to those listed in Chapter I of this Manual.

(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for low-level waste shall be transferred with or be traceable to the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of all functions in the low-level waste management system, as information about waste was identified as an input into every function from the previous function.

Safety and Hazard Analyses. The requirement addresses the need for maintaining accurate characterization data at all stages of the waste management process for LW from generation through post-disposal. Specific weaknesses and conditions being addressed include losing knowledge about waste at any step of the waste management process where particularly vulnerable stages of the process include transfers, transportation, when waste is treated in a way that the form is changed or repackaging occurs, and when storage lasts longer than anticipated. Worker exposures were identified as a specific hazard needing to be addressed through this requirement, as well as impacts to the long-term performance of the disposal facility due to loss of information about disposed waste. Also, this requirement partially addresses the Complex-Wide Review Vulnerability concerning Waste Characterization.

Requirements Analysis. The requirement is an improvement to Requirement DOE 5820.2A, Chapter III.3.m.(2) on waste manifests. The analysis of the 5820.2A waste manifest requirement indicated that it was too restrictive (language limited use of manifests to when there was a package of waste; the function of transfer in the evaluations conducted in developing DOE M 435.1-1 had a broader definition and application). The requirement needed to ensure that maintaining characterization data, and packaging data when applicable, applies to all functions, not just to packages, or transfer of packages. The manifesting requirements of 10 CFR Part 20 were evaluated, and found to be too restrictive since it was limited to offsite disposal of

transported waste, where manifesting documentation was the state-of-the-art. Much of the specific items and directions for manifest use from DOE 5820.2A and Part 20 is now in implementation guidance, and addresses the specific cases when waste is to be transported off of a DOE site to another site or to a commercial waste management facility.

Other Considerations. The requirement is a performance based requirement that applies to all functions of low-level waste management, and not just to a limited set for transportation of waste to a large waste management facility. The principle of ALARA is supported by this requirement by preventing re-certification or re-characterization steps or doing unnecessary sampling and analysis if all characterization data are properly maintained and transferred.

IV. L. <u>Packaging and Transportation</u>. The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging. If containers are used:

(a) Low-level waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container.

(b) When waste is packaged, vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container.

(c) Containers of low-level waste shall be marked such that their contents can be identified.

Basis:

Functions Evaluated. These requirements derive from the analysis of the Generator function for packaging low-level waste, the Treatment function for packaging processed waste, the storage function for monitoring waste in storage, and the Disposal function for handling waste prior to disposal.

Safety and Hazard Analyses. The requirement addresses the need for proper packaging, venting of waste containers, when necessary, and marking and labeling of waste containers for appropriate treatment, storage, and disposal. The requirement addresses the potential conditions and weaknesses of receiving inadequately packaged waste, waste not meeting WAC requirements, waste requiring repackaging, waste with improper or missing marking and/or labeling, wastes without adequate relationship to its shipping papers, and waste in storage longer than anticipated

or in inadequate storage conditions. Potential high hazards were identified to workers due to improper labeling of high-activity low-level waste, and hazards to the environment and workers were identified if waste was not packaged correctly. The requirement also addresses the Complex-Wide Vulnerability concerning Waste in Inadequate Storage Conditions by requiring adequate containers that will endure the expected storage period, and requiring a vent in the event containers become pressurized or contain gaseous waste or waste that could generate gases. Specific incidents in the DOE complex have been reported over recent years concerning over-pressurization of low-level waste containers, and the potential this has raised for dispersal of radioactive material if rapid depressurization of the containers were to occur.

Requirements Analysis. The requirements for packaging are improvements, updates, and additions to packaging requirements in DOE 5820.2A, Chapter III.3.g.(4). DOE O 1540.1, referred to in DOE 5820.2A, is replaced by DOE O 460.1A. DOE O 460.1A, which is required to be complied with in Chapter I, General Requirements, invokes Title 49 CFR Department of Transportation (DOT) requirements for packaging and shipping radioactive material. Therefore, a reference to the DOE Orders on transportation, or to the DOT requirements, is no longer needed in the waste type chapter. DOE Orders covering transportation of radioactive materials (DOE O 460.1A and 460.2) were evaluated and found to be sufficient in providing controls for packaging of low-level waste, except for long-term storage and for packaging prior to shipment or where shipment (transfer) is not clearly under DOE O 460.1A. Requirements included cover these two circumstances.

NRC transportation requirements at 10 CFR Part 71 were also evaluated, but found to have no additional essential requirements to be considered. The additions to DOE 5820.2A in the DOE M 435.1-1 requirement are to provide containment for the storage period or until the waste is removed from the packaging, and for packages to have proper marking, and labeling.

Other Considerations. The final language in the requirement is partially derived from responses to comments on draft versions of DOE M 435.1-1. The requirement adds defense-in-depth to storage requirements by requiring adequate packaging in addition to the improved storage conditions specified in the storage section of the Manual. Venting of packages addresses recent incidents that have been reported in the DOE complex and represents a Best Management Practice. Venting also represents the efforts to be consistent across waste type chapters, as venting for TRU waste containers is required. Marking and labeling are considered best management practices and are employed for radioactive and hazardous waste. The requirements are included in DOE M 435.1-1 to ensure marking and labeling is utilized for the entire life-cycle of the waste. Minimum characteristics for packaged waste following treatment were also identified and these are incorporated in Manual in the form of waste acceptance requirements for disposal, Requirements IV.G.(1)(d).

IV. L. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(2) Transportation. To the extent practical, the volume of waste and number of low-level waste shipments shall be minimized.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator, treatment, and storage functions for transporting waste to receiving storage, treatment, and disposal facilities.

Safety and Hazard Analyses. The requirements contained in 460.1A and in this Manual address the potential conditions and weaknesses of handling waste on and off transport vehicles, securing waste on transport vehicles, and consequences from waste in transport in the event of transportation incidents. The Safety and Hazard Analysis indicated that these weaknesses and conditions result in a high risk activity for management of low-level waste. Also, other studies (e.g., PEIS) also have indicated that transportation is one of the higher risk activities of management of radioactive waste.

Requirements Analysis. The requirement is essentially equivalent to Requirement 5820.2A, III.3.g.(1). The DOE Orders covering transportation of radioactive materials (DOE O 460.1A and 460.2) were evaluated and found to be sufficient in providing controls for transportation of low-level waste. This conclusion was supported also by the specification in DOE O 460.1A that offsite transportation had to meet 49 CFR, DOT requirements for transport of radioactive materials. This requirements for transportation are the only components needed to address the potential conditions and weaknesses not addressed by the requirements of O 460.1. Specifically, waste shipment minimization addresses the risks of adding unnecessary shipments of radioactive materials on the road.

Other Considerations.

The requirement adds defense-in-depth to the requirements of 460.1A (invoked in the General Requirements Chapter) for transportation of Low-level waste to account for possible consequences associated with transportation as indicated in the Safety and Hazard Analysis. The requirement was developed in support of the guiding principles for managing radioactive waste to result in doses As Low as Reasonably Achievable and for cost-effectiveness.

IV. M. Site Evaluation and Facility Design.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for low-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

Basis:

Functions Evaluated. This requirement derives from the analysis of Disposal functions for constructing a new disposal facility, closing and monitoring all disposal facilities, and Storage and Treatment functions for constructing a new facility.

Safety and Hazard Analyses. This requirement addresses the need to acquire meteorologic, topographic, geotechnical, and other environmental data to support decisions about the acceptability of a site for a storage, treatment, and disposal facility, and to provide necessary input to the design of the facility, and specifically to the performance assessment of a disposal facility. This requirement addresses the condition of disposal of waste at sites with poor waste containment characteristics without adequate adjustments to the rest of the disposal system (e.g., limiting radionuclides accepted, supplementing with engineered barriers). The specific hazard addressed by this requirement is the potential for impacts to the long-term performance of the disposal facility. This requirement partially addresses the recommendation of Defense Nuclear Facilities Safety Board Recommendation 94-2 that modeling capability of the Department needs improvement by establishing a requirement for site evaluations that will lead to acquiring sufficient data for use in performance assessments of new or modified disposal facilities.

Requirements Analysis. This requirement is a combination of DOE 5820.2A requirements III.3.i.(7)(b) and 3.i.(8)(a), with significant modifications and expansion. The wording is modified such that it addresses characterization of all low-level radioactive waste management facility locations rather than focusing only on site selection for a potential new low-level waste disposal facility.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. The initial language of site evaluation requirements applied only to disposal facilities. The final wording of the requirement that expanded it to apply to all facilities was in response to achieving consistency with waste type chapters, in responding to comments on draft versions, and to address the needs recognized in the shortcomings of DOE O 420.1.

IV.M.(1) Site Evaluation.

(a) Each site proposed for a new low-level waste facility or expansion of an existing low-level waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities, including for a low-level waste disposal facility, the capability of the site to demonstrate, at a minimum, whether it is:

1. Located to accommodate the projected volume of waste to be received;

2. Located in a flood plain, a tectonically active area, or in the zone of water table fluctuation; and

3. Located where radionuclide migration pathways are predictable and erosion and surface runoff can be controlled.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Basis:

Functions Evaluated. This requirement derives from the analysis of Disposal functions for constructing a new disposal facility, closing and monitoring all disposal facilities, and Storage and Treatment functions for constructing a new facility.

Safety and Hazard Analyses. This requirement addresses the need for sites for low-level waste management facilities to be selected carefully, especially disposal facilities, and for site characteristics to be appropriately incorporated into the design of low-level waste management facilities (storage, treatment, and disposal). The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the weaknesses and conditions associated with poor facility siting, inadequate designs of facilities, and inadequate data for performance assessment calculations for disposal facilities. Some of the consequences resulting from failures evaluated in this part of the analysis were high, because of catastrophic failures of radioactive material containment that could occur due to environmental and geotechnical characteristics, such as flooding, earthquakes, and severe weather events.

Requirements Analysis. Requirement (a) is an improvement and re-working of the concepts in DOE 5820.2A Requirements III.i.(8)(b) and III.i.(7)(c), III.i.(7)(d), and III.i.(7)(e). Requirement (b) has no predecessor requirement in DOE 5820.2A, although Requirement III.i.(8)(a) referred to ensuring that the requirements of the Order could be met through the site design. The requirement is an improvement to DOE 5820.2A by making these concepts applicable to all low-level radioactive waste management facilities, not just disposal facilities, and by expanding and improving those site characteristics that must be specifically evaluated for a low-level waste disposal facility. The requirement is improved also by requiring that a site shall be avoided if adequate protection from severe natural events cannot be achieved by a facility design in order to adequately protect the public, workers, or the environment.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A for site evaluations and incorporating their results in facility design that were canceled when DOE 6430.1A was replaced.

10 CFR Part 61 was evaluated for essential low-level waste disposal site evaluation and facility design requirements. 10 CFR Part 61 contains site suitability requirements that specify characteristics of disposal sites that must be avoided in selecting a site for a new facility. Since the DOE M 435.1-1 requirement is for all low-level waste management facilities, not just disposal facilities, and siting of facilities will take place only at existing DOE sites and reservations, the requirement is worded to cover all management facilities, and the Part 61 requirements, changed to fit the DOE situation, added for applicability to disposal facilities only. Requirement (a) calls for site selection criteria (derived from Part 61) specifically addressing DOE needs to be considered in site selection and site evaluations, and included as part of a site's demonstration that it can contribute to an adequate disposal system. Requirement (b) is attempting to address the stricter concept embodied in the site suitability requirements of 10 CFR Part 61 for eliminating sites which have an environmental or geotechnical characteristics which needs to be avoided, based on there being no ability to design against the characteristic. The specific site characteristics that are to be avoided in Section 61.50 are discussed in the guidance on DOE M 435.1-1.

Other Considerations. The requirements are performance based to accommodate the selection of sites for new DOE low-level waste management facilities, which are restricted to the existing DOE reservations. (It may be preferable to choose the location for a new facility adjacent to a currently operating facility, even if geotechnical and environmental characteristics are not ideal). Therefore the approach is for these characteristics to be incorporated into the design of the facility, and the site should be avoided when the design cannot appropriately compensate for an environmental or geotechnical characteristic in a way that will provide adequate protection.

The requirement adds defense-in-depth to the regulation of storage and treatment facilities for low-level waste as avoidance of sites with inferior environmental and/or geotechnical characteristics has not been specifically required by DOE in past Orders for these facilities. Defense-in-depth for low-level waste disposal facilities is also provided, in a comparable way as in 10 CFR Part 61, except the specific geotechnical and environmental characteristics of this DOE M 435.1-1 requirement are not framed as exclusionary criteria. The use of the performance assessment in support of the design, operation, closure, monitoring, and establishment of site-specific waste acceptance criteria, with consideration of site-specific geotechnical and environmental characteristics, can compensate for the lack of exclusionary site selection criteria in the DOE regulatory scheme of Chapter IV of DOE M 435.1-1. The final wording of these two requirements is partially based on making the waste type chapters of the Manual consistent, and in response to specific concerns of the Defense Nuclear Facilities Safety Board on draft versions of the Manual requirement, the final wording partially addresses Defense Nuclear Facilities Safety Board Recommendation 94-2 that additional requirements, guidance, and standards similar to commercial facilities be incorporated into the low-level waste essential requirements.

IV.M.(1) Site Evaluation.

(c) Low-level waste disposal facilities shall be sited to achieve long-term stability and to minimize, to the extent practical, the need for active maintenance following final closure.

Basis:

Functions Evaluated. This requirement derives from the analysis of Disposal functions associated with design, construction, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for the disposal system (e.g., site location, design, waste emplacement, packaging, closure) to result in a stable site that will perform in a manner which is protective of workers, the public and the environment. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the weakness associated with an unstable site which could result in failures over time and would release radioactivity. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. This requirement has no direct predecessor in DOE 5820.2A. However, Requirement 5820.2A, III.3.f.(2) focused on treatment of waste to provide a stable waste form, and Requirement 5820.2A, III.3.i.(5) implied that disposal site stability was necessary. This DOE M 435.1-1 requirement makes it clear that the site chosen and developed for low-level waste disposal facilities must promote site stability.

10 CFR Part 61 was evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be " . . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the siting element of the Part 61 performance objective.

Other Considerations. The requirement is performance-based to allow flexibility in determining characteristics of the site and design which can be utilized to promote site stability after closure, rather than specifying characteristics that must be achieved.

IV.M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Low-level waste systems and components shall be designed to maintain waste confinement.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions for placing and monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need for some low-level waste management facilities to provide additional confinement barriers in addition to packaging. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the specific weaknesses and conditions of managing liquid low-level waste, and containers in storage leaking or breaking during handling, and waste being in storage longer than planned. Weaknesses identified in the high-level waste safety and hazard analyses included failures due to aging, erosion and mechanical damage.

Requirements Analysis. The requirement is partially derived from the DOE 5820.2A Requirements I.3.b.(2)(a) requiring double containment for all new high-level waste facilities, but is improved and applied to low-level waste treatment and storage facilities. The requirement is also based on an evaluation of *Resource Conservation and Recovery Act* requirements appearing at 40 CFR Part 264, Subpart J and 40 CFR Part 265 Subpart J, and evaluation of DOE 6430.1A.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. The confinement requirement was partially derived from the achievement of consistency between the waste type chapters. The high-level waste chapter has several minimum design requirements specified, and this requirement in the high-level waste chapter addressed some weaknesses and conditions identified in some low-level waste functions. Defense-in-depth is provided for low-level waste treatment and storage facilities by requiring certain minimum design specifications to protect against known hazards in radioactive waste management.

IV.M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(b) Ventilation.

1. Design of low-level waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Basis:

Functions Evaluated. This requirement derives from the analysis of Treatment functions for verifying waste meets waste acceptance criteria, providing interim storage at the treatment facility, and processing waste, and the storage function for monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need to include ventilation systems as appropriate in facilities that treat and store low-level waste due to the receipt of waste in gaseous form, or waste which degrades and creates gases in the container. The requirements address the weaknesses of receiving waste with incorrect characterization information or which contains an unknown material and of having to open containers to verify the contents. Potential impacts to workers is the specific hazard addressed through this requirement. Requirement (b)2. specifically addresses the weakness associated with the receipt of a container that includes a gas or an explosive agent. Processing a container of low-level waste with a gas or an explosive was identified as a high hazard activity due to potentially large consequences in the safety and hazard analysis conducted on low-level waste treatment.

Requirements Analysis. The requirements are similar to the requirement in 5820.2A, I.3.b.(2)(f) requiring ventilation systems to maintain radionuclide release within published guidelines at high-level waste tanks, but it is applied to low-level waste treatment and storage facilities. The requirement is partially derived from requirements in 10 CFR Part 835 *Occupational Radiation Protection,* DOE 5400.5 *Radiation Protection of the Public and Environment,* and 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

Other Considerations. These requirements were partially derived from the achievement of consistency between the waste type chapters. Defense-in-depth is provided for low-level waste treatment and storage facilities by requiring certain minimum design specifications to protect against known hazards in radioactive waste management.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing low-level waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Basis:

Functions Evaluated. This requirement derives from the analysis of Storage and Treatment functions for constructing a new facility and the Treatment function for closure of a treatment facility.

Safety and Hazard Analyses. The requirement addresses the need for incorporating waste generation reduction and minimization into the design of new management facilities. The condition identified in the safety and hazards analyses being addressed by this requirement is managing the residuals from a treatment facility.

Requirements Analysis. This requirement improves on DOE 5820.2A requirements III.3.c on waste generation minimization and reduction, and on the policies in III.2.a. and 2.b. that no legacies requiring remedial action should remain after low-level waste operations are terminated and that low-level waste should be managed in a systematic way that includes waste generation reduction. DOE O 430.1A was evaluated during the development of planning requirements for radioactive waste, and it was found to be sufficient for management of radioactive waste management facilities and other assets of the low-level waste management system, but it did not adequately discuss planning of waste streams to be generated by facilities, including radioactive waste management facilities.

Other Considerations. This requirement was added to promote best management practices to include consideration of the entire life-cycle of the management of waste that will be generated from operating a low-level waste management facility. Preventing or minimizing the generation of waste is a top-level principle that is incorporated into DOE M 435.1-1 wherever possible.

IV.M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of low-level waste treatment and storage facilities to provide volume inventory data and to prevent spills, leaks, and overflows from tanks or containment systems.

(e) Monitoring. Monitoring and leak detection capabilities shall be incorporated in the design and engineering of low-level waste treatment and storage facilities to provide rapid identification of failed containment and/or other abnormal conditions.

Basis:

Functions Evaluated. These requirements derive from the analysis of storage functions for monitoring waste in storage and maintaining the storage facility, and the Treatment functions for providing interim storage at the treatment facility, processing waste, and maintaining the facility.

Safety and Hazard Analyses. Requirement (b) addresses the need to detect system failures that could lead to significant consequences. Requirement (c) addresses the need to provide instrumentation and other engineered items to allow for control of the storage and transfer of waste in tanks and processing lines. Possible hazards addressed by this requirement include unplanned exposures of workers, and impacts to the public and environment due to loss of control of a treatment process. The requirements address the weaknesses and conditions of liquid low-level waste tanks breaching or being overfilled, containers in storage leaking or breaking during handling, or liquid low-level waste lines in treatment facilities breaching. Potentially high hazards were identified due to large consequences of an undetected liquid low-level waste storage tank breach or overfill, or of a treatment facility process line breaking without detection or because adequate controls were not designed in the facility.

The high-level waste safety and hazard analyses identified weaknesses involving failure to detect flammable gas build up, failure to sample and test waste to establish ignition limits, inadequate storage tank level monitoring, and waste transfer line failure.

Requirements Analysis. The requirements are based on the DOE 5820.2A requirements I.3.b.(3)(a) and I.3.b.(2)(h) for high-level waste tanks. The requirements are expanded to apply to low-level waste treatment and storage facilities and the controls are required to be part of the design of new facilities.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. The requirements were partially derived from the achievement of consistency between the waste type chapters. The high-level waste chapter has several minimum design requirements specified, and these requirement in the high-level waste chapter addressed some weaknesses and conditions identified in some low-level waste functions. Defense-in-depth is provided for low-level waste treatment and storage facilities by requiring certain minimum design specifications to protect against known hazards in radioactive waste management. The requirements also support the ALARA principle by attempting to detect and control hazardous situations through design of instrumentation, providing a layer of protection to workers.

IV.M.(3) Low-Level Waste Disposal Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Low-level waste systems and components shall be designed to maintain waste confinement.

Basis:

Functions Evaluated. This requirement derives from the analysis of the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. The requirement addresses the need for the low-level waste disposal facility to provide confinement barriers in addition to the confinement of waste provided by waste containers. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the specific weaknesses and conditions of poorly designed containers, the breaching of containers during operations, containers failing over time, inadequate waste processing, and inadequate characterization of waste. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. Principal design considerations and the specific design requirements for a low-level waste disposal facility in 10 CFR Part 61 were evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a design objective (61.51(a)(1)) calling for disposal facility design features to " . . . be directed towards long-term isolation (of waste) . . ." There are no requirements in Part 61 that specifically require confinement to be provided by the design of the facility. DOE 6430.1A contained modified versions of Part 61 requirements, and other requirements, for the design of low-level waste disposal facilities.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from several requirements in DOE 6430.1A, Section D13, *Special Facilities,* that were canceled when DOE 6430.1A was replaced.

Other Considerations. This is a performance based requirement that reflects the compilation of some design requirements that used to be in DOE 6430.1A, Section D13, *Special Facilities,* Section 1324-5.3, *Low-Level Waste Disposal Facility Confinement.* These were planned for inclusion in the guidance document for implementation of DOE O 420.1. Instead, these requirements were considered essential low-level waste disposal facility design requirements, and are included in this performance based requirement in DOE M 435.1-1, and not the guidance on DOE O 420.1. The requirement is performance-based to allow flexibility in determining characteristics of the design which can be provide for waste confinement, both during operations and after closure, rather than specifying design characteristics that must be used. The requirement provides defense-in-depth for confinement of waste which may escape from its waste disposal container, but also an initial confinement barrier for wastes disposed in bulk, uncontainerized fashion.

IV.M.(3)(b) Ventilation.

1. **Design of low-level waste disposal facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in requirements.**

2. **When conditions exist for generating gases in flammable or explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.**

Basis:

Functions Evaluated. This requirement derives from the analysis of Treatment functions for verifying waste meets waste acceptance criteria, providing interim storage at the treatment facility, and processing waste, and the storage function for monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need to include ventilation systems, where applicable, in disposal facilities due to the receipt of waste which contains a gas or which may degrade and create gases in the container. This requirement addresses hazards to workers due to unplanned exposures. The requirements address the weaknesses of receiving waste with incorrect characterization information or which contains an unknown material. Requirement (b)2. specifically addresses the weakness associated with the receipt of a container that includes a gas or an explosive agent, even though waste accepted at disposal facilities are not supposed to include untreated explosive agents.

Requirements Analysis. The requirements are similar to the requirement in 5820.2A, I.3.b.(2)(f) requiring ventilation systems to maintain radionuclide release within published guidelines at high-level waste tanks, but it is applied to low-level waste disposal facilities, where applicable. The requirement is partially derived from requirements in 10 CFR Part 835 *Occupational Radiation Protection,* DOE 5400.5 *Radiation Protection of the Public and Environment,* and 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

Other Considerations. These requirements were partially derived from the achievement of consistency between the waste type chapters. Defense-in-depth is provided for certain designs of low-level waste disposal facilities by requiring minimum design specifications to protect against

known hazards in radioactive waste management. The design requirement is meant to be applicable for the operational period of the facility, and not for post-closure considerations. Not all low-level waste disposal facilities require ventilation during operations; the requirement was considered necessary when considering above-ground, or highly-engineered below-ground facilities, like vaults, that are more confined spaces than open trench disposal facilities.

IV.M.(3)(c) Stability. Low-level waste disposal facilities shall be designed to achieve long-term stability and to minimize to the extent practical, the need for active maintenance following final closure.

Basis:

Functions Evaluated. This requirement derives from the analysis of the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for the disposal system (e.g., site location, design, waste emplacement, packaging, closure) to result in a stable site that will perform in a manner which is protective of the public, workers and the environment. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the weakness and conditions of poorly designed waste containers, containers failing over time, inadequate waste processing, poor characterization of site features, or the necessary selection of a site with some site characteristic flaws. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. This requirement has no direct predecessor in DOE 5820.2A. However, Requirement 5820.2A, III.3.f.(2) focused on treatment of waste to provide a stable waste form, and Requirement 5820.2A, III.3.i.(5) implied that disposal site stability was necessary. This DOE M 435.1-1 requirement makes it clear that the design of the low-level waste disposal facility must promote site stability following closure.

Principal design considerations and the specific design requirements for a low-level waste disposal facility in 10 CFR Part 61 were evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be " . . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as

necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the design element of the Part 61 performance objective.

Other Considerations. This is a performance based requirement that reflects the compilation of some design requirements that used to be in DOE 6430.1A, Section D13, *Special Facilities.* These were planned for inclusion in the guidance document for implementation of DOE O 420.1. Instead, these requirements were considered essential low-level waste disposal facility design requirements, and are included in this performance based requirement in DOE M 435.1-1, and not the guidance on DOE O 420.1. The requirement is performance-based to allow flexibility in determining characteristics of the design which can be utilized to promote site stability after closure, rather than specifying characteristics that must be achieved.

IV.M.(3)(d) Control of Water. Low-level waste disposal facilities shall be designed to minimize to the extent practical, the contact of waste with water during and after disposal.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Disposal functions for design, construction, operation, and closure of the low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for the disposal system (e.g., site location, design, waste emplacement, packaging, closure) to minimize the contact of water with waste, both during and after disposal, so that the site will perform in a manner which is protective of workers, the public and the environment. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement, as well as short-term impacts to the environment due to contact of waste and water during operations. The requirement addresses the weakness associated with water contacting waste which could result in movement of radionuclides away from the facility; containers failing over time and releasing radioactivity; covers being poorly designed; site characteristics being poorly understood, and; over-reliance on performance assessment modeling for facility design. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. Principal design considerations and the specific design requirements for a low-level waste disposal facility in 10 CFR Part 61 were evaluated for essential requirements for DOE low-level disposal facilities. A principal concept embodied in Part 61 is that the disposal siting, design, operations, and closure should all be directed at minimizing the contact of waste with water. Part 61 requirements 61.51(a)(4), (a)(5), and (a)(6) all require specific design features to achieve this principal goal. These requirements, in a modified form, were included in DOE's design requirements in DOE 6430.1A.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from several requirements in DOE 6430.1A, Section D13, *Special Facilities*, Section 1324-5.3, *Low-Level Waste Disposal Facility Confinement*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. This is a performance based requirement that reflects the compilation of some design requirements that used to be in DOE 6430.1A, Section D13, *Special Facilities.* These were planned for inclusion in the guidance document for implementation of DOE O 420.1. Instead, these requirements were considered essential low-level waste disposal facility design requirements, and are included in this performance based requirement in DOE M 435.1-1, and not the guidance on DOE O 420.1. This provides defense-in-depth to the reliance on the use of the performance assessment modeling for disposal facility design.

The performance based requirement essentially reflects the concept in the three specific 10 CFR Part 61 requirements, but at a higher level. The discussions of those requirements is in the DOE M 435.1-1 guidance documentation. The requirement is performance-based to allow flexibility in determining characteristics of the design which can be utilized to minimize contact of water with waste, rather than specifying characteristics that must be achieved.

IV. N. <u>Storage and Staging.</u>

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Low-level waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Basis:

Functions Evaluated. This requirement is based on analyses of functions associated with the storage of transuranic waste. The specific functions affecting this requirement include developing waste acceptance criteria for receiving waste for storage and placing waste into storage.

Safety and Hazard Analyses. The safety and hazards analysis identified weaknesses or conditions associated with a lack of thorough analysis or a failure to integrate all pertinent data (e.g., safety analysis report) in the development of waste acceptance criteria for the storage facility. The resultant hazard is that containers with incompatible materials or energy sources such as explosives or reactives are received that can cause releases that endanger workers or release radioactivity to the environment.

Requirements Analysis. The requirements analysis determined that a number of existing internal and external requirements require evaluations of hazards that should be considered in decisions about what can be safely put into a container and placed in storage. These requirements are included in RCRA, DOE 5480.21, *Unreviewed Safety Questions*, 5480.22, *Technical Safety Requirements*, 5480.23, *Nuclear Safety Analysis Report*s, and 420.1, *Facility Safety*. Guidance on developing waste acceptance requirements and for establishing a radioactive waste management basis discusses how results of hazards evaluations based on these other DOE Directives and external requirements should be factored into those documents. These other Directives and requirements are invoked in Chapter I of the Manual

Other Considerations. Based on Defense Nuclear Facilities Safety Board comments on draft versions of DOE M 435.1-1, specific requirements for prohibiting certain types of material from storage were added to the Manual. Incorporation of language that specifically identifies materials that are not to be stored adds defense-in-depth by specifically addressing the weaknesses related to not conducting a sufficiently rigorous analysis when developing waste acceptance requirements. The current requirement is a best management practice which will prevent or minimize instances of occurrences which have been reported or observed in waste management at DOE sites.

IV. N.(2) Storage Limit. Low-level waste that has an identified path to disposal shall not be stored longer than one year prior to disposal, except for storage for decay, or as otherwise authorized by the Field Element Manager.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage of low-level waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of loss of characterization data and waste certified for disposal degrading during a storage period longer than anticipated. The most significant hazard addressed by this requirement is potential exposure to workers. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement has no predecessor requirements in DOE 5820.2A, except for storage for decay. This requirement continues the storage for decay policy in DOE 5820.2A, III.h.(4). RCRA storage requirements were also evaluated, however, the approach and time frames in the EPA requirements for hazardous waste were not used as a basis for the storage limitation. Storage for decay is allowed in NRC requirements at 10 CFR Part 20.

Other Considerations. This requirement is a performance based requirement to address the storage vulnerabilities identified at many sites during the Complex-Wide Review. Defense-in-

depth is provided in limiting the allowable storage period to one year for waste with a disposal path to prevent loss of package integrity and characterization information on the waste. The one year period was chosen to provide a reasonable period of time for storage if needed, but which will not result in damage to waste forms or containers, or loss of information. Additionally, studies have demonstrated the cost-effectiveness of disposing of waste in a timely manner following its generation. Comments on draft versions of the Manual resulted in continuance of the storage-for-decay policy in DOE M 435.1-1, which has proven an effective and safe methodology for management of radioactive waste

IV. N.(3) Storage Integrity. Low-level waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions for low-level waste of placing waste in storage and monitoring waste while in storage.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions associated with waste being in storage for longer periods of time than planned, for poor emplacement of waste within a storage facility, and for poor storage containers. The most significant hazard addressed by this requirement is potential exposure to workers. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement has predecessor requirements in the Transuranic Waste Chapter of DOE 5820.2A, Requirements II.3.e.(7) and II.3.g.(2)(f). Also, RCRA storage requirements for hazardous waste were evaluated for assistance in defining a storage approach, with associated time frames if appropriate, for protecting the integrity of low-level waste in storage.

Other Considerations. The current performance based requirement to provide protection of the integrity of waste containers in storage was derived independently from any existing requirements. Original language included protecting stored waste from prolonged exposures to the elements, such as rain and sun, and suggested that covers, temperature controls, and secondary containment were acceptable ways to do this. The final wording resulted partially from ensuring the requirement did not include items which were more appropriately addressed in guidance, and partially from ensuring consistency between waste type chapters. It also addresses a concern raised in comments on draft versions of the Manual from the Defense Nuclear Facilities Safety Board that waste storage should not result in exposure to workers involved in activities unrelated to maintaining the stored waste, i.e., workers involved in other activities should not have stored waste in their work area.

IV.N.(4) Waste Characterization for Storage

(a) Low-level waste that does not have an identified path to disposal shall be characterized as necessary to meet the data quality objectives and minimum characterization requirements of this chapter and to facilitate disposal.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage of low-level waste, and for treatment and storage functions for ensuring disposal waste acceptance criteria are complied with.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of loss of characterization data for waste in storage for long periods of time, and for acceptance of waste at a disposal facility with inadequate characterization information. The potential impacts to the long-term performance of the disposal facility is the most significant hazard addressed by this requirement. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement has no predecessor requirements in DOE 5820.2A. RCRA storage requirements were also evaluated, however, the approach and time frames in the EPA requirements for hazardous waste were not used as a basis for storage limitations on waste with no path forward.

Other Considerations. This requirement is a performance based requirement to address the storage vulnerabilities identified at many sites during the Complex-Wide Review. Defense-in-depth is provided by implementing the data quality objectives process for this waste, which will account for the longer expected storage time in determining what characterization information is needed.

IV.N.(4)(b) Characterization information for all low-level waste in storage shall be maintained as a record in accordance with the requirements for Records Management in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage of low-level waste, and for treatment and storage functions for ensuring disposal waste acceptance requirements are complied with.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of loss of characterization data for waste in storage, (especially for waste stored longer than expected)

and for acceptance of waste at a disposal facility with inadequate characterization information. The potential impacts to the long-term performance of the disposal facility is the most significant hazard addressed by this requirement, especially as it concerns disposal of waste that has been in storage for a very long time. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement is an improvement to DOE 5820.2A, III.3.h.(2). The current DOE Orders on records management were evaluated and determined to implement adequate controls to ensure characterization information on waste in storage would not be lost, therefore, reference is made in the requirement to the General Requirements chapter where these Orders are invoked.

Other Considerations. Defense-in-depth is provided by specifically implementing the records management requirements on stored waste to ensure characterization information is not lost.

IV.N.(5) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of low-level waste to ensure container integrity is not compromised.

Basis:

Functions Evaluated. This requirement derives from the analysis of transuranic waste management functions for maintaining waste storage, and monitoring waste containment and configuration.

Safety and Hazard Analyses. The requirement addresses the need to monitor the conditions of packages in storage to identify problems with stored waste, so that problems are minimized when the waste is transferred for disposal, or if waste is in storage longer than anticipated. The weaknesses and conditions identified in the transuranic waste safety and hazard analyses included of failure of waste packages and releases to the environment and public. The hazards addressed by this requirement include possible releases that could harm workers or damage the environment. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement is derived from the Requirements DOE O 5820.2A, II.3.e.(4) for having a process for package inspection and maintenance for transuranic waste in storage, extended to storage of low-level waste.

Other Considerations. This requirement was derived from the achievement of consistency between the waste type chapters. The transuranic waste chapter contained more prescriptive requirements for stored waste due to the experience of transuranic waste storage, and this

requirement was incorporated into the low-level waste requirements because of the desire to improve the storage of low-level waste in response to the Complex-Wide Review Vulnerabilities.

IV.N.(6) Storage Management. Low-level waste storage shall be managed to identify and segregate low-level waste from mixed low-level waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of transuranic waste storage functions related to disposition of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the need to provide separate storage for mixed low-level and low-level wastes so that different requirements for the hazardous component of mixed waste can be efficiently implemented. The weaknesses and condition identified in the analysis that addressed by this requirement is the additional management steps required for mixed low-level. The hazard addressed by this requirement is the potential additional exposures to workers from additional management steps for complying with RCRA requirements for mixed waste. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement is an improvement on Requirement DOE 5820.2A, III.3.c.(3), and an extension of the segregation concepts in transuranic waste Requirement DOE 5820.2A, II.3.e.(2) to low-level waste management. DOE M 435.1-1 does not address uncontaminated material, so this part of the DOE 5820.2A, Chapter III requirement is dropped. RCRA storage requirements were evaluated to determine the necessity and approach for storage segregation, but no essential requirements were found to specifically address the needs identified.

Other Considerations. The requirement was not originally in the essential low-level waste requirements and was partially derived when consistency between waste type chapters in the Manual was being addressed. Also, segregation of mixed from non-mixed low-level waste is considered a best management practice at many sites, and has proven to be cost-effective. It also supports the ALARA principle, as non-mixed low-level waste does not have to undergo rigorous hazardous waste management inspection regimes.

IV.N.(7) Staging. Staging of low-level waste shall be for the purpose of the accumulation of such quantities of waste as necessary to facilitate transportation, treatment, and disposal. Staging longer than 90 days shall meet the requirements for storage above and in Chapter I of this Manual.

Functions Evaluated. This requirement derives from the analysis of interim storage activities for treatment of low-level waste and emplacement at disposal facilities.

Safety and Hazard Analyses. This requirement addresses the need for safe interim storage at generator, treatment, and storage facilities prior to treatment, long-term storage, or disposal, and safe staging prior to shipment. The requirement addresses the weaknesses and conditions of having waste stored at staging locations for longer periods of time than planned. Also, this requirement partially addresses the Complex-Wide Vulnerability for storing waste in inadequate storage conditions.

Requirements Analysis. Requirements for staging have no predecessor requirements in DOE 5820.2A. RCRA requirements were evaluated and used as a basis for the staging period of 90 days so that there is a consistent time frame allowable for all low-level waste (including mixed) in a staging location. Also, consistent with RCRA requirements, if the waste is to stay in staging for longer than the 90 day period, the storage requirements of DOE M 435.1-1 must be met.

Other Considerations. The requirement is worded to be performance based, and allowing staging promotes cost-effective operation of the waste management facility because of economies of scale, batching, emplacement of waste in groups, etc. By not invoking the requirements of storage on staging, treatment and disposal facilities can apply facility specific requirements necessary for safe management of the waste during interim operations.

IV.O. Treatment.

> **Low-level waste treatment to provide more stable waste forms and to improve the long-term performance of a low-level waste disposal facility shall be implemented as necessary to meet the performance objectives of the disposal facility.**

Basis:

Functions Evaluated. This requirement derives from the analysis of the Treatment function for processing low-level waste.

Safety and Hazard Analyses. This requirement addresses the need for operations conducted at low-level waste treatment facilities to produce waste forms that support disposal site stability and which support meeting the performance objectives. The requirement addresses the weaknesses and conditions of poor waste forms being produced by treatment. The hazards associated with the long-term performance of the disposal facility is addressed by this requirement.

Requirements Analysis. This DOE M 435.1-1 requirements for treatment of waste improves upon the requirements in DOE 5820.2A, Chapter III.3.f (1) thru (3). The part of the requirement for treating waste to facilitate meeting performance objectives is a clarification of DOE 5820.2A that treatment augments the ability to meet the disposal performance objectives. The wording of the requirement is simplified so that references to how treatment can increase the life of the disposal facility (i.e., improved site stability and reduction of infiltrating water) are not specified.

In addition, III.3.f.(3) for development of large scale treatment facilities is addressed by other requirements in the General Requirements Chapter for meeting the existing DOE Orders covering design, construction, environmental and safety documentation. Also, the part of the requirement from III.3.f.(3) requiring a study justifying the need for treatment is deleted. The concepts embodied in the requirement are consistent with the major objectives of 10 CFR Part 61 for site stability after disposal and meeting the performance objectives for disposal of waste.

Other Considerations. The wording of the requirement is performance based, and includes the essential concept that low-level waste produced by all methods of waste is to support the stability and performance of the disposal facility to which it is sent.

IV. P. Disposal.

Low-level waste disposal facilities shall meet the following requirements.

(1) Performance Objectives. Low-level waste disposal facilities shall be sited, designed, operated, maintained, and closed so that a reasonable expectation exists that the following performance objectives will be met for waste disposed of after September 26, 1988:

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment, and the closure of a disposal facility.

Safety and Hazards Analyses. This requirement partially addresses the need to ensure that low-level waste disposal facilities are designed, constructed, operated, and closed in a manner that does not impose an unacceptable dose to current or future members of the public. The requirement addresses potential weaknesses and conditions that could occur if consideration was not given to the potential impacts, including long-term impacts, of waste disposal.

Requirements Analysis. This requirement is a slight modification of the DOE 5820.2A requirement III.3.a. The modification is to remove the date reference (instead it is now part of DOE M 435.1-1, IV.P.(2) which requires a performance assessment), and reference to an implementation plan. Since DOE 5820.2A was issued in 1988, the requirement for compliance with this aspect of the manual should no longer require an implementation schedule. Additionally, the reference to the disposal of waste has been replaced with the functions to be addressed by the performance objectives that follow. 10 CFR Part 61 was evaluated and the concept of performance objectives introduced in 10 CFR Part 61 and used in DOE 5820.2A was retained in DOE M 435.1-1. The performance objectives were revised to more clearly address the performance of a disposal facility in terms of recognized standards for protection of individually exposed members of the public.

The performance objectives for the individual facility are augmented by other DOE M 435.1-1 requirements for preparation of a performance assessment IV.P.(2), the requirement that low-level waste disposal facilities are to be controlled by DOE until they can be released in accordance with DOE 5400.5 IV.Q.(2)(c), and the requirement to develop a composite analysis that assesses the potential collective impact on future members of the public from the low-level waste disposal facility along with other radioactive sources IV.P.(3).

Other Considerations. The final wording in this requirement reflects the responses to comments made by DOE-EH, and more closely reflects the concepts included in 10 CFR Part 61 for the regulation of low-level waste.

IV. P.(a) Dose to representative members of the public shall not exceed 25 mrem (0.25 mSv) in a year total effective dose equivalent from all exposure pathways, excluding the dose from radon and its progeny in air.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that DOE low-level waste disposal does not result in unacceptable doses to the public. The requirement addresses potential weaknesses and conditions that could occur if consideration was not given to the potential impacts, including long-term impacts, of waste disposal.

Requirements Analysis. This requirement is a modification of a portion of the performance objective in 5820.2A, III.3.a.(2). Modifications were made to improve clarity, technical accuracy, and to be consistent with standards for radiological protection. The wording was revised to make it clear that the dose limit is all pathways and to avoid the implication in 5820.2A that there is an allowance of 10 mrem/yr via the air pathway. Changes were made to make the requirement clear that the dose calculation is to be consistent with ICRP 26/30 methodology by specifying that the dose is the total effective dose equivalent. Additionally, consistent with the practice in the National Emission Standards for Hazardous Air Pollutants, the dose from radon and progeny is not included in the all-pathways limit.

This requirement is consistent with established radiation protection practice that allocates a fraction of the 100 mrem/yr public dose limit to a particular practice or activity. It is also consistent with the regulatory practice of the NRC to require an all-pathways assessments, and thus is consistent the NRC low-level waste disposal facility licensing requirements at 10 CFR Part 61.

Other Considerations. The final wording of this requirement resulted from the development of responses to comments on the 2/28/97 draft of the Order and Defense Nuclear Facilities Safety Board Recommendation 94-2 deliverables.

IV. P.(b) Dose to representative members of the public via the air pathway shall not exceed 10 mrem (0.10 mSv) in a year total effective dose equivalent, excluding the dose from radon and its progeny.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility and maintenance of a performance assessment and the closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that low-level waste disposal does not cause doses to members of the public in excess of those established in other requirements and DOE Orders (DOE 5400.5). The requirement addresses potential weaknesses and conditions that could occur if consideration was not given to the potential impacts, including long-term impacts, of waste disposal.

Requirements Analysis. This requirement is a modification of a portion of the performance objective in 5820.2A, III.3.a.(2). Modifications were made to improve clarity, technical accuracy, and to be consistent with standards for radiological protection. Changes were to made to make the requirement clear that the dose calculation is to be consistent with ICRP 26/30 methodology by specifying that the dose is the total effective dose equivalent. Additionally, consistent with the practice in the National Emission Standards for Hazardous Air Pollutants (NESHAPs), the dose from radon and progeny is not included in the air-pathway limit. In addition, rather than refer to the NESHAPs requirements, the specific dose limit for the air pathway is given in the performance objective.

Other Considerations. The final wording of this requirement is in response to comments and the development of Defense Nuclear Facilities Safety Board Recommendation 94-2 deliverables.

IV. P.(c) Release of radon shall be less than an average flux of 20 pCi/m^2/s (0.74Bq/m^2/s) at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/l (0.0185 Bq/l) of air may be applied at the boundary of the facility.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for establishing a practically applicable measure for the disposal of radon-emitting waste at Department of Energy sites. The standard addresses a weakness associated with the disposal of quantities of waste that emit radon and weaknesses in disposal facility design (cover design or depth of burial) necessary to ensure adequate protection from this type of waste.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. The Environmental Protection Agency has recognized in its National Emission Standards for Hazardous Air Pollutants that there is a practical need for a separate standard for radon. Consequently, the requirements of 40 CFR Part 61 Subpart H have a limit for dose via the air pathway from DOE facilities that excludes radon and its progeny. Similarly, the EPA and NRC have established a performance standard for uranium mill tailings, in recognition of the special situation with mill tailings having high levels of radon, that would preclude practical disposal options if a fraction of the public dose limit (100 mrem/yr) were applied. To address the situation where a waste may have a reasonably high radon concentration, the Department is applying the radon flux standard as a separate limit for waste disposal. This requirement was adopted from the uranium mill tailings requirements at 40 CFR Part 192 and 10 CFR Part 40. 10 CFR Part 40 discusses both Rn-222 from the decay of Uranium and Rn-220 from the decay of Thorium, therefore, the performance objective refers only to Radon, and the correct species must be analyzed depending on the characteristics of the waste streams.

Other Considerations. This requirement is consistent with the critical performance assessment assumptions and performance assessment guidance that the Department has developed under its implementation plan for Defense Nuclear Facilities Safety Board Recommendation 94-2. Final wording of the performance objective reflects consideration of comments from DOE-EH on draft versions of the Manual.

DOE wastes should be recognized to be unlike uranium mill tailings where the radon levels are real problems that exist at the current time, the release of radon from much of DOE's waste will not occur for many years to come because of the time needed for uranium and thorium daughter products to build up in the waste.

IV. P.(2) **Performance Assessment.**

A site-specific radiological performance assessment shall be prepared and maintained for DOE low-level waste disposed of after September 26, 1988. The performance assessment shall include calculations for a 1,000 year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in this Chapter are not exceeded as a result of operation and closure of the facility.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement, along with the DOE M 435.1-1 requirement IV.P.(3) for a composite analysis, addresses the need to evaluate the disposal system and expected waste receipts to provide some assurance that today's waste disposal will not present an unacceptable future dose. The requirement addresses the potential weaknesses and conditions of not having evaluated the long-term safety and performance of the disposal facility when it needs to provide safety protection for the long-term, poor integration of documents important to safety (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or no accountability at the highest management positions for ensuring the most important requirements for safety will be met.

Requirements Analysis. This requirement is a modification of the DOE 5820.2A requirement III.3.b.(1). The modifications include specifying a date for applicability (the date was previously stated in paragraph III.3.a of 5820.2A), stating that the PA is to provide a reasonable expectation rather than demonstrating compliance with the performance objectives, and establishing a time of compliance of 1000 years. The requirement for low-level waste disposed of after September 26, 1988 to meet a set of performance objectives was included in 5820.2A, III.3.a. The requirement has been reworded for clarity by stating the relationship to the cutoff date in the positive rather than the negative.

The date of September 26, 1988 was established with the issuance of DOE 5820.2A as a date for application of the performance objectives. This cutoff date was set because only new waste (i.e., waste disposed of after the cutoff) would be able to be disposed of in accordance with the new criteria in DOE 5820.2A. Applying the standard to new waste was done with recognition that the *Comprehensive Environmental Response, Compensation, and Liability Act* provides a process for addressing remediation of past waste disposal, if needed. Maintaining this date recognizes that DOE O 435.1 and DOE M 435.1-1 is an improvement on the performance assessment methodologies of 5820.2A, not a change in concepts or methods.

The addition of the term reasonable expectation was made to put the results of the performance assessment in the proper context. A performance assessment constitutes a projection of future events, not a prediction. Therefore, compliance with performance objectives in the future cannot be demonstrated in the present. Rather, the intent of the performance assessment is to provide a reasonable expectation, considering uncertainties in engineered and natural systems over long time periods, that the actual performance of the disposal facility will not result in exceeding the selected performance objectives.

The time which the performance assessment is to project compliance is set at 1000 years. This time frame was selected after consideration of the times used in other requirements (e.g., 40 CFR Part 191, 40 CFR Part 192), and recognition of the uncertainties and hypothetical nature of long-term projections. Paragraph IV.P.(2)(e) addresses performance assessment calculations for periods longer than 1000 years. Based on the study, "Comparison of Low-Level Waste Disposal Programs of DOE and Selected International Countries," (DOE/LLW-236) two countries (Canada and Sweden) have established a time of compliance of 10,000 years. The other two countries (France and the United Kingdom) have not specified a time of compliance. Similarly, to date, DOE, NRC, and the EPA have not specified a time of compliance for low-level waste disposal facility performance assessments. A team composed primarily of DOE contractor performance assessment staff evaluated the options for a time of compliance. In its progress report, "Performance Assessment Task Team Progress Report" (DOE /LLW-157, Rev. 1), the team recommended a time of compliance of 10,000 years. This time was consistent with the time specified in 40 CFR Part 191 for high-level and transuranic waste disposal, and was considered to be conservative in that no longer times had been seriously proposed. This time or longer times had been used in DOE disposal facility performance assessments conducted up to that time. Subsequently, EPA asked agency reviewers for their opinion on the use of 10,000, 1000 or some other time frame as the time for compliance for low-level waste disposal facility performance assessments. DOE responded that its position was that 1000 years was an appropriate time.

This is consistent with USNRC practice, as a performance assessment is a critical piece of the safety documentation required under 10 CFR Part 61, *Licensing Requirements for Land Disposal of Radioactive Waste*.

Other Considerations. The performance assessment is a performance-based system used to evaluate the low-level waste system and to aid in the design, operation, and closure of a low-level waste disposal facility. Unlike a prescriptive approach to facility design and operation that does not incorporate unique environmental features of a site or the wastes to be disposed of, developing innovative design approaches to address site-specific issues or unique wastes being managed with the use of a performance assessment allows for the implementation of an approach to low-level waste disposal directed toward achieving a desired level of performance. The final wording of this requirement is in response to comments made by the Senior Review Panel on draft versions of the Manual.

IV. P.(2)(a) Analyses performed to demonstrate compliance with the performance objectives in this Chapter, and to establish limits on concentrations of radionuclides for disposal based on the performance measures for inadvertent intruders in this Chapter shall be based on reasonable activities in the critical group of exposed individuals. Unless otherwise specified, the assumption of average living habits and exposure conditions in representative critical groups of individuals projected to

receive the highest doses is appropriate. The likelihood of inadvertent intruder scenarios may be considered in interpreting the results of the analyses and establishing radionuclide concentrations, if adequate justification is provided.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that performance assessments do not become extreme in their analyses by trying to project what the activities and lifestyles of future generations will be. To that end, the requirement is to assume that customs and practices of today are assumed to continue into the future. This provides a common basis across the complex for conducting analyses and avoids speculation about the rate and nature of technological development. The requirement also establishes the basis for the dose calculations to be made in the performance assessment by identifying the critical group of exposed individuals as the potential dose recipients.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement was adopted from a recommendation from the *Performance Assessment Task Team Progress Report* (DOE /LW-157, Rev. 1). This requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2.

Other Considerations. The final wording of this requirement was modified from the draft version of the Order in response to comments received from the Field, DOE-EH, and the Senior Review Panel. The final wording is reflective of international practice with respect to radiation protection of the public.

IV. P.(2)(b) The point of compliance shall correspond to the point of highest projected dose or concentration beyond a 100 meter buffer zone surrounding the disposed waste. A larger or smaller buffer zone may be used if adequate justification is provided.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement is based on the need to establish a point of compliance for the purposes of performing prospective assessments of low-level waste disposal facilities.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. The selected point of compliance represents a DOE policy decision and is not derived directly from any other requirements. However, the point of compliance is consistent with regulatory positions included in 40 CFR 192.32 and 40 CFR 264.95.

The NRC requirements at 10 CFR 61.52(a)(8) states that a "buffer zone of land must be maintained between any buried waste and the disposal site boundary . . ." In NUREG-1200, section 4.3.6 it is recommended that this buffer zone be at least 30 m wide [emphasis added]. The Performance Assessment Task Team recommended a point of compliance of 100 m in the *Performance Assessments Task Team Progress Report* (DOE /LW-157, Rev. 1). In the *Draft Recommendations on Prospective Assessments for Long-Term Management of Low-Level Radioactive Wastes* (memorandum, R. Berube, dated September 5, 1996), the DOE Office of Environment recommended that the point of compliance should be point of public access. Therefore, the point of compliance would be the site boundary. The Office of Environment recommendations further acknowledge that it may be prudent to use a closer point of assessment if there is uncertainty about the future location of the site boundary. 40 CFR 192.32 permits the establishment of alternative concentration limits that are as low as reasonably achievable and meet the standards of 40 CFR 264.94(a) at all points at a greater distance than 500 meters from the edge of the disposal area and/or outside the site boundary.

For most sites where this requirement applies the site boundary is less than 500 meters. 40 CFR 264.95 defines the point of compliance as the vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units.

The DOE M 435.1-1 requirement makes the default location for assessing performance at the location of greatest impact beyond a 100 m buffer zone around the disposal facility. However, it also provides flexibility to accommodate site-specific conditions where there may be cause to evaluate at a closer or further location. Evaluation at a closer location may be dictated by site hydrologic features such as outcropping of water near the disposal site or the possibility of a closer site boundary. More distant points of compliance may be justified based on DOE's intent to not to release land and the cost-benefit consideration of having to find alternative disposal options for a particular waste stream. A more distant point of compliance may also be justified based on DOE plans for retaining ownership of land.

Other Considerations. The use of a 100 m point of compliance introduces a measure of defense in depth to protection from low-level waste in a disposal facility, because it is generally expected

that there will be a greater distance to the point of public access due to DOE's continued ownership of land.

IV. P.(2)(c) Performance assessments shall address reasonably foreseeable natural processes that might disrupt barriers against release and transport of radioactive materials.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. The requirement addresses the need to account for recognized natural processes that will have an effect on the long-term performance of the disposal system. Therefore, in a performance assessment a barrier cannot necessarily be modeled as if it continues to function over long periods as it does at the time of construction. Instead, the modelers have to account for the possibility of agradation or degradation of the cover system, degradation of concrete, consolidation of waste materials, etc.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement was adopted from the *Performance Assessment Task Team Progress Report* (DOE/LW-157) and the *Draft Recommendations on Prospective Assessments for Long-Term Management of Low-Level Radioactive Wastes* (memorandum, R. Berube, dated September 5, 1996).

Other Considerations. This requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2. The use of reasonably foreseeable events is consistent with the concept of demonstrating a reasonable expectation that the performance objectives will be met, as using any hypothetical extreme events that may or may not occur would result in overly conservative results.

IV. P.(2)(d) Performance assessments shall use DOE-approved dose coefficients (dose conversion factors) for internal and external exposure of reference adults.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analysis. The requirement addresses a need to provide consistency in the application of health physics practices in the development of prospective assessments. By establishing a standard for calculating doses, the Department avoids the potential of making management decisions on disposal of waste based on consideration of different receptors at the different sites.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement was adopted from the *Performance Assessment Task Team Progress Report* (DOE/LW-157) and the *Draft Recommendations on Prospective Assessments for Long-Term Management of Low-Level Radioactive Wastes* (memorandum, R. Berube, dated September 5, 1996). Additionally, this practice is consistent with the EPA-proposed *Federal Radiation Protection Guidance for Exposure of the General Public* (59 FR 66423). The rationale for using standard adult dose conversion factors comes from the fact that in a performance assessment one is calculating a postulated dose to a hypothetical future person assumed to be engaged in a set of normal activities over a period of years. Consequently, performing calculations as if real people of known age were being impacted by releases from the facility is not reasonable.

Other Considerations. This requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2. The use of DOE approved dose coefficients is included in the requirement to ensure the dose coefficients used in performance assessment have been properly reviewed and representative of the current scientific understanding of the effects of radiation on human health.

IV. P.(2)(e) The performance assessment shall include a sensitivity/uncertainty analysis.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. In addition to calculations over the time of compliance (1000 years), performance assessments also are to present calculations of the maxima relative to each of the performance objectives. The results of these calculations are to be part of the sensitivity and uncertainty analysis which would support a conclusion that the model is providing a reasonable projection. These longer calculations address the need to ensure that there are no unexpected significant increases shortly after the time of compliance and provide a mechanism for understanding the model performance and the significance of modeling parameters. The calculation of maxima does present the possibility that there may be results that exceed the performance objectives. The significance of these results must be handled with caution and

judgment. The further out in time that the maxima occurs, the less significant is the relationship to the performance objective.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement represents a DOE policy decision; it derives in part from IAEA publication, *Fundamental Principles of Radioactive Waste Management*.

Other Considerations. The calculation of maxima represents best management practice in the conduct of performance assessments. It provides additional information about the behavior of the model of site and the system being modeled that would not be available if the calculations were truncated at the time of compliance. This additional information may be useful in evaluating alternative designs and similar ALARA considerations. The final wording of the requirement reflects consideration of comments from the Field on draft versions of the Manual.

IV. P.(2)(f) Performance assessments shall include a demonstration that projected releases of radionuclides to the environment shall be maintained as low as reasonably achievable (ALARA).

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. Requiring projected releases from a disposal facility to be as low as reasonably achievable is consistent with the concept that a performance assessment is to be used as a tool to aid in the development of facility design, waste acceptance criteria, and closure design. Consistent with the reasonableness portion of ALARA, projected doses or releases well below the performance objectives would not require additional analyses to show that further reduction would not be reasonable.

Requirements Analysis. This is a slight modification of a portion of the DOE 5820.2A requirement III.3.a.(2). The wording has been changed to improve clarity and the requirement has been separated from the performance objectives IV.P.(1). The clarification is to remove the term effluents, which connotes stack and pipeline releases, and instead refer to releases from a disposal facility.

Other Considerations. The use of the ALARA concept in long-term assessments is a best management practice that contributes defense-in-depth to the possible exposures from a disposal facility. Application of the ALARA principle for managing current operational exposures has practical and measurable merit in that real doses are being avoided or reduced. This concept is extended here by addressing projected releases of materials well into the future which <u>may</u> result in doses.

IV. P.(2)(g) For purposes of establishing limits on radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts to water resources.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment, and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that water resource protection is considered in the disposal of low-level waste and to establish inventory controls for waste that can be disposed of in the near surface. This requirement addresses the weakness and condition of eventual degradation of the disposal facility to the point where water resources around the disposal facility could be impacted, leading to health effects long in the future to the public, or damage to the environment. This requirement specifically addresses possible damage to the environment that might occur due to impacts to the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a modification of the DOE 5820.2A performance objective III.3.a.(4) that required protection to groundwater resources. The performance objective was no longer needed as it was worded because it is redundant with one of the fundamental requirements of DOE O 435.1, which is to follow all existing Federal, State, and local laws and regulations. The wording for this requirement has been changed from its 5820.2A wording to broaden the requirement to include surface water, not just groundwater, in the analysis to determine inventory limits, and to improve clarity.

Other Considerations. Guidance developed for this requirement describes a tiered structure for determining appropriate performance measures to include in this part of the evaluation in the performance assessment to be consistent with the site's groundwater protection program. The tiered structure recognizes that, at this time, there are no applicable Federal requirements for protection of water resources at radioactive waste disposal facilities. At some disposal facilities, the performance measure selected to protect groundwater will be 4 mrem/yr through the drinking water pathway or application of the *Safe Drinking Water Act* maximum contaminant limits. Selection of these restrictive performance measures provides defense-in-depth relative to the all-pathways analysis because the limitations imposed by the water protection analysis may result in a six-fold reduction in the allowable limit for a specific radionuclide.

IV. P.(2)(h) For purposes of establishing limits on the concentration of radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts calculated for a hypothetical person assumed to inadvertently intrude for a temporary period into the low-level waste

disposal facility. For intruder analyses, institutional controls shall be assumed to be effective in deterring intrusion for at least 100 years following closure. The intruder analyses shall use performance measures for chronic and acute exposure scenarios, respectively, of 100 mrem (1 mSv) in a year and 500 mrem (5 mSv) total effective dose equivalent excluding radon in air.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. Requirements for intruder calculations address the need to establish concentration limits for waste that can be disposed of in the near surface. This requirement addresses the weakness and conditions of an inadvertent intruder onto a disposal facility at some time in the distant future. While such a form of intrusion is unlikely, the consequences of direct intrusion could be have a significant affect on human health.

Requirements Analysis. This requirement is a significant modification of the DOE 5820.2A requirement III.3.a(3). Wording changes were made to clarify that the purpose of the intruder calculations is to establish concentration limits on waste that can be disposed of near surface. This is a change relative to the language of 5820.2A that implied that the analyses could assure that dose limits for an inadvertent intruder would not be exceeded. The requirement has been removed from the Performance Objectives in recognition that intruder analyses are more a function of the intrusion scenarios that are assumed than of the performance of the disposal system. In addition, the DOE 5820.2A requirement III.3.i.(4), which requires use of a specific performance assessment and a *National Environmental Policy Act* (NEPA) process to justify the disposal of DOE waste exceeding the 10 CFR 61.55 Class C limits, has been deleted.

The concept of protection of inadvertent intrusion is consistent with national and international practice (NCRP, ICRP, IAEA). The NRC included the protection of inadvertent intruders as one of the performance objectives in 10 CFR Part 61. Other international and national organizations have and continue to include the protection of inadvertent intruders as one of the elements of radiation protection.

The NRC implemented inadvertent intruder limits on a generic basis through the establishment of a waste classification system. In spite of the merits of having a single classification system, such a system does not account for geographic differences that influence the resultant consequence of intrusion. Whereas installation of a groundwater well to water a home garden may be reasonable in most parts of the country, at the DOE Nevada Test Site, the depth to groundwater at certain parts of the site is so great as to make an extended, farming intrusion scenario implausible.

Similarly, geographic differences in building practices or well drilling practices (e.g., diameter) provide real differences in the potential impacts of an intruder. The use of intruder performance measures allows for these geographic differences to be considered.

The requirement for special consideration of waste exceeding the NRC Class C limit was deleted because it was considered unnecessary. The requirement for NEPA is not unique to the disposal of waste and is adequately addressed by the Department's rule 10 CFR Part 1021, "National Environmental Policy Act Implementing Procedures." Consideration of this type of waste is adequately addressed in the current system since a performance assessment, which includes consideration of intrusion as well as offsite impacts, is required for each disposal facility. If a waste stream with radionuclide concentrations in excess of the 10 CFR 61.55 limits is proposed for a disposal facility, it would have to be addressed in the performance assessment.

Other Considerations. The clarification of this requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2.

Since the intent of the Department is to control the use of land where low-level waste is disposed until the land can be released, inadvertent intruder calculations provide defense-in-depth by limiting the concentration of waste that can be disposed of in the near surface. With each performance assessment evaluating and developing limits for near-surface disposal, DOE is more cost-effective in managing waste and is consistent with the philosophy of using performance-based requirements.

IV.P.(3) **<u>Composite Analysis.</u>**

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. Performance measures shall be consistent with DOE requirements for protection of the public and environment and evaluated for a 1,000 year period following disposal facility closure. The composite analysis results shall be used for planning, radiation protection activities, and future use commitments to minimize the likelihood that current low-level waste disposal activities will result in the need for future corrective or remedial actions to adequately protect the public and the environment.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement meets the need to evaluate the impact of all sources that impact a potential future member of the public rather than considering only the low-level waste disposed of after September 26, 1988.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A.

The requirement was adopted from the DNFSB 94-2 deliverable, *Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal*, (letter from A. Alm, July 31, 1996). In most cases, the composite analysis will address existing sources of contamination such as previously disposed waste, spills, etc. Therefore, unlike the performance assessment which applies a near-in point of compliance to ensure that new waste disposal has an extra degree of protection, the composite analysis evaluates the potential impacts at the site boundary. The composite analysis takes into account that the current site boundary may not be the future site boundary should DOE release some of the land it now controls. The guidance supporting this requirement calls for the preparation of a corrective action plan if the projected doses exceed the DOE limit for protection of the public. The corrective action plan describes what DOE will do to ensure projected doses are never realized. Actions to be considered include limitations on the use of the active or proposed burial ground, additional cleanup of another source, and enhanced analysis and monitoring to determine whether the projected impacts may be the result of excess conservatism. Also, this requirement is consistent with the concept presented in the draft version of 10 CFR Part 834 of an environmental radiation protection program and plan. The composite analysis provides part of the comprehensive analysis and planning which is needed for developing such a program and plan.

Other Considerations. This requirement for a composite analysis for analyzing the projected dose from a low-level waste disposal facility and other contributing sources addresses the Defense Nuclear Facilities Safety Board 94-2 recommendation concerning evaluating all past, present, and future LW streams at a disposal facility. The final wording of this requirement was developed in response to comments submitted on the draft versions of DOE M 435.1-1 from DOE-EH and the Field.

IV. P.(4) **<u>Performance Assessment and Composite Analysis Maintenance.</u>**

The performance assessment and composite analysis shall be maintained to evaluate changes that could affect the performance, design, and operating bases for the facility. Performance assessment and composite analysis maintenance shall include the conduct of

research, field studies, and monitoring needed to address uncertainties or gaps in existing data. The performance assessment shall be updated to support the final facility closure. Additional iterations of the performance assessment and composite analysis shall be conducted as necessary during the post-closure period.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. The requirement to maintain a performance assessment and composite analysis addresses the need to keep the analyses supporting the authorization basis for the facility up to date. The requirement responds to a weakness associated with receiving waste streams with characteristics not considered in the original performance assessment and a weakness associated with not updating an analysis based on a better understanding of the performance of a disposal system component gained through testing and research. The requirement also addresses a weakness associated with changes in decisions about remediating other sources of radioactivity that may contribute to the dose projected for the disposal facility. The hazards examined that resulted in this requirement are specifically associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a modification of a portion of the DOE 5820.2A requirement III.3.b.(1). The current requirement is an elaboration of the 5820.2A requirement to maintain the performance assessment. The changes convey the fact that a necessary part of facility operation and closure is to evaluate changes that may affect facility performance. Additionally, necessary revisions of the performance assessment may be appropriate even after closure. These same requirements apply to composite analyses.

Other Considerations. The final wording of the requirement specifies that performance assessment and composite analysis maintenance must include the conduct of research, field studies, and monitoring to address the uncertainties or gaps in existing data used in the performance assessment. This change was in response to a comment from DOE-EH.

IV. P.(4)(a) Performance assessments and composite analyses shall be reviewed and revised when changes in waste forms or containers, radionuclide inventories, facility design and operations, closure concepts, or the improved understanding of the performance of the waste disposal facility in combination with the features of the site on which it is located alter the conclusions or the

conceptual model(s) of the existing performance assessment or composite analysis.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. The requirement to revise the performance assessment or composite analysis addresses the need to keep the analyses supporting the authorization basis for the facility up to date. It responds to a weakness associated with receiving waste streams with characteristics that were not considered in the original performance assessment and a weakness associated with not updating an analysis based on a better understanding of the performance of a disposal system component gained through testing and research. The hazards examined that resulted in this requirement are specifically associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a modification of a portion of the DOE 5820.2A requirement III.3.b.(1). The 5820.2A requirement stated that a performance assessment is to be maintained. This requirement elaborates on what is involved in maintenance by requiring a revision of the performance assessment or composite analysis if a review indicates the possibility of changes to the conclusions of the analysis or to the conceptual model.

Other Considerations. Guidance for performance assessment maintenance developed in response to Defense Nuclear Facilities Safety Board recommendation 94-2, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*, indicates that sites should conduct tests and research during the operational life of the disposal facility. The testing and research should be designed to improve confidence in modeling results or to remove conservatism necessitated by conservative assumptions. Additionally, since disposal facilities may be requested to accept certain waste streams that were not specifically considered in the original performance assessment, supplemental analyses may be necessary to evaluate whether the waste can be safely disposed.

This requirement promotes performance-based management of the performance assessment or composite analysis maintenance activity by not demanding a revision on a set timetable, but allowing a decision to be made based on need.

IV. P.(4)(b) A determination of the continued adequacy of the performance assessment and composite analysis shall be made on an annual basis, and shall consider the results of data collection and analysis from research, field studies, and monitoring.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. This requirement addresses the need for maintaining the performance assessment and composite analysis through determining whether waste receipts and operations would cause any changes to assumptions used in the evaluations. The systems engineering of LW identified this as an activity needing requirements, and it was so evaluated. This requirement addresses the need for the field organization to make routine determinations of the acceptability of the performance assessment or composite analysis. This addresses a weakness associated with failure to keep these analyses which support the authorization basis low-level waste disposal facility up to date.

The requirement addresses the potential conditions and weaknesses of the reliance on performance assessments and the use of assumptions in the calculations. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor integration of documents important to safety (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area). The hazards examined that resulted in this requirement are specifically associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. The requirement for evaluations of performance assessments and composite analyses to be conducted by the Department field elements is an improvement to the performance assessment maintenance requirements of DOE 5820.2A, III.3.b.(1). The improvements include requiring an annual evaluation of the continued adequacy of the evaluations and providing summary reports to headquarters concerning the continued adequacy of the assessments and the need to revise the performance assessment and composite analysis. The requirement for annual determinations is based on a requirement in the DNFSB 94-2 deliverable *Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal*, (letter from A. Alm, July 31, 1996).

Other Considerations. The Defense Nuclear Facilities Safety Board Recommendation 94-2 pointed out the inherent weaknesses in using assumptions in the performance assessments. The final wording of the requirement ties the continued adequacy of the performance assessment and composite analysis to the conduct of research, field studies, and monitoring required in the performance assessment and composite analysis maintenance. This change was in response to a comment from DOE-EH.

IV. P.(4)(c) Annual summaries of waste disposal operations shall be prepared with respect to the conclusions and recommendations of the performance assessment and

composite analysis and a determination of the need to revise the performance assessment or composite analysis.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for Headquarters to be apprised of the performance of the disposal facilities with respect the conclusions in the performance assessment and the composite analysis on a routine basis. This also provides a vehicle for routinely notifying Headquarters of the need to revise either the performance assessment or composite analysis.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. The requirement for annual reports is based on a requirement in the DNFSB 94-2 deliverable "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal," (letter from A. Alm, July 31, 1996).

Other Considerations. None.

IV. P.(5) **Disposal Authorization.**

A disposal authorization statement shall be obtained prior to construction of a new low-level waste disposal facility. Field Elements with existing low-level waste disposal facilities shall obtain a disposal authorization statement in accordance with the schedule in the Complex-Wide Low-Level Waste Management Program Plan. The disposal authorization statement shall be issued based on a review of the facility's performance assessment, composite analysis, performance assessment and composite analysis maintenance, preliminary closure plan, and preliminary monitoring plan. The disposal authorization statement shall specify the limits and conditions on construction, design, operations, and closure of the low-level waste facility based on these reviews. A disposal authorization statement is a part of the radioactive waste management basis for a disposal facility. Failure to obtain a disposal authorization statement by the implementation date of this Order shall result in shutdown of the disposal facility.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses a programmatic management need to ensure that prior to committing significant resources to the development and construction of a disposal facility, there is a reasonable expectation the facility will accept the projected waste streams, and provide protection of the future public and the environment. Additionally, it addresses a DNFSB concern and Complex-Wide Review Vulnerability on the operation of low-level waste disposal facilities which have not completed the Performance Assessment Approval process. The requirement addresses the need for a formal process to ensure that a disposal facility has been appropriately evaluated relative to authorizing it to accept waste.

Requiring completion of the PA and composite analysis and issuance of a disposal authorization statement based on a review external to line management addresses a weakness associated with receiving waste which is not appropriate for the disposal facility.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A, which expands on the 5820.2A, III.3.b.1 requirement for a performance assessment for disposal facilities and the 5820.2A, III.3.e.2 requirement for facilities to establish waste acceptance criteria. The requirement for a disposal authorization statement comes from the DNFSB 94-2 deliverable "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal," (letter from A. Alm, July 31, 1996). As discussed in the interim policy, the idea of the disposal authorization statement is similar to a portion of the licensing activity administered by NRC or a NRC Agreement State. However, in this case, the review is focused on the long-term impacts of a disposal facility.

This requirement was newly developed, but is based on the concept of establishing an authorization basis for a facility per DOE 5480.23, *Safety Analysis Reports*, and DOE O 420.1, *Startup and Restart of Nuclear Facilities*. The concept of the authorization basis has been expanded to include consideration of waste management-specific concerns such as performance assessments, composite analyses, closure plans, and waste acceptance criteria.

Other Considerations. This requirement provides for a best management practice by requiring an overall approval step (i.e., issuance of an disposal authorization basis statement) for operating a disposal facility. The Department is not requiring additional documentation beyond what is required under DOE O 435.1 and other orders. The disposal authorization concept is being employed is performance based, the rigor of documentation is commensurate with the hazards and safety implications of activities carried out at a given facility.

IV. P.(6) **<u>Disposal Facility Operations</u>.**

The disposal facility design and operation must be consistent with the disposal facility closure plan and lead to disposal facility closure that provides a reasonable expectation that performance objectives will be met. Low-level waste shall be disposed in such a manner that achieves the performance objectives stated in this Chapter, consistent with the disposal facility radiological performance assessment. Additional requirements include:

Basis:

Functions Evaluated. The requirement addresses the function of designing, operating and closing a low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure the entire process of low-level waste disposal is conducted with consideration of the intended closure, such that the disposed waste will not adversely impact the environment or the public. The weakness remedied by this requirements is the use of waste acceptance criteria for operating practices which are contrary to the analyses included in the performance assessment. This could lead to the closed facility not providing adequate protection of the public and the environment, and other hazards associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a significant rewording of the DOE 5820.2A requirement III.3.i.(2). The modifications were made to embrace the concept that all aspects of the life of a disposal facility (design through closure) are to be consistent with the analyses in the performance assessment, and to separate elements that are addressed in guidance from the basic requirements. The portions of the 5820.2A requirement that suggest the use of a site-specific waste classification system, stabilization, greater burial depth, etc. are addressed in guidance rather than appearing as requirements in the manual. The wording in this requirement is similar to the standards for issuance of a license by the NRC under the requirements at 10 CFR 61.23(b) and (c) that require siting, design, operations, and closure to be submitted together to provide reasonable assurance that the performance objectives will be met.

Other Considerations. Final wording of the requirement uses the term reasonable expectation for consistency with other changes made in response to comments on draft versions of the Manual.

IV.P.(6)(a) **Operating procedures shall be developed and implemented for low-level waste disposal facilities that protect the public, workers, and the environment; ensure the security of the facility; minimize subsidence during and after waste**

emplacement, achieve long-term stability and minimize the need for long-term active maintenance; and meet the requirements of the closure/post-closure plan.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. This requirement addresses weaknesses associated with personnel operating a low-level waste disposal facility or maintaining a disposal facility in a manner that violates facility integrity and impacts long-term performance. Hazards specifically addressed include exposures to workers during disposal facility operations, and hazards associated with the public and environment from long-term impacts on the performance of the disposal facility.

Requirements Analysis. This requirement is a slight modification of DOE 5820.2A requirement III.3.i.(9)(a). 10 CFR Part 61 was evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be " . . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the closure element of the 10 CFR Part 61 performance objective. Also, the standards for issuance of a license in 10 CFR 61.23 contains language which ties the adequacy of operating procedures of the disposal facility to the determination of reasonable assurance that the performance objectives will be met, the facility will meet NRC security requirements, and the facility will remain stable.

Other Considerations. The final wording of this requirement was developed in response to comments on the draft version of DOE M 435.1-1.

IV. P.(6)(b) Permanent identification markers for disposal excavations and monitoring wells shall be emplaced.

Basis:

Functions Evaluated. This requirement addresses the function of designing, operating, and closing a low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. This requirement addresses the need to know the locations of disposal units after backfilling so the units can be monitored, and ongoing operations will not compromise disposal units. This requirement addresses weaknesses associated with personnel operating the low-level waste disposal facility or maintaining the disposal facility in a manner that violates facility integrity and impacts long-term performance. The hazards addressed include possible exposure to workers during disposal operations and long-term impacts to the public associated with disposal of low-level waste.

Requirements Analysis. This requirement is a slight modifications of DOE 5820.2A requirement III.3.i.(9)(b) to improve clarity and consistency.

Other Considerations. This requirement provides defense-in-depth for avoiding the accidental disturbance of disposal units. This defense-in-depth extends through the post-closure period and contributes to the reduction of the potential for inadvertent intrusion. This requirement is similar to the requirement at 10 CFR 61.52(a)(7), except it adds permanent identification of monitoring wells.

IV. P.(6)(c) Low-level waste placement into disposal units shall minimize voids between waste containers. Voids within disposal units shall be filled to the extent practical. Uncontainerized bulk waste shall also be placed in a manner that minimizes voids and subsidence.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. This requirement addresses the weaknesses associated with personnel operating a low-level waste

disposal facility or maintaining a disposal facility in a manner that violates facility integrity and impacts long-term performance. The requirement for minimizing voids was specifically enhanced to address the weakness associated with facilities being closed with significant void spaces. Over time the voids will fill, either by natural settling or through the catastrophic collapse of containers after degradation.

Requirements Analysis. The requirement is similar to the requirement in DOE 5820.2A, Chapter III.3.i.(9)(d), but it has been strengthened and expanded. The 5820.2A version said that voids between packages "should" be avoided; this is now a "shall" statement. The requirement was then augmented by requiring the filling of void spaces that cannot be avoided by methods of waste placement. Minimizing voids in containers is addressed in the waste acceptance criteria. The procedures for facility operations must invoke practices to minimize voids during the placement of waste and backfilling. This requirement is consistent with 10 CFR 61.52(4) and (5).

Other Considerations. This requirement provides defense-in-depth for protecting site stability by the use of a performance based requirement that seeks to "minimize voids . . . to the extent practicable." The use of a performance-based requirement is preferred to requiring the reduction of void space to some arbitrary percentage of the total volume or some other numerical criteria which could not be justified. The final requirement includes a performance based requirement that uncontainerized bulk waste must also be placed in a manner that minimizes voids and subsidence in response to comments by DOE-EH on draft versions of the Manual.

IV. P.(6)(d) Operations are to be conducted so that active waste disposal operations will not have an adverse effect on any other disposal units.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation and closure of a low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. Additionally, it addresses the need to know the locations of disposal units after backfilling to avoid compromising disposal units by ongoing operations. This requirement addresses weaknesses associated with personnel operating a low-level waste disposal facility or maintaining a disposal facility in a manner that violates facility integrity and impacts long-term performance.

Requirements Analysis. The requirement is equivalent to the requirement in DOE 5820.2A, Chapter III.3.i.(9)(e). This requirement is essentially equivalent to 10 CFR 61.52(a)(10).

Other Considerations. This requirement provides defense-in-depth for the protection of site stability. By providing additional support for site stability, the need for long-term maintenance is reduced and additional assurance is provided that the performance objectives will be achieved.

IV. P.(6)(e) Operations shall include a process for tracking and documenting low-level waste placement in the facility by generator source.

Basis:

Functions Evaluated. The requirement addresses the function Emplace Waste under the Disposal of Low-Level Waste.

Safety and Hazard Analyses. The specific need for this or a similar requirement was not evaluated in the original safety and hazard analyses. However, during review of draft versions of the Manual (see Other Considerations), it was identified that future corrective actions at low-level waste disposal facilities would benefit greatly if a system existed that could track waste characterization information prepared by the waste's generator to the specific location of the waste in the disposal facility.

Requirements Analysis. This requirement has no predecessor requirement in DOE 5820.2A. The requirements analysis did not evaluate the need for this specific condition, and did not consider inclusion of this requirement.

Other Considerations. The requirement was added as a result of review of the draft versions of the Manual at the suggestion of DOE-EH.

IV. P.(7) Alternate Requirements for Low-Level Waste Disposal Facility Design and Operation. Requirements other than those set forth in this Section for the design and operation of a low-level waste disposal facility may be approved on a specific basis if a reasonable expectation is demonstrated that the disposal performance objectives will be met.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. The specific need for this or a similar requirement was not evaluated in the original safety and hazard analyses. However, during review of draft versions of the Manual (see Other Considerations), it was identified that there may be some instances concerning the disposal of low-level waste that would benefit if the design of the facility could be

based on an alternative analysis other than the performance assessment methodology, as long as there was still a reasonable expectation that the performance objectives identified for low-level waste disposal would still be met. A facility may need to be designed using an alternative approach if waste streams other than those normally evaluated in disposal of low-level waste using the performance assessment methodology were to be disposed of, for example, a facility planned for disposal of waste exclusively composed of mill tailings for which disposal at an UMTRAP or currently operating mill facility cannot be arranged.

Requirements Analysis. This requirement has no predecessor requirement in DOE 5820.2A. The requirements analysis did not evaluate the need for this specific condition, and did not consider inclusion of this requirement.

Other Considerations. The requirement was added as a result of review of the draft versions of the Manual at the suggestion of DOE-EH.

IV. Q. Closure.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Disposal Facility Closure Plans. A preliminary closure plan shall be developed and submitted to Headquarters for review with the performance assessment and composite analysis. The closure plan shall be updated following issuance of the disposal authorization statement to incorporate conditions specified in the disposal authorization statement.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that the plan for closure of the facility is consistent with the performance assessment. It further addresses the need to ensure that consideration of closure is not postponed to the end of facility operations when options to mitigate projected impacts are more limited. The addresses the current weakness and conditions where existing disposal facilities are developing closure plans long after the initiation of disposal operations.

Requirements Analysis. This requirement slightly modifies DOE 5820.2A requirement III.3.i.(j)(1). The modifications were made to eliminate requirements that were unnecessary, because they were adequately addressed by other requirements (i.e., 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures* and the *Comprehensive Environmental Response, Compensation, and Liability Act*). The additions to the requirement are deadlines on

when closure plans are to be prepared, a requirement for updating. The DOE M 435.1-1 requirement IV.Q.(2) addresses the portion of the 5820.2A requirement III.3.i.(j)(1) dealing with closure of the disposal facility within 5 years after it is filled. This requirement is consistent with 10 CFR Part 61 which requires a closure plan to be submitted prior to the operation of the facility (Part 61.12(g))

Other Considerations. This requirement recognizes that closure is an integral part of planning and operating a low-level waste disposal facility. The final wording of this requirement was prepared in response to comments received on the draft version of the Order, and to improve the clarity of the requirement.

IV. Q. Closure.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Disposal Facility Closure Plans shall:

(a) Be updated as required during the operational life of the facility.

(b) Include a description of how the disposal facility will be closed to achieve long-term stability and minimize the need for active maintenance following closure and to ensure compliance with the requirements of DOE 5400.5, *Radiation Protection of the Public and the Environment*.

(c) Include the total expected inventory of wastes to be disposed of at the facility over the operational life of the facility.

Basis:

Functions Evaluated. This requirement addresses the functions associated with the design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. These requirements address the need to ensure that the plan for closure of the facility is consistent with the performance assessment. They further address the need to ensure that consideration of closure is not postponed to the end of facility operations when options to mitigate projected impacts are more limited. These requirements address the weakness and conditions where existing disposal facilities are developing closure plans long after disposal operations were initiated. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility.

Requirements Analysis. These requirements slightly modify DOE 5820.2A requirements III.3.i.(j)(1). The modifications were made to eliminate requirements that were unnecessary, because they were adequately addressed by other requirements (i.e., 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures* and the *Comprehensive Environmental Response, Compensation, and Liability Act*). The additions are a requirement for updating during the operational life of the facility, and the inclusion of the total expected waste receipts (in the updates). The DOE M 435.1-1 requirement IV.Q.(2) addresses the portion of the 5820.2A requirement III.3.i.(j)(1) dealing with closure of the disposal facility within 5 years after it is filled.

10 CFR Part 61 was evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be ". . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the closure element of the Part 61 performance objective.

Other Considerations. These requirements recognize that closure is an integral part of planning and operating a low-level waste disposal facility and adds defense-in depth by providing minimal requirements for the closure plan that recognize stability and minimizing maintenance.

The requirement for including the total expected inventory in the closure plan was identified as a necessary component of a closure plan and integrated low-level waste operations during the revision of the waste management order.

IV. Q.(2) **Disposal Facility Closure. Closure of a disposal facility shall occur within a five-year period after it is filled to capacity, or the facility is otherwise determined to be no longer needed.**

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for final closure to be accomplished in a timely manner following the end of disposal operations, and in a manner protective of the public and environment, as projected in the performance assessment.

Requirements Analysis. This requirement is a modification of DOE 5820.2A requirement III.3.j.(1). The requirement for closure within 5 years following the end of disposal comes from a portion of 5820.2A, III.3.j.(1). The requirement in 5820.2A has been divided to avoid confusion as to whether the closure plan is due within 5 years or whether the site is to be closed within 5 years. The requirement for the closure plan is addressed in DOE M 435.1-1, IV.Q.(1). In addition, the requirement recognizes the DOE policy regarding institutional control of the land where low-level waste is disposed of until the land can be released pursuant to DOE 5400.5, *Radiation Protection of the Public and the Environment*.

Other Considerations. None.

IV. Q.(2) <u>**Disposal Facility Closure.**</u>

(a) **Prior to facility closure, the final inventory of the low-level waste disposed in the facility shall be prepared and incorporated in the performance assessment and composite analysis which shall be updated to support the closure of the facility**.

(b) **A final closure plan shall be prepared based on the final inventory of waste disposed in the facility, the plan implemented, and the updated performance assessment and composite analysis prepared in support of the facility closure.**

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. These requirements address the need for final closure to be accomplished in a timely manner following the end of disposal operations, and in a manner which is protective of the public and environment, as projected and documented in the performance assessment and composite analysis. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. Specific weaknesses addressed include implementation of final closure plans and conditions without the use of actual final inventories and other information that should be used.

Requirements Analysis. These requirements are modifications and expansions of the DOE 5820.2A requirements III.3.j.(1). The requirement in 5820.2A has been divided to avoid confusion associated with closure requirements. The requirement for the closure plan is addressed in DOE M 435.1-1, IV.Q.(2).

Other Considerations. The requirement to include the total inventory in the closure plan was identified as a necessary component of a closure plan and integrated low-level waste operations during the revision of the waste management order.

IV. Q.(2) **Disposal Facility Closure.**

(c) Institutional control measures shall be integrated into land use and stewardship plans and programs, and shall continue until the facility can be released pursuant to DOE 5400.5, *Radiation Protection of the Public and the Environment*.

(d) The location and use of the facility shall be filed with the local authorities responsible for land use and zoning.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment, and the closure of a disposal facility.

Safety and Hazard Analyses. These requirements address the need for final closure to be accomplished in a timely manner following the end of disposal operations, and in a manner protective of the public and environment, as projected in the performance assessment.

Requirements Analysis. These requirements are modifications and expansions of the DOE 5820.2A requirements III.3.j.(1) and III.3.j.(6). Significant changes have been made to the requirement concerning monitoring and maintenance to change the notion that the site will be released at the end of an institutional control period. Instead, the requirement is to maintain the land until it can be released based on DOE's requirement for release of land documented in DOE 5400.5. This is consistent with the policy that DOE will control the land until it can be released. The 5820.2A requirements were augmented with requirements to provide an agency other than DOE (i.e., local land use planning authorities) with records indicating the location of the low-level waste disposal facility. The requirement to file information with local land use authorities was derived from NRC requirements at 10 CFR 61.80(g).

Other Considerations. As a means of providing some defense-in- depth to mitigate consequences of temporary lapses in active institutional controls, filing information with local authorities with responsibility for land use and zoning is required.

IV. R. <u>Monitoring</u>.

The following requirements are in addition to those in Chapter I of this Manual:

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

(2) Liquid Waste Storage Facilities. For facilities storing liquid low-level waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Basis:

Functions Evaluated. The requirement derives from the analysis of the Treatment function for providing interim storage at a treatment facility. This requirement also derives from the analysis of the following high-level waste management functions: maintaining safe high-level waste pretreatment and storage envelopes, and operating, monitoring, and maintaining high-level wastes storage systems.

Safety and Hazard Analyses. A potentially high hazard scenario was identified for the storage of liquid low-level waste in a tank prior to processing at a treatment facility. Weaknesses and conditions addressed by the requirement include an overfill of an interim storage tank, incompatible materials mixing in a storage tank, over pressurization of stored waste, storage longer than planned for, the opening of containers to verify waste acceptance criteria are met, and specifically respirable fines in waste containers that are opened. The weaknesses and conditions identified in the high-level waste safety and hazard analyses were failing to detect flammable gas buildup in waste storage tanks, failing to sample and test waste storage tank contents to establish ignition limits, and inadequate waste tank level monitoring.

Requirements Analysis. The requirements are similar to requirements at DOE 5820.2A, I.3.b.(3)(a) for high-level waste storage tanks, extended to management of low-level waste and to all low-level waste management activities (in the case of requirement R.(1)), not just storage.

Other Considerations. This requirement is included in the low-level waste chapter as a result of achieving consistency across the waste type chapters. The requirement was not originally identified as an essential requirement in the analysis of low-level waste management, but was recognized as good management practice in storage of high-level waste that should be adopted for management of low-level waste. The requirement supports the ALARA and defense-in-depth

concepts by specifying minimum parameters that must be monitored in all low-level waste management facilities for identifying known hazards, and by implementing monitoring as a contingency rather than relying on waste characterization and certification to guarantee no unacceptable materials will be present in waste. The final wording of the requirement includes the provision that facility monitoring programs are to include verification that passive and active control systems have not failed in response to comments made by DOE-EH on draft versions of the Manual.

IV. R.(3) **Disposal Facilities.** **A preliminary monitoring plan for a low-level waste disposal facility shall be prepared and submitted to Headquarters for review with the performance assessment and composite analysis. The monitoring plan shall be updated within one year following issuance of the disposal authorization statement to incorporate and implement conditions specified in the disposal authorization statement.**

Basis:

Functions Evaluated. This requirement derives from the analysis of activities associated with disposal facility monitoring, both during operations and after closure.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that possible disposal facility releases are monitored during the short-term, and long-term disposal facility stability is monitored following closure. This requirement also addresses the need for evaluating the most important safety related activities necessary to manage low-level waste at the highest level of responsibility. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility.

The requirement addresses the potential weaknesses and conditions for releases from disposal facilities due to poor operational performance, design, or due to poorly performing disposal units or wastes forms. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor integration of documents important to safety (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or lack of accountability at the highest management positions for ensuring the most important requirements for safety will be met.

Requirements Analysis. This requirement for monitoring is a modification of the requirement in DOE 5820.2A, III.3.k.(1). The requirement for disposal facility monitoring plans is added as an essential component of the documentation necessary for the disposal authorization statement. This requirement is consistent with 10 CFR Part 61 which requires the description of a monitoring program to be submitted to the NRC prior to the disposal facility operating (Part 61.12(l)).

Other Considerations. Authorization basis is the implementation of the Department's system engineering of the low-level waste management system which showed the need for accountability to demonstrate requirements are being met.

IV. R.(3)(a) The site-specific performance assessment and composite analysis shall be used to determine the media, locations, radionuclides, and other substances to be monitored.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions for maintaining the low-level waste disposal facility during operational and post-operational periods and for maintaining the performance assessment.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that long-term disposal facility performance and stability is monitored and maintained. The requirement addresses the potential conditions and weaknesses that would result from poor performance assessment assumptions and a lack of understanding of site performance due to poor site characterization or poor operations. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. Also, the requirement partially addresses the Complex-Wide Review Concern on Groundwater Monitoring.

Requirements Analysis. The requirement for facility monitoring to be based on the performance assessment and composite analysis at a low-level waste disposal facility is a significant modification to requirements in DOE 5820.2A, Chapter III.3.b.(3) and III.3.k.(2) and (3). Specific language in requirements from 5820.2A regarding the media to be monitored has been moved to guidance.

Requirements for disposal facility performance monitoring are a performance based set consistent with and partially derived from 10 CFR Part 61 requirements as well as the Defense Nuclear Facilities Safety Board Recommendation 94-2 performance assessment deliverable entitled, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*.

Other Considerations. This requirement adds defense-in-depth for confirmation of modeling/performance assessment calculations and the need to understand changes in disposal facility performance.

IV. R.(3)(b) The environmental monitoring program shall be designed to include measuring and evaluating effluent releases, migration of radionuclides, disposal unit subsidence, and changes in disposal

facility and disposal site parameters which may affect long-term performance.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions for maintaining the low-level waste disposal facility during the operational and post-operational periods.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that possible disposal facility releases are monitored during the short-term and possible releases as well as long-term performance of disposal facility stability is also monitored following closure. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. The requirement addresses the potential conditions and weaknesses of inadequate understanding of the pre-operational conditions of the disposal facility, of a poorly designed monitoring plan or system, and poor site characterization information or performance assessment assumptions.

Requirements Analysis. This requirement for an environmental monitoring program is a significant modification to the requirements in DOE 5820.2A, Chapter III.3.b.(3) and III.3.k.(2). The requirement to design monitoring enhances both III.3.b.(3) and III.3.k.(2) to not only monitor and measure for releases, migration, subsidence, and performance changes but also to evaluate the monitoring results. Requirements for baseline monitoring are a performance based set consistent with and partially derived from 10 CFR Part 61 requirements as well as the Defense Nuclear Facilities Safety Board Recommendation 94-2 performance assessment deliverable entitled, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*.

Other Considerations. This requirement partially addresses the Complex-Wide Review Concern on Groundwater Monitoring. These requirements add defense-in-depth for confirmation of modeling/performance assessment calculations, and the need to understand changes in disposal facility performance. The final wording of this requirement was prepared I response to comments received on the draft version of DOE M 435.1-1.

IV. R.(3)(c) The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives in this Chapter.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions for maintaining the low-level waste disposal facility during operational and post-operational periods and for maintaining the performance assessment.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that long-term disposal facility performance and stability is monitored and maintained. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. The requirement addresses the potential conditions and weaknesses that would result from poor performance assessment assumptions and a lack of understanding of site performance due to poor site characterization or poor operations.

Requirements Analysis. This requirement for monitoring of low-level waste disposal facility performance is essentially equivalent to the requirement in DOE 5820.2A, Chapter III.3.k.(4). The corrective measures requirement is similar to a specific 10 CFR Part 61 requirement (Part 61.12(l)). This requirement partially addresses the Complex-Wide Review Concern on Groundwater Monitoring.

Requirements for disposal facility performance monitoring are a performance based set consistent with and partially derived from 10 CFR Part 61 requirements as well as the Defense Nuclear Facilities Safety Board Recommendation 94-2 performance assessment deliverable entitled, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments.*

Other Considerations. These requirements add defense-in-depth for confirmation of modeling/performance assessment calculations and the need to understand changes in disposal facility performance.