Radiological Clearance
An Industry Perspective

National Academies

BEES Committee on Alternatives

March 26, 2001

NEI

NUCLEAR ENERGY INSTITUTE

NEI's Mission

NEI focuses the collective strength of the nuclear energy industry to shape policy that ensures the beneficial uses of nuclear energy and related technologies in the United States and around the world.

Industry Commitment

- To control radioactive materials
  - in the spirit of the ALARA principle
  - ALARA - As Low As Reasonably Achievable
- ALARA
  - optimizes radiation protection activities in the context of reducing total risk

What is Clearance?

- A process for the removal of safe materials from nuclear facilities for unrestricted use
- Removal of "licensed" status
- Path forward for reuse, recycle, or disposal

Current Situation

- Materials must be released routinely
  - during operations and decommissioning
- Material Release = "Clearance"
  - clearance is a process
- Clearance process requires an evaluation
  - of radiological risk
  - to a given safe standard

Problem Statement

- Acceptance criteria's are:
  - licensee dependent
  - material specific
  - based on inconsistent case-by-case approvals
- Absence of a consistent acceptance criteria:
  - provides inconsistent public protection
  - undermines public confidence
  - wastes resources, perpetuates liability

Why is it Needed?

- Because current regulations:
  - are not health and safety based
  - are inconsistently applied
  - don't cover recycling
  - don't cover volumetric material
  - are inconsistent with international community

Isn't This BRC?

- Yes and No
  - different scope
  - different objectives
  - different environment
  - different procedural process

BRC Vs. Clearance

- Directed by Congress
- Broad Scope
  - release of facilities
  - release of lands
  - recycle of equipment
  - exempt waste streams
- *fait accompli*
  - policy statement issued without public input

- Self directed
- Limited scope
  - release solid materials
    - reuse
    - recycle
    - disposal
    - surface & volumetric
- Enhanced public participation

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Proposed Solution

- Establish clearance standard that is:
  - dose-based
  - national in scope
  - IAEA compatible
  - practical to implement
  - verifiable by stakeholders
  - final

Industry Position

- We endorse ANSI N13.12, a consensus std.
  - ANSI 13.12 is based on 10 uSv/yr (1 mr/yr)
  - NRC should impose strict compatibility
  - ANSI 13.12 uses same dose criteria as IAEA
  - Uses practical screening values
  - Can be verified with available instruments
  - Would establish a "floor" and end liability

Steel Recycling

- Deserves special consideration
  - Orphaned sources are:
    - Public health risk
    - Steel worker risk
    - Financial risk to steel industry
- Clearance of steel
  - should not impede intervention of these sources

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Recommendations

- A national clearance standard
  - Should be developed through rulemaking
  - Should endorse ANSI 13.12
  - Should be expedited for:
    - direct reuse
    - direct disposal
- Steel recycling:
  - Deserves special consideration

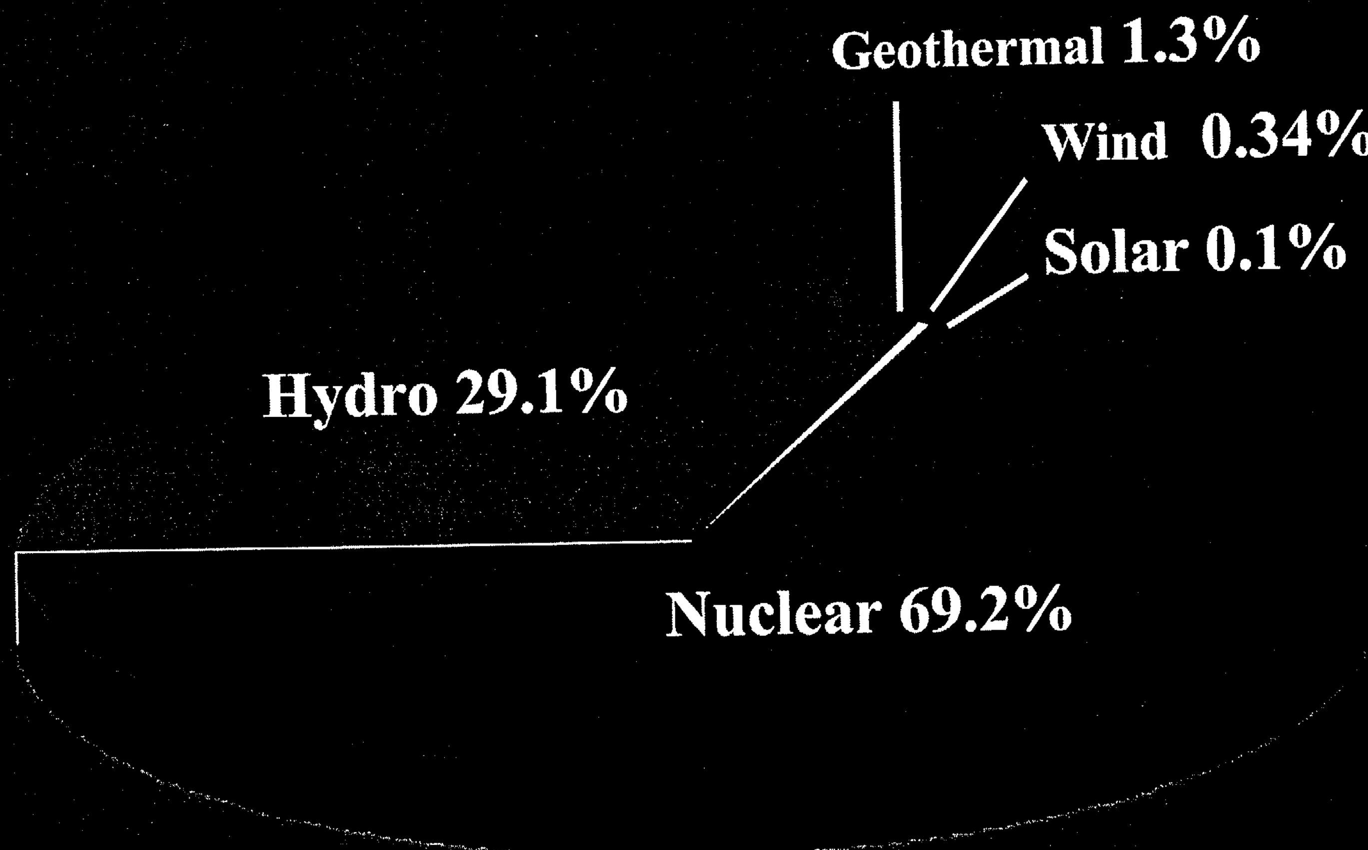
NAS – Release of Radioactive Material

George Vanderheyden
General Manager
Exelon Nuclear

Exelon Nuclear

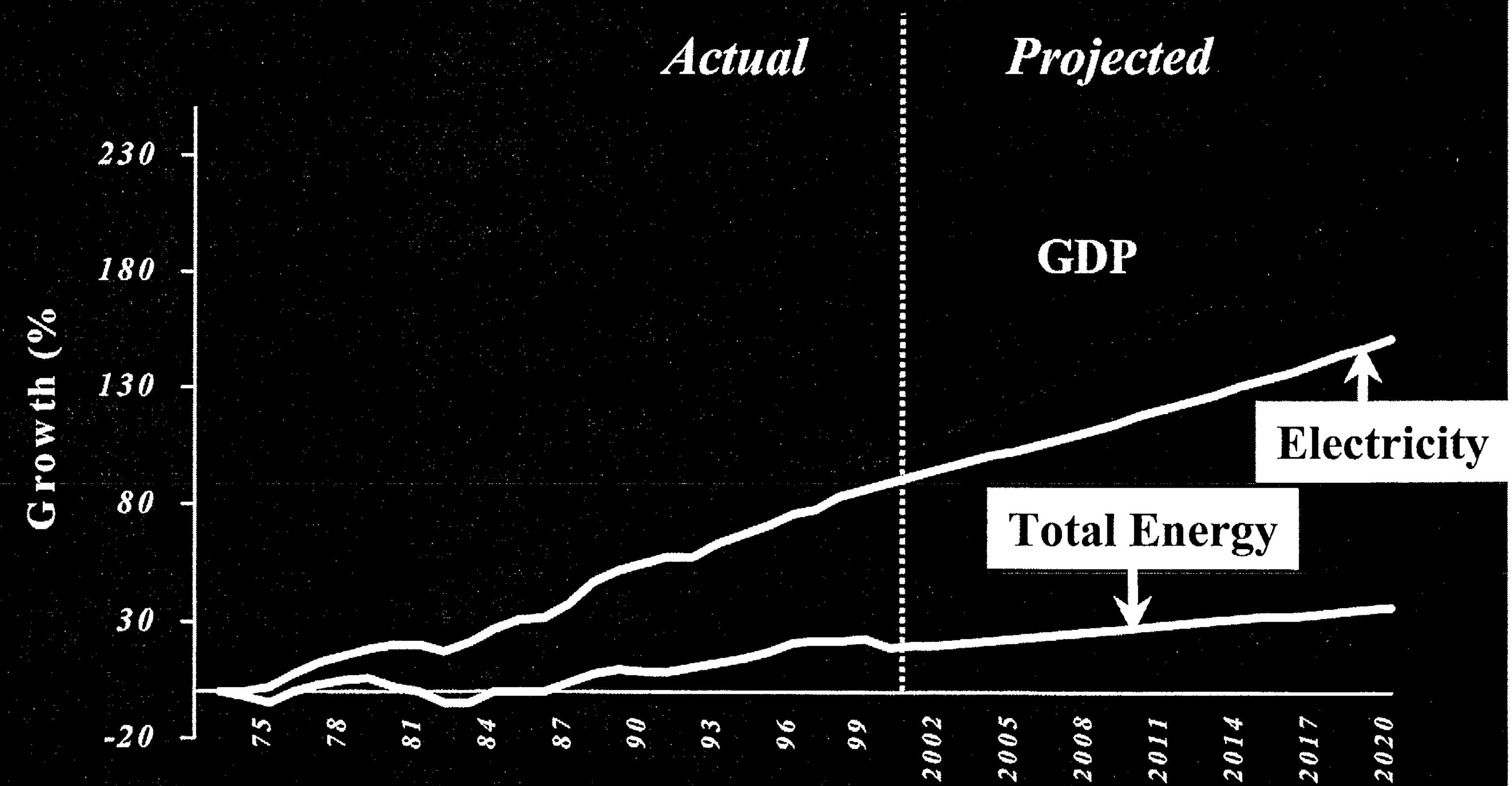
- Formed in 2000
- Merger of Unicom and PECO
- Largest domestic operator of Nuclear power plants
- 400 years of cumulative operating experience

Nuclear Energy: Largest Source of U.S. Emission-Free Generation



Source: EIA

Electricity Supply and the Economy 1973-2020



Overview

- Current regulations are not risk based
- Inconsistency in regulation of radioactive material
- Unintended consequences occur

Regulations are not risk based

- Liquid and gaseous releases are risk based
- Pathway doses = approx. 1 mr/yr
- Natural Background = approx 360 mr/yr
- Release of material prohibited
- Detection limits based on instrument capability

Inconsistent Regulations

- Medical treatments releases material to the environment
- Consumer products contain radioactive material
- EPA regulations establish safe levels of 10mr/yr
- Inconsistency increases price of electric power

Unintended Consequences

- Limits based on instrument capability in 1981
- Capability of new technology is not exploited
- Regulations do not promote excellence

Conclusions

- Regulations need to have a strong technical basis
- Based on risks levels similar to other radioactive material releases
- Need to balance risk with real impact on our society

Maine Yankee Atomic Power Company

William H. Odell

Decommissioning Update

OUTLINE

- Brief on Decommissioning
- Waste Streams
- Release of Materials

Maine Yankee Facts

- 860 MWe, 3 Loop, Combustion Engineering PWR
- On Line in 1972
- Produced 120 Billion KW-Hrs by 1996
- Shutdown 12/96 for Configuration Control
- Board of Directors Vote to Permanently Shutdown Plant 8/97

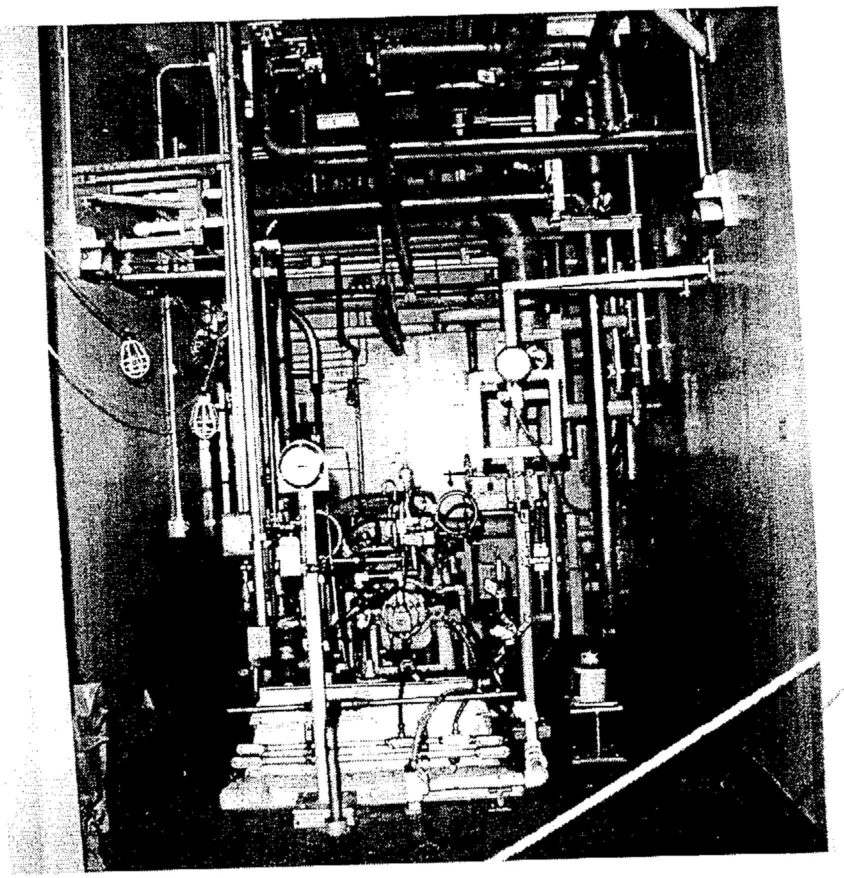
Dose Reduction and Waste Stream

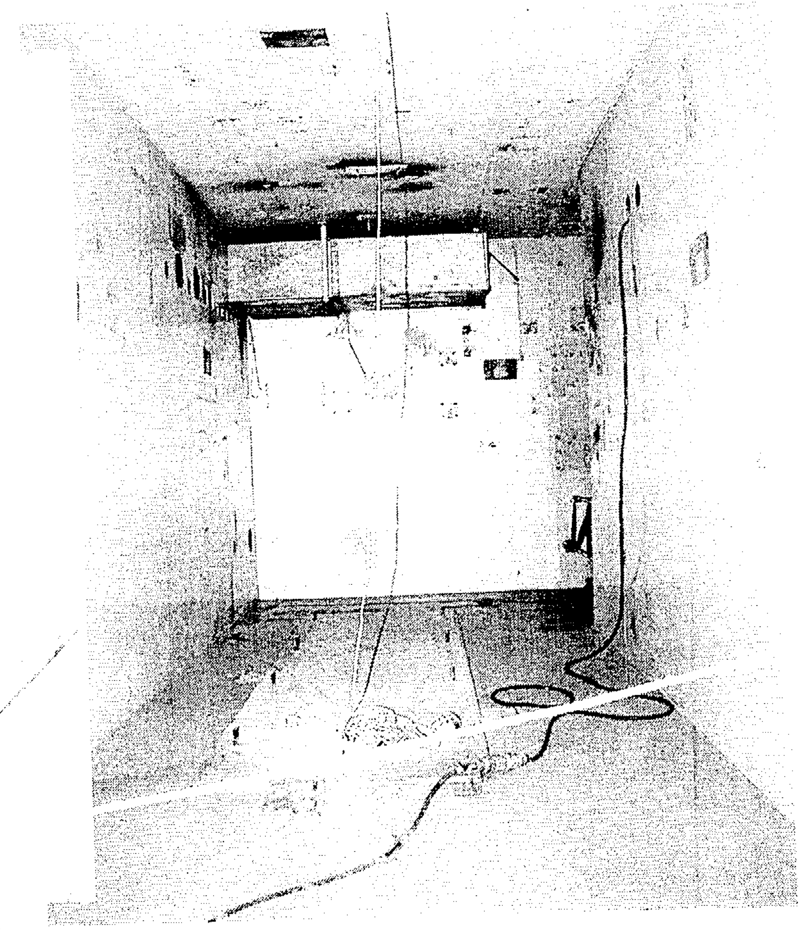
- Reactor Coolant System Decontamination
- Source Term Reduction using Gamma Camera
- Rip and Ship
- Disposal
  - Economic and Regulatory Decision
  - On Site Storage
  - Direct Burial of Radwaste
  - Direct Burial of Clean Waste
  - Processing Off Site

2000 Accomplishments

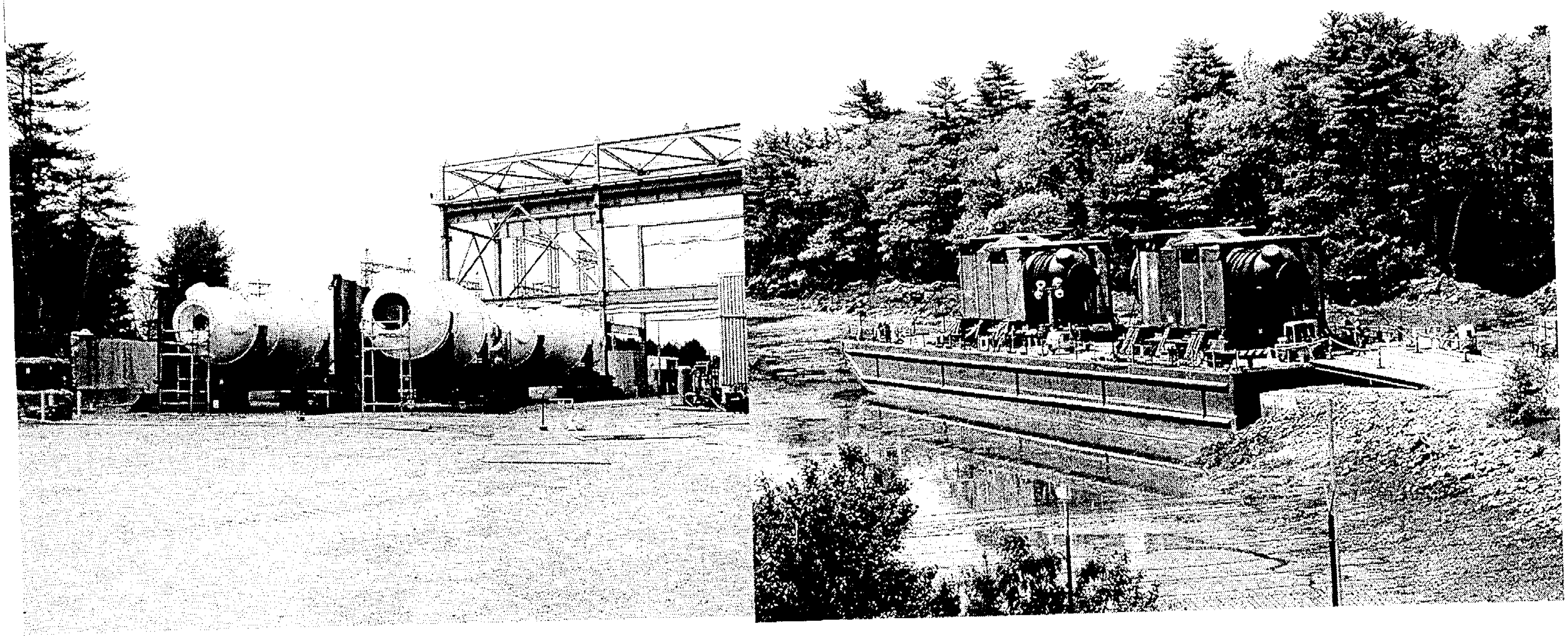
- Containment Opening Enlargement
- Completed RC Large Bore Pipe removal
- Removed and Shipped 3 Steam Generators and the Pressurizer
- Continued Commodity Removal
- Spent Fuel Pool Cleanup

Commodity Removal





Large Component Removal



Non Radioactive Waste Shipped

Category	To-Date	Projected	%Complete
Asbestos	220,744	400,000	55.2%
Other	10,790	30,000	36.0%
Hazardous	18,709	100,000	18.9%
Oil	12,397	24,000	51.7%
Paper/Cardboard	74,340	500,000	14.9%
Trash	523,300	1,250,000	41.9%
Concrete	41,300	60,000,000	0.1%
Soil	3,950,685	5,500,000	71.8%
Demo Debris	2,173,960	7,000,000	31.1%
Metal	5,852,377	15,000,000	39.0%
Totals	12,878,800	89,804,000	14.3%

Radioactive Waste Shipped

Category	To-Date	Projected	%Complete
Concrete	2,703,190	90,000,000	3.0%
Commodities	3,872,084	9,679,264	40.0%
Distributables	1,209,271	3,000,000	40.3%
Large Components	3,216,250	4,586,250	70.1%
Totals	11,000,795	107,265,514	10.3%

D & D Look Ahead

- Reactor Vessel Head (2001)
- Reactor Vessel Internals Segmentation (2000-2001)
- Reactor Vessel Shipment (2001)
- Construct ISFSI (2000-2001)
- Move Fuel to ISFSI (2001-2002)
- Building Demos (2000-2003)

Removal of Materials from Maine Yankee

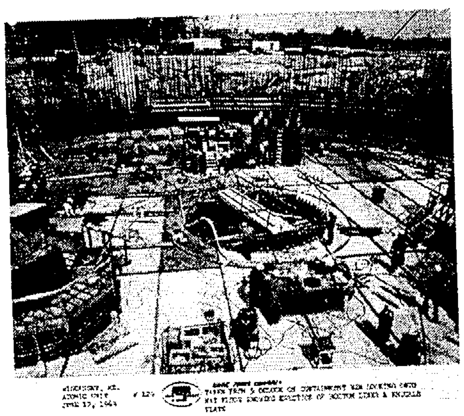
- Generally materials in the radiologically controlled area (RCA) of the plant are shipped to a processor or to a burial site as Radioactive Material.
- Some materials from the RCA like tools, trucks and personal items are decontaminated and surveyed for free release.
- All other materials go through a release process for non-radioactive materials.

Release of NonRadioactive Materials

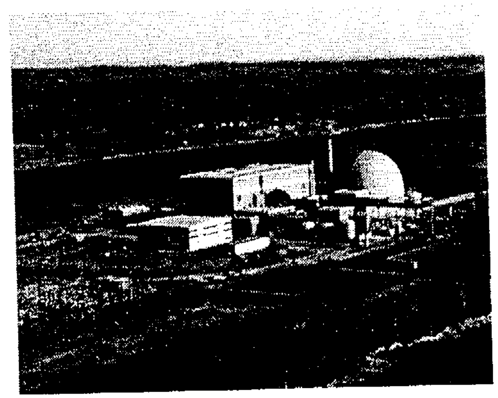
- Biased Surveys for plant derived radionuclides if required. Criteria for release from NRC IE Circular No. 81-07
- Aggregate Survey of each load. Criteria from NRC IE Notice 85-92
- Survey through the Truck Monitor in accordance with agreement with the State of Maine.

Conclusion

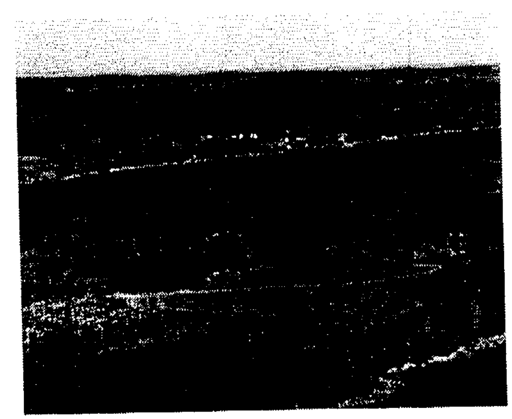
Past



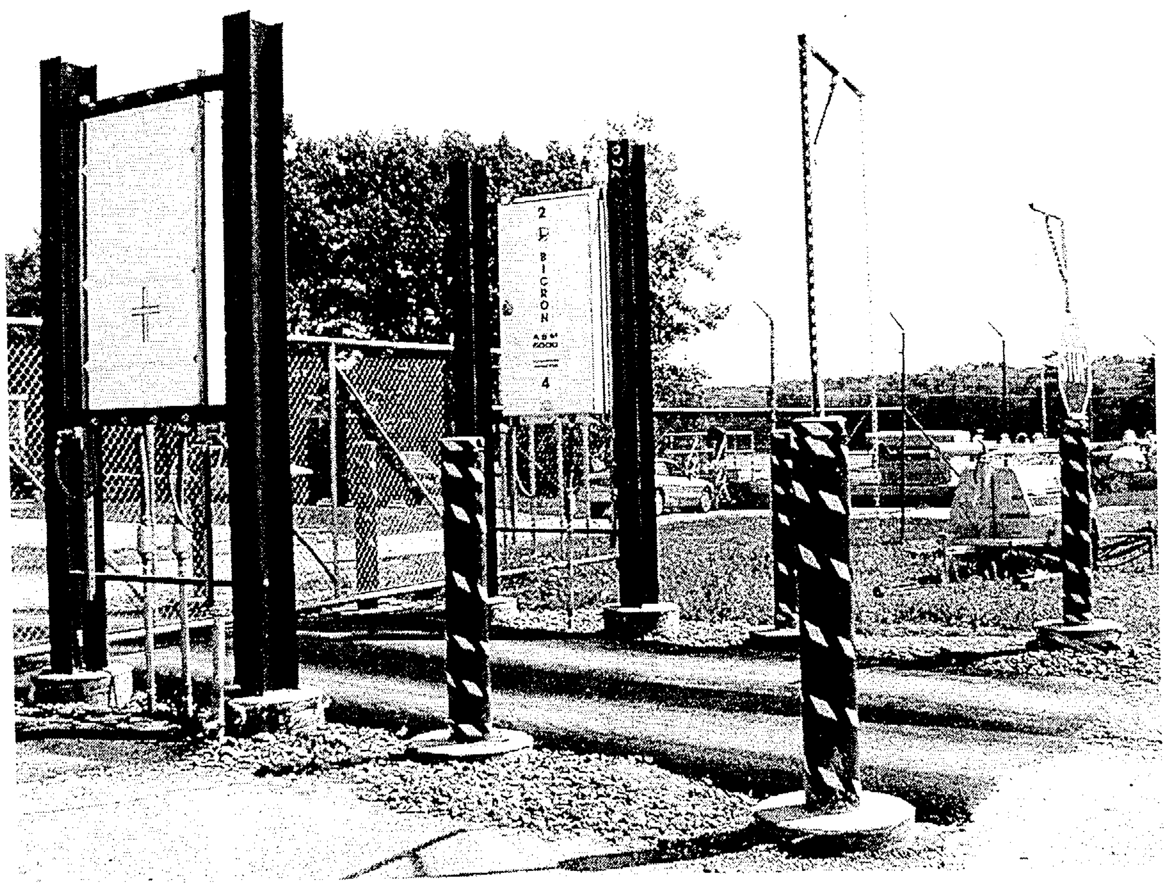
Present



Future

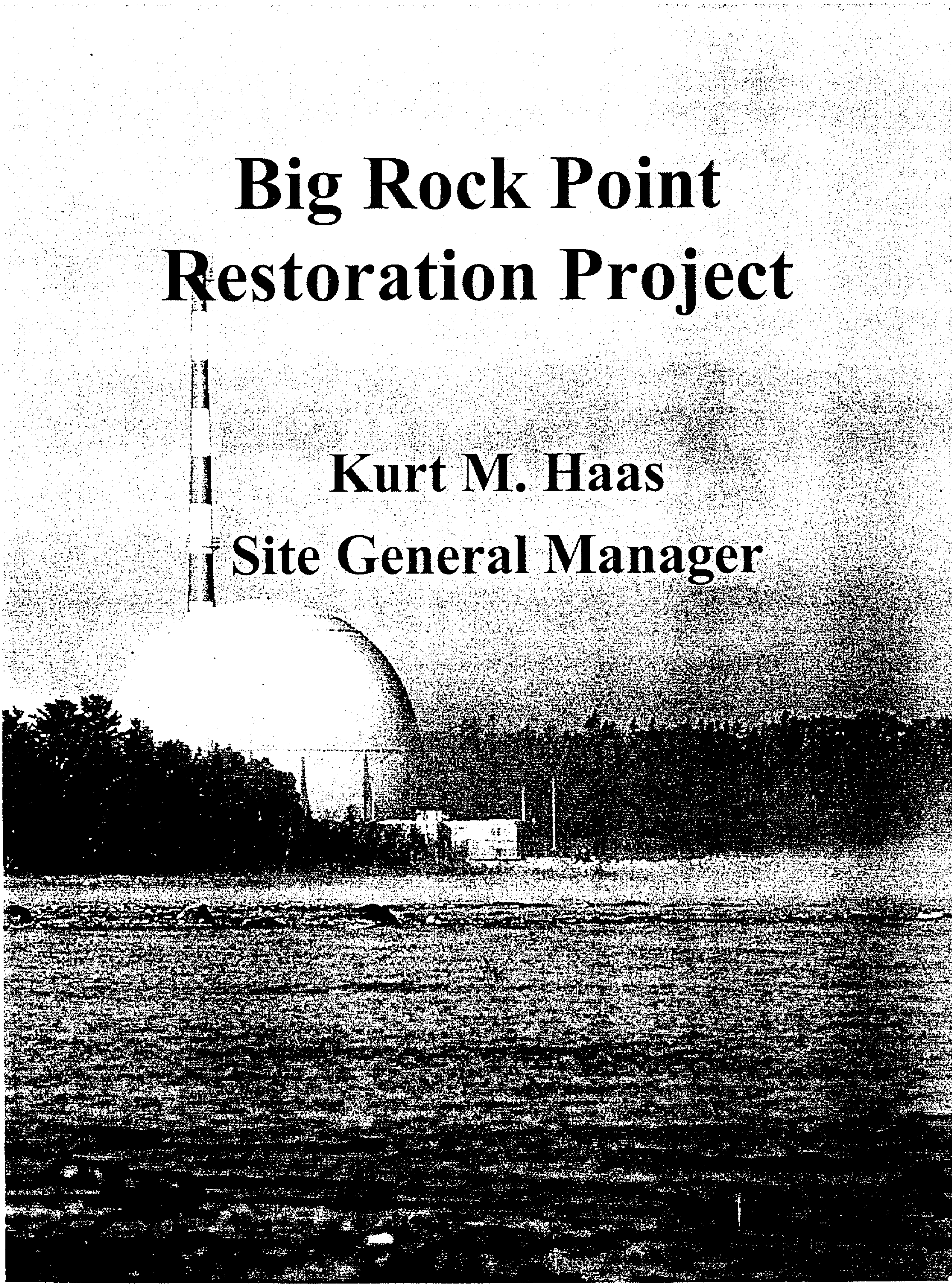


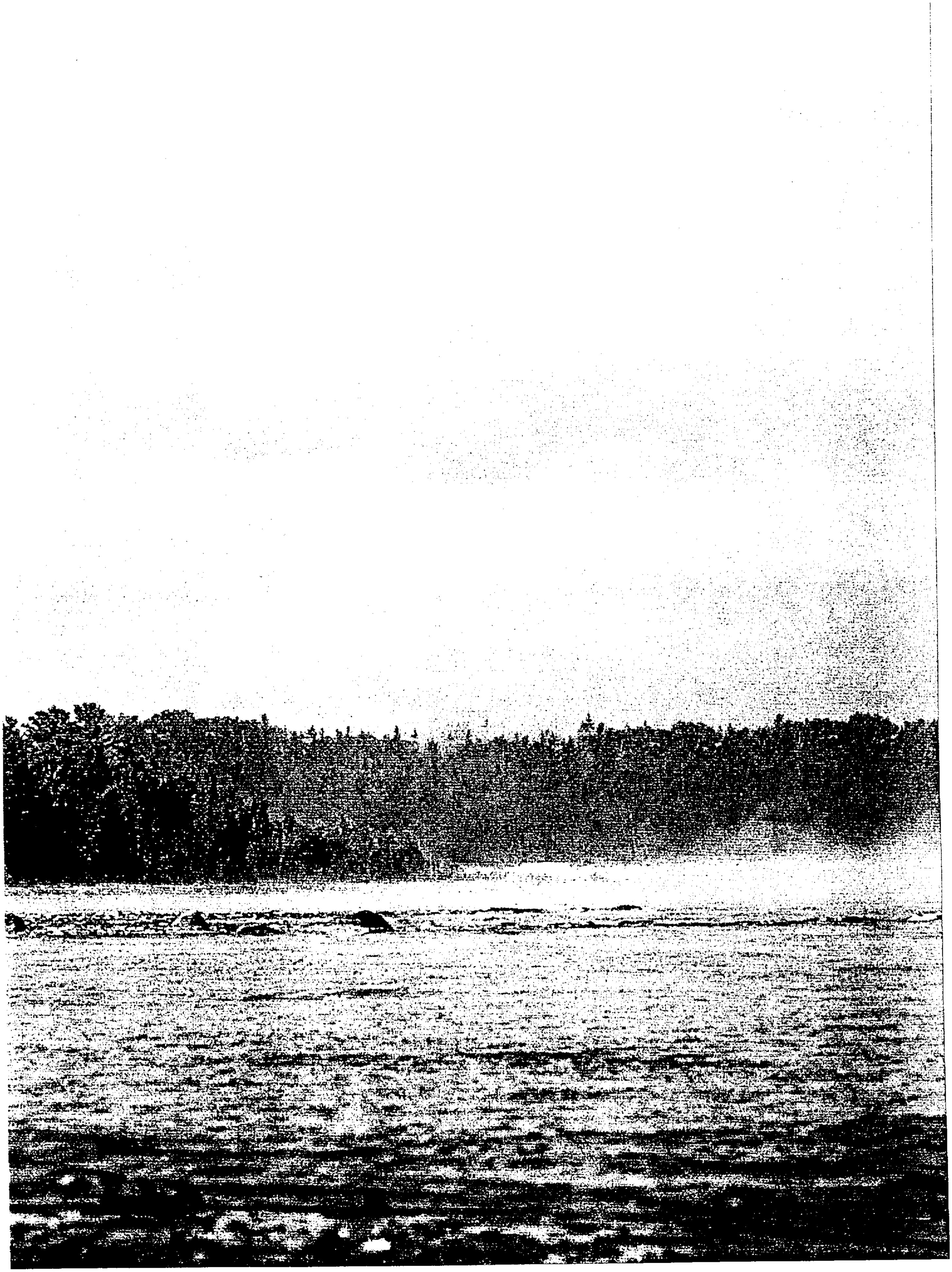
Truck Monitor



Big Rock Point Restoration Project

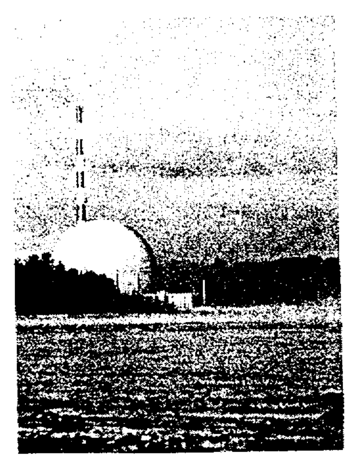
Kurt M. Haas
Site General Manager





Big Rock Point vision

- To conduct restoration in a manner which brings praise from all stakeholders:
  - The local community
  - The public at large
  - Our employees and their families
  - Our company
  - The nuclear community
  - Regulatory agencies
  - Our critics



Priorities

- **Safety**

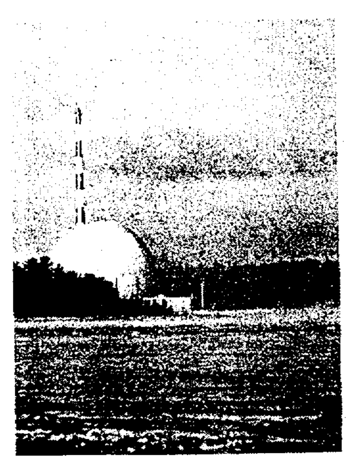
  Nuclear, Radiological and Industrial

2. **Efficient Restoration**

   Use all resources productively

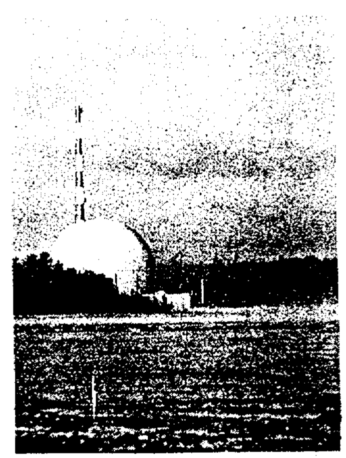
3. **Future**

   Preparation of all people for future changes and opportunities



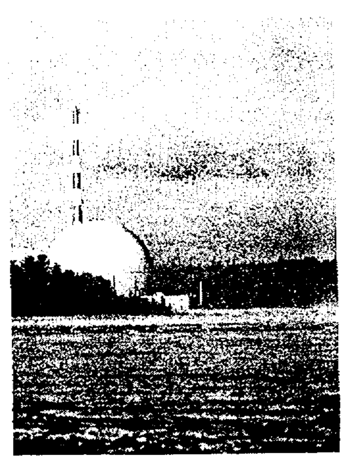
Milestones

- *July 20, 1960* - Ground breaking
- *Sept. 27, 1962* - First chain reaction
- *1962-1965* - Research and development work with Atomic Energy Commission
- *Nov. 1, 1965* - BRP declared commercial
- *July 22, 1977* - World record run of 343 consecutive days ends
- *June 4, 1991*- BRP named a Nuclear Historic Landmark by the American Nuclear Society



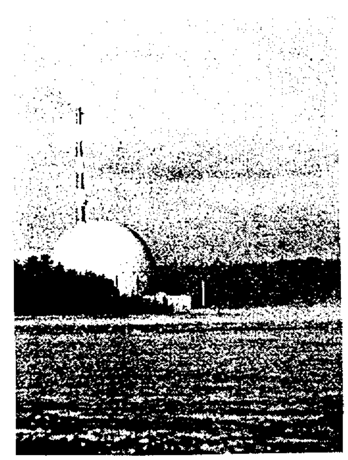
Milestones

- *June 29, 1993* - BRP became the longest running plant in U.S. history
- *Aug. 29, 1997*- BRP shutdown
- *Aug. 30, 1997*- Decommissioning begins
- *Aug. 3, 2000* - BRP employees complete 23 years without lost time accident



Project costs

Total Project Est.	$401 million
PM/Staff	35%
Dry fuel storage	15%
Waste removal/disposal	13%
Dismantlement	13%
Contingency/reserve	11%
Overheads	10%
Tools/equipment	3%



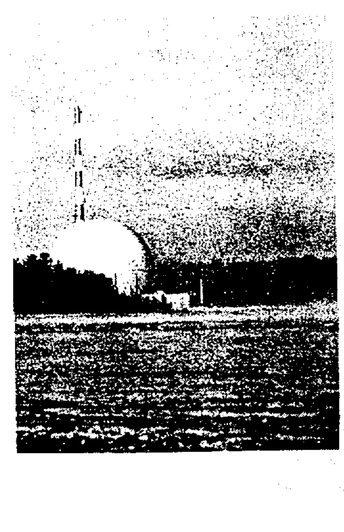
Clean building debris

~ 80,000,000 lb. concrete/rebar

Options

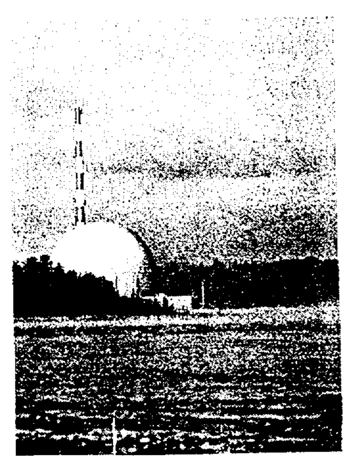
– 10CFR 20.2002 - $4 million
– Out of state processor - $29 million
– Direct disposal to licensed LLW facility - $ $ $ $ $

(cost for shipping and disposal only)

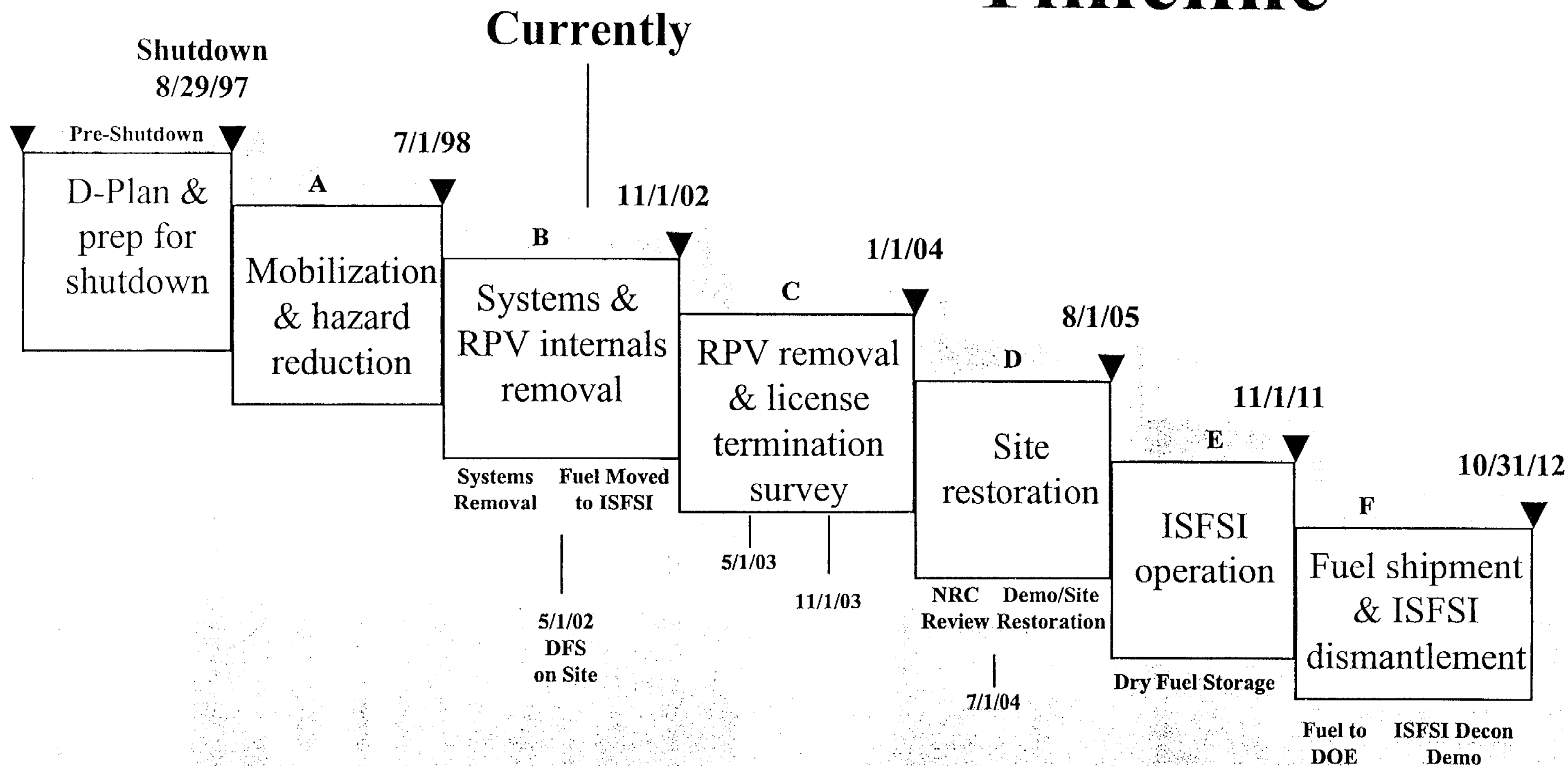


10 CFR 20.2002

- State DEQ supportive
- Independent, environmental monitor found no issues
- Initial NRC staff review in progress
- Expect approval within a year
- Frequently asked questions:
  - Why not leave the material on-site?
  - Why not recycle this material?



Timeline


Currently
Shutdown
8/29/97
Pre-Shutdown
D-Plan & prep for shutdown
A
7/1/98
Mobilization & hazard reduction
B
11/1/02
Systems & RPV internals removal
Systems Removal
Fuel Moved to ISFSI
5/1/02
DFS on Site
C
1/1/04
RPV removal & license termination survey
5/1/03
11/1/03
D
8/1/05
Site restoration
NRC Review
Demo/Site Restoration
7/1/04
E
11/1/11
ISFSI operation
Dry Fuel Storage
F
10/31/12
Fuel shipment & ISFSI dismantlement
Fuel to DOE
ISFSI Decon Demo

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Release of Solid Materials

Ellen M. Heath

Manager, Health Physics Services

Duke Engineering & Services

Marlborough, MA

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Topics

- Decommissioning Experiences
- Materials Encountered
- Release Options
- Application of Reg. Guide 1.86
- Material Disposition
- Conclusion

Decommissioning Experiences

- Yankee Rowe
- Connecticut Yankee
- Argonne National Lab - CP & Hot Cell
- ISU Research Reactor

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Materials Encountered

- Equipment & Components
- Concrete
- Metal
- Asphalt
- Soil
- Wood
- PCB
- Asbestos
- Lead
- Heavy Metals
- Graphite

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Release Options

- Unconditional Release of Non-Contaminated Materials
  - IE Circular No. 81-07
  - Materials Outside Radioactive Processes
  - Decontaminated Materials
- Collect Data for License Termination

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Application of Reg. Guide 1.86

- Radionuclide Mix
- Instrument Selection
- Background Determination
- Fixed vs. Removable Surface Contamination
- Bulk Material Sampling

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Implementation

- Area/Facility Operational History
- Removal of Contaminated Items
- Remediation
- Radiological Survey Plan
- Bulk Shipment Survey

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Candidates for Release

- Equipment & Areas Outside Radiological Environments
  - Plant Turbine Buildings
  - Offices
  - Open Land Areas
- Some Materials Inside Radiological Environments
  - Concrete, Metal, Building Debris

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Not Releasable

- Associated With the Radioactive Process
  - Concrete
  - Metal Components, Piping
  - Areas of Spills, Leaks
  - Resins, Filters
  - Activated Materials

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Material Disposition Options

- Recycle
- Hazardous Waste Disposal
- Industrial Landfill
- "Beneficial Use" on Site

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Material Disposition Options

- Radioactive Waste
  - Metal Melt
  - Incineration
  - Landfill
  - Decontaminate & "Free Release"
  - 10 CFR 20.2002 Determination

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Regulatory Environment

- 10 CFR 20
  - Dose Based
- IE Circular No. 81-07
  - Surface Contamination
- Reg. Guide 1.86
  - Surface Contamination Based

Conclusions

- Release of Material Criteria Depends on Process Stage
- 10 CFR 20 Subpart E Radiological Criteria for License Termination
- "No Detectable" Dilemma
  - Environmental Limits of Detection

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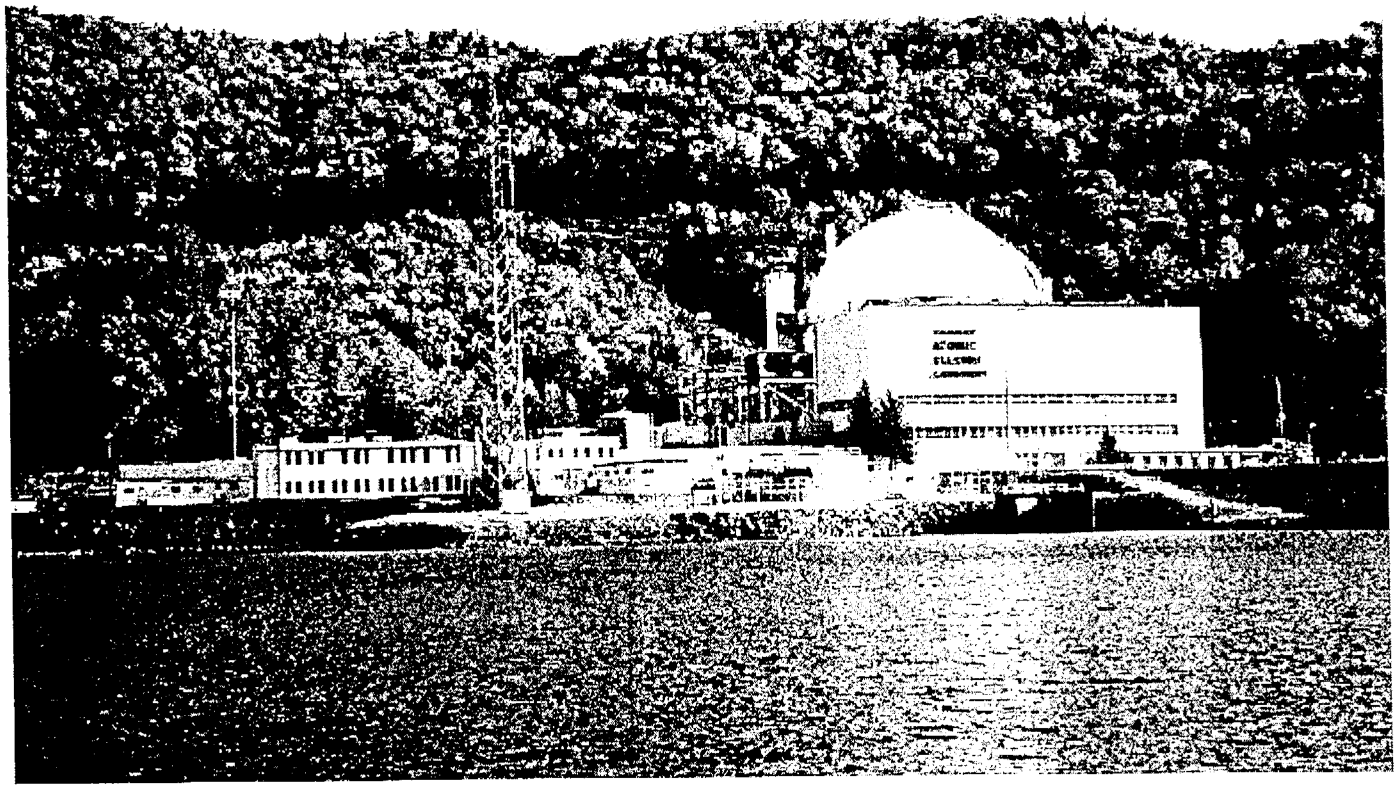

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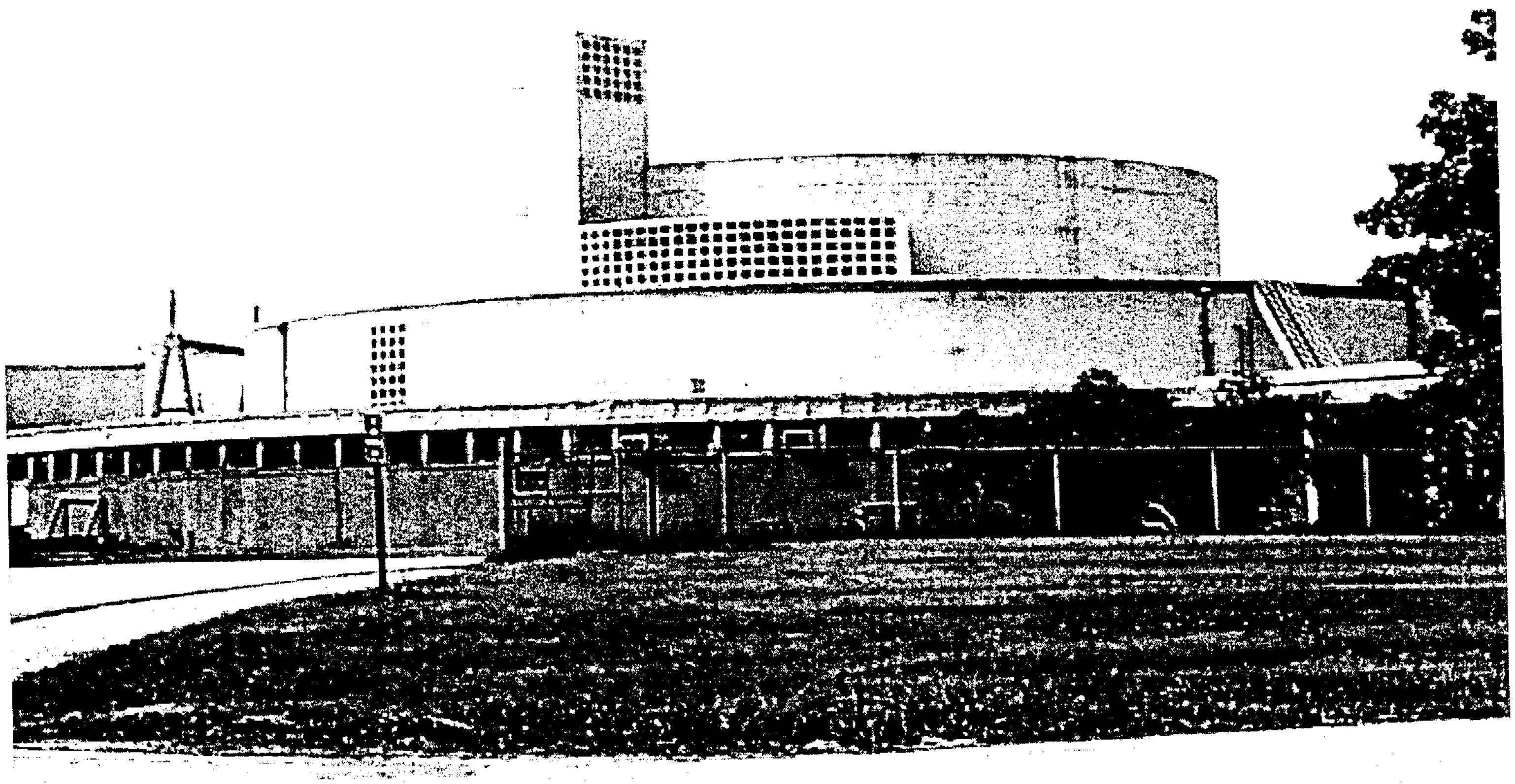

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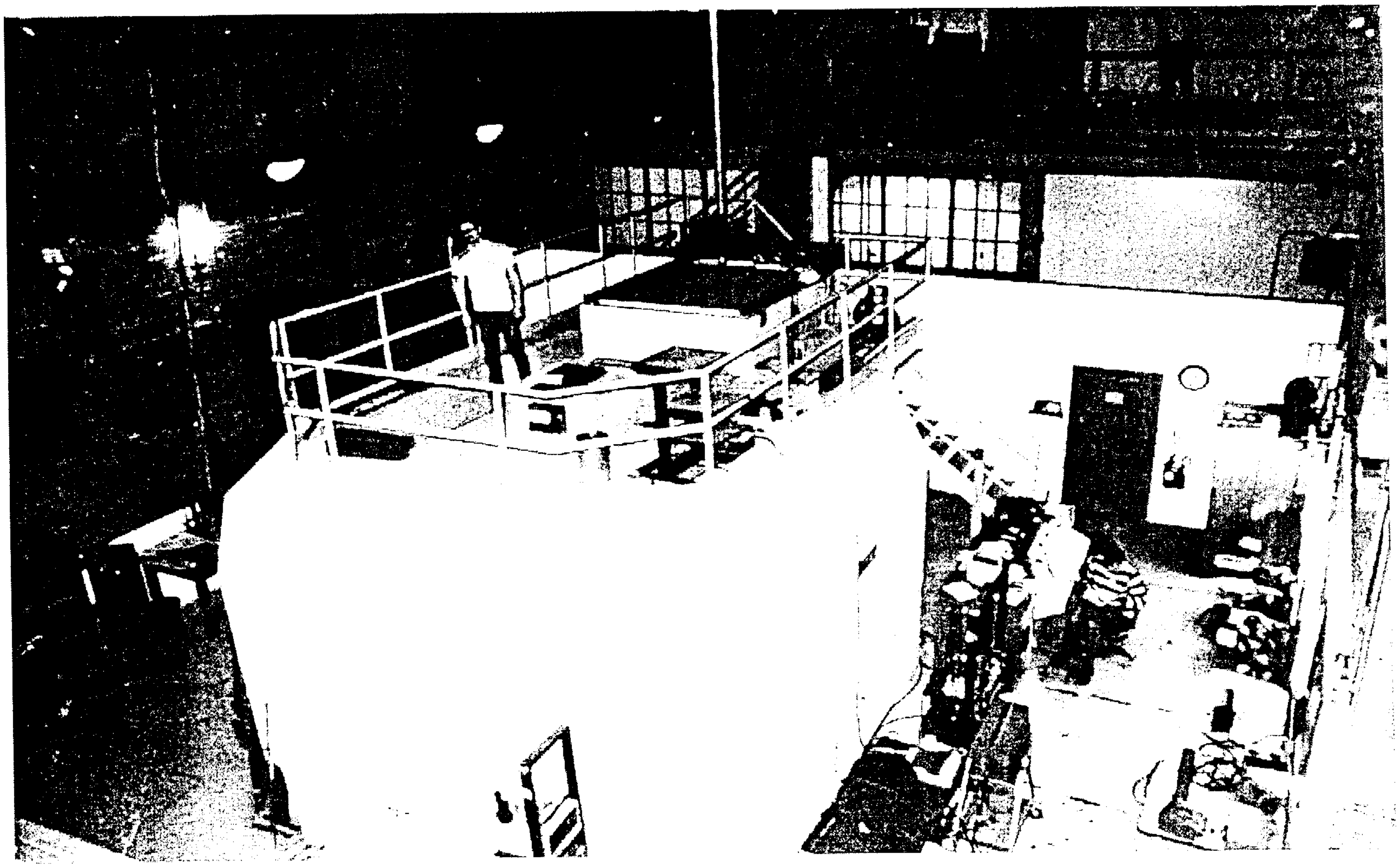

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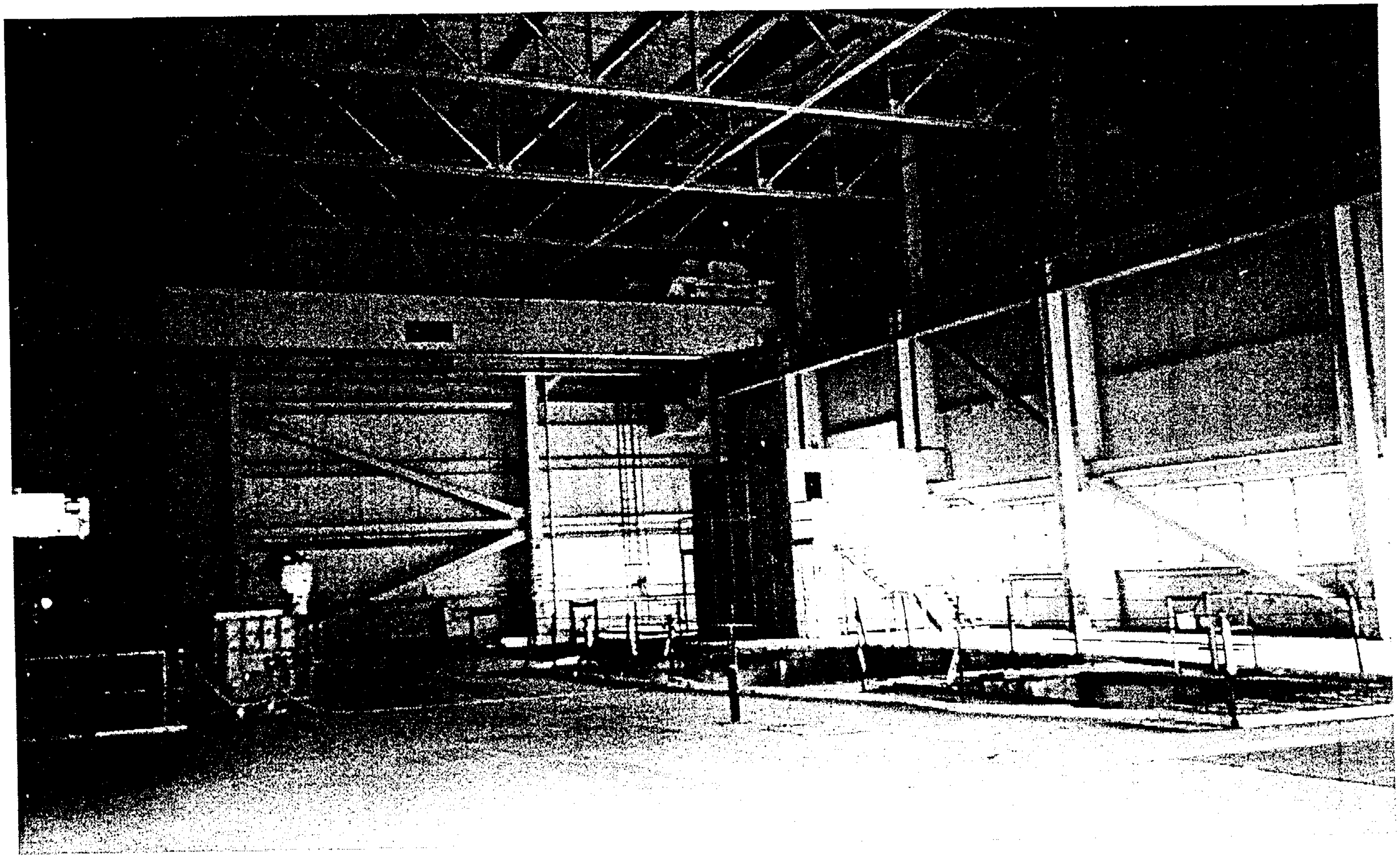

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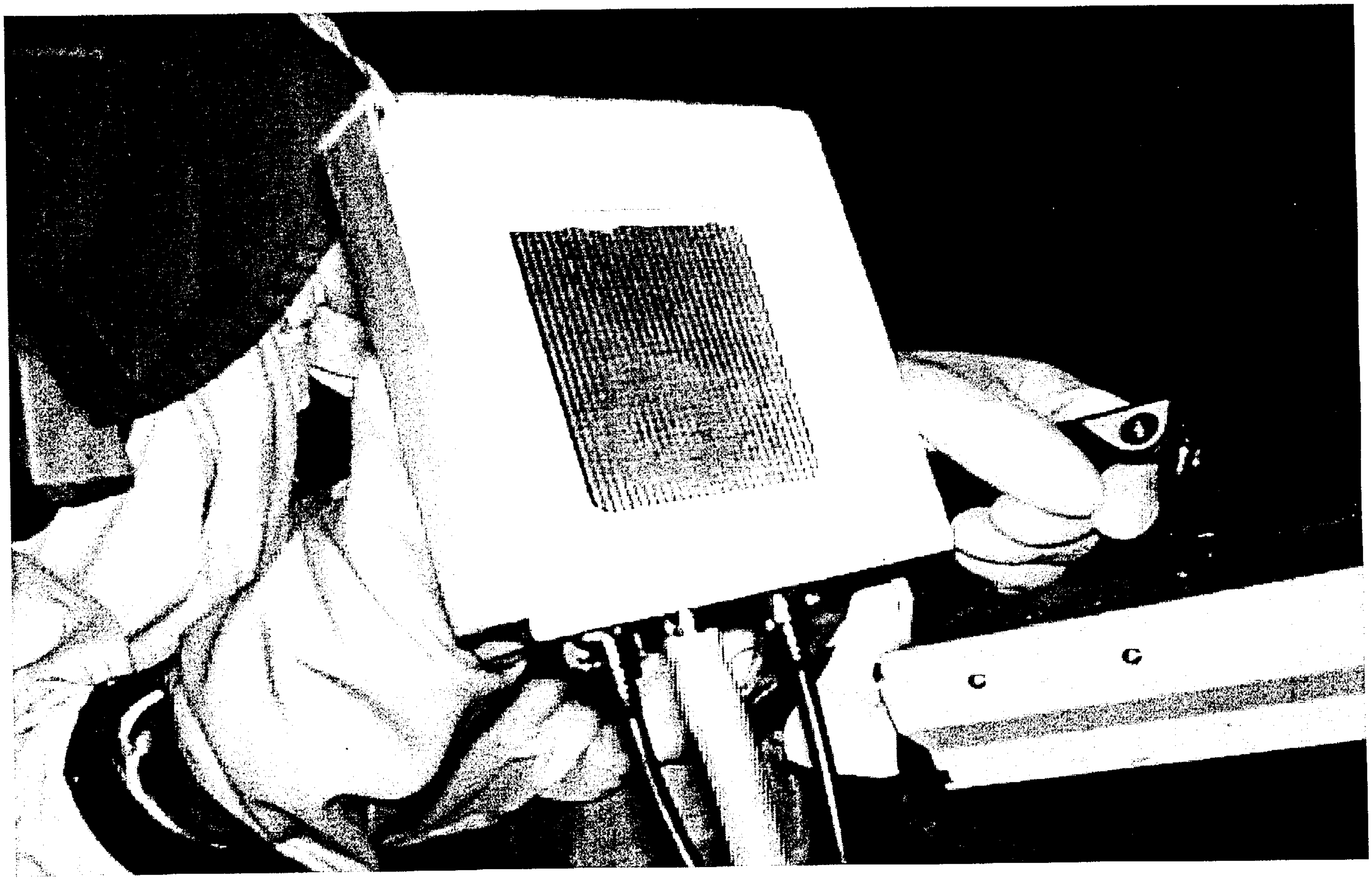

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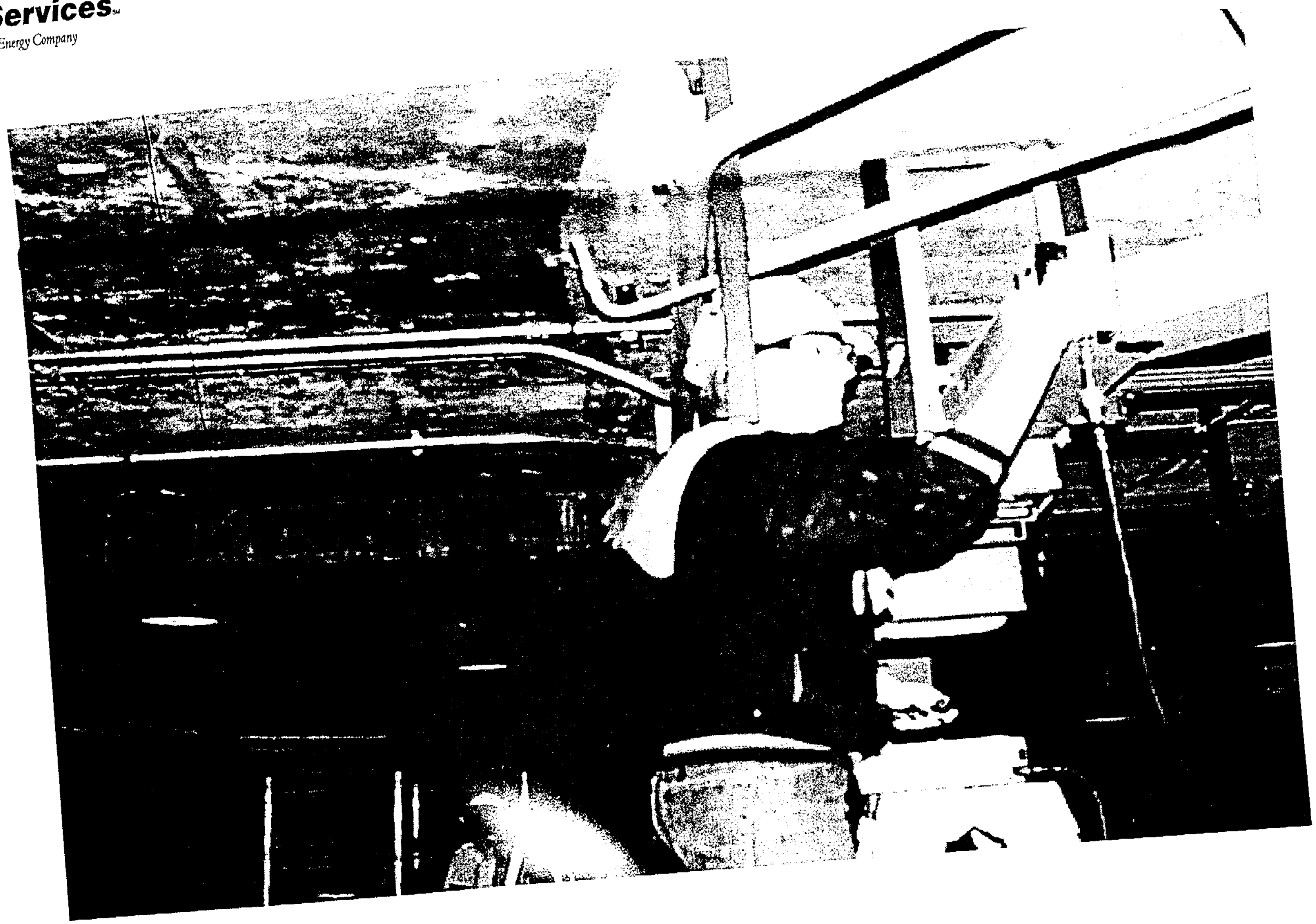

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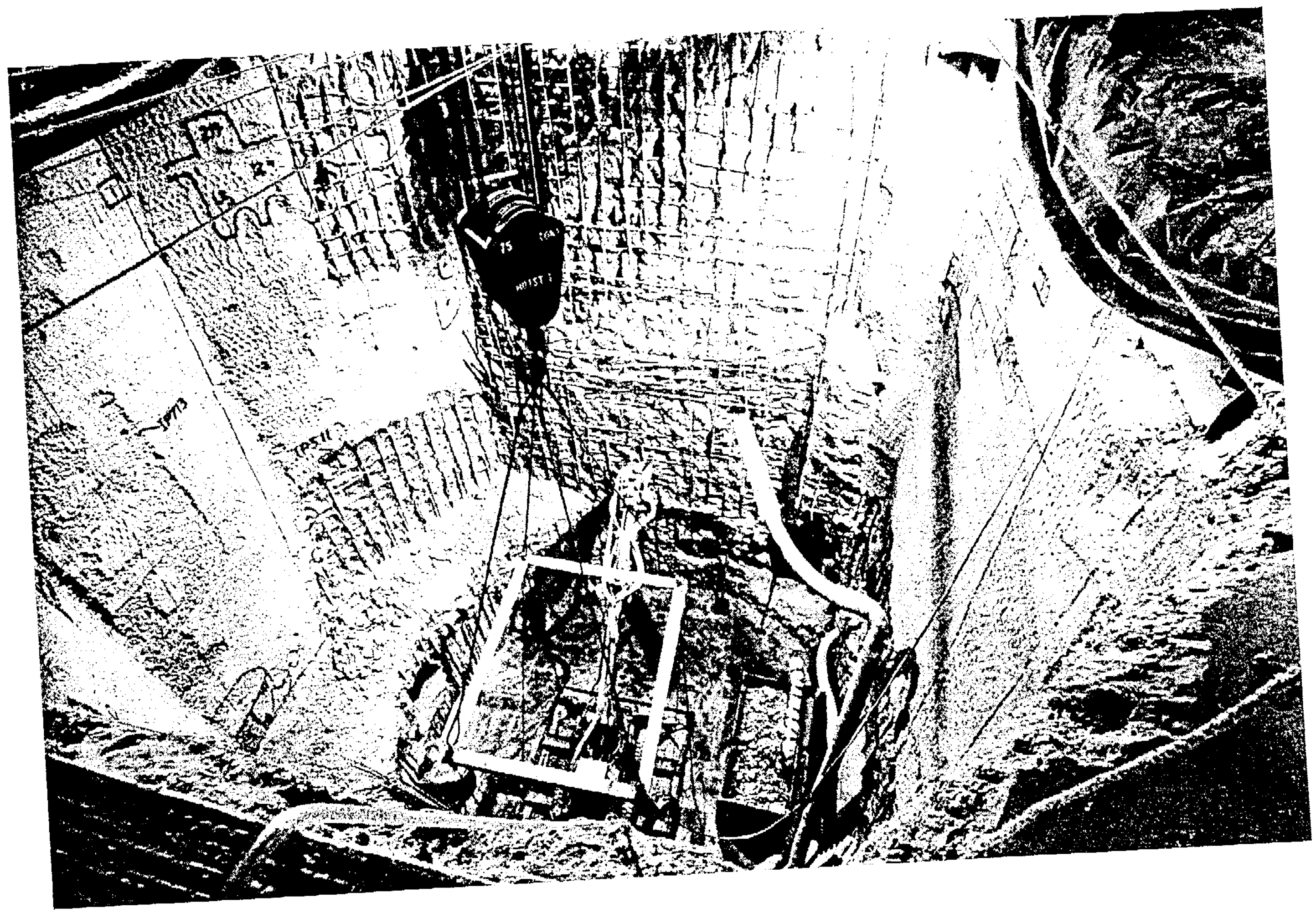

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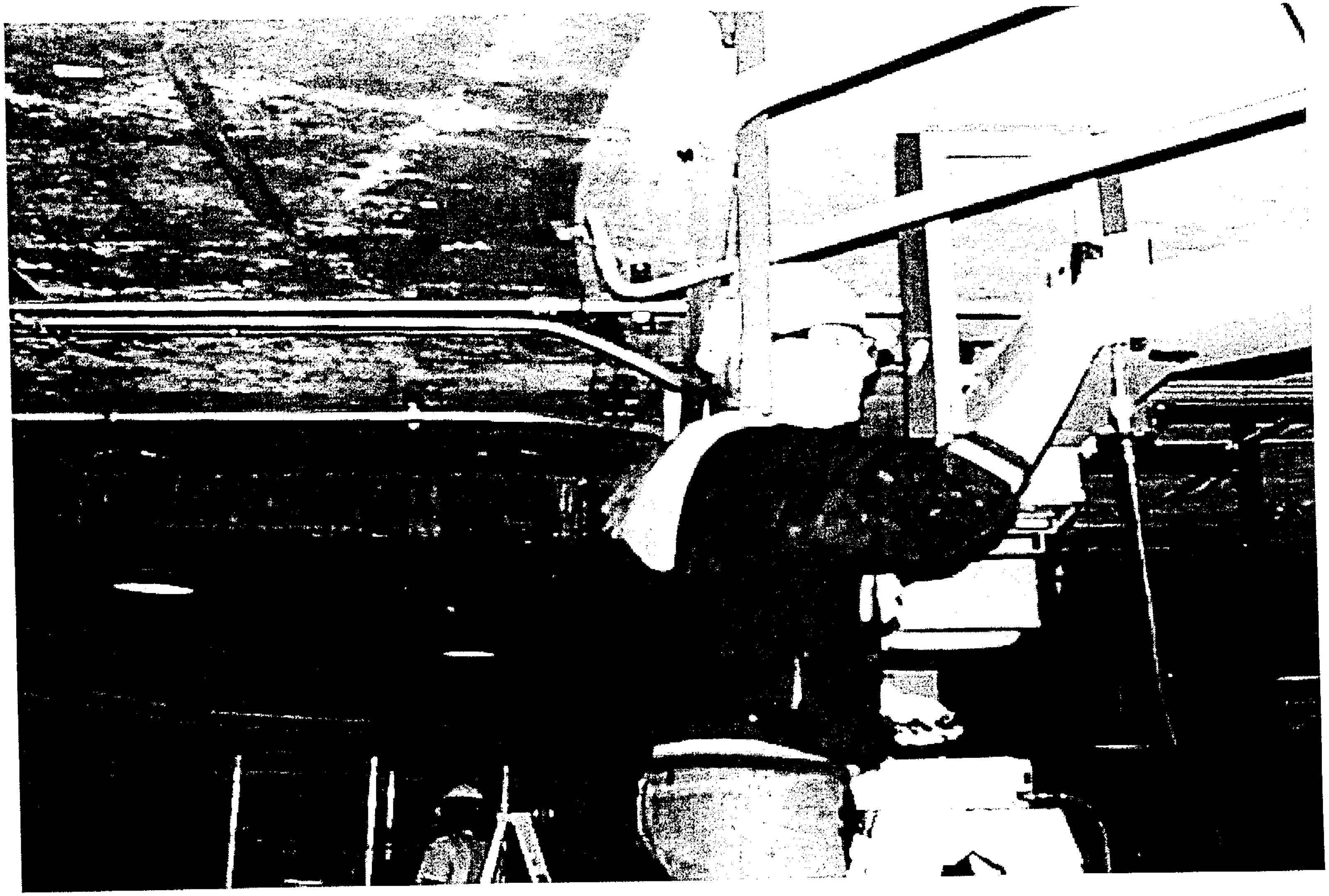

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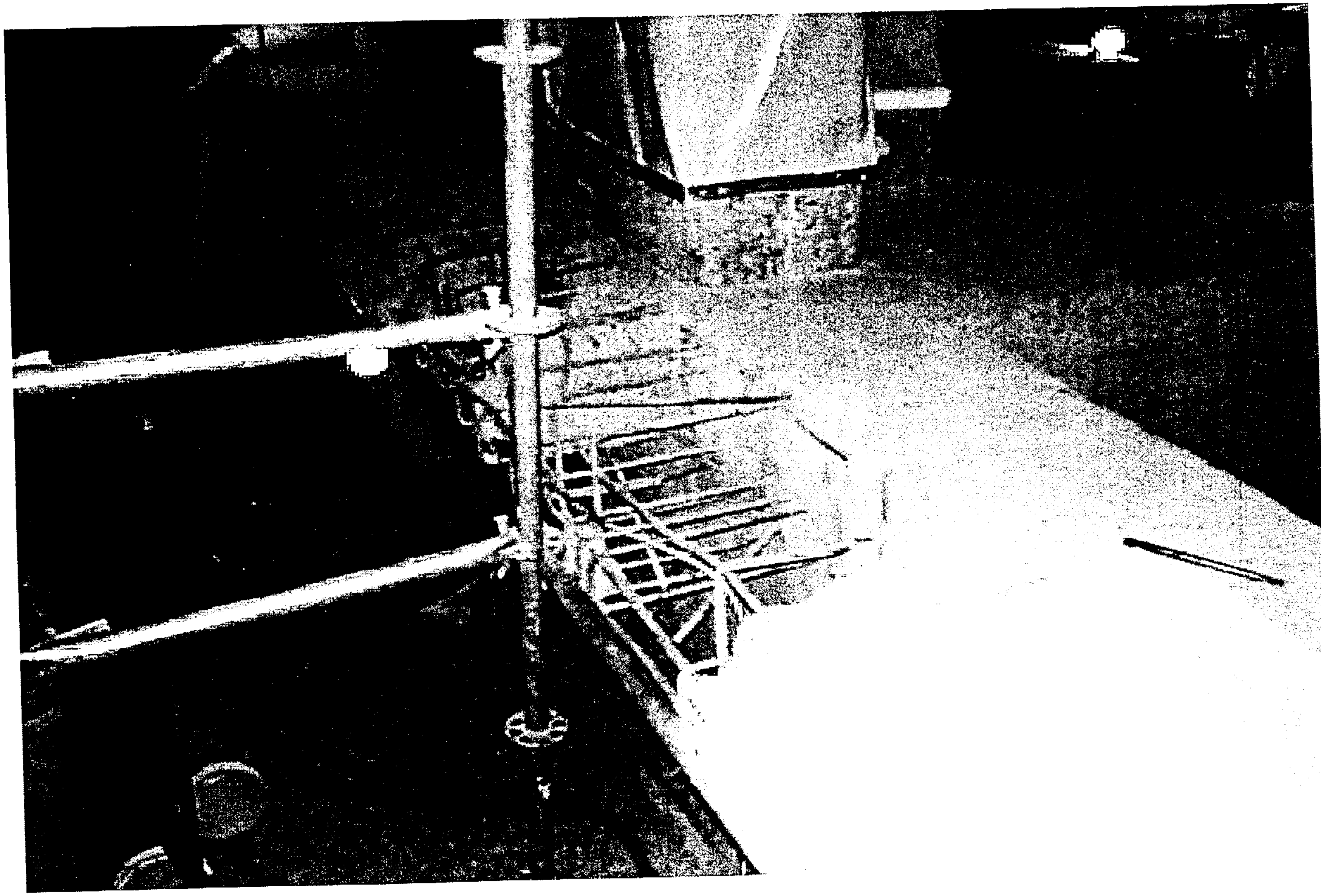

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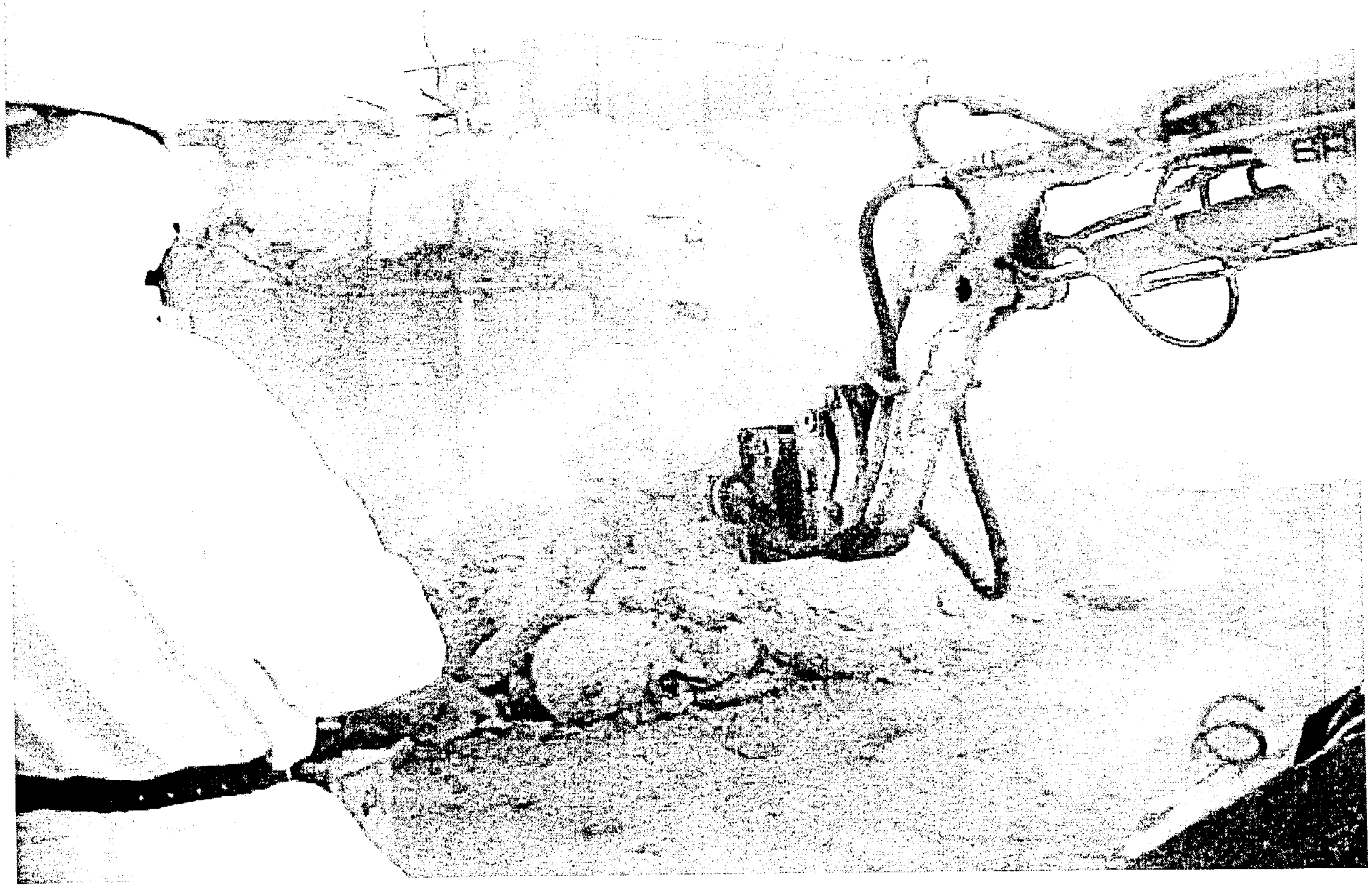

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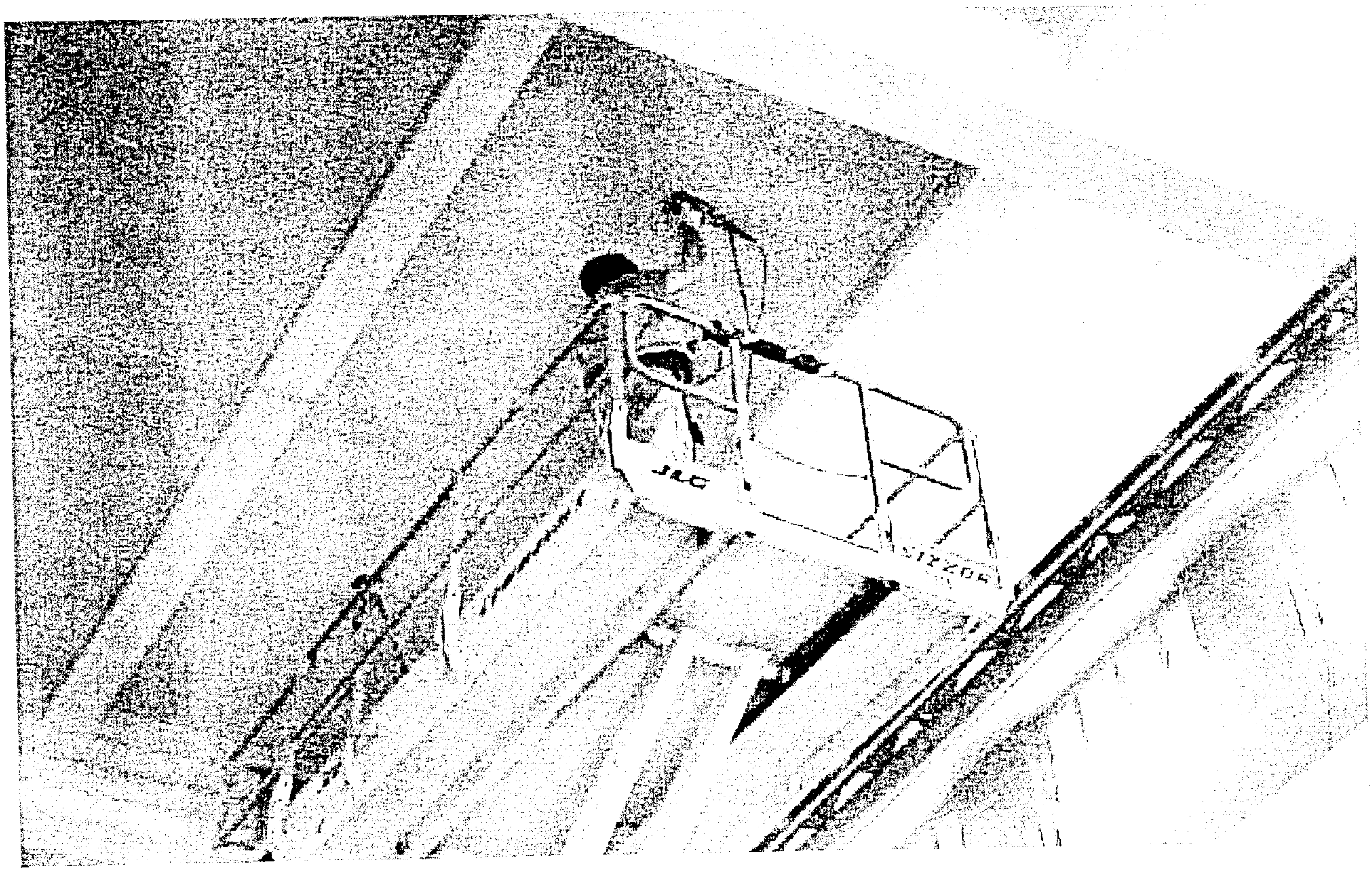

Control of Solid Materials: Need for Harmonizing State, National and International Clearance Standards

Dr. Jas S. Devgun

Chair

American Nuclear Society's

Special Committee on Site Cleanup and Restoration Standards

Presentation to

National Academy of Sciences

Committee Reviewing NRC Rulemaking

March 27, 2001

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American Nuclear Society

About : Committees

www.ans.org

Site Clean-Up Restoration Standards

The ANS Special Committee on Site Cleanup and Restoration Standards (SCRS) is responsible for reviewing draft regulations from federal organizations related to decommissioning of nuclear facilities and providing ANS input to the rule making process. The committee maintains expertise in the areas of license termination, site release criteria, bulk materials free release criteria, and environmental restoration. The committee also assists the ANS President and other committees in these areas.

Committee Chair

Dr. Jas S. Devgun

Devgun@Lnd.com

ANS/SCRS

- Special Committee on Site Cleanup and Restoration Standards

- Not in the business of writing standards

- Primary Role:
  - review and comments on behalf of ANS
  - maintain expertise
  - position papers

ANS/SCRS (Continued)

Review activities

- NRC
  - Development of LTR since 1994 until Final Rule in 1997
  - Draft DG-4006
  - Rulemaking on Control of solid materials
  - Draft NUREG-1640
- EPA
  - Monitoring EPA Efforts
    - 15 mrem/y site release criteria and groundwater protection
    - Clean Materials Program (metals)
- DOE
  - Release of non-real property standards
    - Revisions/additions to DOE Order 5400.5

SCRS: Some Recent Activities

- Participation in NRC's Rulemaking Workshops
  - San Francisco, September 15-16, 1999
  - Chicago, December 7-8
- ANS Annual Meeting 2000 Panel Session
  - "Clearance of Materials: Are we Any Closer to Consensus?", San Diego, June 2000
- Participation in NRC Decommissioning Workshop
  - Rockville, November 8-9, 2000
- ANS Comments to DOE
  - December 4, 2000
- "How Clean is Clean" workshop
  - "Clearance Methodologies: Harmonizing State, National, and International Standards",Tucson, February 25, 2001

SCRS: Future Activities

- Continued participation in the national debate on this issue
- ANS Annual Meeting 2001 Proposed Session
  - "Clearance Criteria - Still Eluding Consensus", Milwaukee, June 2001
- Working on a Draft Position Paper on the issue

ANS Position

- ANS has not issued an official position on this issue
- ANS has not endorsed ANSI N13.12
- ANS Letter To DOE dated December 4, 2000: Comments on DOE Standard
  - "ANS considers 1 mrem/y standard … to be unreasonably low and without a firm scientific justification"
  - "Scientific evidence would seem to support a dose limit several times larger than the proposed 1 mrem/y."

<u>Caution</u>

- SCRS position has not been reviewed/approved by ANS BOD

Why Important

- Regulatory void
  - 10 CFR 20 Subpart K requires demonstration of absence of licensed material prior to release of materials from licensed facilities
- Management of such materials is a substantial cost fraction of D&D
- Savings from disposition of bulk materials in local facilities
- Conserves much needed disposal space at radioactive waste facilities
- Recycling can provide significant means of reducing costs
- Preserves valuable resources

Problems and Issues

- No National or International Standards
  - Major limiting factor to recycling
- No internationally accepted clearance levels
- "One Glove Fits All"
  - concentration standard will not work
- Disposal of materials inherently different from recycle and reuse
- Currently used techniques/equipment archaic, newer techniques/equipment allow delectability to extremely low levels
- Inconsistencies in regulatory approaches
- Lack of uniform release criteria
- Public acceptance

Federal Initiatives

NRC

- Rule making effort on Control of Solid Materials
- Issues paper, NUREG- 1640 Draft
- Workshops
- NAS study

EPA

- Clean Materials Program

DOE

- Release of Non-real Property
- Revision/addition to DOE Order 5400.5
- Plan to codify in 10 CFR Part 834

Other Initiatives

States

- Input through CRCPD
- Agreement states
- Generally agree with 1 mrem/y criteria

Standards

- ANSI N13.12
  - 1 mrem/y criteria
  - Numerous exceptions noted in the standard

International

- IAEA/EC
  Risk-based approach
  10 μSv/y (1 mrem/y) individual dose limit
- OECD/NEA Task Group on Recycling and Reuse (NEA-TGRR- 1996 Report)
  - Compared total risks, recycling, disposal / replacement of disposed material
  - Considered transfer of risks

NRC vs. EPA

- Long standing disagreement
  - GAO Report on Radiation Standards
    GAO/RCED-00-152, June 2000
- Differences:

  Approach
  - NRC: Start with safe dose limit and apply ALARA
  - EPA: Start with acceptable risk, then derive dose limit

  Statutory Basis
  - NRC: AEA
  - EPA: CERCLA

"Radionuclides are not privileged pollutants!"

an EPA catch phrase

Understanding Where EPA is Coming From

- CERCLA/SARA

  Comprehensive Environmental Response, Compensation, Liability Act of 1980
  Superfund Amendment Reauthorization Act (SARA) 1984

- Executive Order 12580

  Federal facilities must comply with CERCLA

- NCP lists 757 radionuclides as hazardous materials

  National Contingency Plan

- Per CERCLA all radionuclides are Group A carcinogens

- EPA acceptable risk range10^{-4} to 10^{-6}
- For license termination
  - NRC and EPA disagree
  - NRC LTR 25 mrem/y, EPA proposed 15 mrem/y
  - 15 mrem/y equates to a cancer risk of $4x10^{-4}$

Recent DOE Actions

- Previous Guidance

  Nov. 17, 1995 Guidance Memo

  - Draft Handbook for Controlling release for Reuse or Recycle of Non-Real Property Containing Residual Radioactive Materials, June 1997
- January 2000, Secretary of Energy memo
  - Moratorium on release of volumetrically-contaminated metals from DOE sites pending decision by NRC on need for standards.
  - Established Re-Use and Recycle Task Force to conduct a review of DOE policies on recycle.

Recent DOE Actions (continued)

- July 2000 Secretary of Energy memo
  - Suspended unrestricted release for recycling of scrap metals
  - Release of scrap metals prohibited for recycling if contamination is detected;
  - Directed revision of relevant DOE directives and guidance

- January 19, 2001 Secretary of Energy memo
  " Managing the Release of Surplus and Scrap Materials"
  - Moratorium on release of volumetrically contaminated metals and suspension of release of all metals from radiological areas continue.
  - Department will prepare an EIS

Inconsistencies in Radiation Standards

- Not a new issue
- 1992 Congress intervened in BRC
- CIRRPC
- ISCORS (1994)
  - NRC, EPA, DOD, DOE, OSHA, DOT, DOH
- GAO Report June 2000

Alternatives

- Metals
  - release with no controls (into common trade)
  - Release for use within the nuclear industry
  - resource value vs. risk
  - disposal
- Concrete
  - recycle
  - disposal
- Other materials
  - reuse
  - recycle
  - disposal

NORM / TENORM

NORM

- State regulated
- Higher levels
- Longer half-life (Ra-226)

TENORM

International (EC) Issue

- Release of large quantities of TENORM at 1000 μSv/y (non-nuclear industry)
- Nuclear industry subjected to 100 times stringent criteria 10 μSv/y for clearance of material

Releases Under the Current System

- Reactor Licensees

  Operational

  NRC's Reg Guide 1.86

  Case-by-case approach

  20.2002 submissions

  Decommissioning

  Bulk materials: no mechanism

- Specific Licensees

  Criteria in Reg Guide 1.86

  State Regulations

Problems with RG 1.86

- Surface contamination guidelines only
- No volumetric criteria
- Not dose based

Conservatism in NUREG-1640

NUREG-1640 Vs. RG 1.86

Surface Clearance Levels

	NUREG-1640 dpm/100 cm^2	RG 1.86 dpm/100 cm^2
Co-60	280	5000
Cs-137	300	5000
Mn-54	820	5000

A Reasonable Philosophy

<u>ICRP - 60</u>

Justification of practice

Optimization

Use of dose and risk constraints

<u>ICRP</u>

Considering new recommendations

1 mrem/y and the Consensus

- Dose based criteria preferable
- Risk informed decision making
- NRC, EPA, and DOT may be coming closer on this
- HPS, NCRP, ICRP agree on 1 mrem/y as "trivial dose"
- IAEA and EC Clearance criteria

  10 μSv/y (1 mrem/y)

  trivial, safe, acceptable

Dilemma

- Input from metals and concrete industries at NRC workshops
  - opposed to recycling of metals with residual contamination
- Public wants zero increased radiation risk
- Technically I mrem/y is 1 mrem/y, extremely low risk
- Reasonable basis for decision making
- As a dose limit it is achievable

Issues

- One standard dose/risk based
  - derive field applicable guidelines
- Standards based on material/use/scenarios
- Release mechanisms for materials from
  - operating facilities (e.g. 10 CFR 20.2002 submissions)
  - decommissioning facilities
- Soils - a significant issue

Issues (continued)

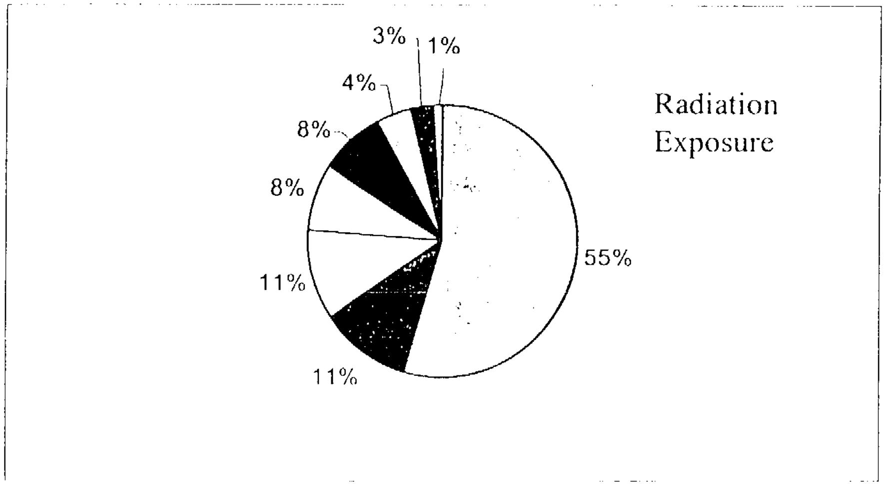
- Pathways Analysis codes
  - RESRAD

    accepted by DOE and NRC, not by EPA
  - DandD
  - RISKCALC

- Will the public accept the concept of trivial dose?

Risk in Perspective

- Risk
  - exposure to loss or injury or specific hazard
  - “risk is inherent in any action, even inaction”
  - Elements
    - What can go wrong?
    - How likely?
    - Consequences?
- Risk assessment
  - risk-benefit
- Risk management
- Risk perception
- Risk communication



55% Rn

11% Internal

11% Medical X Rays

8% Cosmic

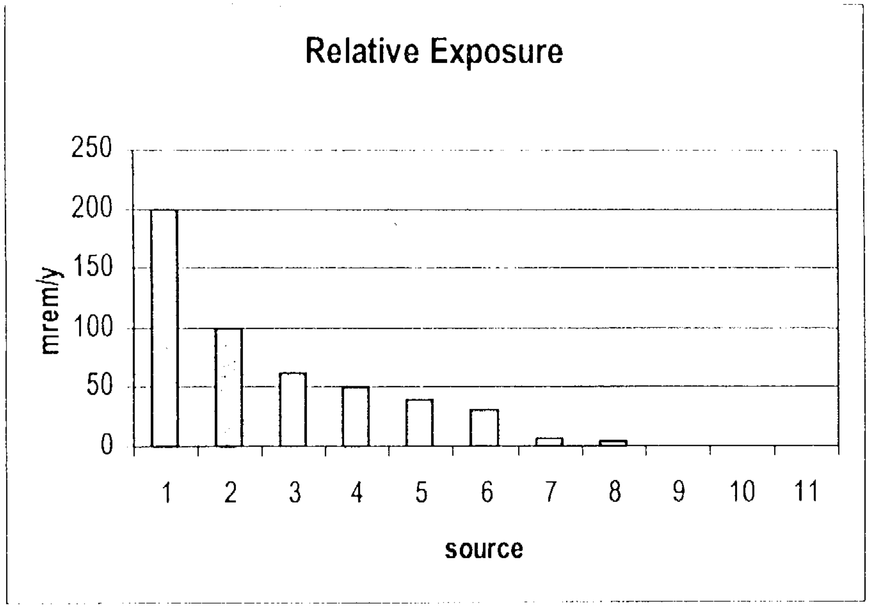
8% Terrestrial

4%% Nuclear Medicine

<3% Consumer Products

<1% Other

NCRP Report 93



How Low is 1 mrem/y ?

1	Radon
2	Brick House
	Concrete House
3	Terrestrial Denver
4	Wood House
5	Internal
6	Cosmic Chicago
7	X ray Chest
8	Flight NY-LA
9	TV
10	Computer
11	1 mrem/y

Need for Consensus is Evident

- One national standard
  - Consensus standard
  - multi-agency effort necessary similar to MARSSIM
  - Mechanism in place (ISCORS); solution awaiting
- Consistent with international guidelines
- Public consensus, communication and acceptance
  - "needed to succeed"

Conclusions / Recommendations

(Devgun/SCRS)

- Yes, a national standard is needed
- Reconcile "Control of Solid Materials" and " Clearance"
- National consensus standard: all federal agencies must sign on to it
- States must apply national standard - uniform application
- 1 mrem/y is a reasonable dose standard
- Separate disposal from recycle
- Public acceptance
- Time is now

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December 4, 2000

Mr. Harold Peterson, Jr.
Air, Water and Radiation Division
U.S. Department of Energy
1000 Independence Ave. SW
Washington, DC 20585

Subject: ANS Comments on Revisions to DOE Order 5400.5 Control of Releases of Materials with Residual Radioactive Contamination from DOE Facilities

Dear Mr. Peterson:

The American Nuclear Society is pleased to provide you our comments on the above.

We agree with the approach given in paragraph 2 of Chapter VI of the proposed criteria for release of scrap metal for allowing the release of property based on process and historical knowledge but with checks to ensure that the property has never been used for radiological activities. This is in keeping with the Multi Agency Radiation Site Survey Investigation Manual (MARSSIM) treatment of non-impacted areas and avoids unnecessary radiological surveys, which would result in the expenditure of taxpayer money with little or no benefit. However, we find paragraph 4 a of Chapter V too vague. The requirement that residual radioactivity be indistinguishable from background based on measurements using appropriate commercially-available technology and a comparison with similar non-impacted materials, leaves many questions unanswered. Our suggestions for clarifying this passage are included in the attached document.

On a strictly technical basis, ANS considers the 1 mrem/year standard for unrestricted release of metals for recycle to be unreasonably low and without a firm scientific justification. Background radiation doses generally vary from 200-300 mrem/year across the United States, and extensive studies have shown no detrimental health effects from exposure to the higher background radiation. Therefore, the scientific evidence would seem to support a dose limit several times larger than the proposed 1 mrem/year, perhaps 25 mrem/year.

Specific reaction to the above and other comments are attached for your consideration. DOE is to be commended for moving forward with this important issue, especially considering that the NRC effort in this area is currently stalled. There is clearly a need for a national standard for the clearance or release of materials and we strongly support steps in that direction. Our standards must also be consistent with the IAEA and the European criteria. We believe that this area needs the urgent attention and cooperation of the three federal agencies, DOE, NRC, and EPA, similar to the consensus effort that produced MARSSIM.

If there are any questions related to our comments, please contact Dr. Jas Devgun at 312-269-2283 or call me at 208-526-2930.

Sincerely,

James A. Lake

James A. Lake, Ph.D.
President

CC: Dr. David Michaels

BCC:

Review Task Force Members
Jas S. Devgun (Chair)
Douglas W. Akers
Leon E. Brown
William E. Kennedy
William J. Manion
David W. Minnaar

ANS COMMENTS
on

DOE proposed criteria for control of releases of solid materials and with residual radioactive contamination from DOE facilities.

Changes to DOE Order 5400.5
Chapter V: Control and Release of Personal Property Including Metal for Recycling
Chapter VI: General Requirements for Release of Property

ANS Comment 1

General Comment

Recent ANSI Standard ANSI N13.12 (August 31, 1999) provides both surface and volume radioactivity standards for clearance of materials. Has DOE considered adopting this standard?

ANS Comment 2

General Comment

The NRC initiated a rulemaking process through an issues paper on the control of solid materials published in the Federal Register on June 30, 1999 (Vol. 64, No. 125, Page 35090-35100). A draft report NUREG-1640 was issued for public comment in 1999 and NRC concluded a series of workshops on this rulemaking effort in 1999. However, NRC has deferred a final decision on whether to proceed with this rulemaking and has asked the National Academy of Sciences to study possible alternatives for release of slightly contaminated materials.

There is clearly a need for a national standard for the release of materials. If metal is released by one federal agency, say for example by DOE, what if it ends up in NRC or EPA jurisdiction? Unless there is a national standard, material released for unrestricted use could end up being restricted under other criteria. Therefore, ANS recommends that a multiagency task force be organized to develop a single consensus Standard that can be adopted by DOE, NRC and EPA.

ANS Comment 3

General Comment

For release of real property, the DOE authorized limits are consistent with the NRC requirements in 10 CFR 20 Part E, i.e., 25 mrem/y. Again, the NRC and EPA have not been able to agree on 25 mrem/y as the site release criteria. Disagreement in radiation standards continues as detailed in a recent GAO report, GAO/RCED-00-152, June 2000. Clearly, there is a need for consensus at the federal level where DOE, NRC and EPA do not go their different ways in developing such standards. We recommend following an approach similar to the multi-agency effort that produced the consensus MARSSIM methodology.

ANS Comment 4

General Comment

Our standards for unrestricted release of metals for recycle have to be in harmony with the international standards given the nature and volume of international trade (for example in recycled steel). The International Atomic Energy Agency and the European Commission have established an essentially dose-based criteria of 10 μSv/y (1 mrem/y), even though the derived mass-specific and surface-specific levels may vary in different countries. DOE criteria in Chapter VI, paragraph 3.d. (2) (a) 1 is consistent with the international criteria (except for the collective dose criteria; see later comments). However, it is just as important to define the methodology (for example, pathways analysis methods and parameters) to demonstrate compliance with this dose limit.

ANS Comment 5

General Comment

The issue of disposal of materials should be clearly separated from recycle. Unlike the recycle option, where the reuse scenarios for the material are limitless, disposal is a specific action that takes the material out of circulation and it is properly isolated from the human environment. The criteria for disposal will be different than if the material is recycled. For example, even based on the 1 mrem/y dose limit, the derived concentration guidelines will be different for the two cases. Specific language should be added in Chapter VI; see ANS Comment 9.

ANS Comment 6

CHAPTER V
Paragraph V 4.a. (2)

Section 4.a. leaves no room for a dose-based detection limit applicable to scrap metal. Unrestricted release of scrap metal can occur only if no radioactive material is detected. Although we can appreciate the purpose of conveyance of this message to concerned members of the public, the detail is glaringly absent. Who determines ▯not detectable▯ and by "what methodology"? The statement "..until residual radioactivity is indistinguishable from background based on measurements using appropriate commercially available technology and a comparison with similar non-impacted materials" is too vague. This is a meaningless direction until DOE defines: a) how to measure background; b) what minimum accuracy, range of nuclides and sensitivity are required of the "commercially-available measuring equipment" and; c) what protocols must be employed, including the level of statistical significance of measurements.

As stated currently, it could lead to applying different standards from site to site. It is problematic because background radiation fields vary significantly in different parts of the country and for non-impacted materials in different locales. Additionally, background could also vary significantly depending merely on how the instrumentation is shielded. From a scientific and radiological protection perspective, we believe that this unique, additional requirement cannot be easily or practically implemented, especially for the release of scrap metal absent some selected dose-based criterion, similar to that discussed later in Chapter VI.

Consequently, the criterion as stated needs much clarification. To start with we suggest that it is more appropriate to require a statement such as "...based on measurements using commercially available instrumentation capable of detecting, as a minimum, surface guidelines specified in Table VI-1 of this order...". DOE should address the issues raised above.

ANS Comment 7

CHAPTER V
Paragraph V.4

The proposed changes do not address metal which may have radioactivity incorporated into the interior or matrix of the metal. This should be noted in Chapter V, Paragraph 4. Footnote 1 to Table VI-1 states that no generic concentration guidelines have been approved for material that has been contaminated to depth. This statement is buried too far back in the document. Similar language should be included in Chapter V.

We suggest adding a paragraph under paragraph VI.3 such as "Scrap metal suspected of containing radioactivity incorporated into the interior or matrix of the metal (such as activated material or smelted contaminated metals) shall not be released unless it meets limits approved consistent with paragraph VI.3.d of this Order and approved by EH-1".

ANS Comment 8

CHAPTER VI
Paragraph VI.2

We agree with the approach given in paragraph 2 for allowing the release of property based on process and historical knowledge but with checks to ensure that the property has never been used for radiological activities. This is in keeping with MARSSIM treatment of non-impacted areas and avoids unnecessary radiological surveys which would result in the expenditure of taxpayer money with little or no benefit. For the site property evaluation, we recommend including MARSSIM in the text.

For the property that has been decontaminated, checks must ensure that it has been decontaminated to meet the DOE authorized limits.

ANS Comment 9

CHAPTER VI

We suggest inclusion of the disposal option in a more explicit form. It appears that Chapter V already has specificity for landfill disposal for scrap metal in paragraph V.4.c. (2). But the general requirements of Chapter VI should contain the landfill disposal option more explicitly by adding to paragraph VI.3.b. (2) following new wording:

"For bulk wastes or personal property, including scrap metal, that will be disposed in permitted waste landfills, there is reasonable assurance the waste or property will not be recycled or otherwise reintroduced into general commerce."

ANS Comment 10

CHAPTER VI

In Chapter VI, the crux of what must be addressed in an authorized limit is a dose-based limit of 1 millirem per year to an individual (see paragraph 3.d. (2)(a) 1/). Except for scrap metal, this appears to provide for an implementable criterion to govern unrestricted release of non-real property.

ANS Comment 11

CHAPTER VI
Paragraph VI 3. d. (2) (a) 1

The statement as currently worded gives the criterion as an individual dose limit of 1 mrem/y or a collective dose criterion of 10 person-rem in a year as an alternative criterion. We recommend the individual dose limit (1 mrem/y) without any references to a collective dose.

Although the DOE ALARA process requires consideration of collective dose to the population (DOE 5400.5 paragraph I.2.a. (2)), it's not appropriate for the release of property. MARSSIM methodology may be applied along with the RESRAD family of codes to determine potential maximum dose to individual members of the public from the release of real property. However, this will not lead to the determination of collective dose. For unrestricted release, collective dose is virtually impossible to determine.

The use of the concept of collective dose is not consistent with ANS Position Statement 41, "Health Effects of Low-Level Radiation". Collective dose takes on meaning only if the concept of the Linear No Threshold hypothesis (LNT) theory is considered valid.

ANS Comment 12

CHAPTER VI

One area of concern is the requirement that the instrumentation used be capable of detecting the concentration indicated in Table VI-1. Footnote 4 of this table has a significant impact on the system detection limits. Footnote 4 indicates that where scanning surveys are not sufficient to detect levels in the table, static counting must be used to measure surface activity, and representative sampling (static counts on the areas) may be used to demonstrate compliance by analyses of the static counting data. The maximum contamination level applies to an area of not more than 100 cm^2. These requirements would suggest that more sophisticated instrumentation will be required in the future to meet the system measurement guidelines of Table VI-1. Current instrumentation used for release measurements is a standard GM hand survey instrument. These requirements will make systems such as scanning assay systems that utilize multi-channel analysis and have isotopic analysis capability mandatory for performing free release analysis.

ANS Comment 13

CHAPTER VI

Another area of concern is that a DOE-approved release protocol will be required. This requirement could and will likely result in significant increases in quality assurance and system calibration requirements that are well beyond those currently in use. This modification could result in a significant increase in characterization costs due to (potentially) much more extensive requirements for measurement system validation, verification, and documentation.

<u>ANS Comment 14</u>

CHAPTER VI
<u>Paragraph VI 3.f (2) (c)</u>

The statement " ..and DOE project management responsible for certifying the release must report directly to DOE" needs clarification.

<u>ANS Comment 15</u>

CHAPTER VI

In paragraph VI 3.d (DOE Approval) and paragraph VI 3. f. (Certification and Verification), the responsibilities of various organizations, such as Field Offices, DOE contractors, DOE/EH are not clearly stated. We recommend that DOE designate a single office with the authority to approve the release criteria and the measurement protocol.

<u>ANS Comment 16</u>

CHAPTER VI

The nomenclature of sections and subsections is confusing and hard to follow. e.g., paragraph VI 3.f.(2) (a) 1/. We suggest a clearer nomenclature of sections and not mixing of alphanumeric, seemingly without a scheme.

<u>ANS Comment 17</u>

CHAPTER VI

Surficial activity guidelines in Table VI-1 compare inconsistently with the ANSI N13.12 Table 1. Has an attempt been made to consider other guidance on this issue?

<u>ANS Comment 18</u>

CHAPTER VI

Provision should be made in the characterization requirements for the use of scaling factors for beta and alpha emitters and relating those scaling factors to measurements of specific gamma emitters associated with the material being characterized. The volatility and solubility of both the scaled radionuclide and measured radionuclide should be considered when developing the scaling factors.

ANS Comment 19

CHAPTER VI
General Editorial/Technical Suggestions

Paragraph VI 3 a. (5)
Change "demonstrate that" to "that demonstrate"

Paragraph VI 3.b. (3)

The word "will" does not appear to belong in the second line.

Paragraph VI 3.c. (2)(b)

Delete ..."collective and"...

Paragraph VI 3.d. (2)(a) 1/

Delete ..."or a collective dose of more than 10 person-rem in a year"...

Paragraph VI 3.d. (3)

Delete ..."or a collective dose of more than 10 person-rem in a year"...

Paragraph VI 3.g. (1)

Use "indicate" instead of "indicated"

Paragraph VI 3.g. (1) (f)

Radioactive waste has no bearing on documentation for the release of property. The documentation should include conditions of the property being released, the limits, and the survey process for release, not the decontamination efforts prior to the release.

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Presentation to National Research Council Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities

by

Gary L. Visscher

Vice President, Employee Relations

March 27, 2001

I appreciate the opportunity to address the Committee and to present the views of the American Iron and Steel Institute ("AISI") regarding the topic that this Committee is charged with addressing: "Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities." AISI is a trade association of North American steel producers. Its 47 producer member companies account for about 70% of the steel produced in the United States and over 80% of the steel produced in Mexico and Canada.

With me today is Mr. Anthony LaMastra, of Health Physics Associates, in Lenhartsville, Pennsylvania. Mr. LaMastra has been a consultant to U.S. steel companies on radiation control and related issues.

AISI, on its own and through the Metals Industry Recycling Coalition has been deeply involved with the issue of release of steel and other metal products from nuclear facilities. It is an issue that has involved many different fronts. AISI submitted comments on the Nuclear Regulatory Commission's 1999 *Issues Paper on Release of Solid Materials at Licensed Facilities* and participated in the Commission's May, 2000 proceeding on Efforts Regarding Release of Solid Material which led to the request to the National Academy of Sciences to which this Committee is responding. AISI, as a member of the Metals Industry Recycling Coalition also contributed its views on the Department of Energy's proposed changes to DOE Order 5400.5, regarding release of radioactively contaminated materials from DOE facilities. In addition, AISI has also been working with steel producers in other countries to through the International Iron and Steel Institute (IISI) to address the problem of radioactive contamination in steel scrap. AISI has also worked with the state radiation control officials regarding better identification of so-called "orphan sources" of radioactive metal, and we are working with the U.S. Customs Service and the Environmental Protection Agency on pilot projects to identify any potential radioactive contamination scrap steel being imported into the United States.

AISI and the metals industries supported the recommendation of the NRC staff to request the National Academy of Sciences to conduct a study and provide recommendations on the release of solid materials from nuclear facilities – the request that you are now engaged in answering. But that support included the caveat that "[f]or this study to be meaningful, NAS must examine the commercial, economic and public perception issues raised" by release of radioactively contaminated metals.

Thus we appreciate the fact that this Committee's "Statement of Task" includes the direction to the Committee to "explicitly consider how to address public perception of risks associated with the direct reuse, recycle, or disposal of solid materials released from NuRC-licensed facilities. The committee should provide recommendations for NuRC consideration on how comments and concerns of stakeholders can be integrated into an acceptable approach for proceeding to address the release of solid materials." (Paragraph (2) of the Statement of Task)

This aspect of the Committee's task goes to the heart of AISI's concern with the release of steel from nuclear facilities. AISI's position is that the concern for the public perception of the safety of steel and other metal products *can only be addressed by a policy of no free release of radioactively contaminated steel and metal products.* Steel and other metal products should be released solely for specified restricted applications that would preclude its being scrapped, melted, and recycled for use in consumer or commercial products where it is not serving a nuclear-related purpose.

The main reason we oppose "free release" from licensed facilities of scrap metal and other metallic products that are not to be used off-site for their original purpose is that once such materials enter the recycling stream in any significant volume, the marketability of metal products for commercial and consumer use will be severely adversely affected.

Regardless of whether, as a matter of exposure models and current health physics, some level of radioactive contamination is deemed "safe" for released steel, that will not address our problem. Whatever the NRC and the DOE may say about the safety of products made from "released" metals having very low levels of radioactivity, the marketability of these products will be determined by public perceptions, not by objective evaluations of risk.

The issue of public perception is an overriding concern for steel producers and other sectors of the metals industry whose markets depend heavily on public trust in the safety of our products. Even if only a small percentage of the public loses confidence in the safety of steel, the impact is substantial. For example, metal food containers is a $1 billion per year market. If the steel industry lost even 10% of that market, it would mean a loss of $100 million per year to the steel industry. If steel lost 50% of the food container market, it would no longer be a viable competitor in that market. Obviously it would be devastating blow to an industry already suffering a severe financial squeeze from the combination of world over-supply and illegal trade practices.

Our concern about the effect of releasing radioactively contaminated steel into the general stream of recycled steel from which commercial and consumer products are made is not simply unwarranted paranoia. In 1999 Wirthlin Worldwide conducted a series of focus groups and a broader survey to gauge public reaction to the possibility of steel and other metals being released from nuclear facilities for recycling into commercial and consumer products. The reactions were overwhelming negative. For example, in the survey, when asked what their impression of steel would be if they knew that a small amount of steel from closed facilities containing far less than the government approved safety level of radioactivity was recycled into the mainstream production of new steel, the respondents gave an average rating of 43.6 on a scale of 0 to 100, with 0 indicating an unfavorable impression of the material and 100 indicating a favorable impression. This was 24 point drop from the rating given to steel prior to introducing the issue of recycled steel from closed nuclear facilities.

I might note here that over the past five years the steel industry has spent a great deal of time, effort and money to increase public awareness of the benefits of steel products – in terms of the safety of the products, the safety benefits of steel to consumers, and the fact that steel is far and away the most recycled material. The entire hard-won gain from that campaign would, we fear, be more than undone by one ill-conceived and unnecessary government policy decision.

It is not, in our view, an acceptable alternative to say that government agencies and/or the steel industry itself would be able to overcome the negative perception by doing a better job of "selling" the safety of radioactively contaminated steel run nuclear facilities. Both the focus groups conducted by Wirthlin and the experience of government agencies suggest that, regardless of what the government says, (1) many consumers are not convinced that we know enough about long term risks of low level radioactivity that they would take a chance with products and materials to which they have daily exposure, and (2) many people simply do not trust any governmental agency, commission or department to tell them what is safe.

Nor will consumers remain ignorant that this material is being released for general recycling. We have already seen instances of media stories on the possibility of having low-level radioactive metals "used for silverware, pots and pans, watches, eyeglasses...the zipper on your pants, your earrings, your belt buckle, a hip replacement joint, your baby carriage." (ABC World News Tonight with Peter Jennings, August 24, 1999) Another article in the magazine The Progressive similarly referred to "your bracelets, your silverware, the zipper on your pants, the coins in your pocket, frying pans, belt buckles, the chair you're sitting on, the batteries that are in your car and motorbike, the batteries in your computer"[1] that could be radioactively contaminated if metal was released from nuclear facilities into general recycling. Against such graphic descriptions, the assurance of a government standard of "safe" level or radioactive contamination is not going to help us keep the confidence in the safety of our products on the part of many consumers.

In short, as I said earlier, we believe that the public perception is adequately addressed *only by prohibiting any free release of radioactively contaminated steel or metal products for general recycling into scrap steel used for commercial and consumer products.*

In fact release of radioactively contaminated steel into the general stream of scrap steel would be a "double whammy" on the steel industry. First, it would likely seriously damage the market for steel products by eroding public confidence in the safety of steel products. But even as free release would, we believe, undermine our market it would also add substantially to our costs. Steel producers do not in fact sell contaminated steel, and steel producers take extensive and expensive steps to prevent any radioactively contaminated scrap steel from reaching their steel making. A melt of radioactive scrap – which currently may result from the presence of "orphaned" sources in the scrap stream – can have severe consequences for a steel mill or other metal-

[1] Anne-Marie Cusac, "Nuclear Spoons," *The Progressive*, October, 1998 at 22.

melting facility. Generally, any radioactivity in scrap is detected by a portal monitor upon entering a steel plant site and the load of scrap is rejected and information given to the appropriate radiation control office. However, there have been several instances in which "orphaned sources" have entered steel plants, escaping detection. The costs of decontamination, disposal, and shutdown associated with "radioactive melts" at minimills have ranged from $8 million to $25 million, and they are estimated to run as high as $100 million or more should a radioactive melt occur at a large integrated facility.

To protect against the risk of a radioactive melt – and to protect their employees, their property, their products, and the general public – steel mills and other metals melting facilities utilize scrap monitoring alarm systems that are set to detect radioactivity levels slightly above background. Free release of radioactively contaminated metals from NRC-licensed facilities, however, could undermine the effectiveness of these monitors in preventing radioactive melt for a number of reasons.

First these systems are sensitive to gamma radiation but not to alpha or beta radiation which may be present in volumetrically contaminated metal of the sort that might be released under a NRC dose-based standard. Thus allowing the free release of radioactively contaminated metals from licensed facilities would increase the risk of radioactive melt. This could be a serious problem even if the level of radioactivity in the scrap would meet dose-based standards when it is released, because the radioactivity could concentrate in the flue dust or slag to a higher level than in the incoming scrap.

Second, even if the sensors detect the above-background radioactivity from "free release" scrap metal so that radioactive melt is avoided, the increasing frequency of the sensor alarm soundings would itself create problems. When a sensor alarm sounds, there is a possibility that the scrap contains a radioactive source which, if melted, would create a very expensive and disruptive problem for the facility. Thus, such alarms must be taken seriously. Responding to a sensor alarm involves substantial costs. Among these are heightened employee concern, disruption of facility operations, the provision of notice to governmental agencies, arranging for return of the scrap to the supplier, and segregating the load pending its removal. There is also the risk that, like the boy who called "wolf" too often, if sensor alarms sound with increasing frequency there is a danger that employees may eventually not take them with appropriate seriousness.

The risk of increased incidents of radioactively contaminated scrap reaching steel plants is, of course, also a risk to workers in the steel industry. Even if the monitoring used in steel plants successfully detects any radioactive contamination, our employees will be subject to additional exposure in the detection and in any decontamination that must take place.

In short, even while free release of radioactively contaminated steel would lead to de-selection of steel because of the public's perception of the safety of steel products, it would also increase the costs and risks to the industry and to our employees of ensuring that steel products are in fact safe. Because of where it is in the recycling

chain, the steel industry becomes the last checkpoint for keeping radioactive contamination out of steel products. As the amount of radioactive material in the recycling chain increases, so too do the costs of ensuring the safety of steel products. In effect, some portion of the disposal costs of radioactive contamination will be transferred to the steel industry, a transfer that is unwarranted and unnecessary.

So what approach do we propose? AISI and the Metals Industry Recycling Coalition have suggested the following approach to both the NRC and the Department of Energy.

1. No unrestricted release of any radioactively contaminated steel or other metals from NRC-licensed facilities, even if the steel meets dose-based release levels which this Committee might recommend and NRC adopt.

2. Metal-containing equipment or products from a licensed facility that are to be used for their original purpose off-site could be released without special restrictions if they meet a dose-based standard.

3. Scrap metal or metallic items from a licensed facility that meets a dose-based standard that are not to be used for their original purposes off-site could be released for disposal in landfills, or released for processing for dedicated, nuclear-related, uses. These might be at an NRC licensed facility or a DOE facility. For example, scrap metal from licensed facilities could be released and reused in containers for storage of nuclear waste.

4. If the operator of the licensed facility reasonably believes and certifies that the scrap metal has not been radioactively contaminated (in other words, comes from a non-radioactive part of the facility) and if the radiation detection technology and sampling/analytical protocols employed by the facility are sufficiently sophisticated and set to detect above background levels of alpha, beta, and gamma radiation for all relevant isotopes, the metal might be released for unrestricted recycling.

5. Any release, under either number 3 or 4 described above, must be conditioned on appropriate labeling, tracking, and monitoring. The labeling and monitoring must be maintained to the point of disposal, reuse or melting. Only in that way would the steel mill know the source of material and be able to make an informed decision as to whether to accept it.

6. Finally, while we understand that the Committee's responsibility is to make recommendations to the NRC, we believe the same approach should be taken by the Department of Energy with regard to any release of radioactively contaminated steel and metal products from DOE facilities.

National Academy of Sciences Presentation

Eric Stuart
Manager, Committee Affairs
Steel Manufacturers Association
March 27, 2001

- THE STEEL MANUFACTURERS ASSOCIATION (SMA)
  - 51 NORTH AMERICAN COMPANIES:
    42 U.S., 6 CANADIAN, AND 3 MEXICAN
  - 147 ASSOCIATE MEMBERS:
    SUPPLIERS OF GOODS AND SERVICES TO THE STEEL INDUSTRY
- SMA MEMBER COMPANIES
  - OPERATE 125 STEEL PLANTS IN NORTH AMERICA
  - EMPLOY ABOUT 120,000 PEOPLE
  - MOSTLY "MINI-MILL" ELECTRIC ARC FURNACE (EAF) PRODUCERS

- **PRODUCTION CAPABILITY**
  - EAF REPRESENTS 47% OF U.S. PRODUCTION IN 2000
  - SMA REPRESENTS OVER HALF OF U.S. STEEL PRODUCTION

- **RECYCLING**
  - SMA MEMBERS ARE THE LARGEST RECYCLERS IN THE U.S.
  - LAST YEAR, THE U.S. RECYCLED OVER 70 MILLION TONS OF FERROUS SCRAP

- **GROWTH OF SMA MEMBERS**
  - EFFICIENCY AND QUALITY DUE TO LOW COST
  - FLEXIBLE ORGANIZATIONS
  - EAF GROWTH TO SURPASS 50%, IN JANUARY, 2001, AND ANTICIPATED TO BE 60% BY 2010

BELIEVE IT OR NOT

RADIOACTIVELY CONTAMINATED SCRAP HAS NO VALUE

FREE RELEASE PROGRAM HAS NO SUPPORT IN METALS INDUSTRY

- INTERNAL DOE STUDIES HAVE SHOWN THAT PRIOR RELEASES WERE NOT PROTECTIVE
- SAME STUDIES SHOWED PAST SORTING METHODS USED AT OAKRIDGE WERE INADEQUATE
- MATERIAL CONSIDERED "BELOW REGULATORY CONCERN" IS STILL NOT ACCEPTABLE TO MILLS
- PROGRAM VIEWED BY MILLS AS A WAY FOR DOE TO SHIFT CLEAN-UP RESPONSIBILITY TO INDUSTRY
- WOULD DAMAGE RECYCLING INDUSTRY'S REPUTATION

SMA Recommends Restricted Release

- Absolutely no "decontaminated" scrap from radiological areas released offsite

- Material should be reused by DOE, stored or disposed of onsite at facility, or disposed offsite

- Dose based standards <u>are not</u> effective measure of protection - some contamination could still exist

- <u>Consumers do not want this material recycled</u>, regardless of the calculated risks

Some DOE Material Could be Recycled

- Some material from <u>non-radiological</u> areas could be recycled:
  - need strict clearance standards (similar to those recommended for decontaminated materials)
  - need a tracking system (manifest, labels, etc.) so material doesn't lose its DOE "identity"
  - must have certifications from contractors & DOE that material was not in affected areas

POSSIBLE IMPROVEMENTS FROM STEEL INDUSTRY'S POINT OF VIEW

- MORE SEVERE PENALTIES HANDED OUT FOR WILLFUL DISREGARD OF NRC RULES & FOR LOST DEVICES
- INDELIBLE MARKING ON ALL DEVICES
- REGISTRATION & TRACKING OF ALL GENERALLY LICENSED DEVICES
- PREVENT KNOWN SOURCES (DOE, NORM, ETC.) FROM ENTERING SCRAP SUPPLY
- REVIEW ACCEPTABLE LEVELS OF RADIONUCLIDES IN BAGHOUSE DUST FROM MELTING ACCIDENTS

METAL SURVEY ERRORS

Recyclable Metal Must Be Surveyed to Determine If It Is Safe for Release

BNFL's contract allows it to sell salvageable metal (excluding nickel) on the open market to recover some of its costs. However, BNFL must survey the metal to ensure that it meets Department Order 5400.5 criteria prior to release. Department Order 5400.5 states that for the isotopes of concern (uranium and technetium), all surface contaminated materials with activity levels exceeding 5,000 disintegrations per minute per 100 centimeters squared (dpm/100 cm^2) averaged over a square meter or a maximum of 15,000-dpm/100 cm^2 at a single point cannot be approved for release on the open market. BNFL established an administrative limit of 5,000-dpm/100 cm^2 at a single point. Since BNFL's administrative limit does not allow for averaging over a square meter, the acceptable activity level is much more conservative than that allowed by the Department.

As part of the process, before BNFL surveys a particular lot of metal, it assigns the material to one of three classification levels utilizing process knowledge and field evaluations. This classification system is based on the Multi-Agency Radiation Survey and Site Investigation Manual. This system dictates the minimum amount of surface area in each lot that must be surveyed depending on the classification of the material. Class I material is known or expected to contain contamination above the Department's release criteria; therefore, 100 percent of each lot must be surveyed. Class II material is known or expected to contain contamination below the release criteria; thus, between 10 and 100 percent of each lot must be surveyed. Class III material is expected to contain little or no contamination, and about 10 percent of each lot must be surveyed.

BNFL's Survey Results Were Inaccurate

As the final step to the release process, the Operations Office hired an independent verification team to verify that BNFL was properly surveying recyclable metal. Through May 2000, the verification team tested 639 lots of metal that BNFL had surveyed and determined to be appropriate for release. The team found that 22 lots exceeded the administrative limit. Of the 22 lots, 2 exceeded the Department release criteria. In several cases, the differences between BNFL's and the team's survey results were significant. For example, in the beginning of the project, BNFL surveyed a lot containing lube oil pipe at 530-dpm/100 cm^2; however, the verification team determined that the metal had an activity level of 110,000. In a more recent case, a lot consisting of pipe supports at 1,973 by BNFL, but the verification team determined the metal had an activity level of 16,000.

The percentage of lots the verification team rejected based on BNFL's administrative limit due to BNFL's surveying errors almost doubled from 1.8 percent to 3.4 percent in the 4 months ended May 2000. As a result, on May 29, 2000, BNFL issued a temporary stop-work order concerning all surveying activities.

Survey Personnel Lacked Adequate Supervision

Many of the results of metal surveys that have been documented to date as being inaccurate were a result of BNFL employees who performed the surveys not being adequately supervised. It has been noted that BNFL experienced significant turnover in survey supervisors. This large management turnover affected training and continuity with the BNFL survey program and was creating potential systematic problems with the release process. Specifically, the knowledge which the supervisors obtained concerning the areas of material most likely to contain contamination as well as recurring problem areas would have been lost unless BNFL documented the information in work records and then required every new supervisor and every new survey technician to review those records. BNFL, however, was not documenting recurring problem areas and thus did not initiate corrective actions on a trending basis. For example, the verification team reported problems with transformer surveys to BNFL in September 1999. The team then found three more lots where BNFL personnel incorrectly surveyed transformer activity levels in December 1999, February 2000, and April 2000. The verification team also reported that problems were occurring with supply duct surveys in February 2000. During the next two months, the team identified four additional lots that exceeded the release criteria.

Risk of Release of Contaminated Metals Increased

As a result of inaccurate surveys, the risk to the public that contaminated metals were released from the site was increased. Since the verification team does not verify every item in each lot, additional surveying errors would not be detected, and in some cases, lots exceeding the release criteria may have been released. As of the end of May 2000, about 6.6 million pounds of unrestricted metal were released for recycling from the site. To date, no instances of contaminated metal have been reported by recipients of the recycled metal.

Although unrelated to our report, the Secretary of Energy suspended the release of potentially contaminated scrap metals for recycling from Department nuclear facilities effective July 13, 2000.

September 12, 2000

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)
Inspector General

SUBJECT: INFORMATION: Audit Report on "The Decontamination and Decommissioning Contract at the East Tennessee Technology Park"

BACKGROUND

The East Tennessee Technology Park (ETTP), formerly known as the K-25 Site, was established in 1942 to produce enriched uranium. Since the production mission ended in 1987, the Oak Ridge Operations Office (Operations Office), which is responsible for the ETTP, has focused on environmental management of the site. In August 1997, the Operations Office awarded a $238 million fixed-price contract to BNFL, Inc. (BNFL) to decontaminate and decommission (D&D) three large uranium enrichment buildings in the ETTP. BNFL was also to recycle or dispose of the materials in the buildings and make the buildings available for commercial use by September 2003. Through June 2000, the Department approved upward price adjustments to the contract totaling $12 million. The objective of this audit was to determine whether the D&D of the three buildings will be completed within the current contract price and on schedule.

RESULTS OF AUDIT

BNFL is not on track to complete the D&D of buildings K-29, K-31, and K-33, within the current contract price or on schedule. As of March 2000, BNFL had incurred 61 percent of the costs associated with the current value of its contract, but it had completed only 14 percent of the project. The audit disclosed that BNFL's management team was ineffective. We found that the contractor had changed project management teams twice during the first two years of the contract and has been slow to identify and correct significant problems. We noted, as well, that the Operations Office did not pay sufficient attention to BNFL's escalating project cost. In discussions during the audit, the contracting officer was not aware that BNFL's total project cost would be significantly higher than the contract price. To put the problem in perspective, we estimate the project will cost $94 million more than the current contract amount of $250 million and that completion is at least two years behind schedule. This estimate is based on the current scope of work and does not include uncertified requests for equitable upward price adjustments totaling $107 million, which BNFL has already submitted.

Observations:

1. Status of knowledge of demand for LLW containers is very poor.
   1996 - Demand estimated at 417,000 tons steel.
   2000 - Demand estimated at 426,000 tons steel, but far higher proportion of Stainless and Alloy 22, and mostly in the period 2011-2035.
2. Status of Knowledge of supply of scrap from DOE facilities is very poor.
   1998-99 - Supply estimated at 625,000 tons carbon steel, 59,900 tons stainless steel, 67,000 tons nickel.
   2000-2001 - Supply estimated at 865,000 tons carbon steel, 174,000 tons stainless steel, 37,600 tons nickel. Most generated in period 2003-2008.
3. Costs of surface decontamination ($600 - $2000 per ton) are far in excess of the value of the scrap ($50 per ton), even assuming someone wants it.
4. Costs of disposal (burial) are obscenely high. Contract for $25MM to dispose of (not clean) 5000 tons of scrap steel vessels that have been sitting on a one acre site at Portsmouth, ($5,000 per ton), is obscene.
5. Best solution would be to seal up the GDP plant buildings and let them sit. The buildings are good for nothing else anyway, and no one will want them.
6. Management of the D & D process is out of control. To quote Charles Crocker during the building of the Central Pacific RR in 1867, who said he would "never have anything more to do with anything that had to be managed in government style, " clearly nothing has changed in the intervening 133 years. DOE Inspector General has reported on the cost overruns by BNFL at Oak Ridge, and cannot even guess at the final total.

RECOMMENDATIONS TO SEC OF ENERGY TASK FORCE

G. H. GEIGER

- The melting and refining of large tonnage's of steel scrap should be done by companies and people with experience in this type of operation. That is the only way to do it EFFICIENTLY AND SAFELY.

- There is no need to invest in a new facility to perform this work. Some incremental investment in environmental control equipment at existing sites will be required, however, in all cases. Nevertheless, this will cost far less than a new facility.

- New technology should not be tried for this business. The history of new technology start-ups in the steel industry is fraught with excessive start-up times and many failures. This is not the place to try something new.

- There are two existing commercial steel melting facilities whose owners have indicated a willingness to enter into further discussion to provide a leased, dedicated site to melt carbon and/or stainless steel for DOE.

- The ratio of nickel available (68,000 tons) to carbon steel available (623,000 tons) is very close to that needed to convert all of the material to 300-series stainless steel, if desired. Ferro-chromium would have to be purchased at a cost of about $200 per ton of stainless steel product, but the resulting 300-series Cr-Ni stainless steel would cost **$1000 per ton less** than if purchased from the commercial market. For 700,000 tons of stainless steel over 10 years, **the savings versus buying commercial material would be about $700 MM**. The material could be rolled to whatever thickness is needed, from 0.135 inch (12 gauge) for B-25 boxes to 10 mm for high-level waste or spent fuel flasks. **I recommend that the scrap be used to melt as much stainless steel as possible.**

- The dedicated site can melt and cast slab material that would then be rolled into hot-rolled carbon or stainless steel coils directly at site B , or at another site on a tolling basis if melted and cast at site A.

Plant B			
Tons coil per year		50,000	100,000
Total Operating Cost per ton DOE scrap melted		**$269.25**	**$251.63**
Annual Fixed Cost w/o Fee	**$4,590,000**		
Management Fee, net of taxes		$60.00	$55.00
Total Cost per ton of DOE scrap melted		**$329.25**	**$306.63**
Total Cost per ton of Coil		$341.59	$318.12
Annual Capital Investment per ton of DOE scrap melted	$1,913,545	$36.89	$18.44
Annual Capital Investment per ton of coil		$38.27	$19.14
Total cost per ton DOE scrap including capital charge		**$366.14**	**$325.07**
Total cost per ton coil including capital charge		$379.86	$337.26
Note: For stainless steel add 440 lbs.of ferrochromium at $0.53/lb to per ton cost			

Plant A			
Tons Coil per year		50,000	100,000
Total Operating Cost per ton DOE scrap melted		**$270.84**	**$232.83**
Annual Fixed Cost w/o Fee	**$6,575,000**		
Management Fee, net of taxes	$3,000,000	$58	$30
Total Melt/Cast cost per ton DOE scrap melted		$328.67	$262.83
Capital recovery	$3,344,233	$64.47	$0.00
Toll Rolling Cost to hot strip		$70.00	$70.00
Cost of Hot Strip w/o capital recovery		$398.67	$332.83
Cost of Hot Strip with capital recovery		$463.14	$332.83
Note: For stainless steel, add 440 lbs of ferrochrome at $0.53/lb.to the cost per ton.			

Capital Costs for Options

Option 4 Brownfield DOE, melting and casting only

3 scrap buckets		$300,000
Lime storage and charging system		$200,000
used 65 ton EAF		$1,500,000
new Transformer		$1,000,000
Spare transformer		$1,000,000
new Substation		$4,000,000
Cooling tower-furnace		$500,000
Water treatment and recirculation system		$3,000,000
Cooling tower-casting machine		$300,000
2 -reconditioned 120 ton cranes		$2,500,000
4- 65 ton ladles		$240,000
3- slagpots		$300,000
Slagpot carrier		$300,000
slag crushers/screens/dust control		$1,500,000
600,000 cfm Baghouse (new)		$6,000,000
HEPA filter system beyond baghouse (new)		$2,000,000
dust handling system		$500,000
oxygen supply plant		
slab casting equipment		$12,000,000
Caissons/piling		$2,000,000
Building to support 120-ton cranes		
with 90 foot width and height , 700 ft length		$7,200,000
ladle reline and preheat facility		$500,000
Ferroalloy storage and supply system		$1,000,000
Chemical analytical facility		$1,000,000
Met Lab (ASTM testing)		$800,000
Rail spur to bring in scrap	1 mile	$1,000,000
locomotive to move rail cars (used)		$125,000
Initial fill refractories		$500,000
Furnace power control system		$500,000
Electrical installation	40000 hrs @$60	$2,400,000
Mechanical installation	40000 hrs @$60	$2,400,000
Hydraulic installation	40000 hrs @$60	$2,400,000
Air permit		$100,000
Water permit		$100,000
Project management		$2,000,000
	Subtotal	$61,165,000
Engineering @8%		$4,893,200
Contingency @20%		$13,211,640
	Total	**$79,269,840**

Option 5 Greenfield, melting and casting only

3 scrap buckets		$300,000
Lime storage and charging system		$200,000
new 65 ton EAF		$4,000,000
new Transformer		$1,000,000
Spare transformer		$1,000,000
new Substation		$4,000,000
Cooling tower-furnace		$500,000
Water treatment and recirculation system		$3,000,000
Cooling tower-casting machine		$300,000
2 -reconditioned 120 ton cranes		$2,500,000
4- 65 ton ladles		$240,000
3- slagpots		$300,000
Slagpot carrier		$300,000
slag crushers/screens		$1,500,000
600,000 cfm Baghouse (new)		$6,000,000
HEPA filter system beyond baghouse (new)		$2,000,000
dust handling system		$500,000
oxygen supply plant		
slab casting equipment		$12,000,000
		$2,000,000
Building to support 120-ton cranes		
with 80 foot width and 500 ft length		$7,200,000
ladle reline and preheat facility		$500,000
Ferroalloy storage and supply system		$1,000,000
Chemical analytical facility		$1,000,000
		$800,000
Rail spur and yard to bring in scrap	4 miles	$1,000,000
locomotive to move rail cars		$125,000
Initial fill refractories		$500,000
Furnace power control system		$500,000
Electrical installation		$2,400,000
Mechanical installation		$2,400,000
Hydraulic installation		$2,400,000
Air permit		$100,000
Water permit		$100,000
Office/locker room		$1,500,000
Project management		$2,000,000
	Subtotal	$65,165,000
Engineering @8%		$5,213,200
Contingency @25%		$14,075,640
	Total	**$84,453,840**

Capital Costs - Option 3

Plant	A Without rolling capability	B With rolling capability
Baghouse	0	6,000,000
HEPA filter	2,000,000	2,000,000
pressure slab caster, installed	12,000,000	0
radiation detectors	150,000	150,000
First fill refractories	500,000	500,000
General refurbishment	1,500,000	1,500,000
Electrical/Mechanical installation	2,000,000	0
RAD Training	50,000	50,000
Engineering	500,000	500,000
Subtotal	18,700,000	10,700,000
Contingency @20%	3,740,000	2,140,000
Total	**$22,440,000**	**$12,840,000**

Cost per ton

Years amortized	10	10
interest rate	8.00%	8.00%
Capital recovery factor	0.14903	0.14903
Annual cost	$3,344,233	$1,913,545
Cost per ton @ 50K	$66.88	$38.27

Option 3. Relocate commercial arc furnace and and retrofit existing DOE facility to conduct melting operations at that site.

In this option, the material from the Dissasembling operation would be segregated by isotopes present, and the material which was considered Low Contaminated would be further cut into maximum five foot long pieces and moved to the DOE site, located in one of the existing GDF plants. This would involve shipping material from other DOE sites to the one with a retrofitted operation. The Highly Contaminated material would go to burial sites for final disposal, or is cut into one foot pieces for melting in existing small melting facilities in Oak Ridge for production of shield blocks.

A commercial electric arc furnace would be purchased and relocated to a DOE GDP plant, installed, along with casting equipment, and the scrap would be melted, refined, and cast into slabs for further processing into sheet or plate product and fabrication into containers elsewhere. Slag and dust from the refining operations would go to Low Level Waste disposal, and the metallic product would be used entirely within the DOE complex. Operation of the facility would be by a contract operator using existing DOE GDP personnel.

Option 4. An existing commercial electric arc furnace facility would be contracted for dedicated use for melting, casting, and rolling Low Contaminated scrap metals.

In this option, segregation of scrap again separates the Low Contaminated material from the Highly Contaminated material, and the Highly Contaminated material goes to burial, or is cut into one foot pieces for melting in existing small melting facilities in Oak Ridge for production of shield blocks.

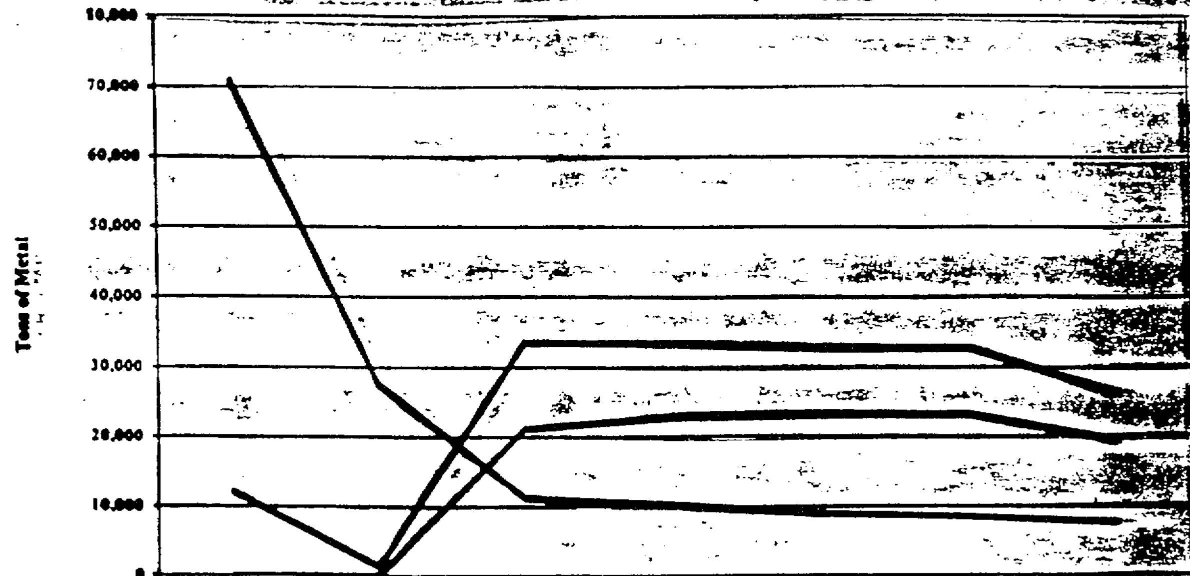
Again the Low contaminated material is cut into maximum five foot pieces. It is then shipped to an existing commercial steel mill site, where it is melted, refined, cast, and rolled into sheet or plate. From there it goes to a commercial fabricator of containers to be used within the DOE complex. . Slag and dust from the refining operations would go to Low Level Waste disposal. The mill would be dedicated to this use by its owner/operator, who would provide the operating crews and manage the production operation under contract to DOE.

Option 5. A new facility outside of the DOE facilities would be built to accomplish the melting, casting, and rolling of the Low Contaminated scrap metal

This option assumes that some firm builds an entirely new facility to accomplish the same process as in Option 4.

Exhibit 2-[illegible]. [illegible] Reuse Metal Product Demand

[illegible] the demand over the time period indicated.



	FY 2003-2005	FY 2006-2010	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035
Carbon Steel	71,005	27,645	11,185	10,232	8,897	8,457	7,[illegible]
Stainless Steel	12,013	1,288	33,428	33,328	32,640	32,640	28,223
Alloy 22	0	0	21,147	23,836	23,221	23,196	19,320

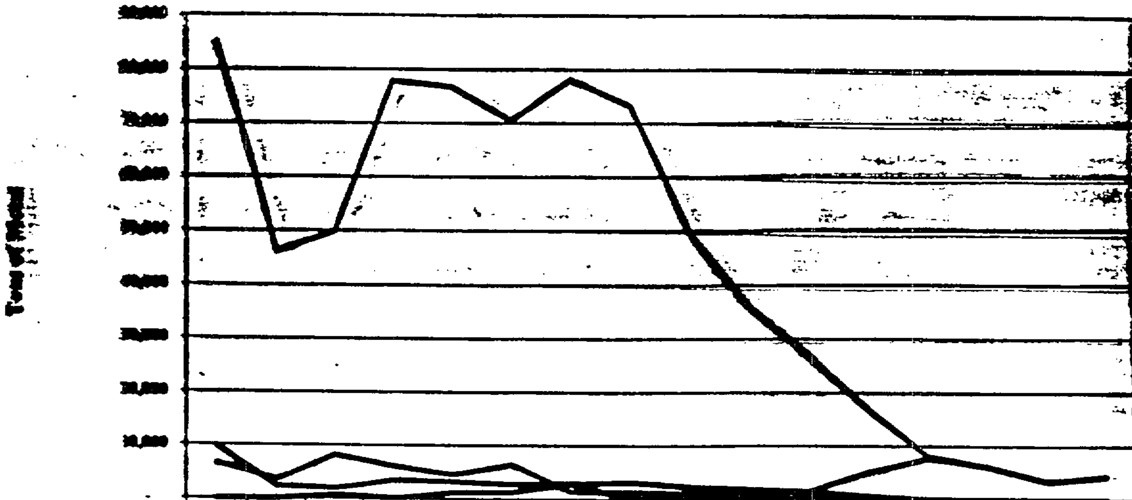
Exhibit 2-8. Component Metal in Each Product Category

Product Category	Total Metal Weight (Tons)	Type of Metal in Category	Component Metal Weight (Tons)
Boxes/Small Containers (<1,000 lbs tare)	30,301	Carbon Steel	30,301
Large Containers/Roll-offs/ Cargos/Sea Land	44,748	Carbon Steel	42,074
		Stainless Steel	2,675
Drums	17,668	Carbon Steel	17,668
Infrastructure/Construction	59,300	Carbon Steel	44,700
		Stainless Steel	14,600
Other Products	274,463	Carbon Steel	10,258
		Stainless Steel	154,284
		Alloy 22	109,920

Exhibit 3-2. Current and Projected Generation of Metal by Year

"Feeds" Quantity of Metals

***Note: For the 5 year periods beginning in FY-2011, the listed metal quantities equal the generation/year**



	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011-2015*	FY 2016-2020*	FY 2021-2025*	FY 2026-2030*	FY 2031-2035*
Carbon Steel	85,387	46,199	49,917	77,838	76,723	70,399	78,179	73,885	49,637	36,254	22,026	16,871	8,868	6,166	3,380	4,480
Stainless Steel	6,609	3,501	8,217	6,078	4,505	6,513	1,254	1,312	986	1,289	1,486	5,972	7,747	6,695	3,239	4,822
Nickel	9,700	2,283	1,879	3,476	3,168	2,670	2,874	3,114	2,233	1,897	1,497	587	0	0	0	0
Iron	11	53	778	101	1,181	1,267	2,822	75	97	53	53	106	26	26	26	26

Fiscal Year

Exhibits 3-3 through 3-6 reflect both a minimum and maximum level for the current and projected inventory for metal based on the confidence level of the data, as well as the adjusted base quantity. **The data should be given no more significance than the nearest thousand tons.**

Washington State's Perspective on Controlling the Release of Solid Materials from Nuclear Facilities

John Erickson, Director
Department of Health
Division of Radiation Protection

March 27, 2001

Washington State Radiation Program

- 400 Radioactive Materials Licensees
- Low Level Radioactive Waste Site
- Two Uranium Mill Sites
- Several U.S. Navy Facilities
- Hanford

Our Radioactive Materials Licensees

- Most licensees use sealed sources or relatively short-lived radionuclides.
- Very few pose a threat to the environment.
- Some licensees evaluate potentially contaminated material for possible release.

D&D in the Past 5 Years

- Two Uranium Milling Operations
- Nuclear Laundry
- Waste Processor/Decontamination Service Provider
- Hanford

Methods Used for Release of Material

- Normal operations
  - Survey for levels indistinguishable from background
  - Instrument dependent

Methods Used for Release of Material (cont)

- Criteria in Regulatory Guide 1.86
  - Release of contaminated equipment
  - Release of building components
  - Release of contaminated metal

Methods Used for Release of Material (cont)

- Case-by-case evaluations
  - Soil contamination from spills
  - Detector geometry issues for releasing odd shaped materials
  - Non-uranium mine tailings

Methods Used for Release of Material (cont)

- D&D License Termination Rule
  - Releases facilities for unrestricted use
  - Termination surveys for medical licensees and R&D labs
  - Meant for land and buildings only, not for removal of material from site

Hanford

- In general we get involved after something has moved offsite and is found to be contaminated in some way
  - Recycled metal
  - Free released facilities
  - Contaminated facilities partially free released

Where We are Today

While our use of case-by-case decision making is very complicated, it works well for the few licensees needing it.

Overall our current system serves our needs.

What Do We Suggest?

- Update Reg Guide 1.86
  - Provide specific activity limits of contamination based on dose instead of instrument capability
  - Define models and parameters to be used to meet the dose

More Suggestions

- The tables in 10CFR on exempt concentrations and exempt quantities should be re-evaluated. They are not based on a dose limit.
- Release of volumetrically contaminated material should be tied to these tables.

More Suggestions

- Use one millirem (10 microsieverts) risk-informed, dose-based criterion
- Consensus among these groups:
  - NCRP
  - IAEA
  - ICRP
  - ANSI
  - Some environmental groups
- Need to consider its application to naturally occurring radioactive material

Reasons for 1 millirem

- One millirem annual dose constraint achievable
- Allows multiple exposures
- Vocal public wants zero increased radiation risk
- Appropriate for removable material limit to be less than limit for fixed facilities

  (1 vs 25 mrem)

Restricted vs Unrestricted

- Oppose "restricted" category of free release. Radioactive material needs to be controlled or not controlled.
- Difficult to track over state boundaries.
- Limit should apply to all substances.
- If the dose is trivial the matrix is unimportant.

Finally
How Low Should We Detect?

- Ever lower detection limits are useful in research but not necessary at all levels of operation.
- Balance the ability to detect low levels with the necessity for doing so.

Comments on Clearance Rules
Organization of Agreement States

Presented by John Erickson, Washington Division of Radiation Protection

On behalf of the Organization of Agreement States (OAS) I would like to thank the National Academy of Sciences for the opportunity to provide comments on Clearance rulemaking issues. The OAS understands that you are hearing comments from several states on issues important to their particular state regarding clearance of radioactive material. The information presented by those states should help you understand the scope and range of issues important to states in general.

The OAS would like to encourage the NAS to look towards creating a set of standards that could be used on a national level. These standards should address free release of material and guidance or standards for restricted release of material (for recycling or reuse of material with slight contamination). This approach is similar to the Nuclear Regulatory Commission's tiered approach to termination of licensed sites. Different uses of radioactive material (including oilfield and pipeline diffuse NORM and activated components of accelerators in addition to materials covered under the AEA) need to be considered.

Whenever standards are drafted, there must be discussions with regulators (including NRC, EPA, and states), licensees, professional societies, members of the public, and other federal entities (such as the Army Corps of Engineers and the Department of Energy). Consensus on standards is difficult to achieve, but there should not be differing standards for different regulatory agencies or federal entities.

These comments are purposefully brief because of the late hour of the day, and because you will be receiving more specific comments from individual states. This issue will have an impact on states, and the members of the OAS are interested to hear about your progress on this issue. In fact, you may want to consider presenting information and obtaining additional comment and feedback at the OAS Annual Meeting in Santa Fe later this year (October 8-10).

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National Academies
National Research Council
Division on Engineering and Physical Sciences
Board on Energy and Environmental Systems

Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission - Licensed Facilities

Meeting #2
March 26th - March 28th, 2001

Kathleen McAllister, Chair
Conference of Radiation Control Program Directors E-23 Committee
on
Resource Recovery and Radioactivity

Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission - Licensed Facilities

Meeting #2
March 26th - March 28th, 2001
by
Kathleen McAllister, Chair
CRCPD's E-23 Committee on Resource Recovery and Radioactivity

INTRODUCTION

Let me start by expressing my appreciation for being invited to participate in this important meeting. The control of solid materials from licensed facilities is a major National issue and this meeting of the National Academies' Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission - Licensed Facilities provides an excellent platform for focusing attention on scientific evidence and policy issues.

My experience includes working first as a civilian Physical Science Technician in the Naval Nuclear Propulsion Program, then as a Health Physicist for the New Hampshire Agreement State Program, and currently as a Radiation Control Officer for the Commonwealth of Massachusetts' Agreement State Program and as chair of the Conference of Radiation Control Program Directors, Inc. (CRCPD) E-23 Committee on Resource Recovery and Radioactivity. I am here today to express the views and recommendations of CRCPD's E-23 Committee.

CRCPD is a nonprofit professional organization whose members include individuals in state and local government who regulate the use of radiation sources, and individuals with an interest in radiation protection. CRCPD was formed in 1968, and its primary purpose is to serve as a common forum for governmental radiation protection agencies to communicate with each other and to promote uniform radiation protection regulations and activities.

HISTORICAL PERSPECTIVE

CRCPD has been involved with issues concerning the control of solid materials for more than two decades. In 1981, its members passed a resolution asking the NRC and EPA to coordinate their efforts in establishing levels of concentrations of radioactive materials, specific to a particular waste stream, below which regulatory control is no longer required.

In 1989, CRCPD issued a position statement affirming its support of coordination between the EPA and NRC for development of an individual dose criterion, and for establishing a policy and rulemaking based on sound, risk-based policy for exempting products or practices based on associated individual risks being trivial. States suggested establishing a reasonable frame of reference below which further regulation is unnecessary, and that demonstrates doses are as low as reasonably achievable without further cost-benefit analysis. CRCPD recommended 4 to 5 millirem because this was thought to be more appropriate than the range of 10 to 100 millirems being considered by NRC at that time. The recommendation was based on the possibility of exposure from combined exempted sources, regulatory actions already being taken with regard to licensed activities, and the recommendations of the International Atomic Energy Agency (IAEA).

IAEA had recommended that an individual effective dose equivalent in the range of 10 - 100 microsieverts (1 - 10 millirems) per year would represent an associated risk that is trivial, and a risk which most experts can agree is acceptable.

General consensus on this issue was said to be important, because inconsistencies between federal agencies are difficult to explain and justify to the public and licensees. States also recommended that NRC should coordinate any ensuing rulemaking efforts with other federal agencies, such as the Department of Transportation and the Department of Energy.

Regulatory agency program managers in every state, which included those that had already entered into an Agreement with the NRC for the discontinuance of NRC authority over byproduct, source and special nuclear material below certain concentrations within their state, those contemplating entering into an agreement, and those whose regulation of byproduct, source and special nuclear material remained under NRC's authority were participants to adoption of this resolution and position statement, which remain relevant to the matters under discussion today.

BACKGROUND

NRC and Agreement States (AS) typically regulate through the issuance of specific license conditions or through the promulgation of generally applicable rules, with NRC's own regulatory program defining the level of protection to be achieved by AS programs. For purposes of compatibility, states must contain aspects of NRC's program to ensure conflicts, duplication of efforts, or gaps in the overall system of radiation protection in our nation from materials covered under Section 274 of the Atomic Energy Act (AEA) do not occur.

States must adopt requirements that are essentially identical to NRC's requirements regarding basic radiation protection standards and significant trans-boundary implications. However, states have flexibility for other NRC requirements, such as most licensing requirements, and they may impose more restrictive requirements than NRC as long as they have a health and safety basis and they do not preclude a practice that is in the national interest.

In those cases where NRC has not established a requirement, a state has flexibility and discretion to adopt its own regulation, as long it maintains a program adequate and compatible to NRC's. This has resulted in differing approaches by states and NRC in establishing criteria for releasing slightly contaminated solid materials from licensed facilities. These differences are rooted in NRC's limited authority to apply its regulations and license conditions to only AEA material, the lack of generally applicable regulations promulgated by NRC to address the control of solid materials, and confusion with the interpretation and application of current guidance that addresses surface contaminated solid materials and not volumetrically contaminated materials.

Both NRC and states currently approve the release of slightly contaminated solid materials from licensed facilities. Reactor licensees are allowed to release materials in accordance with criteria specified in NRC*s Reg Guide 1.86, with no additional approval process for their procedures used. For specific licensees, the criteria in RG-1.86, or equivalent guidance documents are used for case-by-case evaluations, license conditions based on the guidance are used to establish release criteria, and some states have written release criteria into their regulations.

EXAMPLES OF CONFUSION FROM LACK OF UNIFORM REGULATIONS

Improvements in radiation monitoring and detection capabilities since guidance on surface contaminated materials was developed have accentuated gaps and inconsistencies with application of the guidance and license conditions. Monitoring equipment used at a release location may have a less sensitive detection efficiency than monitoring equipment used at a destination site, such as a scrap yard or landfill.

Very sensitive monitoring equipment has been installed at receiving facilities in order to intercept and protect workers and property from unexpected and improperly discarded stolen, lost or abandoned radioactive material. Monitoring equipment at landfills, incinerators and similar facilities is installed for the same reasons, and it is also used to ensure local environmental laws prohibiting burial or incineration of radioactive material are complied with.

The increased sensitivity of instruments and increased utilization of monitoring equipment, especially at landfills, has resulted in the increased detection of radioactive materials. Occasionally an alarm involves a lost or abandoned discrete source requiring prompt intervention and control for radiation protection purposes, but much more frequently, it involves waste from discharged patients who have recently undergone medical procedures with diagnostic and therapeutic radioactive materials. Patients often disregard, or do not understand, instructions given to them on the proper control and disposal of their wastes.

Migration of solid waste is "borderless" with regard to its transport and disposal, and this coupled with inconsistent regulations for safe, prompt, and legal disposition of a radioactive component to it has become not only a trans-border problem involving the states, but occasionally involving international trans-border issues between Canada and a state.

Canada has performed safety evaluations and developed exemption quantities below which radioactive material is considered acceptable for disposal and unrestricted handling, with no further concern for its radioactive properties. Waste may be disposed of legally in Canada, but it causes confusion and aggravation when it is transported to, and detected in, the states.

On a domestic level, accelerator produced radioactive material that is not covered under the AEA, and therefore not regulated by NRC, is also inadequately regulated by some states in which these medical procedures are performed. If this waste is transported to a monitored facility in a state that, by law, prohibits burial and incineration of radioactive material, its acceptance is refused in accordance with the facilities' permitting requirements. These, and similar situations involving patient waste, create a cascade of paperwork and expense for state agencies and the companies involved, it diverts resources from other priorities, and can indirectly serve to prolong the risk of exposure to far more serious consequences from chemical and biological contamination associated with the waste. Situations such as these occur daily, and do little to inspire confidence in a national system of meaningful radiation protection.

Despite inconveniences caused to them by installing radiation monitoring equipment at their un-licensed facilities, it is reasonable to assume that landfills and scrap recycling yards, as well as municipal public sewer facilities, and possibly concrete facilities will take it upon themselves to install radiation monitoring equipment, not only to detect unexpected radioactive materials, but for purposes that are in addition to radiation safety concerns, such as protection from baseless liability claims, to address the fears and concerns of workers, and to prevent adverse public perceptions that could lead to a loss of customers or market share.

These examples are meant to bring to the forefront concerns over every-day complications and confusions potentially recurring for states if a successful resolution to the issues and alternatives for controlling solid materials will apply only to NRC licensed facilities, and will not include the full scope of licensed activities regulated by AS.

NEED FOR COMPREHENSIVE EVALUATION

Intentionally released solid materials slightly contaminated with byproduct, source and technologically enhanced naturally occurring radioactive material may inadvertently be combined with unintentionally disposed radioactive materials from stolen, lost or abandoned sources, as well as with disposed consumer products containing intentionally introduced radioactive materials specifically exempted from further regulatory control, all at a single process facility. Thereby causing these sources of radioactive materials to be combined during the recycling process and reintroduced into finished consumer products. Consequently, it is important to assure that considerations with respect to second, third, and even later generation consumer products are uniform and uniformly applied, and that assumptions and exposure pathway modeling includes conservative assessments on the potential that these types of sources will, on occasion, be combined, with particular attention paid to the re-concentration of radioactive materials in the byproducts from recycling such as slag.

PROGRESS

Substantial progress has been made by respected scientific bodies in verifying the underlying scientific evidence used as the basis for implementing risk-based decisions limiting ionizing radiation doses below which risk to human health and the environment can be readily described as reasonable and safe. With the current initiatives started by NRC, and investigations conducted by this honorable committee, this is a welcomed process for closing gaps in current regulations and associated guidance. Under the public participatory process, federal agencies, states, industry, environmental groups and members of the public are active participants in this process and are directly influencing the selection of uniform improvements. E-23's experience with this process has fortified our earlier recommendations to NRC, and we continue to advocate for the eventual promulgation of clear, consistent and enforceable regulations based upon a one millirem annual dose criterion and nuclide specific concentration guidelines.

SUMMARY RECOMMENDATIONS

1. We recommend the promulgation of nationally applicable regulations, and development of concurrent guidance, that will address, but not necessarily be limited to, the following:

    - Adequacy of survey techniques and instruments

    - Training for personnel performing surveys

    - Survey requirements for objects with inaccessible and porous surfaces

- Sampling methods for volumetric solids

- Core sampling procedures, or alternative methods for adequately measuring radioactivity in soils and concrete that have been exposed to neutron flux

- Survey and control methods for avoiding the improper release of items exposed to neutron flux that may potentially contain internal activated components

- Sampling for alpha contamination

- Record keeping requirements

- Record retention

2. Maximum permissible activity concentration levels should be derived for commodities containing long lived radionuclides from past accidents, atmospheric nuclear testing, and prior improper disposals.

3. NRC and states should work as equal partners in an alliance to improve the control of solid materials and establish a uniform national regulatory system consistently adequate in protecting human health and the environment.

4. Scientific evidence, consensus standards, and recommendations developed by respected organization such as CRCPD, OAS, NCRP, ICRP, IAEA, Health Physicis Society, and ANSI N13.12 Committee should be the basis for technical decisions on dose-based criteria.

5. Maintain a flow of communication aimed at resolving policy issues and generating consensus based on shared science

DHEC

PROMOTE PROTECT PROSPER

South Carolina Department of Health and Environmental Control

Presentation to National Academy Of Sciences

Henry Porter, Assistant Director
Division of Waste Management
(803) 896-4245

Experiences With Release of Contaminate' Solid Materials

- Wastes

- Recyclable materi

- Products

Wastes

- Soil
- Waste water treatment sludge
- Electric arc furnace baghouse dust (NRC BTP)
- Calcium fluoride

Wastes

- Requests for disposal of slightly contaminated materials in RCRA, disposal facilities
- Reviewed as state equivalent 10 CFR 20.2002
- Request may come from licensee or disposal facility

Considerations for Wastes

- Risk (RESRAD) $\leq$ 1 mrem/yr.
- RCRA mixed waste that is not acceptable for disposal at an NRC or agreement state licensed facility
- Cost for disposal
- Disposal facilities generally in favor of receiving this material

Recycled Material

- Metals (aluminum, carbon steel, lead)
- Reusable military and commercial equipment

Considerations for Recycled Material

- Risk (pathway analysis)
  - Exposure during recycling
  - Partitioning in the recycling process
  - Exposure during use

Considerations for Recycled Material (cont.)

- Direct reuse or mixing with other "clean" material
- Future use of material
- Disposal cost and value of equipment
- Recyclers generally not in favor of receiving this material

Products

- Fluorine compou   - gases
- Hydrofluoric acid – liqu

Considerations for Products

SC has not to date approved any products

- Risk
  - Human consumption or application
  - Uses of the material
- Uses of products
- Value of products

Concerns

- Adequat pathway evaluation
- Public perception
- Detection at recyclers facilities
- Disposal capacity
- Costs

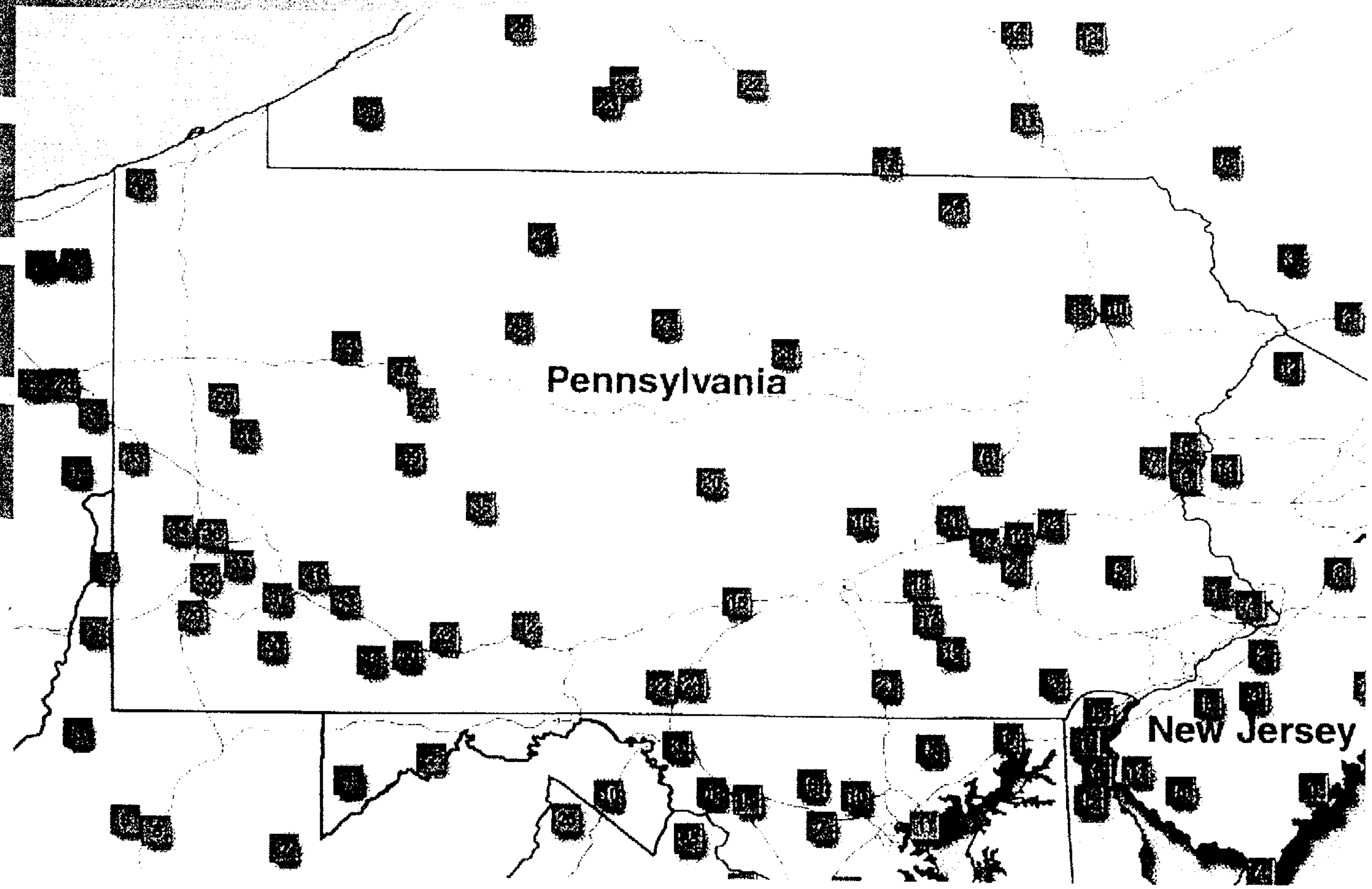
RADIOACTIVITY IN SOLID WASTE

Regulations and Guidance for Dealing With Radioactivity in Solid Waste in Pennsylvania

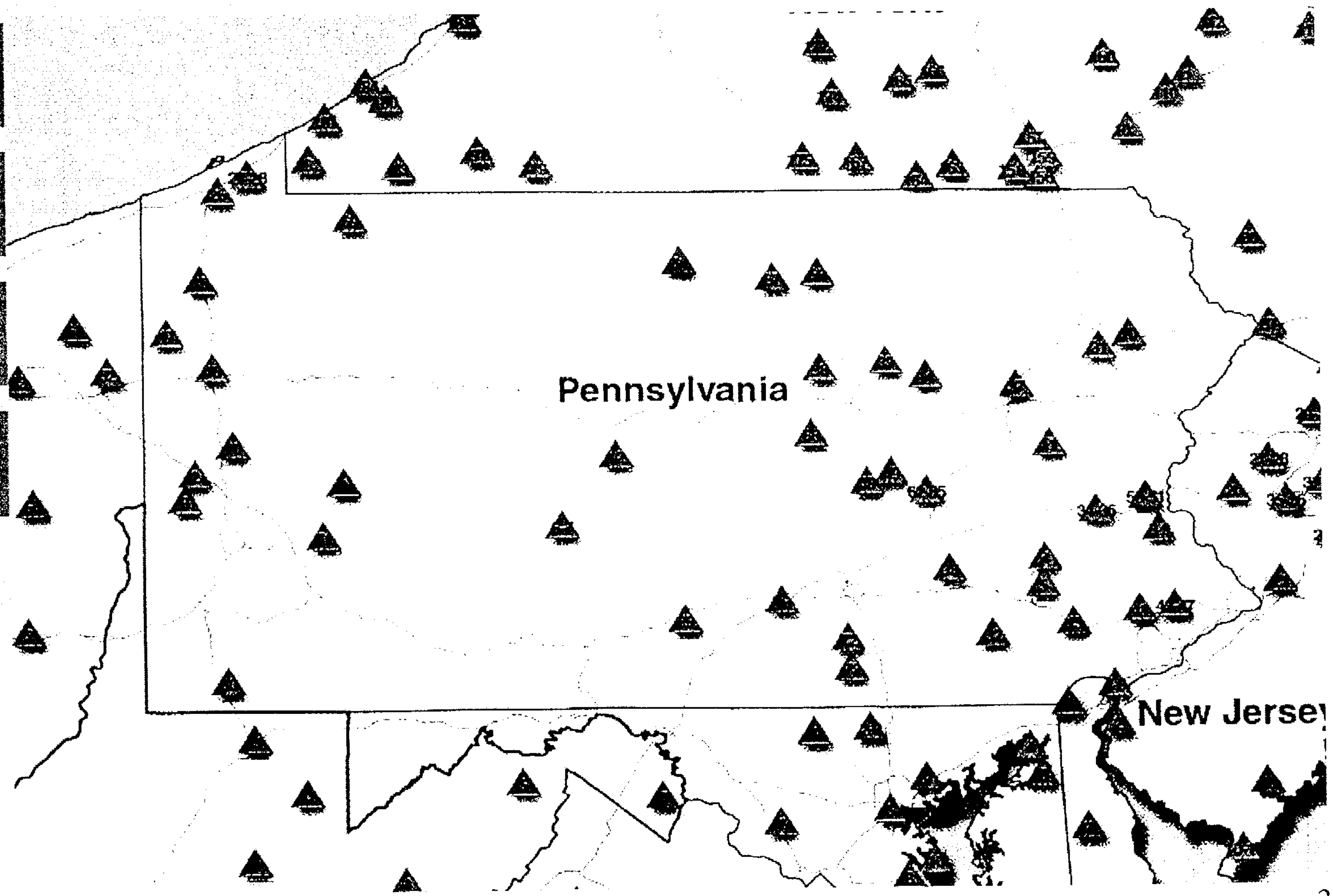
David J. Allard, CHP
William P. Kirk, Ph.D., CHP
PaDEP Bureau of Radiation Protection

(Rev. 3/22/01)

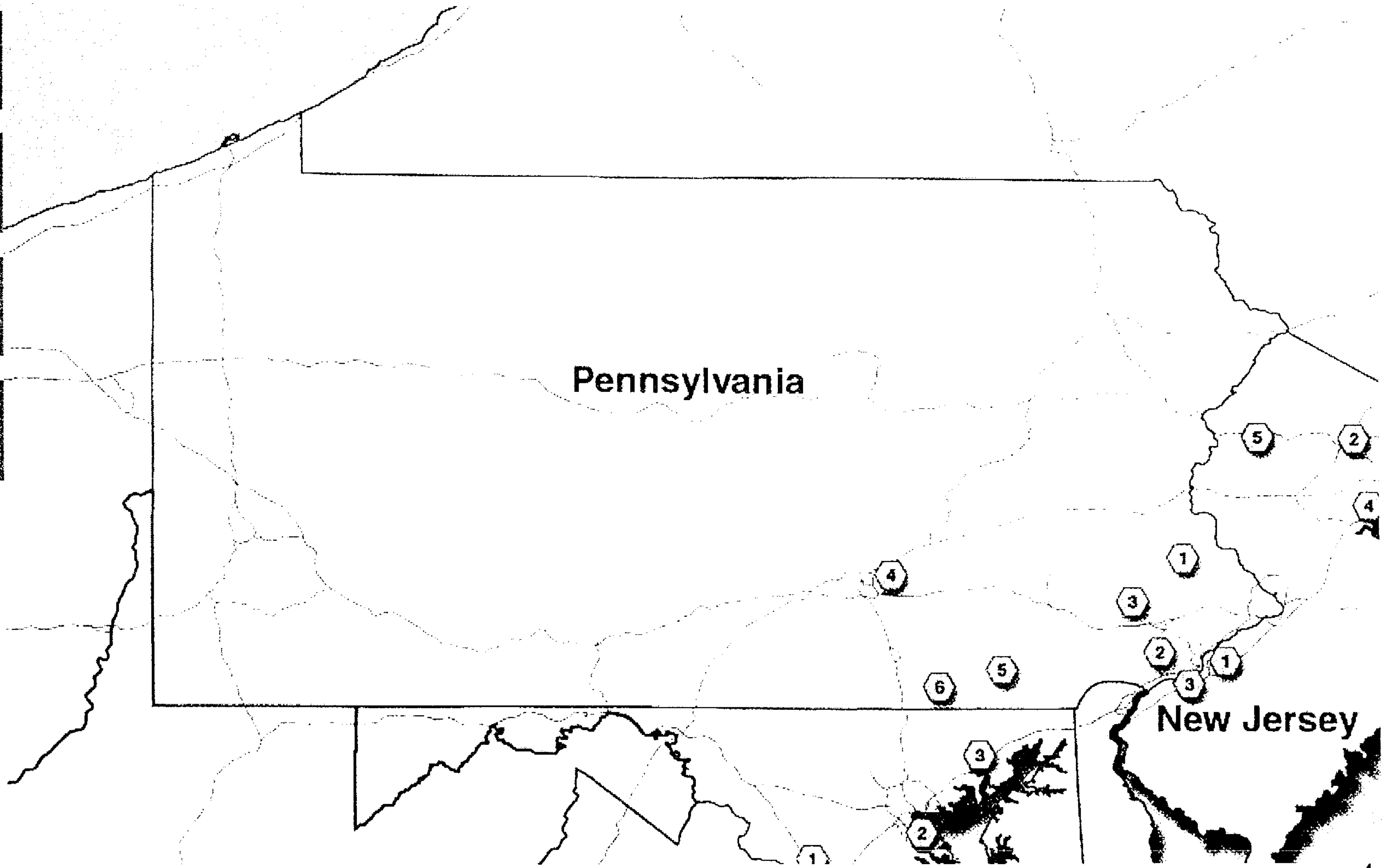
LANDFILLS



TRANSFER STATIONS



WASTE TO ENERGY FACILITIES



Why did we need new regulations and guidance for solid waste (SW)?

- Permits at SW facilities say no "radioactivity"
- Some SW facilities have installed radiation / radioactive materials (RAM) monitors
- Differences between monitors, policies, alarm set point, sensitivity, modes of use, etc.
- Alarms require response by facilities and BRP
- RP staff responding to several alarms a week
- A "quagmire" of national regulations and standards regarding the RAM involved

Why did we need regs and guidance ?

- Ensure the responses are appropriate from the public health & environmental standpoint
- Alarms usually involve PaDEP RP Program staff, and sometimes NRC or EPA staff
- Most of the alarms result from radioactive material that has been disposed of legally [i.e., nuclear medicine (NM) procedures; RAM w/ T1/2 < 65 days]

Why do we need regs and guidance?

- The entity with the source / radioactive material possession is responsible to act
- Most of the alarms are of little or no radiological significance (i.e., NM RAM)
- High costs of response if RAM > 65 day T½
- If classified as low-level rad. waste who pays?
- Hauler or SW facility may have to pay if originator can't be identified

Why have facilities been installing monitors without mandate ?

- To protect their image and legal interests
- Current PaDEP permits prohibit accepting "radioactivity"
- Cost of facility cleanup if contaminated
- Concerned citizens & monitoring groups
- Concern for illegal disposal of LLRW

Why do we have this problem?

- Almost everything in the world contains some radioactivity, mostly of natural origins; **but**
- There is no accepted *legal* definition of what may be detectable as "radioactive," but of such a low public dose impact (i.e., health risk) as having little need for regulatory control
- Now SW facility permit holder will have install radiation monitors and develop an "Action Plan" for alarm detection response

Sources of Radioactivity – Nuclear Medicine Procedures

- Short-lived NM radioisotopes w/ T1/2 < 65 days
- NM Diagnostic or therapy procedures
- No longer controlled to 30 mCi, use dose limit
- Once in the patient, now dose based to determine if patient leaves facility
- Excreta to sanitary sewer – biosolids with RAM, or contaminated household items in trash
- While in facility, contaminated items are controlled, but may get in trash accidentally

Sources of Radioactivity – Nuclear Medicine Procedures

- Commonly contaminated items in hospitals or medical clinics
  - Personal hygiene items
  - Cleaning wipes, paper towels
  - Newspapers, magazines
  - Dishes, tableware
  - Bedding
  - Anything else touched by patient
- At home, much of above materials may get into trash

Sources of Radioactivity - Industry

- Radium sources can be a major hazard
- Discarded NRC General License (GL) RAM (e.g. static eliminators) and thickness gauges
- Stolen or lost sources:
  - Well loggers
  - Moisture / density gauges
- Some RAM are not gamma emitters & can't be detected by usual monitors (e.g., GL tritium EXIT signs)

Sources of Radioactivity - NORM
Naturally Occurring Radioactive Material

- Primordial Radioactive Elements
  - Present since earth was formed
  - Very long half-lifes (billions of years)
  - Uranium, thorium, and decay products
  - Potassium-40 (K-40)
- Cosmogenic Radionuclides
  - Formed continuously through interactions of cosmic rays with air, e.g., C-14, Be-7, H-3

Sources of Radiation – Items containing NORM or Technologically Enhanced (TENORM)

- Rocks
- Minerals
- Fertilizer
- Gypsum
- Sheet rock
- Oil & gas brines and sludges
- Coal fly ash
- Coke slags
- Metal processing slags
- Media from water purification -Rn, Ra
- Fire Bricks
- Mineral Sands
- Soils
- Anything from earth

Sources of Radiation – Consumer Products

- Self luminous items
  - Timepieces (tritium, radium, promethium)
  - Gauges for aircraft etc (same as timepieces)
  - GL Tritium "EXIT" signs (hydrogen-3)
- Smoke detectors (Am-241)
- Pottery [and glass] used natural uranium compounds for color in glazes
- Gas lantern mantles (thorium)

Sources of Radiation – Consumer Products

- Optical lenses - cameras, glasses, binoculars, telescopes, etc. (thorium)
- Welding rods (thorium)
- (Old) Dental porcelain (uranium)
- Gold recovered from radon seeds used for interstitial therapy (Pb-210)
- Fertilizers (uranium, radium, K-40)
- Lite salt or road salt (KCl), or other potassium compounds (K-40)

Objectives of Regs and Guidance

- To protect environment, public and workers from unnecessary exposure
- To protect SW facility property from RAM contamination and costly decontamination
- To help prevent unlawful disposal of controlled RAM
- To assist facility operators in complying with revised regulations and permits
- To conserve PaDEP / RP Program resources by reducing unnecessary response activity

SW Regulations – Basic Limitations

The following radioactive material controlled under specific or general license or order authorized by any federal, state or other government agency shall not be processed at the facility, unless specifically exempted from disposal restrictions by an applicable Pennsylvania or federal statute or regulation:

- NARM
- Byproduct material
- Source material
- Special nuclear material
- Transuranic radioactive material
- Low-level radioactive waste

SW Regulations – Basic Limitations

- The following radioactive material shall not be disposed/processed at the facility, unless approved in writing by the department and the disposal/processing does not endanger the health and safety of the public and the environment:

  - Short lived radioactive material from a patient having undergone a medical procedure
  - TENORM
  - Consumer products containing radioactive material

- The limitations in subsections ( ) and ( ) shall not apply to radioactive material as found in the undisturbed natural environment of the commonwealth.

Guidance General

- Definitions (RAM, NARM, NORM, TENORM, etc.)
- Background; reg drivers, sources, past events
- General Considerations
  - Personnel Training
  - Monitoring and detection of radiation
  - Awareness of items containing RAM
  - Initial response to detection
  - Notifications; internal/external (PaDEP)
  - Characterization
  - Disposition; reject, dispose/process onsite
  - Record keeping

Guidance
Action Plans

- Approved Action Plan, can have a disposal option for NM RAM, and small quantity of TENORM and consumer products
- Plan summary posted for facility personnel
- Facility personnel trained to plan
- Proper response if alarm exceeded
- Customer and waste hauler awareness
- Ensure that at least one trained person on duty

Guidance
Action Levels

- Below, average background + 10 μR h^{-1} (max) NO ACTION REQUIRED - Treat waste in normal manner.

ACTION LEVEL 1

- Above, average background + 10 μR h^{-1} (max) shall cause an alarm. INVESTIGATE.

Note: 10 μR h^{-1} limit on instrument background.

ACTION LEVEL 2

- Above 2 mR h^{-1} in vehicle cab, 50 mR h^{-1} any other surface, or contamination – notify PaDEP / BRP and isolate waste and / or vehicle

Guidance
Detection and Initial Response

- System must alarm with 10 $\mu R\ h^{-1}$ radiation field at detector element, with Cs-137
- Must detect 50 keV and above gamma rays
- Alarm set at no higher than average instrument background + 10 $\mu R\ h^{-1}$ (maximize sensitivity, minimize false alarms)
- Background is instrument response AT THAT LOCATION; may need to shield to 10 $\mu R\ h^{-1}$
- If wastes exceeds alarm set point, test again
- Still above alarm set point – survey truck

Guidance
Monitoring Equipment

- Recommends that facilities have suggested types of monitoring devices
  - Fixed portal monitors to survey vehicles / SW
  - Hand-held instrument and 2 probes (NaI and "pancake" G-M) for dose rate and contamination
  - Portable MCA
- Annual calibration
- Daily performance source checks if used
- Staff training on field use and maintenance

Guidance

Detection & Initial Response

- Facility situation specific Action Plan
- Initial measurements below Action Level 2, T½ < 65 days and patient excreta, facility may have PaDEP blanket approval for disposal option
- If > 2 mR h^{-1} cab and/or > 50 mR h^{-1} on surface, or removable contamination- isolate and call PaDEP / BRP
- **DO NOT** send driver back on road until proper action determined, and if needed, DOT Exemption obtained from PaDEP/BRP
- If waste rejected, PaDEP will need to know destination to notify other state agencies

Guidance
Characterization

- Identification of radioisotope – use portable MCA for gamma spectroscopy
  - T1/2 < 65 days and NM RAM, see guidance
  - T1/2 > 65 days, see guidance
- May have to unload or hold in Designated Area

  - Isolate vehicle, bag, or container

  - STOP, isolate vehicle from people, call PaDEP if Action Level 2 exceeded

Guidance

Determining Origin

- Ask driver where the shipment came from
- Record information required by SW regs
- Identification on containers or bags. Look for anything with radiation labels while unloading. Any printed material where radiation is localized.
- Assistance from PaDEP/BRP, perhaps NRC, DOE or EPA

Guidance - Disposition

- Dispose of NM RAM with half life less than 65 days (if determined by DEP not to endanger health and safety of site staff, public and environment)
- Small quantity TENORM and consumer products can be pre-approved too
- Expect most facilities will want blanket approval of PaDEP in Action Plan, or
- PaDEP RP managers can approve case by case

OR

- Return to point of origin (with DOT Exemption manifest from PaDEP / BRP)

Guidance – Disposal Option

Examples of Nuclear Medicine RAM *

Isotope	T-1/2
Tc-99m	6 hr
Tl-201	3.0 days
Ga-67	3.3 days
I-131	8 days

* About 95% of alarms to date are from patient contaminated solid waste

Guidance - Disposal Option

TENORM

- TENORM, surface dose rate < 50 μR h^{-1} @ 5 cm, combined radium activity < 5.0 pCi/g, and below one cubic meter – facility can dispose / process with DEP approval
- Higher permitted with BRP Director approval, if pathways analysis demonstrates annual dose to maximum exposed person is less than 10 mrem yr^{-1} air, 4 mrem yr^{-1} DW, and 25 mrem yr^{-1} for a total from all exposure pathways

Guidance - Disposition

$T_{½}$ > 65 days, except NORM / TENORM

- Above ACTION LEVEL 1 - Reject and return to point of origin (with DOT Exemption Form from BRP), or arrange for proper recovery and disposal
- Above ACTION LEVEL 2 - Respond in consultation with PaDEP / BRP, and perhaps U.S. NRC or EPA

Guidance
Records & Notification

- Daily Operational Records
  - Date/time/location
  - Brief Narrative
  - Any info on origin
  - Isotope ID if known
  - Name, address, tel.# of hauler/ supplier/driver ID
  - Final deposition (dispose/reject)

- DEP Notification
  - For DOT Exemption
  - For disposal NM RAM w/ $T^{1/2} < 65$ days
  - Immediate if Action Level 2 exceeded
  - Annual report of detected RAM

Guidance
APPENDICES

- PaDEP contact and tel.# for notification, by region, normal and off-hours
- RAM activities for released patients
- Guidelines for monitoring equipment
- Guidelines for Action Plans
- Background information on RAM in solid waste
- Radiation Protection Fundamentals

National Academies – National Research Council

March 27, 2001 Meeting of the Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission Licensed Facilities

ISSUES TO CONSIDER -

- General Licensed sources in the recycle and solid waste stream (e.g., gauges with RAM and tritium EXIT signs)
- Other Orphan Sources in the solid waste stream (e.g., RaBe)
- Exempt RAM in the solid waste stream (e.g., Am-241 smoke detectors)
- Consumer products in the solid waste stream (e.g., radium dial clocks and watches); a "Universal Waste" analogy?
- NORM or TENORM in the solid waste stream into RCRA
- Re-concentrated RAM in sewage treatment plants (e.g., Kiski Valley and Royersford)
- Waste from Specific Licensed sites that have terminated operations and used the new 25 mrem/yr dose-based License Termination Rule
- Other site RAM cleanups, e.g., Ra operations, CERCLA, FUSRAP, DOE, imported materials from over-seas, etc.
- Short-lived RAM from animal and human patient nuclear medicine procedures contamination in the solid waste stream
- Some cities in USA collect waste contaminated with short-lived RAM; alternately use a special tag to prevent landfill alarms?
- UK considering using landfills for all short-lived LLRW

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Radiation Protection and
Bureau of Land Recycling and Waste Management

DOCUMENT NUMBER: 250-3100-001

TITLE: Final Guidance Document on Radioactivity Monitoring at Solid Waste Processing and Disposal Facilities.

EFFECTIVE DATE: September 16, 2000

AUTHORITY: Solid Waste Management, Act of July 7, 1980, P.L., No. 97, as amended, 35 P.S. Sections 6018.101-6018.1003; Radiation Protection Act, Act of July 10, 1984, P.L. 688, No. 147, 35 P.S. Sections 7110.101-7131.1101; The Administrative Code of 1929, Section 1917-A, 71 P.S. Section 510-17; Solid Waste Regulations, 25 Pa. Code Chapters 273, 277, 279, 281, 283, 284, 288, 289, 293, 295 and 297; Radiological Health Regulations, 25 Pa. Code Chapters 215-240.

POLICY: To protect the environment and the public health, safety and welfare from the possible dangers of radioactive material that is delivered to solid waste processing and disposal facilities.

APPLICABILITY: This guidance document applies to all owners and operators of solid waste processing and disposal facilities that are required by regulation to monitor for radiation from incoming loads of waste, and to those facilities that choose to monitor even though not required. This guidance document also applies to all Department personnel and activities involved with waste facility permitting, operations and enforcement, radiation protection, grants, monitoring, administration and emergency response.

DISCLAIMER: The policies and procedures outlined in this guidance document are intended to supplement existing requirements. Nothing in the policies or procedures will affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of the Department to give these rules that weight or deference. This document establishes the framework, within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 44 pages

LOCATION: Volume 5, Tab 7

DEFINITIONS: See attached.

GUIDANCE DOCUMENT ON RADIOACTIVITY MONITORING AT SOLID WASTE PROCESSING AND DISPOSAL FACILITIES

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DEFINITIONS

Absorbed Dose: Measure of energy absorbed by material interacting with radiation. The unit in the older conventional system is the rad, which is equal to the energy of 100 ergs per gram of irradiated material. In the System International (SI), the unit for absorbed dose is the gray (Gy), which is equal to 100 rads.

Activity: Rate of decay for radioactive material. The older conventional unit is the curie (Ci). The System International (SI) unit is becquerel (Bq), where $1 Ci = 3.7 \times 10^{10}$ Bq.

Byproduct Material: (1) Radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium or thorium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition. (10 CFR § 20.1003)

Decay: Transformation of atoms of a radioactive element to atoms of another by emission of alpha or beta particles (positive or negative), or gamma rays from its nucleus. The resulting decay product may be radioactive or stable.

Department or DEP: The Pennsylvania Department of Environmental Protection.

Dose Equivalent: The dose of an ionizing radiation that will cause the same biological effect as one rad of x rays or gamma-rays. In the older conventional system, the unit is the rem. In the SI system, the unit is the sievert (Sv), 1Sv = 100 rem. Dose equivalent is calculated by multiplying absorbed dose (rad, Gy) by a quality factor (QF) that accounts for the effectiveness of the radiation, relative to gamma or x rays, in causing a biological effect, i.e., rem = rad x QF; Sv = Gy x QF. (*Note: For this guidance, and x ray or gamma radiation, rem = rad = R.)*

DOT: The U.S. Department of Transportation.

DOE: The U.S. Department of Energy.

EPA: The U.S. Environmental Protection Agency. *(Note: According to the revised Federal Radiation Emergency Response Plan (FRERP), EPA is responsible for providing assistance to states in managing incidents involving radioactive material of unknown origin that is found outside of Nuclear Regulatory Commission (NRC) licensed facilities unless the radioactive material is clearly associated with a NRC licensee, in which case the NRC assumes responsibility for assistance. In general, federal agencies provide assistance at the request of the state.)*

Exposure Rate: An older measurement quantity of intensity for x ray or gamma radiation causing ionization of air. It is still in practical use in the U.S.A.; measured in roentgen (R) or microroentgen (μR) per unit time, usually an hour, as in Rh^{-1} or μRh^{-1}. 1 R = 2.58 E-4 C/kg of air.

Half-life: The time required for half the atoms of a quantity of a radioactive material to decay or become transformed to another nuclide.

Isotope: A chemical element with the same atomic number (i.e., number of protons), but different atomic mass.

Multichannel Analyzer (MCA): An electronic instrument which, when coupled with an appropriate detector, can determine the energy associated with various radiations and thereby identify the radioactive material emitting the radiation.

NARM: Naturally occurring or accelerator-produced radioactive material. The term does not include byproduct, source or special nuclear material.

NORM: Naturally occurring radioactive material is a radioisotope that is radioactive in its natural physical state, not man-made, but does not include source or special nuclear material.

NRC: The U.S. Nuclear Regulatory Commission, which is the federal agency responsible for the regulation of power and research reactors, and radioactive materials produced in nuclear reactors, and certain quantities of uranium and thorium.

Radioactive Material (RAM): A material – solid, liquid or gas - which emits radiation spontaneously.

Radiation: The ionizing particles (alpha, beta, others) or photons (x or gamma ray) emitted by radioactive materials in the process of decay or nuclear transformation.

Radioisotope: A radioactive isotope of an element.

Source Material: (1) Uranium or thorium or any combination of uranium and thorium in any physical or chemical form; or (2) ores which contain, by weight, 0.05 percent or more, of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material. (10 CFR § 20.1003)

Special Nuclear or Material: (1) Plutonium, uranium-233, uranium enriched in the isotope 233 in the isotope 235, and in any other material that the Nuclear Regulatory Commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954 determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing but does not include source material. The term "Department" shall be substituted for the term "Commission" when the Department assumes Agreement State status from the Nuclear Regulatory Commission. (10 CFR § 20.1003)

TEDE: Total effective dose equivalent. Means the sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). (10 CFR § 20.1003.)

TENORM: Technologically enhanced naturally occurring radioactive materials. It is naturally occurring radioactive material not specifically subject to regulation under the laws of the Commonwealth or Atomic Energy Act (Public Law 83-703, 68 Stat. 921, 42 U.S.C. §2011 et seq.), but whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the undisturbed natural environment by human activities.

Transuranic (TRU) Radioactive Material: The term "transuranic radioactive material" means material contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium and curium. TRU waste disposal is strictly regulated by the NRC and DOE.

TECHNICAL GUIDANCE

Background

The Department has the responsibility of protecting the health and safety of the citizens of the Commonwealth and the environment from toxic and hazardous materials in the environment. This includes most sources of radiation. With increasing frequency, radioactive materials have been detected in the municipal waste stream by monitors installed at waste processing and disposal facilities. Radioactive material (RAM) can also appear in the residual waste stream. Sometimes the radiation comes from naturally occurring radioactive material (NORM), but most often it comes from man-made radioactive materials. Man-made radioisotopes are regulated by the U.S. Nuclear Regulatory Commission (NRC) and / or the individual states. Accelerator-produced radioactive materials are regulated by the Commonwealth. Naturally occurring radioactive materials (NORM) are not regulated in Pennsylvania unless resulting radiation doses exceed the limits set forth in Title 25, Chapter 219 of the Pennsylvania Code. However, in the case of radium-226, the Commonwealth can regulate individual discrete sources above 0.1 microcurie (μCi), as set forth in Chapter 217. Thus, one can have RAM that is regulated (through specific or general license), unregulated, deregulated, or exempted from regulation by a variety of federal and state regulatory authorities, and yet the material may cause a solid waste facility radiation monitor to alarm.

Almost everything in the world contains small amounts of radioactive elements, which in turn emit radiation. Most radiation found in the natural environment comes from NORM and cosmic radiation from space, with minor amounts from past above ground testing of nuclear weapons, the nuclear fuel cycle, and perhaps effluents from medical and industrial uses of radioisotopes. Most of the alarm events with radiation monitoring of the municipal waste stream in Pennsylvania have been from short-lived isotopes often used in medical procedures. However, a number of very dangerous RAM sources have been recovered in recent years (e.g., 4.2 Ci Ir-192 and 20 mCi radium-beryllium neutron sources). It is possible that the medical isotopes are getting into the waste stream directly from the medical facilities via contaminated items getting into general trash by mistake. Alternately, the contaminated items are discarded in municipal waste from homes of patients who have had nuclear medicine procedures and been discharged from the treating facility. Other credible routes to the waste stream include contaminated items being discarded in regular trash containers by mistake from clinical or research laboratories, industrial facilities, misplaced encapsulated RAM sources, and construction, residual or industrial waste containing NORM, TENORM or other types of radioactive material.

State and federal regulations require that those who are licensed to handle radioactive materials will maintain strict controls relative to the use and disposal of the material, and will take appropriate actions to prevent unauthorized releases of radioactive materials in solid waste. Nonetheless, for some radioactive materials licensed by NRC or state regulations, once radioisotopes have been administered to patients, and are not likely to cause a dose to an individual above the proscribed public dose limit, the RAM is no longer regulated and patients can be discharged from the treating facilities. The potential amount of radioisotope in a patient's body that may be released from a medical facility is noted in NRC Regulatory Guide 8.39.[1] It should be noted, even small amounts of radioisotopes used for diagnostic tests or radioactivity retained on items touched by patients may emit enough radiation to set off a facility radiation monitoring alarm. Licensees are encouraged to investigate ways of effectively monitoring institutional waste streams coming from facilities using radioactive material before the waste leaves the facility. The NRC has recently issued guidance to RAM licensees for the "Management of Wastes Contaminated with Radioactive Materials" in Information Notice 99-33.

Additionally, there are a number of consumer and industrial items containing RAM in general use that are distributed under a regulatory "exemption" or "general license;" that is, the fabricator or distributor must be licensed but the individual owner/user does not have a "specific license." Examples of exempt RAM include some types of smoke detectors, self-luminous watches or clocks, and many others. Some of these consumer items, like smoke detectors are assumed by the NRC to be discarded in municipal waste during their normal life cycle, however return to the manufacturer is recommended. Other RAM is supposed to be returned to the manufacturer for proper recycle or low-level radioactive waste disposal (e.g., self-luminous tritium EXIT signs). For the more hazardous higher activity sources, the NRC and the Department are presently developing registration requirements to inventory generally licensed (GL) devices used in industry and other areas.

It is interesting to note the first time an alarm went off at one large landfill in Pennsylvania, the cause was a load of sludge containing TENORM (specifically radium-226) from a facility that treated oil and gas well brine. Similarly, most rocks, bricks, gypsum wall board, slag from metal processing, waste from coal ash or coke processing, and similar residuals contain some natural radioactivity. Depending on their origin, these materials may emit enough radiation to set off the radiation alarms at solid waste facilities. These are all examples of NORM or TENORM.

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[1] Regulatory Guide 8.39, Release of Patients Administered Radioactive Materials. U.S. Nuclear Regulatory Commission, Washington, DC April 1997. A copy of the relevant table from Regulatory Guide 8.39 is attached to this guidance document as Exhibit B.

Given the above examples of RAM that may set off waste facility radiation alarms, materials that are regulated, deregulated, exempt or unregulated, there are no current standards for radiation monitor alarm set points, and the potential for serious impact on human health and the environment - the DEP Bureaus of Radiation Protection and Land Recycling and Waste Management have recommended to the Department's Solid Waste Advisory Committee and the Environmental Quality Board, that the Department promulgate regulations requiring monitoring for radiation and radioactive materials at the following types of facilities:

- Municipal waste landfills. (25 Pa. Code Ch. 273)
- Construction/demolition waste landfills. (25 Pa. Code Ch. 277)
- Municipal Waste transfer facilities. (25 Pa. Code Ch. 279)
- Commercial municipal waste composting facilities that will receive sewage sludge or unseparated municipal waste, or both. (25 Pa. Code Ch. 281)
- Resource recovery and other municipal waste processing facilities. (25 Pa. Code Ch. 283)
- Commercial infectious or chemotherapeutic waste processing facilities. (25 Pa. Code Ch. 284)
- Noncaptive residual waste landfills. (25 Pa. Code Ch. 288)
- Noncaptive residual waste disposal impoundments. (25 Pa. Code Ch. 289)
- Noncaptive residual waste transfer facilities. (25 Pa. Code Ch. 293)
- Noncaptive residual waste composting facilities. (25 Pa. Code Ch. 295)
- Noncaptive residual waste incinerators and other noncaptive residual waste processing facilities. (25 Pa. Code Ch. 297)

Operators of these facilities must comply with the new regulatory requirements as they are adopted and phased in. Requirements may be implemented by following the recommendations of this guidance document. Briefly, the facilities will have to be equipped with suitable gamma radiation detection devices to monitor incoming loads of waste for radioactive materials in the waste, and will be required to have an appropriate Action Plan that is approved by the Department. These, and the other applicable requirements and recommendations, are discussed herein. It is the Department's belief that these regulations and guidance will be a model for all solid waste facility operators that monitor for radioactive material in incoming waste loads. For Pennsylvania solid waste facilities not required to monitor, but wish to do so as a best management practice, this guidance document should be followed.

General Considerations

Detecting radiation and dealing with radioactive materials in the waste stream is a multiple phase process, including:

- Monitoring and detection of gamma radiation,
- Personnel Training,
- Awareness of items that may contain RAM,
- Initial response to the detection of RAM,
- Notifications - within the company, to DEP, and to others as necessary,
- Characterization,
- Disposition, and
- Record keeping.

The details of these phases may vary somewhat with the type of facility; but in most respects they are similar, except for disposition of the radioactive material. In some cases the facility may have the option of onsite processing or disposal with Department concurrence or pre-approval. Alternately, the waste load may be rejected. However, once RAM has been identified in the waste, it may not be transported on public roads without an evaluation for compliance with DOT regulations. The Department has the authority to exempt carriers from DOT regulations with the scenario of RAM in waste if certain conditions are satisfied.

Action Plans

The Department's regulations require specified facilities to have an approved Action Plan to give direction to operating staff and facility users regarding procedures for detecting and dealing with radioactive material in the waste stream. Action Plans will be part of the solid waste facility permit by modification, and must be approved by the Department. Guidance for preparation of Action Plans and their content is described below, and is also provided in Appendix D. As part of the submission of a proposed Action Plan, the Department may approve the processing and / or disposal of short lived RAM (e.g., I-131, Tc-99m, Tl-201, etc.) from a patient having undergone a medical procedure, small quantities of TENORM, and consumer products containing RAM. This will require providing appropriate justification and / or pathway analysis for modeling potential public and facility staff doses.

Dose Limits for Public and Workers

The public and occupational annual dose limits that will be utilized by the Department in evaluating proposed Action Plans are as follows:

Facility staff -	5,000 mrem	(considered as "occupationally" exposed)
Facility staff -	100 mrem	(if considered member of the "public")
Vehicle driver -	100 mrem	(considered member of the public)
General Public -	4 mrem	(for the drinking water pathway)
General Public -	10 mrem	(for the air pathway)
General Public -	25 mrem	(all pathways combined)

The above public radiation dose limits are all TEDE, where an external deep dose and internal committed dose is summed. It is important to emphasize that all public and facility staff exposure to radiation should be maintained as-low-as-reasonably-achievable (ALARA). As stated above, some facility staff may be considered members of the public, if it is unlikely they will exceed the 100 mrem per year dose limit. However, certain personnel may be considered occupationally exposed workers if higher exposures are anticipated (e.g., the individual that may be performing vehicle surveys). The Action Plan should include consideration of relevant requirements outlined in the Department's Standards for Protection Against Radiation (25 Pa Code Ch. 219) and Notices, Instructions and Reports to Workers (25 Pa Code Ch. 220) if personnel are to be considered occupationally exposed.

In all reviews of proposed Action Plans, the Department will perform evaluations to ensure solid waste processing or disposal does not endanger the environment, facility staff and public health and safety. Therefore proposed Action Plans should describe the potential exposure pathways for members of the general public, and how these expected doses were modeled. For certain solid waste facilities where processing solid waste may release RAM to the environment, the Department recommends the use of basic and conservative regulatory computer codes for such pathway analysis and dose modeling, e.g., the EPA's CAP88 or DOE/NRC's RESRAD codes. These codes and support documentation can be downloaded from various internet web sites. However, valid manual calculations using dispersion equations and published dose conversions factors are equally acceptable to the Department.

Detection of Radiation

The Department's revised solid waste regulations require radiation monitoring and response at the solid waste facilities specified above. Additionally, the regulations state that the radiation detector elements shall be as close as practical to the waste load, and in an appropriate geometry to monitor the waste. The Action Plan should require notification to the Department for conditions specified in the regulations (i.e., radiological conditions noted below in Action Level Two), the detection of prohibited RAM, or the case when a waste load is rejected and a DOT Exemption Form must be issued. Action Plans should address the two basic scenarios, or Action Levels, when radiation is detected from a truck or waste container:

1. Action Level One: A radiation monitor alarm at the facility indicating the potential presence of radioactive material in a waste load.

(Note: The regulations require a gamma exposure rate from a cesium –137 source, at a level no higher that 10 $\mu R\ h^{-1}$ above the average local background, at any detector element, shall cause an alarm at the facility. Instrument background shall be kept below 10 $\mu R\ h^{-1}$ using shielding if needed, and the system shall be set to detect gamma ray energies of 50 kiloelectron volts and higher.)

2. Action Level Two: Radiation dose rates of 20 $\mu Sv\ h^{-1}$ (2 mrem h^{-1}) or greater in the cab of the waste transport vehicle, 500 $\mu Sv\ h^{-1}$ (50 mrem h^{-1}) or greater from any other surface, or the detection of contamination on the outside of the vehicle shall require immediate notification of the Department, and isolation of the vehicle.

Measurements should be made in accordance with guidance provided in Appendix D.

IDENTIFICATION AND DISPOSITION OF RADIOACTIVE MATERIAL FOUND IN THE WASTE STREAM

1. Landfill or Disposal Impoundment

A. RAM from Patients Having Undergone a Nuclear Medicine Procedure

If the gamma spectroscopy or other measurement indicates the radiation is from a radioisotope with a half-life of 65 days or less, the DEP Area Health Physicist may authorize the contents of the waste load to be processed and/or disposed of immediately. (See Appendix A for telephone numbers during normal and non-business hours.) This is provided there is a high likelihood, through radioisotope identification, the RAM is from a patient having undergone a medical procedure, and the disposal does not endanger the health or safety of the facility staff, the public or the environment. Alternately, as noted above, the facility may provide justification (e.g., considering the facility's engineered barriers, all the RAM will decay in place) in the proposed Action Plan, and apply for a blanket approval to dispose of short lived RAM from patients treated with radioisotopes.

For reference, the total estimated radioactivity that may be released in a patient is detailed in NRC Regulatory Guide 8.39, which is duplicated in Appendix B as Table 1. The solid waste facility operator will always have the option to reject any waste load causing an alarm; however, no vehicle containing RAM shall leave the facility without written approval and an authorized DOT Exemption Form issued by the Department.

Upon formal request and appropriate environmental analysis, the Department's Director of the Bureau of Radiation Protection may authorize disposal of RAM with a half-life greater than 65 days, if the material is not under state or federal regulatory controls and / or disposal restrictions. (See Appendix D for additional guidance.)

B. Naturally Occurring Radioactive Material

If the gamma spectroscopy or other measurement indicates the radiation is from NORM or TENORM, the Action Plan should outline an approach to determine the nature of the waste, or perhaps cover material, entering the facility. If the radiation source is determined to be from the undisturbed natural environment of the Commonwealth (e.g., cover material soil or rock with elevated NORM levels), then there are no disposal restrictions and the material can be accepted at the facility. Similarly, if the source is determined to be potassium or any related compound (e.g., potassium permanganate used for odor control), with a natural abundance K-40, there are no processing or disposal restrictions.

In the case where process knowledge would indicate the presence of TENORM, the DEP Area Health Physicist may authorize immediate disposal. However, the following conditions must be satisfied: a) the volume of waste does not exceed one cubic meter, b) the gamma radiation level at a distance of 5 cm from any source surface does not exceed 0.5 $\mu Sv\ h^{-1}$ (50 $\mu rem\ h^{-1}$), and c) the concentration of combined radium isotopes does not exceed 5.0 $pCi\ g^{-1}$. A facility may submit, in their proposed Action Plan, to obtain a blanket approval for disposal of such small quantities of waste with TENORM. For a blanket approval, the applicant shall provide appropriate justification (e.g., presence of engineered barriers) in the proposed Action Plan. Disposal of waste with TENORM of higher volumes, emitting higher radiation levels, or at higher radium concentrations, may be approved by the Department's Director of the Bureau of Radiation Protection. Such evaluations shall require the appropriate environmental assessment and pathway analysis to demonstrate that the annual dose to any member of the public is unlikely to exceed those values noted above. (See Appendix D for additional guidance.)

Again, the facility operator may reject any waste load causing an alarm, however, no vehicle containing RAM shall leave the facility without written Department approval and an authorized DOT exemption form.

C. Consumer Products Containing Radioactive Material

If certain consumer products containing radioactive material are observed in waste or cause an alarm - and are subsequently identified through a visual means to be an individual commodity smoke detector, radium dial watch / clock, exempt thorium metal alloy (e.g., welding rod), or uranium glaze / glass product – a facility may propose in their Action Plan that such an individual waste product be disposed of immediately. A recent life cycle analysis of these exempt RAM sources by the NRC notes that the above public dose limits will not be exceeded in such a disposal scenario (see NRC NUREG-1717). The facility Action Plan could have such an allowed disposal scenario for the specific individual items noted above, but should prohibit the disposal of aggregate quantities of these exempt devices or other products without written approval by the Department. It is recommended that smoke detectors, when found, be returned to the manufacturer for appropriated disposal. If a "generally licensed" tritium EXIT sign is found in any waste stream, it shall be returned to a licensed manufacturer for recycle or shipped for proper low-level radioactive waste disposal.

Consumer products containing exempt radioactive materials may be recovered by the facility, and stored for ultimate disposal as low level radioactive waste by the operator. Alternately, the facility operator may reject any waste load causing an alarm; however, no vehicle containing RAM shall leave the facility without written Department approval and an authorized DOT exemption form.

2. Other Facilities

A. RAM from Patients Having Undergone a Nuclear Medicine Procedure

If the gamma spectroscopy or other measurement indicates the radiation is from a radioisotope with a half-life of 65 days or less, the DEP Area Health Physicist may authorize the contents of the waste load to be processed and/or disposed of immediately. (See Appendix A for telephone numbers during normal and non-business hours.) This is provided there is a high likelihood, through radioisotope identification, the RAM is from a patient having undergone a medical procedure, and the disposal does not endanger the health or safety of the facility staff, the public or the environment. Alternately, the facility may provide in the proposed Action Plan, the justification through modeling that the above general public dose limits are met, and apply for a blanket approval to dispose of short lived RAM from patients treated with radioisotopes.

For reference, the total estimated radioactivity that may be released in a patient is detailed in NRC Regulatory Guide 8.39, which is duplicated in Appendix B as Table 1. The solid waste facility operator will always have the option to reject any waste load causing an alarm, or forward the waste load to a solid waste facility that will process or dispose of the material. However, no vehicle containing RAM shall leave the facility without written approval and an authorized DOT Exemption Form issued by the Department.

Upon formal request and appropriate environmental analysis, the Department's Director of the Bureau of Radiation Protection may authorize processing or disposal of RAM with a half-life greater than 65 days, if the material is not under state or federal regulatory controls and / or disposal restrictions. (See Appendix D for additional guidance.)

B. Naturally Occurring Radioactive Material

If the gamma spectroscopy or other measurement indicates the radiation is from NORM or TENORM, the Action Plan should outline an approach to determine the nature of the waste entering the facility. If the radiation source is determined to be from the undisturbed natural environment of the Commonwealth (e.g., soil or rock with elevated NORM levels), then there are no processing or disposal restrictions and the material can be accepted at the facility. Similarly, if the source is determined to be potassium or any related compound (e.g., potassium permanganate used for odor control), with a natural abundance K-40, there are no processing or disposal restrictions.

In the case where process knowledge would indicate the presence of TENORM, the DEP Area Health Physicist may authorize immediate disposal. However, the following conditions must be satisfied: a) the volume of waste does not exceed one cubic meter, b) the gamma radiation level at a distance of 5 cm from any source surface does not exceed 0.5 $\mu Sv\ h^{-1}$ (50 $\mu rem\ h^{-1}$), c) the concentration of combined radium isotopes does not exceed 5.0 $pCi\ g^{-1}$, and d) the processing or disposal of such material will not cause any above stated general pubic dose limit to be exceeded. A facility may submit, in their proposed Action Plan, to obtain a blanket approval for disposal of such small quantities of waste with TENORM. For a blanket approval, the applicant shall provide appropriate justification and modeling in the proposed Action Plan.

Processing or disposal of waste with TENORM of higher volumes, emitting higher radiation levels, or at higher radium concentrations, may be approved by the Department's Director of the Bureau of Radiation Protection. Such evaluations shall require the appropriate environmental assessment and pathway analysis to demonstrate that the annual dose to any member of the general public is unlikely to exceed those values noted above. (See Appendix D for additional guidance.)

Again, the facility operator may reject, or forward to a landfill that will accept it, any waste load causing an alarm. However, no vehicle containing RAM shall leave the facility without written Department approval and an authorized DOT Exemption Form.

C. **Consumer Products Containing Radioactive Material**

If certain consumer products containing radioactive material are observed in waste or cause an alarm - and are subsequently identified through a visual means to be an individual commodity smoke detector, radium dial watch / clock, exempt thorium metal alloy (e.g., welding rod), or uranium glaze / glass product – a facility may propose in their Action Plan that such an individual waste product be processed or disposed of immediately. A recent life cycle analysis of these exempt RAM sources by the NRC notes that the above public dose limits should not be exceeded in such processing or disposal scenario (see NRC NUREG-1717). The facility Action Plan could have such an allowed processing or disposal scenario for the specific individual items noted above, but should prohibit the processing or disposal of aggregate quantities of these exempt devices or other products without written approval by the Department. It is recommended that smoke detectors, when found, be returned to the manufacturer for appropriated disposal. If a "generally licensed" tritium EXIT sign is found in any waste stream, it shall be returned to a licensed manufacturer for recycle or shipped for proper low-level radioactive waste disposal.

Consumer products containing exempt radioactive materials may be recovered by the facility, and stored for ultimate disposal as low level radioactive waste by the operator. Alternately, the facility operator may reject, or forward to a landfill that will accept it, any waste load causing an alarm. However, no vehicle containing RAM shall leave the facility without written Department approval and an authorized DOT exemption form.

3. Records and Reports

A. Each person or municipality who operates a waste processing or disposal facility which has detected radioactive materials in any manner or radiation levels in excess of Action Level One to cause an alarm shall maintain records of each incident, containing the information set forth in section b, below, in the facility's daily operational record.

B. The daily operational record should include information required by regulation, such as the following:

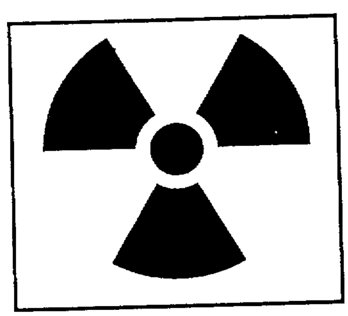
1) Date, time and location of the occurrence,
2) A brief narrative description of the occurrence,
3) Specific information on the origin of the material, if known,
4) A description of the RAM involved, if known,
5) The name, address and telephone number(s) of the supplier, handler or transporter of the RAM contaminated waste, the name of the driver, and
6) The final disposition of the material (processed, disposed, or rejected).

C. The facility's annual report should include a record of detected RAM summarizing the above information.

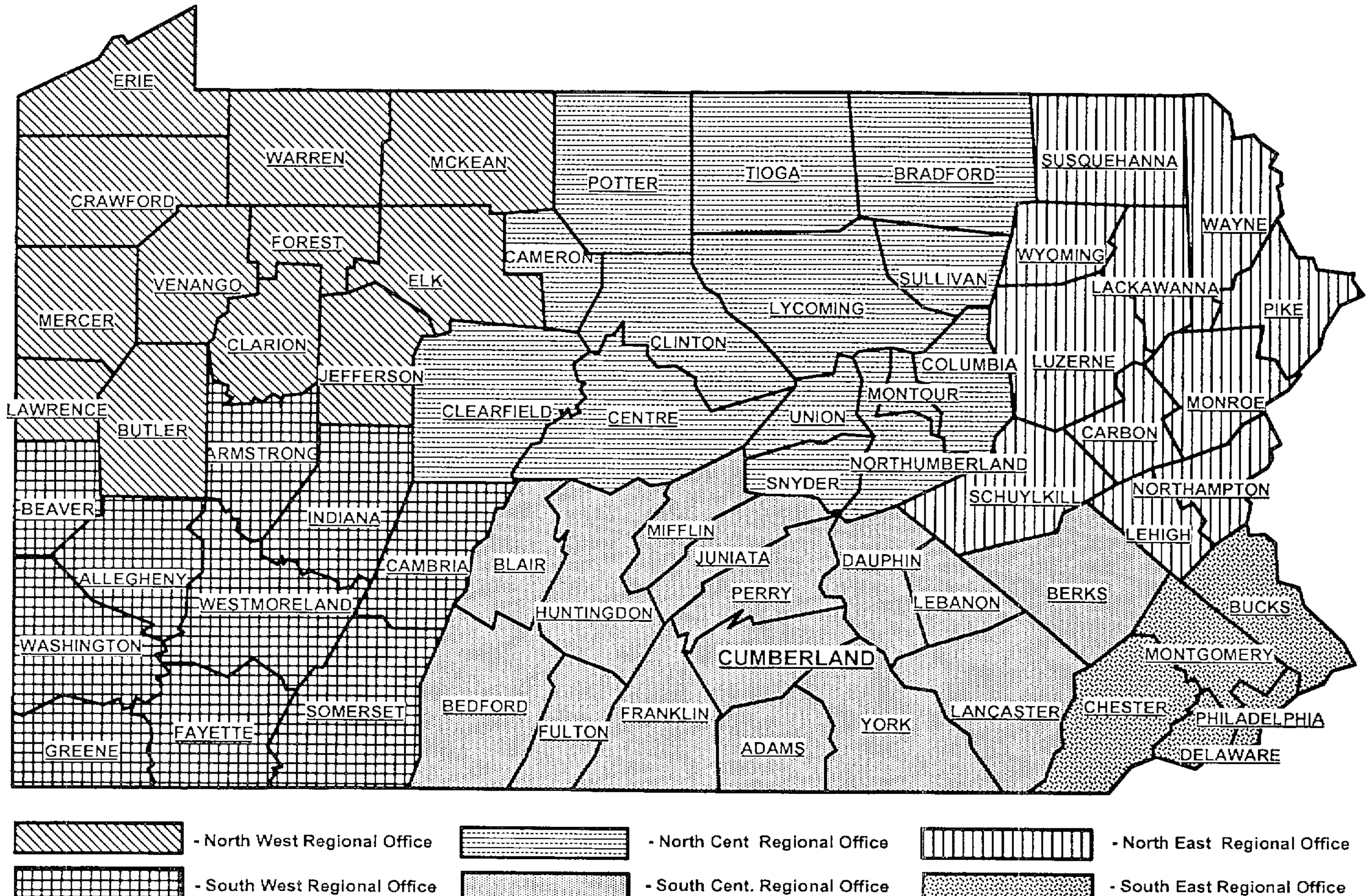
4. Monitoring and Equipment

Facilities monitoring for radiation emitted from radioactive material must have appropriate monitoring equipment onsite. (See Appendix C for more information). Employees should be trained on proper use of all fixed and portable equipment. Additionally, facility operational staff should be trained to visually monitor waste during transfer or unloading for the potential presence of RAM. Specifically, they should be able to identify the caution "radiation symbol" on containers, and items that may not be detected by gamma monitors (e.g., tritium "EXIT" signs).

RADIATION SYMBOL



APPENDIX A. NOTIFICATION OF INCIDENTS OF RAM IN SOLID WASTE AND/OR REQUEST FOR DOT EXEMPTION FORM (Rev. 2-1-01)



Department of Environmental Protection		
Area Health Physicist James G. Yusko, CHP Business hours: (412) 442-4227	Area Health Physicist James Kopenhaver Business hours: (717) 705-4712	Area Health Physicist Ivna Shanbaky, Ph.D. Business hours: (610) 832-6041
Northwest Region: Butler, Clarion, Crawford, Elk, Erie, Forest, Jefferson, Lawrence, McKean, Mercer, Venango and Warren Counties. Emergency Coordinator Non-business hours: (800) 373-3398	**Northcentral Region:** Bradford, Cameron, Clearfield, Centre, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga and Union Counties. Emergency Coordinator Non-business hours: (570) 327-3696	**Northeast Region:** Carbon, Lackawanna, Lehigh, Luzerne, Monroe, Northhampton, Pike, Schuylkill, Susquehanna, Wayne and Wyoming Counties. Emergency Coordinator Non-business hours: (570) 826-2511
Southwest Region: Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington and Westmoreland Counties. Emergency Coordinator Non-business hours: (412) 442-4000	**Southcentral Region:** Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry and York Counties. Emergency Coordinator Non-business hours: (877) 333-1904	**Southeast Region:** Bucks, Chester, Delaware, Montgomery and Philadelphia Counties. Emergency Coordinator Non-business hours: (610) 832-6000

APPENDIX B. ACTIVITIES AND DOSE RATES FOR AUTHORIZING PATIENT

RELEASE FROM MEDICAL FACILITIES[1]

Table 1. Activities and Dose Rates for Authorizing Patient Release†

Radioactive Material	COLUMN 1 Activity at or Below Which Patients May Be Released		COLUMN 2 Dose Rate at 1 Meter, at or Below Which Patients May Be Released*	
	(GBq)	(mCi)	(mSv/hr)	(mrem/hr)
Ag-111	19	520	0.08	8
Au-198	3.5	93	0.21	21
Cr-51	4.8	130	0.02	2
Cu-64	8.4	230	0.27	27
Cu-67	14	390	0.22	22
Ga-67	8.7	240	0.18	18
I-123	6.0	160	0.26	26
I-125	0.25	7	0.01	1
I-125 implant	0.33	9	0.01	1
I-131	1.2	33	0.07	7
In-111	2.4	64	0.2	20
Ir-192 implant	0.074	2	0.008	0.8
P-32	**	**	**	**
Pd-103 implant	1.5	40	0.03	3
Re-186	28	770	0.15	15
Re-188	29	790	0.20	20
Sc-47	11	310	0.17	17
Se-75	0.089	2	0.005	0.5
Sm-153	26	700	0.3	30
Sn-117m	1.1	29	0.04	4
Sr-89	**	**	**	**
Tc-99m	28	760	0.58	58
Tl-201	16	430	0.19	19
Y-90	**	**	**	**
Yb-169	0.37	10	0.02	2

† The activity values were computed based on 5 millisieverts (0.5 rem) total effective dose equivalent.
* If the release is based on the dose rate at 1 meter in Column 2, the licensee must maintain a record as required by 10 CFR 35.75(c) because the measurement includes shielding by tissue. See Regulatory Position 3.1, "Records of Release," for information on records.
** Activity and dose rate limits are not applicable in this case because of the minimal exposures to members of the public resulting from activities normally administered for diagnostic or therapeutic purposes.

[1] **Source:** Regulatory Guide 8.39, Release of Patients Administered Radioactive Materials. U.S. Nuclear Regulatory Commission, Washington, D.C. April 1997.

APPENDIX C. GUIDELINES FOR RADIOLOGICAL MONITORING EQUIPMENT

1. General Information About Radiation Detectors

In general, radiation detection equipment consists of a detector and electronics to convert the signal received by the detector into meaningful values. The passage of radiation through the detector (or probe) causes an impulse to be generated within the detector, which is converted into a preset unit, usually counts per minute (cpm). There are two general types of detectors likely to be used in municipal and residual waste monitoring. The first, called a Geiger-Muller (G-M) counter with thin window probe, converts electrical discharge pulses into counts, which are displayed on a meter. This is the best type of detector for detecting beta particles, because most of the beta particles that pass into the detector will register. However, certain low-energy beta particles will not penetrate through the outer wall of the detector and, therefore, will not be detected. Examples of radioactive materials emitting such low-energy beta particles include carbon-14 and tritium (hydrogen-3), which are commonly used in medical research programs and may inadvertently be disposed of in waste. This type of detector is gas-filled and is less efficient at detecting gamma radiation because most pass through the detector without causing a pulse to be generated. Nevertheless, G-M counters are normally used in hand-held instruments, and a "pancake" type thin window G-M probe can be used for alpha, beta, and gamma measurements when properly calibrated.

The second type of radiation detector also uses a probe that converts the impulses caused by the radiation striking the detector surface into counts, which are recorded on the meter. However, this type of detector differs from the G-M counter in that the signal transferred to the meter is dependent on the radiation type and energy striking the detector. Typically, this type of radiation detector is called a scintillation detector. Scintillation detectors convert the radiation energy into a light impulse within the probe. The amount of light generated is based on the amount of radiation that strikes the probe. This light impulse is then converted to a measurement that may be used to determine the energy of the radiation and the total amount of radiation. Because of this capability, scintillation detectors are useful in determining the type of radioactive material present in the waste as well as the relative radiation hazard associated with the material. Scintillation detectors are also more efficient at detecting gamma radiation than a G-M counter because they are solid material (i.e., a greater number of interactions occur between the detector and the radiation yielding a greater number of counts). Zinc sulfide scintillation detectors may be used to quantify the amount of alpha particle radiation from contamination materials, although this is often conducted in laboratories rather than field settings. In addition, the scintillation medium may be liquid, thus allowing greater contact of the medium with the radioactive

material and further increasing the efficiency of the measurement. Liquid scintillation is often used to quantify the amount of radioactive materials that emit low-energy beta particles, such as carbon-14 and tritium. However, this technique is employed exclusively in laboratories, rather than in the field.

Sodium iodide (NaI) crystals, germanium crystals, zinc sulfide coatings, and specially formulated plastic materials are the most common media used in solid scintillation detectors. Plastic scintillation detectors may be more sensitive to beta/gamma radiation than NaI detectors due to size and window thickness, however neither detect alpha radiation. In addition, plastic detectors are usually more resistant to environmental stresses than NaI detectors and can be purchased in larger sizes, allowing better geometry for detection of radioactive material in waste. However, though plastic detectors may be less expensive than NaI detectors, they may not offer the same degree of discrimination in terms of identifying the energies of the gamma radiation. Solid state germanium detectors are often used in laboratories for precise determination of the type and amount of radioactive materials present. Although some germanium detectors are sufficiently rugged to be used in the field, most are designed for use in laboratories.

2. Facility Monitoring Equipment

Many solid waste facilities have installed radiation detection equipment at the entrance portal to the facility or in conjunction with other onsite facilities, such as scales. In such installations, the radiation detector elements (e.g., NaI crystals) are typically installed to screen incoming waste and should be installed, operated, and maintained in a manner that ensures that the measurements are meaningful and fulfill the objectives for detecting radiologically contaminated waste. The detectors should be positioned as close as practical to the waste load, and calibrated so that they measure radiation [in $\mu R\ h^{-1}$, or equivalent counts per unit time] emitted from vehicles that are used to haul the solid waste into or out of the facility. The waste load portal detectors are normally scintillation type detectors. In the scenario where time permits (i.e., waste loads are infrequent) or fixed portal monitors become inoperable, hand-held microR meters may be used to scan incoming waste loads.

Both fixed and portable scintillation and G-M detectors can be calibrated to display radiation in units of exposure rate ($\mu R\ h^{-1}$), or dose equivalent rate ($\mu rem\ h^{-1}$). Equipment that display in counts per unit time should have calibration factors that can be related to these qualities. The radiation unit displayed by the detector is less important than the selection of the appropriate type of radiation detector element or probe, and the proper subtraction of background radiation is made. Factors that should be considered when developing radiation detection and monitoring programs are:

- Area background radiation level,
- Detector efficiency and ruggedness,
- Detector calibration and response checks,
- Detector positioning and shielding,
- Detector element physical protection,
- Counting time,
- Alarm set point,
- Overall system sensitivity, and
- Alarm response procedures and training.

Because of the complex nature of radiation detection instrumentation and the multiple objectives for which such instruments may be deployed, facility staff should be trained to determine the appropriate type of instrument and / or detector probe to be used at a facility based on the established operational objectives. In addition, it is recommended that only individuals with proper experience and training (e.g., manufacturer's representative or knowledgeable health physicist) should be permitted to initially install, calibrate fixed radiation detection equipment.

3. Monitoring Equipment – General Recommendations

Facilities shall comply with specific regulatory requirements, but the following general recommendations for monitoring equipment may be used for initial detection of radioactive material at solid waste facilities:

A. Monitoring equipment should consist of both portable (hand-held) and fixed radiation monitoring equipment. Portable instrumentation should have multiple probes for contamination and a range of gamma dose rate measurements (i.e., 10 $\mu R\ h^{-1}$ to over 50 mrem h^{-1}).

B. Fixed monitoring equipment should be capable of detecting and displaying ambient background radiation levels. For both portable and fixed instrumentation, the equipment should provide a visual readout of the $\mu Sv\ h^{-1}$, $\mu rem\ h^{-1}$, $\mu R\ h^{-1}$ or count rate (e.g., cpm) level. Should the background radiation level be above 10 $\mu R\ h^{-1}$, the detector elements will require shielding to maintain the rate below this level.

C. The readout on the instrumentation should allow either scale multiplying factors or logarithmic scales to display higher radiation levels.

D. Portable instrumentation should be powered either by replaceable batteries or power cells with charging units and provide indication if battery/power cell capacity is not at levels for proper unit function. Fixed instrumentation should be line operated (e.g., 110 volt AC).

E. Waste monitors should be installed according to the manufacturers recommendations, with the radiation detectors as close as practicable to the waste load (i.e., close as possible and preventing physical damage). The alarm set-point for fixed monitoring equipment shall be no higher than 10 $\mu R\ h^{-1}$ above background, with a cesium-137 gamma radiation field at the radiation detector element(s). The ambient gamma background in Pennsylvania ranges from about 5 $\mu R\ h^{-1}$ to 25 $\mu R\ h^{-1}$. Instrument readings in microroentgen per hour ($\mu R\ h^{-1}$), or equivalent counts per unit time (e.g., cpm), will need to be averaged during calibration to determine the appropriate alarm set point. If capable of energy discrimination, the radiation monitor shall be set to detect gamma rays of a 50 kiloelectron volt (keV) energy or higher.

The alarm should provide an audible signal to the operator and may provide a visible signal that the alarm set point has been exceeded. The operator should be able to reset the audible signal from the readout position. Written indication of radiation levels, such as by a data log print out or chart recording, may be available as an option for the readout.

F. The detector element assemblies for fixed monitoring may be located at or near the weigh scale for vehicles. Provision should be made to stop or slow the vehicle during the monitoring for radioactive material, with a geometry and collimation of the radiation detectors to maximize system sensitivity. It is recommended an appropriate housing and other barriers be installed to protect the detector assembly from physical damage due to vehicles and from environmental conditions, such as precipitation, high humidity, and thermal variation.

G. If the detector assembly for fixed monitoring equipment is supplied with electrical power other than the monitoring unit, provision should be made to display power condition or availability to the detector assembly.

H. The range of readout for portable (hand-held) monitoring equipment and various probes should be 0.01 to approximately 100 mrem h^{-1}, and have a known gamma energy response. A "pancake" type G-M probe will be adequate for gross counting of wipes taken for gross contamination evaluations of vehicles. Again, hand-held micoR meters would be suitable for temporary vehicle monitoring if fixed systems become inoperable.

I. The monitoring equipment used at solid waste facilities should be calibrated no less frequently than annually, and (if utilized) its function should be tested on a daily basis using a check source for which the instrument's expected response has been previously determined.

4. Evaluation Equipment

If a radiation alarm is determined to be valid, evaluation of waste may require supplies, calibrated survey meters with capabilities similar to those specified above, and may require any of the following to determine the specific radioisotope, and if contamination is present:

A. Portable multichannel analyzer (MCA) coupled to a sodium iodide (NaI) detector or solid state detector. Appropriate calibration source(s) will also be needed to check the library of spectra.

B. Probes for survey meter capable of detecting beta and gamma radiation. Depending on the survey meter and probe(s) used for beta / gamma monitoring, a different probe could be obtained for alpha monitoring, if desired.

C. Supplies for taking samples for laboratory analysis, such as wipes (or smears), containers for water and soil/waste samples, plastic bags, indelible markers, trowels, tongs, etc. would be useful to have on hand.

D. Plastic tarps, disposable protective clothing and gloves for personnel handling potentially contaminated waste. *(Note: the use of some types of protective mask requires that the employing firm have an approved respirator qualification program.)*

E. A supply of radiation warning signs, rope, tape, etc.

F. Supplies and information for data analysis, e.g., scientific calculator, survey forms, tables of radioisotopes with half-life, etc.

APPENDIX D. GUIDELINES FOR ACTION PLANS FOR DETECTION AND HANDLING OF RADIOACTIVITY AT SOLID WASTE FACILITIES

1. Procedures for Development and Review of Action Plans

A. Qualifications of Persons Preparing the Action Plan

Plans should be prepared by individuals having, at a minimum, the following qualifications:

1) Two years of on-the-job training in health physics; or one year of on-the-job training in health physics plus one year of formal college level study in health physics, physics, chemistry, biology, engineering, or radiation science.

2) Experience with radiation detection and measurement, and in developing radiation safety procedures and plans.

Comprehensive certification by the American Board of Health Physics satisfies numbers 1 and 2, above. It is recommended that facilities employ a certified health physicist (CHP) as a consultant for developing and implementing their Action Plan.

B. Implementation of the Action Plan

The provisions of the Action Plan should be activated whenever situations arise in which the pre-established action levels are exceeded.

C. Persons Responsible for Implementation of the Action Plan

Each facility should designate an individual responsible for implementation of the Action Plan. This individual should have adequate authority to implement the plan. In the event that the individual(s) implementing the Action Plan is/are different from the individual who prepared the Action Plan, the Action Plan should specify a minimum one day training session in the fundamentals of radiation safety and detection.

(Note: Provided onsite operational facility personnel are able to appropriately respond to the radiological scenarios at Action Levels One and Two, the Action Plan may reference the use of corporate or consultant health physics support staff for further RAM characterization.)

D. Revision of the Plan

The plan should be reviewed and updated periodically by the permittee. At a minimum, this should occur when any of the following occurs:

1) Applicable Department regulations or policies are revised.

2) The Action Plan fails during an incident.

3) The facility operation changes in a manner that would interfere with implementation of the Action Plan.

4) The individual responsible for implementing the plan changes.

5) The monitoring equipment used is changed.

6) The designated area for vehicles in which RAM has been detected changes.

7) As otherwise required by the Department.

2. Content and Format of Action Plans

A. General Instructions

The main elements of the Action Plan should cover all the appropriate regulatory requirements, and are described in this basic guidance document. Details are outlined below. Certain Action Plan elements may not be entirely applicable or appropriate for a specific facility or type of incident. In these cases, the person preparing the Action Plan should act accordingly and provide a brief explanation as to why the Action Plan element(s) in question are not applicable or appropriate.

The most important thing to remember in developing an Action Plan is that the actual effectiveness of the plan will depend upon its simplicity, readability and summary instructions for facility operational staff.

B. Action Levels

The Action Plan must be designed to address two radiological scenarios or action levels, namely:

Action Level One: A radiation monitor alarm at the facility indicating the potential presence of radioactive material in a waste load.

(Note: The regulations require a gamma exposure rate from a cesium –137 source, at a level no higher that 10 $\mu R\ h^{-1}$ above the average local background, at any detector element, shall cause an alarm at the facility. Instrument background shall be kept below 10 $\mu R\ h^{-1}$ using shielding if needed, and the system shall be set to detect gamma ray energies of 50 kiloelectron volts and higher.)

Action Level Two: Radiation dose rates of 20 $\mu Sv\ h^{-1}$ (2 mrem h^{-1}) or greater in the cab of the waste transport vehicle, 500 $\mu Sv\ h^{-1}$ (50 mrem h^{-1}) or greater from any other surface, or the detection of contamination on the outside of the vehicle shall require immediate notification of the Department, and isolation of the vehicle.

The Action Plan should provide for notification of the Department.

1) For Action Level One, notification and request for DOT Exemption Form prior to rejection of a waste load, or request for disposal or processing approval of RAM in solid waste if blanket approval was not requested.

2) For Action Level Two, notification must be made immediately.

C. Detection and Initial Response

Fixed and portable radiation monitoring systems shall be calibrated annually to a traceable cesium-137 source. This radiation standard shall be traceable to the U.S. National Institute of Standards and Technology. Radiation monitors may be response checked daily on a relative basis. If the alarm level of 10 $\mu R\ h^{-1}$ over background is exceeded when a vehicle is at the monitoring location, the following procedures are recommended:

1) Reset the monitor alarm and evaluate the vehicle or container a second time.

2) If the alarm level is still exceeded, promptly survey the vehicle surfaces at a distance of 5 cm with a portable radiation survey meter to determine if Action Level Two levels are exceeded, and if an area of highest radiation level can be determined. Mark this location with chalk if other gamma spectroscopy measurements are to be performed.

3) If surveying the vehicle with a portable survey meter at 5 cm fails to reveal the presence of radioactive material, scan the driver with a portable survey meter (or have him/her stand between the monitor detectors) to determine if the driver has triggered the alarm. Alarms have been triggered by drivers who have undergone nuclear medicine procedures involving radioactive material. If this is the case, and the driver alone has triggered the alarm, no further action under this guidance document is necessary.

4) **Action Level One:** If the radiation monitor alarmed on a second count, the following procedures are recommended:

   a) Remove the vehicle to the Designated Area for vehicles found to contain RAM. (See D below.) Contact the individual responsible for supervising response to alarms at the facility. If the waste load is to be rejected, contact the appropriate DEP Area Health Physicist for approvals. If disposal or processing is considered, keep the load onsite until the nature of the RAM and proper actions are determined. Do not allow the vehicle or container to leave the facility without the permission of the Department, and the driver being issued a DOT Exemption Form signed by the Department's Area Health Physicist or their authorized representative. If a driver leaves the facility with a contaminated waste load, they must carry a copy of the signed DOT Exemption Form. *(Note: once a solid waste facility has an approved Action Plan, it is anticipated that facility survey data and DOT Exemption Form can be exchanged via fax to allow for immediate action on the part of the Department.)*

   b) If the driver leaves with the vehicle without a DOT Exemption Form and before the RAM can be evaluated, contact the Pennsylvania State Police and provide them with any information you may have on the vehicle such as make, model, color, company name, license plate number, time left and the direction in which the vehicle was traveling and, if possible, the intended destination. This is to ensure that the driver does not dispose of the contaminated waste improperly. Notify the appropriate DEP Area Health Physicist listed in Appendix A and apprise that individual of the situation.

5) **<u>Action Level Two</u>:** If the dose rates indicated by a radiation survey at a distance of 5 cm equal or exceed either limit in this Action Level on the exterior or in the cab of the vehicle, remove the driver and all other personnel from the immediate area. Similarly, if contamination is detected by wiping vehicle areas that may have contacted the waste during loading, or seams that may leak liquid, isolated the vehicle and call the Department's Area Health Physicist for your location as listed in Appendix A. Proceed as directed by the Area Health Physicist.

D. Designated Area

The Action Plan should include the location of a Designated Area for vehicles found to contain RAM. This area is to be used for surveys, and if needed, to isolate a vehicle or container to maintain personnel radiation exposure ALARA. If surveys show that either exterior dose rate limit in Action Level Two is exceeded, but there is no removable contamination on the exterior of the vehicle and the dose rate in the cab is below 50 mrem/hr, the vehicle should be promptly moved to the Designated Area for an addition characterization or evaluation by facility or Department staff. The area should be appropriate for the various types of RAM potentially found in waste, size of facility, size of truck, employees in the proximity of the truck, and any other suitable steps warranted by the potential situation at hand and site-specific facility layout. Protection of the health and safety of facility operators, and the environment, may be achieved through consideration of time, distance, shielding, and contamination containment.

E. Characterization

If blanket approval is requested for immediate disposal or processing of short lived RAM from patients, NORM, TENORM, or individual consumer products containing RAM (as described above), the Action Plan must have procedures for characterizing the radioactive material present in the waste. Characterization is best executed under the direct supervision of the person who prepared the Action Plan, or another similarly trained and qualified individual. The Action Plan should address steps to confirm the radiation level detected by the monitoring device and identify the radioisotope(s).

<u>At Action Level One</u>, the procedure to identify the radioisotope must include means to determine the gamma ray spectrum. Procedures used in the characterization phase should be situation specific and will be determined by many factors including the type of truck and how it is loaded, the nature of the waste, radiation levels indicated by the survey, highest dose rate, location of RAM in the load, instrumentation, personnel available, weather, and other factors.

At Action Level Two, radiation protection personnel from DEP, and perhaps federal agencies, may come onsite to provide additional guidance and assistance.

In general, appropriate characterization procedures should include the following:

1) If the cab radiation level is over 2 mrem/hr, vehicle surface is over 50 mrem/hr, or contamination is detected - immediately notify the Department's Area Health Physicist. If there is no contamination and the cab radiation level is less than 50 mrem/hr, promptly relocate the vehicle or container to the Designated Area. Using appropriate instrumentation and measurement set-up, identify the radioisotope (i.e., via gamma spectroscopy).

   If the gamma spectroscopy indicates the radiation is from RAM with a half-life of 65 days or less and is most likely from a patient having undergone a medical procedure, the DEP Area Health Physicist may authorize the contents to be processed or disposed of immediately in the facility, provided there is minimal risk to workers. Alternately, the waste load may be rejected. As noted above, a solid waste facility may apply for a blanket approval to process or dispose of certain RAM in waste (i.e., short lived radioisotopes form patients, NORM, TENORM and individual consumer products).

2) Survey the exterior of the vehicle with a portable survey meter set at the most sensitive setting and holding the survey meter no more than two inches (5 cm) from all vehicle surfaces. Mark areas where radiation levels appear to be the highest. If containerized, monitor the waste during unloading from the vehicle. If the radiation levels from the vehicle or any container exceeds 50 mrem/hr at any time during unloading, stop removing the waste, remove personnel from the area and call the DEP Health Physicist at the numbers provided in Appendix A.

3) If contamination is found or the dose rate on the vehicle or cab exceed Action Level Two, Department staff will oversee the surveying the waste vehicle or containers (if waste is containerized in the vehicle). Personnel who are handling the waste to isolate the source should have appropriate training, wear radiation monitoring devices, protective clothing, including coveralls, boots, gloves and dust masks to avoid skin contamination, inhalation, or ingestion with the radioactive material or other potentially hazardous material. The Action Plan and facility should provide for personal protective equipment for facility or consultant personnel if waste off-loading is anticipated.

4) If the waste is containerized, remove the individual waste containers (if not contaminated) from the vehicle and survey each with a survey meter. Look for signs and container labels that might identify the radioactive material or other hazards and the point of origin. Caution should be exercised to ensure that injuries do not occur during removal of the waste containers. Do not attempt to open containers and sort through the waste. The waste may contain sharps, biological waste, and other pathological or hazardous waste that could cause immediate, and more significant risks to the workers.

5) If the waste load is in bulk form and can not be processed or disposed of in the facility or rejected, remove the bulk waste until the estimated location of the radioactive source is approached. Survey bulk waste removed with the portable meter to isolate the RAM. When the source is located, attempt to separate the RAM from the waste, provided it can be done without jeopardizing the health and safety of workers due to other hazards present in the waste. The Action Plan should specify precautions to be taken to monitor external exposure and prevent workers from becoming contaminated by the radioactive material in this process. The contaminated material should be placed in containers and taken to the Designated Area where it can be stored safely and in a manner that protects facility staff, and prevents environmental contamination (e.g., due to runoff, infiltration, pests, etc.) until the means of disposition is determined.

6) If radiation is detected at more than 0.5 mSv h^{-1} (50 mrem h^{-1}) above background levels on the surface of any container, isolate this area within the facility property and contact the DEP Area Health Physicist.

7) The area(s) where radioactive material is identified per (5) and (6) above, should be roped off or otherwise secured to prevent persons from entering areas where radiation levels exceed 0.02 mSv h^{-1} (2 mrem h^{-1}), and labeled with appropriate signs. Radiation levels in areas occupied by operational staff should be kept ALARA. The contaminated waste should be physically secured against removal or inadvertent disposal or else be under observation by facility staff at all times.

8) If radioactive material is not detected in any of the waste containers or in the bulk waste, resurvey the exterior of the vehicle. Mark any areas where radiation levels exceed background levels. The source of the radiation may be the transport vehicle itself (i.e., contamination or a small sealed source).

F. Determination of Origin.

The plan should include procedures to determine the place where the waste originated that contained RAM. These procedures should be thorough (e.g., interview driver) and capable of providing the best attempt to determine the origin of the waste. This effort is most likely to be successful with monitoring at the transfer station.

G. Disposition and/or Storage.

The plan should have procedures for rejection, disposition, or perhaps storage for decay of the waste containing RAM in accordance with the requirements and recommendations set forth in this guidance document. The procedures must take into account the radiation level, the type and amount of waste involved, the radioactive material present in the waste, the form in which the radioactive material is present, availability of the storage option at the waste processing site, and the health and safety of personnel handling such waste or present in the immediate area.

Experience to date indicates that many, if not most, alarms at solid waste facilities involve radioactive materials used in medical procedures which have half-lives sufficiently short (i.e., less than 65 days) that it is practical to either process or dispose of the waste immediately, or to store the waste in a secure area until it has decayed to a non-radioactive form. If the waste is contaminated with short-lived radioisotopes from medical procedures, and the facility operator requests blanket approval to disposed or processed at a solid waste facility immediately, the proposed Action Plan should contain a justification and / or pathway analysis indicating that the RAM will decay in place or not cause a radiation dose to the general public above respective limits noted above. Similarly, for NORM, TENORM or individual consumer products containing RAM, the disposal or processing shall not cause a radiation dose to the general public above applicable limits.

H. Training

The Action Plan should provide for training of individuals responsible for implementing the plan in the areas of:

1) Fundamentals of radiation safety.

2) Operation of the monitoring instrumentation used by the facility, including daily operation and other response checks.

3) All aspects of the Action Plan.

I. Other Items to be Included

1) Provision for written alarm procedures to be posted where they can be seen by the personnel performing the waste monitoring. The alarm procedures should be coordinated in advance with facility personnel, including appropriate notification of DEP or other applicable state or local agencies and authorities.

2) Posting of notices so that waste haulers will be aware of the procedures that will be followed if radiation and radioactive material is detected in their vehicle, including notification of out-of-state radiation protection authorities and declaration of where the waste will be returned. Again, any rejected waste load must have an approved DOT Exemption Form from the Department.

3) Procedures to ensure that at least one individual per shift is trained in and responsible for the implementation of response procedures in the event an alarm is activated.

4) Informing customers in advance of the procedures in the event that an alarm point is exceeded, especially if the procedures include "waste load rejection" provisions under which the suspect waste may be promptly returned to the shipper.

5) Instructing facility personnel on the appropriate procedures to be followed in the event the alarm is activated. The instructions should include graduated contingency plans in the event that RAM in waste is detected, or criteria of Action Level Two is exceeded.

APPENDIX E. BACKGROUND INFORMATION ON RADIOACTIVE MATERIAL IN SOLID WASTE

1. Introduction

Radioactive material is used for a variety of beneficial purposes in the United States, including medical diagnosis and treatment and materials testing. The use and disposal of most types of radioactive material are regulated by the Nuclear Regulatory Commission (NRC) and individual states. Other types of radioactive material are regulated by the Environmental Protection Agency (EPA) and the States. Although low-level radioactive waste must be disposed of in a licensed radioactive waste disposal facility, occasionally unregulated RAM (e.g., from patients having undergone a medical procedure) is found at solid waste processing sites that are not licensed by the NRC or states for the control radiation hazards. Additionally, with increasing frequency, NORM, TENORM or consumer products are detected, as well as less frequent lost or improperly discarded higher hazard radioactive sources.

Radioactive materials in municipal waste have been detected with increasing frequency at landfills, incinerators, transfer stations, and associated facilities. This increase can be partially attributed to increased use of radiation detection instruments at the solid waste facilities. The operators of facilities have been installing such instruments in response to concerns by regulatory agencies and the public or in an attempt to limit liability for potentially costly remedial actions for radioactive contamination. When radioactive contamination is detected, it often prompts an emergency response until the potential hazards posed by the waste are determined and the material is properly controlled.

2. Sources of the Contamination

It should be noted just about everything contains some trace amount of radioactivity, and the earth is continually bathed in cosmic radiation from space. Radioactive materials exist naturally in soil, rocks, and water. There are a great many of these radioactive materials in construction materials, food, and waste. These materials may also be concentrated artificially above naturally occurring levels in their use or production (i.e., TENORM). In addition to these naturally occurring radioactive materials, municipal waste may also contain radioactive materials that have been introduced in consumer products (e.g., most domestic smoke detectors contain the radioactive material americium-241). These detectors enter the waste stream when consumers dispose of them in municipal waste.

Although the NRC and the Agreement States (States that have assumed regulatory control over certain nuclear materials through an agreement with NRC) strictly control the possession, use, storage, transportation and disposal of certain radioactive materials through their licensing and inspection activities, on occasion, radioactive material can find its way into municipal solid waste streams. Over the last several years, the Department and NRC have monitored event reports involving detection of radioactive materials in municipal wastes. Based on reported incidents, the principal man-made sources of radioactively contaminated waste in municipal waste landfills are medical facilities, private and university laboratories and radiopharmaceutical manufacturers.

The radioactive materials reported in contaminated waste have consisted primarily of the following radioisotopes: iodine-131, technetium-99, thallium-201, gallium-67, iodine-123, indium-111, etc. In most cases, such RAM has been legitimately released within patients in accordance with the NRC and state requirements. However, in other cases the event has been caused in violation of applicable requirements, such as lost sealed sources of cobalt-57 and iridium-192.[1]

In the practice of nuclear medicine, radioactive materials are administered to patients for the diagnosis or treatment of illnesses such as thyroid cancer or dysfunction. NRC and Agreement State regulations allow patients receiving radiopharmaceuticals to leave the hospital or clinic when the amount of radioactive material present in their bodies has dropped to certain levels or they present a low exposure potential to members for their family and the public. (See Appendix B). After these patients leave the hospital, they may inadvertently contaminate ordinary trash that is then disposed of in municipal solid waste disposal facilities. Contaminated materials that have been generated by nuclear medicine practices and detected at municipal solid waste facilities include diapers, bed linen, disposable medical supplies and general trash (for example, food, plastic and paper dishes and utensils, newspapers and magazines). Again, these items often become contaminated with radioactive materials when they are contacted by patients that have received the nuclear medicine administration, either while the patient is in the hospital or after the patient has returned home. Although the amount of radioactivity in the municipal waste is often small, detection systems used by solid waste facilities are often sensitive enough to detect the radioactive contamination.

[1] Of particular note and concern is an incident that occurred in Pennsylvania when an high activity iridium-192 source used in cancer treatment was inadvertently disposed of as medical or "red bag" waste - see NRC document number NUREG-1480 for more information.

Hospital, clinics, laboratories and universities use radioactive materials in research, including the marking and detection of molecules in genetic research, the study of human and animal organ systems, and in the development of new drugs. There is a potential that municipal wastes may become contaminated with radioactive materials when contaminated laboratory trash is inadvertently mixed with municipal waste. Contaminated materials may include contaminated glass or plastic, gloves, animal bedding, or paper lab countertop protectors. Waste from radiopharmaceutical manufacturers is similar to the waste produced by laboratories and universities. On rare occasions, sealed sources are mistakenly discarded from such facilities, and shall be retrieved when detected.

In addition to radioactive material that may inadvertently be included in municipal solid waste, solid waste facilities may detect NORM, which is found in a variety of common household or construction materials. NORM, such as radium, thorium or uranium is often found in bricks, wall board or building rubble containing these construction materials. It should be noted, this NORM was present in the base material that was used to produce these construction materials. Natural potassium also contains trace amounts of the radioisotope potassium-40 (K-40). In sufficient quantities, NORM potassium salts may trigger radiation alarms. In no case, because of radiological concerns, shall the presence of potassium or any related compound (with K-40 at natural abundance levels) prevent the immediate disposal or processing of solid waste.

The NRC and most Agreement States allow licensees with waste contaminated with radioactive material having a short half-life (e.g., less than 65 days), to be held for at least ten half-lives onsite at licensed facilities. After this period, the licensees are allowed to dispose of the decayed waste, if it is indistinguishable from background radiation levels based on an appropriate survey. There have been occasions when municipal waste becomes contaminated when a licensee fails to properly monitor radioactively contaminated waste before releasing it for disposal as ordinary trash. In other reported detection incidents, licensees may have properly managed the waste, but the disposal facility's detection equipment was more sensitive than the licensee's equipment.

The NRC and some Agreement State regulations also allow small quantities of specific radioactive materials used in clinical or laboratory tests to be disposed of as if they were not radioactive. Although no incidents involving the disposal of these types of radioactive material have been reported, incidents involving medical waste have shown that detection systems are capable of detecting the low levels of radioactivity associated with these exempted materials.

Some radioactive materials that could contaminate solid waste include:

Radioisotope	Half-Life	Radiation Type
Iodine-131	8 days	beta, gamma
Iodine-125	60 days	Gamma
Iodine-123	13 hours	Gamma
Technetium-99m	6 hours	Gamma
Indium-111	2.8 days	Gamma
Thallium-201	73 hours	Gamma
Gallium-67	3.3 days	Gamma
Cobalt-57	270 days	Gamma
Hydrogen-3	12 years	Beta
Iridium-192	74 days	beta, gamma
Potassium-40	$1.3x10^9$ years	beta, gamma
Radium-226	1600 years	alpha, gamma
Uranium-238	$4.5x10^9$ years	alpha, gamma
Thorium-232	1.4×10^{10} years	alpha, gamma
Americium-241	432 years	alpha, gamma

Lastly, under NRC and Agreement State regulations, some sources and devices may be possessed under a General License. These items include industrial gauging equipment, tritium "EXIT" signs, etc. There is a real potential for such items to be present in solid waste streams. When they are identified through radiation alarms, or visual observation of a GL device or radiation warning symbol, the waste processing facility shall investigate, isolate the item, and contact the Department if needed. Action Plans should contain procedures for the appropriate response if a tritium (hydrogen-3) EXIT sign, or other package with a caution radiation symbol, is observed during processing or disposal of solid waste.

3. What is Radioactivity and Radiation?

The term "radiation" as it relates to "radioactive materials" means the energetic emissions given off by the material as it decays. Ionizing radiation produces charged particles, or ions, in the material that it encounters. Potential adverse effects from radiation on humans are caused by these charged particles, and the energy they deposit in tissues and organs.

Detailed information on radioactivity and radiation is provided in Appendix F.

If you have questions about radiation or require more information, please contact the Bureau of Radiation Protection at the Department of Environmental Protection in Harrisburg (717) 787-2480 or the Area Health Physicist listed in Appendix A for your location.

APPENDIX F. RADIATION PROTECTION FUNDAMENTALS

1. What is Radiation?

Radiation is energy that comes from a source and travels through any kind of material and through space. Light, radio, and microwaves are types of radiation. The kind of radiation discussed in this appendix is called *ionizing radiation* because it can produce charged particles (ions) in matter.

Ionizing radiation is produced by unstable atoms. Unstable atoms differ from stable atoms because unstable atoms have an excess of energy or mass or both. Radiation can also be produced by high voltage devices (e.g., x-ray machines).

Unstable atoms are said to be *radioactive.* In order to reach stability, these atoms give off, or emit, the excess energy or mass. These emissions are called *radiation.* The kinds of radiation are electromagnetic (like light) and particulate (i.e. mass given off with the energy of motion). Gamma radiation and x rays are examples of electromagnetic radiation. Beta and alpha radiation are examples of particulate radiation.

Interestingly, there is a "background" of natural radiation everywhere in our environment. It comes from space (i.e., cosmic rays) and from naturally occurring radioactive materials contained in the earth and in living things. Background radiation levels are typically 5 to10 $\mu R\ h^{-1}$ depending on location, but may be as high as 25 $\mu R\ h^{-1}$.

<u>Radiation from Various Sources</u>

External Background Radiation	60 mrem/yr, U.S. Average
Natural K-40 Radioactivity in Body	40 mrem/yr
Air Travel Round Trip (NY- LA)	5 mrem
Chest X-ray Internal Dose	10 mrem per film
Radon in the Home	200 mrem/yr (variable)
Man-made (medical x rays, etc.)	60 mrem/yr (average)

2. Types of Radiation

The radiation one typically encounters is one of four types: alpha radiation, beta radiation, and gamma (or X) radiation.

A. Alpha Radiation

Alpha radiation is a heavy, very short range particle, and actually an ejected helium nucleus. Some characteristics of alpha radiation are:

1) Alpha radiation is not able to penetrate human skin.
2) Alpha emitting materials can be harmful to humans if the materials are inhaled, swallowed, or absorbed through open wounds.
3) A variety of instruments have been designed to measure alpha radiation. Special training in the use of these instruments is essential for making accurate measurements.
4) A thin window Geiger-Mueller (GM) probe can detect the presence of alpha radiation.
5) Instruments cannot detect alpha radiation through even a thin layer of water, dust, paper, or other material, because alpha radiation is not penetrating.
6) Alpha radiation travels only a short distance (a few inches) in air, but is not an external hazard.
7) Alpha radiation is not able to penetrate clothing.

Examples of some alpha emitters: radium, radon, uranium, thorium.

B. Beta Radiation

Beta radiation is a light, short range particle, and actually an ejected electron. Some characteristics of beta radiation are:

1) Beta radiation may travel several feet in air and is moderately penetrating.
2) Beta radiation can penetrate human skin to the "germinal layer," where new skin cells are produced. If high levels of beta emitting contaminants are allowed to remain on the skin for a prolonged period of time, they may cause skin injury.
3) Beta emitting contaminants may be harmful if deposited internally.
4) Most beta emitters can be detected with a survey instrument and a thin window G-M probe (e.g., "pancake" type). Some beta emitters, however, produce very low energy, poorly penetrating, radiation, that may be difficult or impossible to detect. Examples of these difficult to detect beta emitters are hydrogen-3 (tritium), carbon-14, and sulfur-35.
5) Clothing provides some protection against beta radiation.

Examples of some pure beta emitters: strontium-90, carbon-14, tritium, and sulfur-35.

C. Gamma (or X) Radiation

Gamma radiation or x rays are very long range, penetrating electromagnetic radiation. Some characteristics of gamma radiation are:

1) Gamma radiation or x rays are able to travel many feet in air, and many inches in human tissue. It readily penetrates most materials, and is sometimes called "penetrating" radiation.
2) X rays are like gamma rays. X rays, too, are penetrating radiation. Sealed radioactive sources and machines that emit gamma radiation and x rays respectively constitute mainly an external hazard to humans.
3) Gamma radiation and x rays are electromagnetic radiation like visible light, radiowaves, and ultraviolet light. These electromagnetic radiations differ only in the amount of energy they have. Gamma rays and x rays are the most energetic of these.
4) Dense materials are needed for shielding from gamma radiation. Clothing provides little shielding from penetrating radiation, but will prevent contamination of the skin by these materials.
5) Gamma radiation is easily detected by survey meters with a sodium iodide detector probe.
6) Gamma radiation and/or characteristic x rays frequently accompany the emission of alpha and beta radiation during radioactive decay.

Examples of some gamma emitters are: iodine-131, cesium-137, cobalt-60, radium-226, technicium-99m.

3. How is Radiation Measured?

In the United States, radiation dose or exposure is often measured in the older units called rad, rem, or roentgen (R). For practical purposes with gamma and x rays, these units of measure for exposure or dose are considered equal.

Smaller fractions of these measured quantities often have a prefix, such as, milli (m) means 1/1000. For example, 1 rad = 1,000 mrad. Micro (μ) means 1/1,000,000. So, 1,000,000 μrad = 1 rad, or 10 μR = 0.000010 R.

The "System International" of units (SI system) for radiation measurement is now the official system of measurement, and uses the "gray" (Gy) and "sievert" (Sv) for absorbed dose and equivalent dose respectively.

1 Gy = 100 rad
1 mGy = 100 mrad
1 Sv = 100 rem
1 mSv = 100 mrem

With radiation counting systems, radioactive transformation events can be measured in units of "disintegrations per minute" (dpm) and because instruments are not 100% efficient, "counts per minute" (cpm). Background radiation levels are typically less than 10 $\mu R\ h^{-1}$, but due to differences in detector size and efficiency, the cpm reading on a fixed portal monitor and various hand-held survey meters will vary considerably.

4. How Much Radioactive Material is Present?

The size or weight of a quantity of material does not indicate how much radioactivity is present. A large quantity of material can contain a very small amount of radioactivity, or a very small amount of material can have a lot of radioactivity.

For example, uranium-238, with a 4.5 billion year half life, has only 0.00015 curies of activity per pound, while cobalt-60, with a 5.3 year half life, has nearly 513,000 curies of activity per pound. This "specific activity," or curies per unit mass, of a radioisotope depends on the unique radioactive half-life, and dictates the time it takes for half the radioactive atoms to decay.

In the U.S., the amount of radioactivity present is traditionally determined by estimating the number of *curies* present. The more curies present, the greater amount of radioactivity and emitted radiation.

Common fractions of the curie are the millicurie (1 mCi = 1/1000 Ci) and the microcurie (1 µCi = 1/1,000,000 Ci). In terms of transformations per unit time, 1 µCi = 2,220,000 dpm.

The System International of units (SI system) uses the unit of becquerel (Bq) as its unit of radioactivity. One curie is 37 billion Bq. Since the Bq represents such a small amount, one is likely to see a prefix noting a large multiplier used with the Bq as follows:

37 GBq = 37 billion Bq = 1 Curie
1 MBq = 1 million Bq = ~ 27 microcuries
1 GBq = 1 billion Bq = ~ 27 millicuries
1TBq = 1 trillion Bq = ~ 27 Curies

5. How Can You Detect Radiation?

Radiation cannot be detected by human senses. A variety of instruments are available for detecting and measuring radiation.

The most common of these are:

Geiger-Mueller (G-M) Tube or Probe -- A gas-filled device that creates an electrical pulse when radiation interacts with the gas in the tube. These pulses are converted to a reading on the instrument meter. If the instrument has a speaker, the pulses also give an audible click. Common readout units are: roentgens per hour (R/hr), milliroentgens per hour (mR/hr), rem per hour (rem/hr), millirem per hour (mrem/hr) and counts per minute (cpm). G-M probes (e.g., "pancake" type) are most often used with hand-held radiation survey instruments.

Sodium Iodide Detector -- A solid crystal of sodium iodide creates a pulse of light when radiation interacts with it. This pulse of light is converted to an electrical signal, which gives a reading on the instrument meter. If the instrument has a speaker, the pulses also give an audible click. Common readout units are: microroentgens per hour (μR/hr), and counts per minute (cpm). Sodium iodide detectors are often used with hand-held instruments and large stationary radiation monitors. Special plastic "scintillator" materials are also used in place of sodium iodide.

(Note: For practical purposes, consider the rad, roentgen, and the rem to be equal with gamma or x rays. So, 1 mR/hr is equivalent to 1 mrem/hr.)

6. How Can You Keep Radiation Exposure Low?

Although some radiation exposure is natural in our environment, it is desirable to keep radiation exposure as low as reasonably achievable (ALARA) in an occupational setting. This is accomplished by the techniques of time, distance, and shielding.

Time: The shorter the time in a radiation field, the less the radiation exposure you will receive. Work quickly and efficiently. Plan your work before entering the radiation field.

Distance: The farther a person is from a source of radiation, the lower the radiation dose. Levels decrease by a factor of the square of the distance. Do not touch radioactive materials. Use shovels, or remote handling devices, etc., to move materials to avoid physical contact.

Shielding: Shielding behind a massive object (such as a truck, dumpster, or pile of dirt) provides a barrier that can reduce radiation exposure.

7. What is Radioactive Contamination?

If radioactive material is not in a sealed source container, it might be spread onto other objects. Contamination occurs when material that contains radioactive atoms is deposited on materials, skin, clothing, or any place where it is not desired. It is important to remember that radiation does not spread or get "on" or "in" people; rather, it is radioactive *contamination* that can be spread. A person contaminated with radioactive material will receive radiation exposure until the source of radiation (the radioactive material) is removed.

-- A person is *externally* contaminated if radioactive material is on the skin or clothing.

-- A person is *internally* contaminated if radioactive material is breathed in, swallowed, or absorbed through wounds.

-- The *environment* is contaminated if radioactive material is spread about or is unconfined.

8. How Can You Work Safely Around Radiation or Contamination?

You can work safely around radiation and/or contamination by following a few simple precautions:

A. Use time, distance and shielding to reduce exposure.
B. Avoid contact with the contamination.
C. Wear protective clothing that if contaminated, can be removed.
D. Wash with non-abrasive soap and water any part of the body that may have come in contact with the contamination.
E. Assume that all materials, equipment, and personnel that came in contact with the contamination are contaminated. Radiological monitoring is recommended before leaving the scene.

9. Is it Safe to be Around Sources of Radiation?

A single high-level radiation exposure (i.e., greater than 10,000 mrem) delivered over a very short period of time may have potential health risks. From follow-up of the atomic bomb survivors, we know acutely delivered very high radiation doses can increase the occurrence of certain kinds of disease (e.g., cancer) and possibly negative genetic effects. To protect the public, radiation workers (and environment) from the potential effects of chronic low-level exposure (i.e., less than 10,000 mrem), the current radiation safety practice is to prudently assume similar adverse effects are possible with low-level protracted exposure to radiation. Thus, the risks associated with low-level medical, occupational and environmental radiation exposure are conservatively calculated to be proportional to those observed with high-level exposure. These calculated risks are compared to other known occupational and environmental hazards, and appropriate safety standards have been established by international and national radiation protection organizations (e.g., ICRP and NCRP) to control and limit potential harmful radiation effects.

Annual Radiation Dose Limits- TEDE

Facility staff -	5,000 mrem	(considered as "occupationally" exposed)
Facility staff -	100 mrem	(if considered member of the "public")
Vehicle driver -	100 mrem	(considered member of the public)
General Public -	4 mrem	(for the drinking water pathway)
General Public -	10 mrem	(for the air pathway)
General Public -	25 mrem	(all pathways combined)

Both public and occupational dose limits are set by federal (i.e., EPA and NRC) and state agencies (i.e., DEP) to limit cancer risk.

(Note: It is important to remember when dealing with radiation sources in other materials or waste that there may be chemical or biological hazards separate and distinct from the radiation hazard. These chemical or biological hazards are often more dangerous to humans than the radiation hazard.)

PaDEP's NEW MUNICIPAL AND RESIDUAL WASTE RADIATION MONITORING AND RESPONSE REGULATIONS
Title 25. Environmental Protection

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NOTE: THE REGULATIONS ARE BASICLY THE SAME FOR THE APPLICABLE SOLID WASTE FACILITIES. BELOW IS A FULL TEXT EXAMPLE FROM – GENERAL PROVISIONS AND MUNICPAL WASTE LANDFILLS

CHAPTER 271. MUNICIPAL WASTE MANAGEMENT – GENERAL PROVISIONS

§ 271.1. Definitions.

NARM— Naturally occurring or accelerator-produced radioactive material – The term does not include byproduct, source or special nuclear material.

NORM— Naturally occurring radioactive material – NORM is a nuclide, which is radioactive in its natural physical state—that is, not man-made—but does not include source or special nuclear material.

Radioactive material— a substance which spontaneously emits alpha or beta particles or photons (gamma radiation) in the process of decay or transformation of the atom's nucleus.

Source material— the federal definition for "source material" in 10 CFR § 20.1003 (relating to definitions) is incorporated by reference.

Special nuclear material— the Federal definition for "special nuclear material" in 10 CFR § 20.1003 is incorporated by reference. The term "Commission" refers to the

Nuclear Regulatory Commission. The term "act" refers to the Atomic Energy Act of 1954 (42 U.S.C.A. §§ 2011-2297h-13), as amended. The term "Department" shall be substituted for the term "Commission" when the Department assumes Agreement State Status from the Nuclear Regulatory Commission.

TENORM – Technologically Enhanced Naturally Occurring Radioactive Materials – A naturally occurring radioactive material not subject to regulation under the laws of the Commonwealth or the Atomic Energy Act of 1954, whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities.

Transuranic radioactive material — Material contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium and curium.

§ 271.114. Transition period.

A person or municipality possessing a permit for a municipal waste disposal or processing facility which was issued by the Department prior to December 23, 2000, shall file with the Department an application for permit modification to bring the facility operation into compliance with the following requirements for radioactive material monitoring and detection that became effective on December 23, 2000, according to the following schedule, unless the Department imposes in writing an earlier date in a specific situation for reasons of public health, safety or environmental protection:

(1) *Municipal waste landfill.* An application for a permit modification addressing the requirements of §§ 273.133(a)(14) and 273.140(a) (relating to map and grid requirements and radiation protection action plan) shall be filed by December 23, 2001.

(2) *Construction/demolition waste landfills.* An application for a permit modification addressing the requirements of §§ 277.133(a)(14) and 277.140 (relating to map and grid requirements and radiation protection action plan) shall be filed by December 23, 2001.

(3) *Municipal waste transfer facility.* An application for a permit modification addressing the requirements of §§ 279.103(a)(18) and 279.110 (relating to maps and related information and radiation protection action plan) shall be filed by December 23, 2002.

(4) *Commercial municipal waste composting facility that will receive sewage sludge or unseparated municipal waste, or both.* An application for a permit modification addressing the requirements of §§ 281.112(a)(20) and 281.119 (relating to maps and related information; and radiation protection action plan) shall be filed by June 23, 2001.

(5) *Resource recovery and other processing facilities.* Including infectious and chemotherapeutic waste processing facilities, an application for a permit modification addressing the requirements of §§ 283.103(20) and 283.113 (relating to maps and related information and radiation protection action plan) shall be filed by September 23, 2001.

CHAPTER 273. MUNICPAL WASTE LANDFILLS

§ 273.133. Map and grid requirements.

(a) An application shall contain a topographic map of the proposed permit and adjacent areas showing the following:

(14) A designated area for vehicles for use in the event of the detection of waste containing radioactive material. The designated area shall, by location or shielding, protect the environment, facility staff and public from radiation originating in the vehicle. The Department's Guidance Document on *"Radioactivity Monitoring at Solid Waste Processing and Disposal Facilities,"* Document Number 250-3100-001, describes various factors to consider in determining an appropriate designated area.

§ 273.140a. Radiation protection action plan.

(a) An application shall contain an action plan specifying procedures for monitoring for and responding to radioactive material entering the facility, as well as related procedures for training, notification, recordkeeping and reporting.

(b) The action plan shall be prepared in accordance with the Department's Guidance Document on *"Radioactivity Monitoring at Solid Waste Processing and Disposal Facilities,"* Document Number 250-3100-001, or in a manner at least as protective of the environment, facility staff, and public health and safety and which meets all statutory and regulatory requirements.

(c) The action plan shall be incorporated into the landfill's approved waste analysis plan, under § 271.613 (relating to waste analysis plan).

§ 273.201. Basic limitations.

(l) The following radioactive material controlled under specific or general license or order authorized by any Federal, State or other government agency may not be disposed at the facility, unless specifically exempted from disposal restrictions by an applicable Pennsylvania or federal statute or regulation:

(1) Naturally occurring and accelerator produced radioactive material.

(2) Byproduct material.

(3) Source material.

Upon a confirmed exceedance of the alarm level in subsection (c), a radiological survey of the vehicle shall be performed.

(e) An operator shall notify the Department immediately and isolate the vehicle when radiation dose rates of 20 μSv/hr (2 mrem/hr) or greater are detected in the cab of a vehicle, 500 μSv/hr (50 mrem/hr) or greater are detected from any other surface, or contamination is detected on the outside of the vehicle.

(f) Monitoring equipment shall be calibrated at a frequency specified by the manufacturer, but not less than once a year.

(g) If radioactive material is detected, the vehicle containing the radioactive material may not leave the facility without written Department approval and an authorized United States Department of Transportation exemption form.

§ 273.311. Daily operational records.

(b) The daily operational record shall include the following:

(10) A record of each incident in which radioactive material is detected in waste loads. The record shall include:

(i) The date, time and location of the occurrence.

(ii) A brief narrative description of the occurrence.

(iii) Specific information on the origin of the material, if known.

(iv) A description of the radioactive material involved, if known.

(v) The name, address and telephone numbers of the supplier or handler of the radioactive material and the name of the driver.

(vi) The final disposition of the material.

§ 273.313. Annual operation report.

(b) The annual operation report, which shall be submitted on a form supplied by the department, shall include the following:

(9) A record of detected radioactive materials.

• Office of the President
Robert A. Garbini

NATIONAL READY MIXED CONCRETE ASSOCIATION®

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COMMENTS OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION TO THE NATIONAL RESEARCH COUNCIL, THE BOARD ON ENERGY AND ENVIRONMENTAL SYSTEMS TO THE COMMITTEE ON ALTERNATIVES FOR CONTROLLING THE RELEASE OF SOLID MATERIALS FROM LICENSED NUCLEAR REGULATORY COMMISSION FACILITIES

Tuesday, March 27, 2001

Comments provided by Robert A. Garbini, P.E., President of the National Ready Mixed Concrete Association, 900 Spring Street, Silver Spring, MD 20910, 301-587-1400, bgarbini@nrmca.org.

The National Ready Mixed Concrete Association is the national trade association representing ready mixed concrete producers and suppliers to the industry in the United States. Ready mixed concrete is a $30 billion part of the construction industry. It is the most universally available building material around the world. The United States consumes approximately 1.5 cubic yards of ready mixed concrete for every man, woman, and child in this country or approximately 400 million cubic yards. It is used in literally every single construction project in this country. Even steel, wood, or asphalt projects usually have some concrete within them. Ready mixed concrete plants, of which there are approximately 7,000 across the United States are within every city, town and hamlet.

In addressing the scenarios of using low-level contaminated concrete waste from licensed facilities of the Nuclear Regulatory Commission (NRC, Commission), I will address responses to the issues stated in the Congressional Federal Register 10 CFR Part 20.

Issue Number 1 – Should the NRC Address Inconsistency in its Release Standards by Considering Rulemaking on Release of Solid Materials?

Issue Number 1 concerning whether the NRC should consider developing a rule for the release of solid materials. There has not been sufficient time for NRMCA's leadership to develop a position on this question. I can, however, state that establishing a rule for the release of solid materials would or should have been consistent with the charter of the NRC under the Atomic Policy Act to protect the general population from radioactive exposure greater than the background. The Commission was charged with controlling the release of contaminated air and water from single point sources. The proposal to allow the use, speaking for the concrete industry, of contaminated concrete products into the general population removes the control originally given to the Commission for single point sources and allows the disbursement of licensed material into the general population where it can no longer be controlled nor monitored.

Nonetheless, NRC continues to perform case-by-case rulings on solid materials where they should be guided by the original mandate to control "single point" releases of contaminated material in air and water. It is our opinion that the NRC should create a rule regarding the release of solid materials. The conditions and components of such a rule will require careful study to continue the original mandate of NRC to prevent widespread disbursement of radioactive contamination into the general population.

Issue Number 2 – If NRC Decides to Develop a Proposed Rule, What are the Principal Alternatives for Rulemaking that Should be Considered and What Factors Should be Used in Making Decisions Between Alternatives?

In the alternatives listed for Issue Number 2, in our opinion there may be the ability to use contaminated concrete in restricted uses. These would have to be clearly defined, should still come under the control of the NRC, and must overcome debilitating economic, health, and public perceptions. It is difficult

at this time to conceive of unrestricted use of contaminated concrete, which was previously licensed by the NRC to be used in widespread use of construction throughout the United States. The potential exists to expose the general population to an ever-accumulating level of radioactive exposure. Already radioactive materials were to be licensed under the Atomic Policy Act. Their unrestricted use under any rule would make a de facto termination of that control.

Faced with the challenges of closing licensed facilities and handling contaminated concrete, it is logical to conclude that a rule regarding release of contaminated materials from licensed sites should be made. It is not, however, an adequate conclusion in our opinion that these materials should be placed in unrestricted use or even restricted use without further definition. Concrete, as several other construction materials, is ubiquitous to our society. The concept of concrete framed buildings across the United States being made with radioactive materials housing millions of people exposing them to potential radioactive material greater than background exposure is contrary to the charter of the NRC.

The Commission has stated that a "precedent setting" example of integrating waste products back into society was made by the 1992 rule from the Environmental Protection Agency (EPA) directing government projects to consume, where possible, fly ash in its concrete products is hardly a basis for allowing licensed material to be released. Fly ash, not licensed by NRC, has low levels of radioactive contamination at one-third the level of normal background radioactivity. These materials from licensed facilities contain radioactive contaminations of unknown levels at this time, and these levels may vary greatly depending on their origin. Unrestricted use of contaminated materials from licensed facilities can put an extreme burden on unqualified handlers of radioactive materials such as ready mixed concrete producers. It should also be clear that neither the ready mixed concrete producer nor the consumer should assume the responsibility for the liability of use of these materials or the economic cost. Licensees of these facilities cannot abrogate their responsibilities under any proposed rule, nor should the NRC be facilitator to relieve the licensees of their obligations.

Of additional concern is the economic impact for the use of commissioned licensed materials in concrete production. Would it be contemplated that the ready mixed concrete producers would be responsible for transporting, crushing, and preparing contaminated concrete? This obviously constitutes an extreme financial burden in attempting to prepare ready mixed concrete

producers for handling radioactive material, which heretofore was managed by the licensees of these facilities. The use of fly ash is not an example of how concrete can be used. Fly ash constitutes trivial radioactive material and does not require any additional processing. Waste concrete from licensed facilities would require the expense of crushing and screening and additional handling to bring it into conformance with current standards of the American Society of Testing and Materials and the American Concrete Institute to be used as an acceptable construction product. Fly ash, on the other hand, requires no special processing and need only be blended with Portland cement products for its use. In addition, the experience of the ready mixed concrete industry in using recycled concrete for aggregate in fresh concrete is not a good one, nor is it accepted by many states for their work. Processed concrete, while may be used as roadbed material or other fill, does not have the same characteristics as raw sand and gravel or natural aggregates. Acceptability of recycled concrete whether with radioactive contamination or not, does not have the best record in the construction industry. In fact, many state departments of transportation prohibit the use of fly ash or other recycled materials. Of course, the liability issues and acceptance of the use of radioactive materials by the consumer and the public would put concrete into a disadvantageous position.

Issue Number 3 – If NRC Decides to Develop a Proposed Rule Criteria for Release of Solid Materials, Could Some Form of Restrictions on Future Use of Solid Materials is considered as an Alternative?

In our opinion, it is possible that some form of restricted use could be made of these contaminated concrete materials. We, however, believe that restricted use should be defined to "single point" uses where contact for exposure by the general population is minimal. Such examples might include non-water supply concrete dams for flood control, deep concrete foundations, possibly concrete bridges, or concrete containment facilities for this express used of storing these solid materials into a "single point", licensed storage facilities. Restricted use, however, should entail licensing as low-level nuclear facilities by the NRC. This will allow the users and the general public to have full knowledge of risk levels and exposure with public comment and further remove the issues of liability and monitoring costs by controlling its use in "single point" uses.

Issue Number 4 – If NRC Decides to Develop a Proposed Rule, What Materials Should be Covered?

In responding to this issue, whether for concrete or other building materials, I would state again our concern of allowing licensed materials to be disbursed within the general population. However, understanding the need to integrate various philosophies in today's complex environment, we believe that solid materials from licensed facilities should have a rule contemplated for their management and could be used under qualified conditions and could be used for restricted use. We again state that unrestricted, widespread use of any of these solid materials off of licensed facilities is unacceptable.

Statement of Dan Guttman

National Academies
National Research Council
Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission - Licensed Facilities
March 27, 2001

My name is Dan Guttman, My work address is 1155 15th Street, N.W., Suite 410; telephone no. 202-638-6050; email: dguttman@ari.net. Thank you for the opportunity to appear before you today. I appear on my own behalf as a citizen, but draw from experiences I have been privileged to have shared in matters related to the panel's charge.[1]

Introduction and Summary

This Committee's work raises three questions, the importance of which extends well beyond the formal terms of the panel's contractual commitment to the Nuclear Regulatory Commission ("NRC"):

(1) Why did the NRC – an entity vested with primary responsibility for protecting the public against radiation risk-- fail to ask the National Academy of Sciences ("NAS") the proper questions regarding the radiation risk to which the NRC

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[1] Experience which informs this testimony includes: (1) counsel to numerous municipally/cooperatively owned electric systems regarding the purchase of ownership interest and/or power from nuclear plants; construction of nuclear plants; nuclear power plant decommissioning costs/methods;(2) special counsel to Senator David Pryor in oversight investigation of the Department of Energy's management of its contractors and consultants; (3) Executive Director of President Clinton's Advisory Committee on Human Radiation Experiments; (4) Commissioner of the U.S. Occupational Safety and Health Review Commission; (5) counsel to the Oil, Chemical, & Atomic Workers union (now a component of the Paper, Allied-Industrial, Chemical & Atomic Workers Union, PACE), the primary representative of workers at the nuclear weapons complex, and a representative of workers at nuclear utilities and other hazardous and energy intensive work sites, on matters including the recycling of radioactive waste and the privatization of the U.S. Enrichment Corporation (operator of the NRC regalated Portsmouth and Paducah gaseous diffusion plants); (6) adviser to Nye County, Nevada, on matters related to the siting of the nuclear waste repository; (7) adviser to the special delegation to the United States of the Chancellor of Austria regarding the Temelin nuclear power plant. I have been called on to advise the Department of Energy regarding the recently enacted nuclear workers compensation legislation and the Russian nuclear cities program. I am a fellow of the Center for the Study of American Government at Johns Hopkins University and of the National Academy of Public Administration.

seems predetermined to expose the public?

(2) Why did the NAS – an entity with essential responsibility for vouchsafing the integrity of scientific advice to the nation -- accept without any evident question, a framework for its work which it knew, or should have known, effectively excluded from inquiry most important facts bearing on the protection of the public?

(3) What will this panel do to ensure that the necessary and proper questions are asked, and that there is a full public record regarding the inquiry?

The terms of the NRC referral to the NAS, and the NAS's acceptance of these terms, confirm that the NRC and the NAS believe that the primary issues here are technical -- *i.e.*, the amount and/or quality of radioactive materials that can, in the abstract, harm humans and their environment, and the ability of equipment to decontaminate waste to these levels. This is not so.

It is now known that agencies (and private adjuncts) that performed well in the Cold War development and production of nuclear weapons, exposed citizens, soldiers and workers to undue risk of radiation exposure – without adequate provision for:

(1) disclosure so that citizens might choose to protect themselves; and

(2) recordkeeping and monitoring needed to vouchsafe public health at decades remove from initial exposure.

Moreover, the secretive, lawless, and/or incompetent exposure of citizens to radioactive hazards is, at least in regard to the recycling of radioactive waste, demonstrably not a thing of the past. The public record now shows that these features have hallmarked the recent promotion of the recycling of radioactive waste by DOE (and its contractors), and, indeed, underlay Secretary Richardson's 2000 intervention to impose a moratorium on recycling.

The NRC, in the proceeding underlying this panel's work, showed the public that it is determined to ignore that which is of public concern. It has:

* refused to acknowledge its own responsibility for the recycling of DOE waste, the largest and most potentially lucrative, source of radioactively contaminated metals;

* abdicated its duty to provide independent and expert analysis of risk to a contractor (SAIC) possessed of obvious conflict of interest;

* declined to subject to public review the manner in which DOE contractors took advantage of the NRC's lax oversight to launder the recycling of volumetrically contaminated radioactive nickel through the secretive processes of the Tennessee Department of Environmental Conservation ("TDEC")

* persists on forwarding SAIC's tainted handiwork – even though the SAIC analysis, on its face, also ignored the most realistic of risk scenarios -- past and present DOE experience.

In short, the central issue here is not, as the NRC's referral to the NAS would have it, one of addressing an "hysterical" and "ill-informed" "public perception" (that low level doses of radiation are risky)-- a task which, it is hoped, can be accomplished by the NAS's august confirmation that a given amount of radiation is safe (or, if not safe, a risk somehow worth taking). Rather, the issue here is the intelligent public's increasingly well-informed understanding that governmental and contractor institutions that now purport to protect them from radiation risk have hitherto unjustifiably withheld information, lied, and demonstrated a startling incapacity to technically abide by public protection standards.

In sum:

.* The NAS must address evidence that recycling is unsafe at any speed until ~~DOE~~ and NRC (and their contractors, delegatees, and licensees) demonstrate an ability to act lawfully, competently, and openly in matters that expose the public to the unrestricted reuse of recycled radioactively contaminated metals;

* Under no circumstances should the release of radioactively contaminated metals for unrestricted reuse be permitted in the absence of:

– provision for 100% verification of the released metals;

– provision for labeling and recall of the released metals.

I. The NAS Must Address Evidence that Recycling is Unsafe at Any Speed until the DOE and DOE (and their contractors, licensees and delegatees) Show the Consistent Ability to Act Lawfully, Competently, and Openly in Matters that Expose the Public to the Unlabeled and Unrestricted Reuse of Radioactive Waste

In the proceedings before the NRC, PACE (and many others) laid out the evidence that the track record of the institutions entrusted with recycling radioactive waste does not permit a reasoned conclusion that any public protection standard(s) will be abided by. The NRC failed to address this evidence (much less contradict it). To the contrary, the NRC gave ample basis for further reasoned public concern.

A. We Now Know that the Government and its Contractors Knowingly Exposed Citizens, Soldiers, and Workers to Undue Radiation Risk Without Adequate Provision for Advance Disclosure, Recordkeeping and Post Hoc Monitoring

In its 1995 report to President Clinton, the Advisory Committee on Human Radiation Experiments ("ACHRE") found that -- at its 1947 birth -- the Atomic Energy Commission ("AEC"), predecessor to the DOE and the NRC, embraced a (secret) policy of covering up health, safety, and environmental information that could embarrass, or be a source of liability to, the government or its contractors. ACHRE found that this policy where national security itself could not serve as grounds to keep information on risk secret. ACHRE did not find that this covert policy was ever countermanded. [2]

By the late 1990's it became apparent that coverup continued for decades and that, by consequence, an unknown number of (the 600,000) nuclear weapons workers were placed at undue and increased risk of cancer and other ills. In January, 2000 Secretary of Energy Richardson acknowledged that the government's evasions and lies had harmed workers.[3] In October, 2000, the United States Congress provided for compensation for these workers. In enacting the Energy Employees Occupational Illness Compensation Act, Congress found that:

> (2) Since the inception of the nuclear weapons program and for several decades afterwards, large numbers of nuclear weapons workers at Department of Energy and at vendor sites who supplied the Cold War effort were put at risk without their knowledge and consent for reasons that, documents reveal, were driven by fears of adverse publicity, liability, and employee demands for hazardous duty pay.
>
> (3) Numerous previous secret records documented unmonitored radiation, beryllium, silica, heavy metals, and toxic substances' exposures and continuing problems at the Department of Energy and vendor sites across the country, where since World War II the Department of Energy and its predecessors have been self-regulating with respect to nuclear safety and occupational safety and health.

In short, we now know that the United States and its contractors systematically, and over the course of decades, failed to protect untold thousands of its workers -- who were putatively

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[2] *See, The Human Radiation Experiments: Report of the President's Advisory Committee* (Oxford U.P. 1996) at chapter 13 ("Secrecy, Human Radiation Experiments, and Intentional Releases.") The Committee recommended, and the Administration agreed, that where the government engaged in coverup of risk, the victims (or next of kin) are entitled to apology and, even in the absence of physical injury, a measure of compensation. (*See* Recommendation 1, at 512).

[3] *See New York Times*, January 29, 2000 ("U.S. Acknowledges Radiation Killed Weapons Workers: Ends Decades of Denials; Compensation is Possible for Survivors' of Cancer Victims who Worked with Bombs"). Secretary Richardson told the *Times* that: "This is the first time that the government is acknowledging that people got cancer from exposure at the plants."

protected from the start by rules that provided for limitations on exposure, recordkeeping, and monitoring. Why should the public have confidence that its frying pans, braces, and knives and forks will – in the absence of labeling or monitoring -- be given any better protection?

B. The DOE/BNFL Oak Ridge Recycling Project Is the Primary Real World Precedent for Recycling and Must Be Addressed by any Committee that Purports to Address Public Health Protections

In 1996 DOE announced what was proclaimed as a model and precedent setting project for the recycling of 100,000 tons of radioactive metallic waste from the Oak Ridge K-25 site. DOE boasted that its contractor – British Nuclear Fuels (BNFL) – would deploy innovative nickel recycling technology, guarantee performance at a fixed price ($238 million) and save taxpayers hundreds of millions of dollars in cleanup costs.[4] The continuing revelations regarding the failure of this showcase recycling project must be understood and addressed by any Committee that purports to address the protection of the public from the potential hazards of recycled radioactive waste.

1. A Federal Court Has Found that, Through use of the NRC's Offices and Otherwise, DOE and BNFL Placed the Public at Unlawful and Unexamined Risk

Prior to the August, 1997 contract award to BNFL, OCAW and environmental groups called on DOE to conduct a public review of the proposed recycling, as required by the National Environmental Policy Act (NEPA). This request was ignored. OCAW, joined by environmental interveners, sought a court order that NEPA be complied with.

In June, 1999 a Federal District court confirmed that DOE awarded its quarter billion dollar recycling contract to BNFL without regard for the basic requirements of environmental law and openness (See, *Oil, Chemical & Atomic Workers, et al. v. Pena, et al.* 62 F.Supp. 2d 1 (D.D.C. 1999). Judge Kessler found that the Superfund law barred citizens from obtaining court ordered relief,[5] but, nonetheless, found that the concerns raised by the union and environmental groups were valid (emphasis added)

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[4] The October, 1996 DOE press release quoted Vice President Gore as promising that: "This reinventing government initiative not only solves an environmental problem, but will create jobs and stimulate the economy of Oak Ridge."

[5] The Court's reasoning was based on the DOE/BNFL claim that recycling was integral to an underlying Superfund cleanup, and the law provides that Superfund cleanups cannot be challenged during their conduct. In fact, as Secretary Richardson's moratorium on the Oak Ridge recycling confirms, the DOE/BNFL claim that the recycling was integral to the K-25 cleanup (which is ongoing) was itself spurious.

The court acknowledges and shares the many concerns raised by [PACE and environmental intervenors]. *The potential for environmental harm is great, especially given the unprecedented amount of hazardous materials which [DOE and BNFL] seek to release.*

The court found "ample evidence that the proposed recycling significantly affects the quality of the human environment." The court found that "plaintiffs allege and [DOE and BNFL] have not disputed, that there is no data regarding the process efficacy or the track record with respect to safety."[5]

Finally, the court pointedly noted that BNFL had availed itself of a license under the Nuclear Regulatory Commission's Tennessee state program. "TDEC," noted the court, "which has neither the resources nor the extensive expertise of a national regulatory agency, is the only body with any supervisory power." *In short, as the court found, it was the Nuclear Regulatory Commission – and not the Department of Energy – that ultimately opened the door for the unprecedented, unrestricted and unlabeled reuse of nuclear weapons complex nickel.*

2. Testimony in the Court Proceeding Revealed that the BNFL Contract was Forwarded in Defiance of Secretary Pena's Directive that DOE Protect the Public Against Unrestricted Use

Discovery in the court proceeding revealed that high DOE officials ignored or defied Secretary Pena's directive that the DOE/BNFL contract reserve DOE's right to protect the public against unrestricted uses.[6]

Discovery revealed that Secretary Pena instructed high DOE officials to assure that the contract provide DOE authority over end uses. Jim Hall, DOE head of Oak Ridge Operations who signed the August, 1997 contract for DOE, testified that Secretary Pena – in recognition of the issues raised by the steel industry, labor, and environmentalists – directed DOE officials to make sure the final contract provided for DOE control over the end use of metals to be released.[7]

In fact – and to the claimed surprise of the Mr. Hall – the Secretary's directive was ignored. At his deposition, Mr. Hall initially testified that the Secretary's directive had been complied with. On review of the contract, (which he signed for the Department) he recognized

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[6] BNFL's contract proposal to DOE stated that "volumetric contamination will limit the metals to restricted end use." (BNFL proposed reuse in nickel hydride batteries.) Nothing in the contract negotiation materials provided to OCAW by DOE and BNFL contemplated the broad free release rights BNFL later claimed.

[7] James Owendoff, Acting Assistant Secretary for Environmental Management in August, 1997, testified to similar effect.

that the Secretary's directive had been disobeyed. The contract placed no restrictions on BNFL sale of materials once they leave MSC's processing facility.[8]

The question of how and why Secretary Pena's directive was countermanded remains a public mystery. The reasoning public might want to know the answer to this mystery before entrusting itself to the good graces of further federal protection from recycled waste.

3. DOE Awarded the Contract to BNFL With No Regard for its Noncompliance with Environmental, Safety, and Health Requirements and Admitted Lack of Management Competence

DOE awarded the $238 million contract to BNFL based on a statutorily required determination that BNFL was the sole "responsible source." DOE's "Justification for Less than Full and Open Competition" relied on the qualifications of "MSC," which operates a metals recycling facility in Oak Ridge. Federal procurement rules provide that where the prime contractor's affiliate – here BNFL's wholly-owned subsidiary MSC – may affect performance under the contract, the "responsibility" of the affiliate is also of the essence.

BNFL, however, failed to disclose information to DOE that bore directly on the responsibility and integrity of MSC - and the DOE never asked for it.

In advance of BNFL's purchase of 100% ownership of MSC, BNFL official James

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[8] BNFL/MSC's President James McAnally testified:

Q. So you deal with, for example, a middleman?
A. Yes.
Q. And you don't care where the middleman distributes the metal, just as long as the middleman buys your recycled metal?
A. No.
Q. No, meaning you don't care?
A. No, in that we sell a product that is released that meets all the standards for release, and where it goes from there is not our concern.
Q. So, for example, it could go into a metal joint for a hip replacement?
A. Yes.
Q. And it could go into spoons used for eating, right?
A. Yes.
Q. It could go into children's braces?
A. Yes.
Q. There's no restriction on the end use?
A. No.

Deposition of James McAnally at 175-176.

McAnally performed a management audit of MSC. Mr. McAnally testified under oath that his analysis led to his conclusion – in May 1997, during the midst of negotiations with DOE regarding the contract (which was signed on August 25, 1997) – that MSC suffered fundamental management weaknesses. [9] BNFL evidently failed to disclose its findings (and the 200 page audit itself) to DOE.

In January of 1998, moreover – months following the August, 1997 contract award -- DOE belatedly performed an audit of the MSC Oak Ridge facility. DOE auditors found, among other deficiencies, that: (a) "[a] training program has not been implemented. . . [t]he training program has been identified as a recurring deficiency by MSC"; (b) "[t]he records and document system at MSC has not been formally implemented"; (c) the procurement system "does not ensure that procured materials or services meet the established requirements and perform as specified"; (d) there were many repeat problems in operations and laboratory quality control; and (e) the respiratory protection and lock-out/tag-out programs were in violation of OSHA.

These health and safety deficiencies -- longstanding and basic -- were found in a company that had been operating under both DOE (Morgantown R&D) contract and Tennessee/NRC license for years. [10]

4. DOE Awarded the BNFL Contract Based on BNFL Possession of Unique Recycling Technology Which BNFL did not Possess

On behalf of the noncompetitive contract award to BNFL, DOE claimed that BNFL (through its affiliate MSC) had "developed" a unique technology to recycle nickel.

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[9] Mr.McNally testified:

Q. What did the report have to say about the management weaknesses of MSC?

A. I don't recall the exact language, but the – basically, that the organizational structure was weak, that management did not have the professional management skills to manage an enterprise the kind of output that was needed from the BNFL assets.

* * *

A. . . . I rated the quality of the workforce as being extremely good, but the overall management, strategic thinking, organization, meeting goals, execution, I rated as weak.

[10] Moreover, the OSHA deficiencies were likely the tip of the iceberg. DOE's Jack Howard, the contract officer for the BNFL project, explained in court testimony that DOE auditors were not even looking for OSHA violations.

But court discovery revealed that BNFL did not even possess the right to utilize the technology. Judge Kessler found that, "even as of March 18, 1999 when parties appeared before the court for a status conference, it was not fully clear when BNFL would be granted the legal rights to use the recycling process." 62 F. Supp 2d. at 12 [11]

DOE's contract justification also cited the experience of BNFL's parent company in decommissioning a gaseous diffusion plant in Capenhurst, England. The contract award was accompanied by a DOE press release which declared the K-25 approach would be based on "BNFL's successful experience in the Capenhurst facility in Great Britain." In 1998 deposition testimony, however, DOE's Jim Hall, who signed the DOE/BNFL contract, testified that BNFL did not recycle nickel at Capenhurst. As of 1998, the radioactive nickel was still sitting in drums in a warehouse in England.

5. BNFL Sought to Launder its Proposal Through NRC/TDEC Closed Door Processes

No federal rule provided (or provides) for recycling of the volumetrically contaminated nickel that was to provide the lion's share of BNFL's profits. With knowledge of the public controversy surrounding the nickel recycling, BNFL secretly planned to launder the recycling through the NRC's delegatee -- the Tennessee Department of Environment and Conservation. A secret BNFL strategy memo explained (emphasis added):

Issuance of radioactive materials licenses within the State of Tennessee

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[11] In his October, 1998 deposition, then-Acting Assistant Secretary for Environmental Management James Owendoff testified that "the reason we signed the contract with BNFL" was that BNFL claimed its team had the technology to recycle volumetrically contaminated nickel.

Q. Did you understand that BNFL claimed that it or its teaming partner, MSC, had technology to recycle volumetrically contaminated nickel.

A. Yes.

Q. And did you understand that claim was one of the reasons BNFL/MSC got the contract.

A. It was the reason we signed the contract with BNFL, yes.

Similarly, Jim Hall, the Oak Ridge Operations Manager who signed the contract, testified regarding patent ownership: "I assume I was told it was MSC technology."

In fact, as of March, 1999, Judge Kessler noted, BNFL did not have a right to use the patent. Indeed, the patent owner filed an administrative claim with DOE. By consequence, if and when nickel recycling proceeds, taxpayers may be obligated to pay extra millions so that BNFL can use the technology the unique possession of which was the basis for its contract award.

has not previously involved a public consultation process. It is unlikely that this will continue to be the case for the long term...Therefore, amendment to the existing MSC license for release of a small quantity of decontaminated nickel is being pursued to establish the precedent for nickel release.

6. NRC/TDEC Rubberstamped BNFL's License in Secret, with Minimal Regard for Worker and Public Health and Safety

As BNFL hoped, TDEC proceeded to amend the existing BNFL/MSC license to provide for nickel recycling. It did so without any opportunity for meaningful public comment; indeed, public comment would have been impossible because virtually all the risk analyses and further documents under review by TDEC were allegedly secret.[12] Moreover, it did so in the absence of any evident analysis of the risks to workers performing the recycling.

Furthermore, deposition testimony of the TDEC radiation protection chief confirmed that TDEC was blissfully unaware that DOE auditors had found that MSC was in noncompliance with quality control, environment, and worker health and safety protocol. There is no indication that the audit, or further evidence of MSC's noncompliance, was taken into account by TDEC in its approval of BNFL's nickel recycling license.

Following the issuance of the license, OCAW and the Natural Resources Defense Council ("NRDC") repeatedly called on TDEC to provide the public with explanations of the basis for its license approval. TDEC never responded to these inquiries.[13]

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[12] When, pursuant to court order, BNFL provided OCAW with documents that it had presented to the TDEC, each and every document was claimed to contain business secrets and, therefore, could not be made public.

[13] See October 5, 1999 and October 18,1999 letters of Dan Guttman (counsel for PACE) and David Adelman (Counsel for Natural Resources Defense Council) to Mike Mobley, Director TDEC.

The (still unanswered) questions posed by the October 5 letter were:

1. *Which plans, protocol, etc. submitted by MSC/BNFL in support of the license amendment spell out protections that will prevent worker and citizen contamination from plutonium and neptunium?*

2. *Does TDEC or MSC/BNFL know how much plutonium and neptunium and other radionuclides are in the waste that will be removed from the Oak Ridge Reservation K-25 site for recycling at the MSC facility?*

3. *Does TDEC know whether the waste to be delivered to MSC/BNFL for recycling*

7. DOE's Inspector General Has Now Confirmed That the Public Cannot Rely on the Integrity of Verification Procedures

a. The IG Found, and DOE concurs, that DOE Cannot Ensure that Recycling Will not Increase Public Risk

In September, 2000 the Department's own Inspector General ("IG") reported on its audit of the BNFL recycling contract. The IG concluded (DOE/IG-0481, at 2) (emphasis added):

> *BNFL did not perform accurate surveys of contaminated metals before the contractor released the metals for recycling on the open market. We found that employees who performed the surveys were not adequately supervised. As a result, there was increased risk to the public that contaminated metals were released from the site, a condition that, obviously, was contrary to the Department's objectives when it established this program.*

The IG report records that DOE management concurred with "the findings and recommendations." (Id.).[14]

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includes any radioactive or otherwise toxic materials or chemicals whose identity is still classified?

4. What license requirements will assure that those working in and around plutonium and neptunium at MSC facilities will be protected from radionuclides that can cause cancer when present in the minutest amount?

5. Prior to the license award, what did TDEC independently do to identify whether the many violations of quality control, environmental, health, and safety laws and protocols found by DOE in 1998 had been fully corrected -- i.e. to assure that MSC's operations of its facilities will not in any way be an imminent or endemic danger to worker and community health and safety?

6. Has TDEC independently verified that MSC is now capable of the competent contract management required in its October 1 letter?

7. What requirements are built into MCS's license amendment to assure that its operations will be independently monitored by expert sources other than those which TDEC and DOE have already found to be insufficient to protect workers and the public?

8. When will the full documentation relied on by TDEC in support of the license amendment be made public?

The (still unresponded to) October 18, 1999 letter asked TDEC to provide the statutory and regulatory provisions under which the license amendment was issued.

[14] *Moreover, the IG report explained, at 8, that BNFL's failure had little to do with flawed technical standards or equipment and all to do with bad management:*

BNFL's disregard for public health took place under a showcase contract, which was ultimately put under the light of court and Congressional and press scrutiny. If BNFL/DOE did not feel constrained to follow minimally requisite management practices in such a setting, why would the public be wrong in doubting that public protection standards will be honored in any other circumstances?

b. The IG Confirmed that Independent Verification Does not Ensure Public Protection

DOE's BNFL project proclaimed that the public would be protected because the surveys of BNFL would be reviewed by an "independent verification" team. The presence of such a team, the IG found, did not "ensure" that the public was protected. To the contrary, as the IG report explained, the "independent verification" team only reviews a sample of the contractor's work: "Since the verification team does not verify every item in each lot, additional surveying errors would not be detected, and in some cases, lots exceeding the release criteria may have been released."

C. The NRC Proceeding Shows an Agency Bent on Reinforcing Public Perception that it Will not or Cannot Protect Against Recycling Risk

1. The NRC Bedrocked its Proceeding on Conflict of Interest – Regarding which it Still Refuses to Come Clean

In November, 1999 PACE pointed out to the NRC that its employment of SAIC to perform the technical analysis for its proceeding ("NUREG-1640") was unacceptable. SAIC had long been the teaming partner to BNFL in the quarter billion dollar DOE sponsored effort to

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Many of the results of metal surveys that have been documented to date as being inaccurate were a result of BNFL employees who performed the surveys not being adequately supervised. It has been noted that BNFL experienced significant turnover in survey supervisors. This large management turnover affected training and continuity with the BNFL survey program and was creating potential systematic problems with release process. Specifically, the knowledge which the supervisors obtained concerning the areas of material most likely to contain contamination as well as recurring problem areas would have been lost unless BNFL documented the information in work records and then required every new supervisor and every new survey technician to review these records. BNFL, however, was not documenting recurring problem areas and thus did not initiate corrective action on a trending basis.

promote nuclear waste recycling.[15] Moreover, PACE pointed out, the conflict was particularly egregious where:

> (1) the terms of the SAIC contract called on a private contractor – likely in violation of longstanding prohibitions against contracting out inherently governmental functions – to do the Commission's basic thinking, and even to provide the Commission with a summary of the views of other stakeholders;
>
> (2) the NRC relied on SAIC over a period that began in 1992; and
>
> (3) the NRC was forced to award SAIC a second contract in August, 1999 because SAIC did not complete the required work under the first.[16]

By letter to SAIC of December 16, 1999, NRC issued a stop work order to SAIC regarding the August, 1999 contract. In March, 2000 the NRC announced the termination of the August, 1999 contract. *The NRC, however, conspicuously refuses to make public facts which might explain to the curious public how it contrived to rely on a contractor with such obvious conflicting interests. To boot, the NRC now asks the public to suspend disbelief and assume that the tainted study is acceptable as is.*

2. The NRC Prejudged the Result which it Now Asks NAS to Rubberstamp

In the November, 1999 public sessions, many public commenters noted that the NRC's June, 1998 Staff requirements memorandum (SRM) revealed that the NRC had prejudged the outcome of the recycling proceeding. Commission staff vigorously protested this conclusion, and professed to openmindedness. (See, November 1-2, 1999 NRC transcripts.) No sooner was the proceeding adjourned, then PACE learned that, evidently unknown to these staff, the Commission's 1998 prejudgment had, indeed, been reiterated with emphasis in August, 1999.[17]

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[15] Indeed, documents obtained in the BNFL court case revealed that SAIC expected to obtain tens of millions of dollars from work on the BNFL project, with its role including that of assuring regulatory compliance.

[16] The above points were spelled out to the NRC in PACE's November 16, 1999 comments, which I presume have been provided to the NAS and are part of the record here.

[17] SAIC contract NRC-04--99-046, effective August 4, 1999 is entitled, "Technical Assistance Support for Clearance of Materials and Equipment." The statement of work declared that the predicate for SAIC's continuing work was the NRC's June 30, 1998 Staff Requirements Memorandum (SRM). The statement of work explained (at 1):

3. The NRC Refused to Engage in Reasoned Public Exchange or Inquiry Regarding The Abuse and Breakdown of NRC Recycling Regulation

In the face of a court scepticism of the adequacy of NRC/TDEC licensing, and PACE/ NRDC showing that the TDEC review was, on its (barely visible) public face, deficient, reasonable citizens might have expected the NRC to assure the public that it would thoroughly review the facts of the TDEC licensing. To the contrary, the NRC treated calls for due diligence (on the part of Congressmen as well as citizens) as if it were TDEC, and not the NRC, that were the superior body.

4. The NRC Declined to Address, Much Less Dispute, the Evidence that Government and Contractors Cannot Be Trusted to Protect the Public Against Recycling Risk

Pursuant to the NRC's invitation, in 1999-2000 PACE, and others, identified basic factual questions regarding real world experiences that must be addressed and answered before any steps are taken to proceed with a rulemaking that might result in the release of materials for public use.[38]

For example, PACE's November 1, 1999 comments to the NRC called on the NRC to engage in discussion and fact finding regarding:

* Federal court confirmation that precedent setting Oak Ridge recycling was proceeding in violation of environmental law;

* government/ contractor historic practices of keeping information on radioactive releases secret from the exposed public;

The Commission in an Staff requirements Memorandum (SRM) dated June 30, 1998 directed the NRC staff to proceed with rulemaking on clearance of materials and equipment having residual radioactivity. Specific directions regarding the content of a clearance rule contained in SRM are that: (1) it will not be a detectability standard but will instead be a dose-based regulation...(2) it will base standards on realistic scenarios of health effects from low doses; and (3) it will be a comprehensive rule applicable to all metals, equipment, and materials, including soil, unless a narrower scope is justified based on problems with applying the rule to certain categories of materials that could delay completing the rulemaking.

[38] I understand that PACE (and further) submissions to the NRC are part of the record before this panel.

* evidence that those entrusted with the public release of radioactive materials do not have requisite competence to protect the public;

* the failure of DOE and recycling contractors to provide credible analysis of the worker exposures stemming from recycling, and the real world difficulties of assessing such effects; and

* evidence that the NRC's predecessor may have historically sanctioned the commercial release of radioactively contaminated materials without any public notice.

The NRC provided assurances to PACE and other public participants that information sought by PACE and others would be diligently pursued. [19] No responses were forthcoming, and the NRC made plain that it had little interest in fact finding on these matters.

5. NUREG-1640 Excludes the Most Dangerous Realistic Scenarios from Risk Analysis

It is axiomatic that any risk analysis must contemplate the real world in which risk is experienced. To its credit, NUREG-1640 acknowledges the importance of considering real world "scenarios." However, the document shows that SAIC/NRC ruled out consideration of the "scenarios" that, if past is prologue, pose the greatest danger to the public and workers. NUREG-1640 states, at xvii (emphasis in original):

> The purpose of this report is *to calculate realistic estimates of the dose factors for the average member of the critical group associated with the clearance of equipment and of scrap iron and steel, copper, aluminum and concrete on a radionuclide-by-radionuclide basis.*
>
> - "Realistic" estimates are estimate using scenarios and models whose parameters are based on general practices of the U.S. nuclear power industry...

Thus, as just quoted, the NUREG document purports to address the nuclear utility industry, but does not purport to address the "general practices" of the DOE (and DOE contractors).

III. Conclusion: This Panel Must Decide Whether to Embrace the NRC on its Terms (and Confirm Reasoned Public Doubts about the Radiation Establishment) or to

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[19] Thus, in opening the November 1, 1999 public participation meeting, NRC staff proclaimed that the NRC's intent was "to exchange information, not just between NRC and you, but also amongst yourselves." (Tr. at 24.)

Affirm the Ethical Imperatives of Openminded Scientific Inquiry

In days past, the Advisory Committee on Human Radiation Experiments found, AEC insiders understood the NAS to be a tool to sell the public on positions that would not be credited if they emerged directly from the AEC's mouth. The Advisory Committee reported: (*Id.*, at 406)(emphasis added; fn. omitted)

> AEC insiders recognized that credibility was a problem. In a December, 1954 letter to DBM's [AEC Division of Biology and Medicine] director, Charles Dunham, Los Alamos Health Division Leader Thomas Shipman...lamented the lack of credibility possessed by those too closely associated with the AEC:
>
> > There is also the fact that Los Alamos may be regarded as a rather biased institution. Some people may feel that we are rather interested parties. *I am certainly only too well aware of a resistance, particularly in the Press, to accept pronouncements and conclusions coming out of the AEC. Strangely enough, they were quite willing to accept the conclusions of the National Academy of Sciences, completely forgetting that the subcommittees were in very large measure composed of AEC or AEC contractor representatives. They were the same guys wearing different hats.*

The reasoning public might suspect that, at least in regard to the recycling of radioactive waste, *plus ca change plus ca reste meme.*

This panel has the ability to demonstrate that such suspicion is unwarranted. Whatever its basis for accepting the crabbed NRC assignment, this panel's present obligations are clear:

(1) The panel must provide for thorough and public review of the evidence that the DOE and its contractors cannot be reasonably relied on by the public to abide by whatever radiation protection standards might, in the abstract, appear reasonable.

(2) The panel must provide for:

- full public disclosure of how and why the NRC came to rely on a tainted contractor to perform its key regulatory analysis;

- full public disclosure of how and why the NRC persists in reliance on the tainted and deficient work product of a contractor that, the NRC itself now agrees, violated basic ethical rules;

- full public disclosure of how and why the NRC failed to provide for public

review of the NRC/TDEC secret rubberstamping of BNFL's nickel recycling license;

Finally, the panel must provide that, in light of the facts summarized here, there can be recycling of radioactive waste for unrestricted use absent:

(1) provision for 100% verification;[20]

(2) provision for labeling, monitoring, and recall of the recycled waste.

Addendum:Continued Proclamations of Ignorance of/Lack of Responsibility for the Department of Energy's Waste Are Unacceptable and Unbecoming

It appears that this panel, following the course of the NRC, may be taking the head in the sand approach that the radioactive waste at issue here is essentially that produced by nuclear utilities. The facts, as briefly summarized above, and presented at great length before the NRC, render such position incredible and, indeed, unbecoming for an expert panel.

To briefly recap:

(1) the NRC's public proceedings confirmed that the lion's share of the metallic waste at issue is that created by the Department of Energy (and its contractors); [21]

(2) the NRC proceedings confirmed that DOE officials and contractors are the prime -- perhaps the sole -- active promoters of the unrestricted release of contaminated metals (at least for purposes of commercial profit);

(3) DOE's project to recycle 100,000 tons of radioactive metals from the Oak Ridge K-25 facilities is far and away the most ambitious recycling project undertaken;

(4) DOE contractors calculate that they can avoid Federal standard setting and public review by laundering their recycling behind the cozy closed door confines of the NRC's state delegatees;

(5) DOE's recycling contractors managed to taint the NRC proceeding through the performance of the NUREG-1640;

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[20] To be clear, following a reasonable period of demonstration by a contractor (or other recycling entity) that the materials it would place into commerce meet the designated standard 100% of the time, sampling of the contractor's output may be in order.

[21] DOE estimated radmetal waste volume is in excess of 1,000,000 tons.

(6) DOE has repeatedly stated that DOE's recycling policy will necessarily follow NRC's action.

In sum, this panel cannot excuse itself from doing the hard work of examining the facts of public record regarding nuclear weapons complex waste.

Committee Must Safeguard Public Health and Allow More Public Interest Input

Statement of David Ritter
Public Citizen's Critical Mass Energy & Environment Program
To the Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities, National Academies of Science

Thank you for the opportunity to present to this committee a public interest viewpoint that values public health and the integrity of the environment first and foremost among all considerations.

Public Citizen, founded in 1971 by Ralph Nader, is an advocacy organization that exposes threats to health and safety and gives citizens a voice in Washington. Since 1974, Public Citizen's Critical Mass Energy & Environment Program has worked on issues related to nuclear power, radioactive waste and energy production.

We are quite concerned at the possibility that the committee might recommend to the NRC that radioactively contaminated solid materials be released from NRC-licensed facilities. Whether these releases would come under the guise of "restricted" or "unrestricted" release, or in the faux-green form of "recycling" or "beneficial reuse", Public Citizen stands adamantly opposed to any policy that facilitates such releases, and we are confident that such a stance is in line with that of our members and the vast majority of concerned Americans. Compounding our concern is the unbalanced agenda and skewed composition of the panel chosen to make presentations before the Committee.

We believe that exposures to radiation should be prevented and reduced, not legally increased. Should the Nuclear Regulatory Commission make a rule that allows radioactively contaminated materials to be released into the marketplace or environment, this will impose multiple -and likely untraceable- forced exposures to radiation upon a public that has neither asked for nor consented to such. This action would clearly violate the principle of "informed consent", and not only for consumers in the marketplace; even those acting to avoid certain products could be exposed to radiation if materials in the public sphere were contaminated. The range of materials that could be released is broad: metals, concrete, wood, soil, plastics, paper, etc. The potential for widespread distribution of harmful radiation is nearly unlimited. Should radioactively contaminated materials be released, a person could prepare breakfast in a contaminated skillet, eat breakfast with contaminated utensils, retrieve the morning paper from a contaminated concrete porch, ride to work in a contaminated car, bus, or train, cross over a contaminated bridge, carry contaminated coins in a pocket close to the reproductive organs, speak all day on a contaminated phone, and relax in a park tainted with contaminated soil, all while breathing contaminated air from the emissions of a contaminated materials recycler. How would anyone know what is safe to use, own, or touch, and what is not? How would anyone realize when they might have exceeded the typical radiation dose estimated by health physicists? While cynical assumptions might be made that these exposures are "negligible", the truth is that each and every exposure increases one's risk of developing cancer and a variety of health problems, and that forcing an accumulation of multiple exposures upon a non-consenting public shows a callous disregard for human life.

Unfortunately, many releases have already occurred in the U.S., and still do occur. When these releases later contaminate other materials or are later detected, it can be difficult or impossible to

determine their originating source. As of June 1997, a database maintained by the NRC showed over 2300 reports of radioactive materials found in recycled metal scrap.

The pressure is on for the US to follow international standards in setting limits on how much radiation a person ought to receive within a year. Before considering such "harmonization" with global standards, it might be instructive to consider the degrees of radioactive contamination in some other nations, and incidents that indicate radioactive materials are not tightly monitored:

- In January 1999 two Turkish scrap dealers were exposed to radiation (Cobalt 60) on the outskirts of Istanbul and were hospitalized. They were attempting to break up a two-ton block of iron and lead they had bought weeks before.
- In April 2000, Uzbek State customs committee reported the interception of radioactive scrap traveling to Pakistan from Kazakhstan. An official statement said "...gamma rays emanating from the load had radiation levels which exceeded the safety level by over 100 times."
- In March 2000, at a metal alloys plant in Tamworth, UK, a uranium metal bar was discovered "of a type used in the nuclear generating industry."
- In Taiwan, radioactively contaminated steel in pipes and fittings were identified in buildings containing 1,600 apartments that were constructed between 1982-83. The apartments showed background radiation levels at more than 1,000 times that of most buildings in Taiwan. In mid-1998, 6,400 people had been identified as living in this radioactive environment for up to 16 years. The British medical journal The Lancet reported raised levels of cancer in occupants and also congenital disorders, unusual chromosomal and genetic damage.

While American control over its own nuclear materials is not at all exemplary, it seems ill-advised to consider international harmonization. Certainly, the US needs to be a leader in setting the strictest regulations to protect the public health and environment.

The motivations for such releases are clear enough. When it is cheaper to release the materials -and have them mix into a largely unregulated, uncontaminated product stream- than it is to store them in a properly monitored waste site, what NRC licensees euphemistically refer to as "radioactive recycling" is simply a cost-cutting tactic to improve the "bottom line." To knowingly expose the public to the radiation in these materials with the goal of saving money for the generators of those very same materials is the worst kind of cost-benefit analysis – precisely the kind which regulatory structures should guard against. Dealing responsibly with these materials can be an expensive activity, but it is unacceptable to transfer this liability to the public, in the form of unquantifiable health risks. The materials being discussed need to be isolated and tightly monitored. The NRC should require the permanent disposition of all such material in licensed waste disposal facilities equipped to handle them. There is absolutely no necessity whatsoever for releasing, reusing, or recycling these materials. Furthermore, the public does not want such releases. The public has an intuitive and intelligent objection to radiation exposures. Therefore, to make estimates of increased cancer risks, and describe such risks as "reasonable" or "acceptable", is an abuse of science. Neither economics nor science exist in a vacuum. Public health should always come first, and never be subordinate to financial considerations. The benefits of the free release of these materials all go to the nuclear industry. There are no benefits to people; we are just asked to accept an increase in our exposures to radiation. In this case, where much still remains unknown about the precise cumulative effects of low-level radiation exposure, a precautionary principle must apply and conservative regulations must be adopted to be sure that mistakes made are more likely to harm a corporate bank account than a human being. If the nuclear industries can't afford to deal responsibly with their own by-products, this is only further evidence that the industry is not economically viable. There may be some here today who disagree

with the assessment of Dr. John Gofman, nuclear physicist and former director of the Livermore National Laboratory, who said: "There is no safe dose or dose rate below which dangers disappear. No threshold-dose. Serious, lethal effects from *minimal* radiation doses are not 'hypothetical,' 'just theoretical,' or 'imaginary.' They are real." Still, responsible decisions made by this committee should seriously consider his assessment.

Frequently, we are told that "the world is a radioactive place" and that we are always exposed to some naturally occurring background levels of radiation. First, it should be remembered that mankind has, in many areas, increased background levels by his nuclear activities. Secondly, the implied logical error should be rejected by any thinking person. Just because some level of background radiation exists, this does not justify adding more radiation to the environment.

Since I have just addressed one logical fallacy, I would like to address another fallacy that we were offered yesterday, in which airport security was compared to the nuclear power plant decontamination & decommissioning (d&d) process. It was suggested that, just in the same way that it is completely impractical and excessively burdensome for airport security to go through every bag of each passenger individually, so too is it impractical and excessively burdensome for the industry to crush all of their concrete (and all materials) and perform rigorous detection on it. The comparison is a poor one. The airlines and the public both benefit by some compromise being struck between expediency in lines and safety on the planes. Few would travel by plane if it meant waiting for 8 hours in line to get a bag checked. Yet, for nuclear plant d&d, the public does NOT benefit from the industry doing things quickly and cutting corners on safety to save money. The public only needs a decommissioned reactor, and does not need it quickly. Only the industry benefits from cost-cuttting in d&d.

This is not the first time that the NRC has attempted to give the nuclear industry a break at public expense. In 1986, and again in 1990, the NRC adopted two "below regulatory concern" (BRC) policies, which would have released radioactive waste and materials from regulatory control. The material could have been used in everyday consumer products, manufacturing practices, or unloaded in household garbage dumps, sewers, and incinerators--all without notifying the public or labeling the products. The outcry resulting from these policies was loud and clear. Grassroots efforts led to passage of local and state ordinances and resolutions that required ongoing regulatory control of such BRC waste. As a result, Congress wisely revoked the NRC's BRC policies in 1992. Unfortunately, the nuclear industry's influence over the agencies regulating them has persisted. Although we are spared the irresponsible phrase "below regulatory concern," we are now barraged with technical minutiae regarding dose assessments and probabilistic analyses all designed to convince us that (in their terms) "a marginal risk to safety" is acceptable if it saves the industry money. Public Citizen fought hard against BRC, and we intend to challenge any decision that would result in radioactively contaminated materials being released into the marketplace or the environment generally.

Public Citizen finds it highly objectionable that initiatives for regulatory retreats should come from the regulated community itself. For the NRC to appease the nuclear industry by considering a reduction in its regulatory role is indicative of the weakness of the agency. This overly friendly state of affairs should not surprise anyone. Two months before Congress struck down BRC in 1992, the NRC began a contractual relationship with a private contractor called Science Applications International Corporation (SAIC), and renewed this contract in 1999. SAIC prepared NUREG 1640 -entitled "Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities"- which provided the technical basis for a process that pursued release, reuse, and recycling of radioactive materials. The strategy to pursue release was essentially indistinguishable from BRC, in that the entire process was predicated on the belief that radioactive recycling WOULD take place. SAIC also maintained a

business relationship with British Nuclear Fuels, Ltd. (BNFL) as a teaming partner in the quarter billion dollar contract at the DOE's Oak Ridge, Tennessee facility, to release 127,000 tons of radioactive metals, including volumetrically contaminated nickel. Clearly, use of the phrase "conflict of interest" in this instance would be a gross understatement. Such scenarios beg the question: Who is regulating whom?

While a rule allowing the release of these materials would likely have a negative effect on the NRC's image and the public's confidence in the agency, their record thus far in regulating radioactive materials is hardly laudable. In November of last year Millstone Nuclear Power Station (Unit 1) in Connecticut filed a licensee event report (LER) in which the whereabouts of two full-length irradiated fuel rods could not be determined, and was not properly tracked in the Special Nuclear Material (SNM) records. According to the LER, the rods have not been seen since 1980. These rods, which together contain over 7000 grams of uranium and 40 grams of plutonium, are high-level waste. One might reasonably think that the industry and the NRC would maintain absolute control over these materials – materials that even they concede to be dangerous. Apparently, that is an unreasonable assumption. One hates to fathom how the NRC assesses and regulates innumerable bits and pieces of contaminated rubble.

The National Academies of Science should also be concerned that if the Committee should choose to recommend release, reuse, or recycling of these materials, this could cause irreparable harm to the reputation of the Academies as bodies that provide "independent advice on matters of science, technology, and medicine" and make "efforts to improve the health, education, and welfare of the population." To recommend radioactive release of these materials rather than their continued isolation and regulation for their dangerous lifetime would be to prioritize the interests of the nuclear industry and its so-called regulators over the interests of the public. It would essentially be using the entire nation as a laboratory, wherein the experiment would be to determine the cumulative, long-term effects of repeated forced exposures to radiation. There would be no control group, as we would all be susceptible. Certainly, this could not be an effort to improve the health or welfare of the population.

Public Citizen is concerned about the bias of this committee. It appears that the committee has chosen to give the nuclear industry more of its time and undivided attention during this meeting than it has given to the public interest community. We hope that this bias can be corrected in all future meetings.

Lastly, we ask that this NAS committee recommend to the NRC that any and all materials that have been radioactively contaminated be isolated and contained from humans and the environment generally for their entire dangerous lifespan. Such a recommendation by the NAS committee, and a stringent rule by the NRC reflecting that protective stance, would set both agencies on course to fulfilling their prescribed missions. May independent, sound science and ethical principles be your guiding motivations. Thank you.

D..VID RITIER, ..ublic Citizen

- **Exposures to radiation should be avoided and reduced, not legally increased.**

- **Radiation sources and radioactively contaminated materials should be contained and isolated from the biosphere. Such materials should be strictly regulated and monitored.**

- **Currently existing background levels provide no justification for additional, forced exposures**

- **Policies that allow added radiation exposures to people and their environment will be challenged**

Nuclear Information and Resource Service

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Comments to the US Nuclear Regulatory Commission
May 9, 2000
RE: SECY 0070
Radioactive Waste and Materials Release and Recycling

The US Nuclear Regulatory Commission (US NRC) is asking for the public's opinion. I have provided the Commissioners with opposition statements from over a hundred organizations. We repeat—We do not want ANY MORE exposure from the nuclear power and weapons fuel chain. That means that we want the source, byproduct and special nuclear material now under the control of governments and industries to remain regulated, monitored, isolated from general commerce for as long as it remains radioactively and/or chemically hazardous.

We are responding to your desire for public input by calling for you to require continued care of the radioactive wastes and materials that have been created and to isolate them. You do not have our permission to release or to stop holding radioactive wastes and materials in a condition that prevents public exposures. NRC's job is to prevent exposures to the public and environment. *Take this job seriously and develop workable scenarios to prohibit release and recycle of radioactive waste and materials.*

Environmental organizations and much of the public did not participate in the NRC's workshops because of the predetermined outcome to allow radioactive materials to be released from regulatory control into general commerce and regular trash, as stated in the NRC's June 1998 Staff Requirements Memo directing staff to come up with a standard that "allows quantities of materials to be released," prohibits a "detectability standard, and codifies "clearance levels above background."

After the bitter experience of participating in the NRC's "enhanced rulemaking" on decommissioning standards, it does not appear that our voices are being heard or taken at all seriously. They still are not. Not one level of this Commission is capable of articulating even a theoretical plan that would *prevent* radioactive wastes and materials from being deregulated and released into daily commerce and normal trash. SECY-00-0070, March 23, 2000 appendix 1 page 1 lists the US NRC's options: make a rule to release radioactive materials or continue releasing under the current provisions with a possible "update" of those provisions. Both avenues mean continuing and increased radioactive materials and wastes being released/recycled.

Punting public attention to the National Academy of Sciences (NAS) is a waste of tax-dollars, time and the public's attention. It was admitted last week at the staff briefing that the purpose of the NAS study is to divert attention from the US NRC while NRC continues to "develop a

technical basis" for recycling and releasing atomic waste into everyday household items. The public deserves to know the missions and potential conflicts of interest of those agencies, organizations and contractors on whom you rely for that technical basis.

Be forewarned that the NAS does not have the prestigious reputation that you might hope regarding radioactive waste and radiation issues. In my years of observation I have witnessed a pattern of bias, imbalance and secrecy by the panels and staff carrying out studies on Ward Valley, Yucca Mountain, so-called "low-level" radioactive waste siting in New York State, which were the subject of letters from federal and state legislators and members of the National Academy itself to the president of the NAS. The current panel on the Biological Effects of Ionizing Radiation (BEIR VII), reassessing radiation health effects, is under international scrutiny and criticism for imbalance, conflicts of interest and secrecy, which could result in the federal agencies being prohibiting from using their conclusions when they come out. We have grave concerns another ongoing NAS study on "low-level" radioactive waste. The 1968 restructuring of the section of the NAS that works on radioactive waste resulted in more sympathy to the Atomic Energy Commission, whose mission was to promote nuclear power. That sympathy toward the nuclear industry continues today in the attitude and makeup the committees and panels and in the procedures behind closed doors.

The NAS Board proposed to carry out the US NRC's project on radioactive recycling has already produced a report (NAS BEES report 1996, "Affordable Cleanup?" pages 129 and 134) which recommends that ..." DOE and regulatory authorities [to] set free-release standards quickly and permit recycling of recovered metals (within DOE complex or for sale to the commercial market) where economically feasible," and states that "A DOE commitment to permit such release once the new criteria have been approved is essential."

The NAS procedures are highly secretive and will not result in the openness and impartiality US NRC might be seeking to evaluate the proposed standards and radioactive release options. Exactly how will the NAS committee evaluate public opposition to unnecessary exposures if it proceeds?

We oppose the proposed NAS /US NRC contract and call on NRC to move directly to *prohibiting* releases and recycling of radioactive wastes into commerce.

One of the unconscionable ways the US NRC is attempting to justify setting standards legalizing recycling of nuclear waste into commerce is by pointing to international efforts to do so. The fact is the US NRC and nuclear industry are major promoters of those international standards. The international bodies such as the International Atomic Energy Agency[1], the European Commission[2] section on nuclear power. Euratom, the Nuclear Energy Agency of the OECD[3] are

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[1] International Atomic Energy Agency (IAEA) ARTICLE II Objectives: The Agency shall seek to accelerate and enlarge the contribution of atomic energy...throughout the world. (article II Statute of the International Atomic Energy Agency; (http://www.iaea.org/worldatom/Documents/statute.html#A1.1)

[2] Euratom: The specific programme of research and training in the field of nuclear energy implements the section of the Fifth Framework Programme covered by the European Atomic Energy Community (Euratom) Treaty. The aim of the Nuclear Energy programme is to help exploit the full potential of nuclear energy, both fusion and fission, in a

all nuclear power promoters by definition and mission statement. US NRC directing the NAS to review their proposals does nothing to assuage public opposition to unnecessary exposure from release and recycling of atomic power and weapons wastes.

Conflicts of Interest

Once US NRC was forced to look at its contractor for technical support, Scientific Applications International Corp. (SAIC), their blatant conflict of interest required the contract be stopped. But NRC appears to continue to rely on the data from their work over many years to justify radioactive waste recycling into the marketplace.

Has the US NRC evaluated the potential conflicts with its other contractors [ICF, DOE's Environmental Measurements Lab and Oak Ridge Institute of Science and Education (ORISE) and any others]? The reliance on international pro-nuclear agencies is also highly questionable. Asking the NAS, which has its own nuclear propensities to review the work is not the next best step for the US NRC.

An ironic point is that recycling has a very positive connotation by the public right now but contamination of recycling streams with nuclear waste at any level threatens that important step the public has made toward resource conservation.

We are frustrated with the refusal by this commission at every level to do what it is charged to do: protect us from ionizing radiation from Source, Byproduct and Special Nuclear Materials from nuclear power and weapons. We encourage NRC to prohibit radioactive release and recycling into commerce and normal trash. We support state and local authority to set stricter, more protective standards than federal. Finally, we encourage our federal agencies to call on other nations and international agencies to prohibit, not legalize radioactive release, clearance and recycling into commerce.

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sustainable manner, by making current technologies even safer and more economical, and by exploring promising new concepts.

OECD NEA: The Nuclear Energy Agency (NEA) is a semi-autonomous body within the Organisation for Economic Co-operation and Development (OECD), located in the Paris area in France. The objective of the Agency is to contribute to the development of nuclear energy as a safe, environmentally-acceptable and economical energy source through co-operation among its participating countries.

New England Coalition on Nuclear Pollution
Post Office Box 545, Brattleboro, Vermont 05302

March 26, 2001

Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission Licensed Facilities
Board on Energy and Environmental Systems
National Research Academies
National Academy of Science
Washington, DC

Ladies and Gentlemen,

The public interest stakeholders of New England are not invited participants in the March 26 and 27 meeting regarding release of solid materials. This is a serious omission challenging the credibility of your interest in hearing from a fair representation of all stakeholders.

Although New England is a small geographic region, it is host to five operating and four decommissioning power reactors, plus numerous other nuclear sites including two nuclear submarine repair yards. Each of the four decommissioning reactors is the subject of citizen activist intervention in Nuclear Regulatory Commission proceedings. The State of Maine, at the prompting of environmental activists, has enacted statutory rejection of the designation and concept of "Below Regulatory Concern." Maine and Massachusetts have adopted radiological site release criteria more stringent than that in federal regulation.

New England environmental activists clearly have a substantial interest in the release of radiologically contaminated or activated solid materials. They have strong and informed convictions on the release of solid materials and they, along with the rest of the nation's public interest community, deserve to be heard in full by this National academy of Sciences Committee.

While deliberations press forward, we ask the Committee to consider that the release of solid materials cannot be rightly compared to licensed facility air and water releases. Air and water releases are quantified and their accumulation in the local environment is measured and tracked. Calculated doses are assigned to the neighboring and, to some degree, informed public.

Nuclear power facilities have purported to demonstrate enormous beneficial health and environmental impact offsets against fossil fuel plants in order to gain the public's tacit consent to radiological doses resulting from operations. No comparable offset is contained in this universal dose proposal.

Informed and concerned citizens may choose to remove themselves from the vicinity of nuclear facilities. No such information and no such choice exist when contaminated materials are free-released for recycle.

The present proposal contemplates no limit in the total number of curies released and no limit in the total number of people exposed. Quantifying the proposal's environmental and health effects will not, in our opinion, pass the straight face test.

We believe that a comparison more reasonable than the licensed air and water release comparison exists: this proposal may be more appropriately compared to nuclear weapons testing fallout. It will mean that dose, some dose, will be randomly and universally distributed to unwitting, and likely unwilling, human targets. Worse, the contemplated dose is not justified by national security.

It is not even justified by the recovered value of the recycled materials. The large benefit is to waste generators and it is in disposal costs avoided. This single fact should tag the proposal for what it really seems to be, a waste disposal method, and little more commendable than the practice of draining hospital radwaste into municipal systems.

Given remaining uncertainties regarding radiological health effects that are presently being debated in the scientific community, this universal dose prescription can reasonably be regarded as experimental.

Committee members may recall that at the height of the Cold War several thousand scientists signed a declaration of conscience regarding radioactive fallout that helped lead to a ban on atmospheric weapons testing. The New England Coalition on Nuclear Pollution is fully prepared to solicit endorsements of the broad science community on a similar petition regarding the proposal to distribute commercial "fallout" should the initiative gain the Committee's approval.

We ask the Committee for a hearing and consideration of our point of view. We now anxiously await the Committee's response.

Raymond Shadis
Staff Advisor
New England Coalition

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STATEMENT of CONCERN about BALANCE and PERSPECTIVE
to the
National Academy of Sciences
Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities

Date: March 26, 2001

RE: Non-industry input on the issue of releasing and dispersing radioactive materials into everyday commerce.

This National Academy of Sciences Committee has been formed to assist the Nuclear Regulatory Commission in rulemaking regarding the free-release of solid radioactive materials from licensed facilities. The precedent will also impact the release of radioactive materials from DOE, DOD, and other weapons and fuel chain sites.

Clearly the nuclear power industry, the creator of large amounts of radioactive waste, stands to benefit, by selling or donating radioactive material or dumping in unlicensed disposal, rather than paying to properly isolate it from the environment and the public. It has a vested economic interest in externalizing its costs of doing business, pushing its waste into commerce and the public, and thus, in the outcome of this Committee's review. The public's right to protection from unnecessary radiation exposure should be the pre-eminent concern.

The Committee has scheduled this meeting to hear from "stakeholders." The nuclear industry is a stakeholder, but the public, into whose products, homes and lives the industry proposes to dump its radioactive waste is the key stakeholder.

We are disappointed that the stakeholder presentations are so heavily skewed towards the nuclear industry.

The first of the two-day meetings is entirely taken up with nuclear industry representatives. Five (5) nuclear power industry representatives, some of whom plan to build new nuclear reactors (thus generate even more radioactive waste that could be released into commerce), have been invited to address the full committee the first afternoon. Not a single critic of the policy, representing the public interests, will address the full committee. The critics will not have the chance to address the whole committee as the second day is split into two simultaneous sessions. This is blatantly unfair and biased. It discredits the supposedly scientific process that should be independent of powerful economic interests.

Of the 25 total time slots scheduled, only 2 or 3 represent the general public that will be impacted. Numerous others requested the opportunity to present, but were refused, some with unique and comprehensive knowledge of the very issues with which this Committee must contend. All of the Committee members will be bombarded with arguments for "clearing" radioactive waste from numerous industry and agency representatives.

Although several others will present critical perspectives, most likely from directly impacted industries, more nuclear industry proponents will continue to present on the second day including regulators from at least one state that is already permitting the release of radioactive materials into general commerce.

The organizations and individuals listed below believe that the decision of the NAS Committee to hear primarily from proponents of radioactive release and dispersal and to have the radioactive waste generators present to the full committee but delegate critics to smaller sessions reflects a bias toward the perspectives of nuclear waste generators and promoters of release and dispersal of radioactive materials.

We request that this bias be corrected in all future sessions and that the expertise of this committee focus seriously on practical mechanisms to isolate radioactively contaminated materials from the public and the environment.

From:
A. Gayle Hudgens, PhD, Sustainability Coaching
Adrian Zolkover, Henderson, Nv.
Alan Muller, Green Delaware
Andy Peri, Social Justice Center of Marin, Ca.
Anne Rabe, Citizens' Environmental Coalition
Athanasia Gregoriades, NY
Barbara Wiedner, Grandmothers for Peace International
Bill Linnell, Cheaper, Safer Power
Bob Darby, Tom Ferguson, Food Not Bombs/Atlanta
Bob Kinsey, Peace& Justice Task Force, Rocky Mountain Conf., United Church of Christ
Bonnie Raitt
Bonnie Urfer, Nukewatch, Wi.
Brent Blackwelder, Erich Pica, Friends of the Earth
Bruce A Drew, Prairie Island Coalition, Minneapolis, Mn.
Buffalo Bruce, Western Nebraska Resources Council
Charlene Johnston, Toledo Coalition for Safe Energy
Chris Williams, Citizens Action Coalition of Indiana
Claire Stadtmueller, Hope, R.I.
Clem Wilkes, California Safe Food Coalition
Corrine Carey, Don't Waste Michigan
Cyndy deBruler, Columbia Riverkeeper, Wa.
Dave Kraft, Jennifer Moore, Nuclear Energy Information Service, Il.
David DeRosa, Washington, D.C.
David N. Pyles, New England Coalition on Nuclear Pollution
David Ozonoff, MD,MPH, Dept Env'tal Health, Boston Univ. School of Public Health
Dave Rapaport, Vermont Public Interest Research Group
David Ritter, Public Citizen

Deborah Bors, Baltimore, Md.
Deborah Katz, Citizens Awareness Network, New England
Diane D'Arrigo, Nuclear Information and Resource Service
Don Eichelberger, California State Green Party
Douglas Belyeu
Dr. Jane E. Nielson (Geologist), Public Employees for Environmental Responsibility
Dr. John Gofman, Committee for Nuclear Responsibility
Dr. Judith Johnsrud, Sierra Club
Dr. Robert J. Gould, San Francisco Bay Area, Physicians for Social Responsibility
E.M.T. O'Nan, Protect All Children's Environment, N.C.
Elaine Babian
Elisabeth King and Maria Holt, R.N., The Midcoast Health Research Group, Bath, Maine
Ellen Thomas, Proposition One Committee, Washington, D.C.
Erick Highum, Mn.
Ernest Goitein, Californians for Radioactive Safeguards
Eulia Mishima, Gresham, Or.
Eva Hallvik
Frank C. Subjeck, Air, Water, Earth, Org., Az.
Fred Golan, L.A., Ca.
George Crocker, North American Water Office, Lake Elmo, Mn.
Georgiana Podulke, St. Paul, MN
Greg Wingard, Waste Action Project, Seattle, Wa.
Harvey Wasserman, Citizens Protecting Ohio
Henry W. Peters, Radiological Evaluation & Action Project, Great Lakes (REAP GL)
Howard Wilshire, Public Employees for Environmental Responsibility
Hyun Lee, Heart of America Northwest
J Truman, Downwinders
James Warren, NC WARN, Waste Awareness and Reduction Network
Jane Magers, Earth Care, Des Moines, Ia.
Janet Michel, Oak Ridge Communities Allied
Jeanne Koster, South Dakota Peace and Justice Center
Jennifer Olaranna Viereck, HOME: Healing Ourselves & Mother Earth
Jessica Hiemenz, Taking Responsibility for the Earth and the Environment, Va.
Joan and Robert Holt, Truro, Ma.
Joani Matranga, Carbondale, Co.
John Blair, Valley Watch, Inc., Indiana
John J. Furman, Utica Citizens in Action, NY
Joni Arends, Concerned Citizens for Nuclear Safety, NM
Joyce and Steve Kuschwara, Jersey Shore Nuclear Watch
Juanita Mendoza Keesing, Voices Opposed To Environmental Racism (VOTER)
Judy Treichel, NV Nuclear Waste Task Force
Karen Keith, Friends of Ward County, Tx.
Katharine Dodge, Northeast Pa. Audubon Society
Kathy Dorn, Irradiation Free Food Hawaii
Kathy Stein, BEYOND RECYCLING
Keith Gunter, Citizens' Resistance at Fermi Two

Leonore Lambert, East Aurora, NY
Linda S. Ochs, Finger Lakes Citizens for the Environment
Lloyd Marbet, Oregon Conservancy Foundation
Lou Zeller, Blue Ridge Environmental Defense League
Luanne Napton, South Dakota Resources Coalition
Lynn Sims, Don't Waste Oregon
Maite Diez, The Inner Ear, Hull, Ma.
Marc Borbely, Washington, D.C.
Maria Mendez, Susan Lee Solar, Grandmothers and Mothers' Alliance for the Future, Tx.
Mark Knapp, Health Physicist, Minneapolis, MN
Mary Byrd Davis, Yggdrasil Institute, Georgetown, Ky.
Mary Lampert, Massachusetts Citizens for Safe Energy
Mary Lulu Lamping, ML3, Inc., New Hamburg, NY
Mavis Belisle, the Peace Farm, Texas
Max Obuszewski, Hiroshima-Nagasaki Commemoration Committee
Michael J. Keegan, Coalition for a Nuclear Free Great Lakes
Michael J. Wright, United Steelworkers of America
Michael Welch, Redwood Alliance, REEI
Nancy Hirschfeld, Informed Choices, Slidell, La.
Norm Rubin, Energy Probe, Canada
Paige Knight, Hanford Watch, Oregon
Patricia A. Noble, Conference of Social Justice Coordinators of Southern California
Paul Hancock, Eastern Sierra Geological Society
Peg Ryglisyn, Michael Albrizio, Connecticut Opposed to Waste
Peter Montague, Ph.D., Environmental Research Foundation
Phil Klasky, Bay Area Nuclear Waste Coalition
Rachel Griffiths, Chicago, Il.
Residents for Environmental Safety and Security, Oh.
Richard Bramhall, Low Level Radiation Campaign, UK
Richard Geary, Citizens Action for Safe Energy, Ok.
Richard Wall
Rob Sargent, Massachusetts Public Interest Research Group (MASSPIRG)
Robin Mills
Roger Herried, Abalone Alliance
Scott Cullen, Standing for Truth About Radiation-STAR Foundation, NY
Sidney and Irma Goodman, NJ
Solange Fernex, Ligue Internationale des Femmes pour la Paix et la Liberté (WILPF)
Stephen Brittle, Don't Waste Arizona, Inc.
Susan Tansky, California Alliance in Defense of Residential Environments (CADRE)
Suzanne Kneeland, Jim Laybourn, Jackson, Wy.
Suzy T. Kane, Bedford Hills, NY
Ted Smith, Silicon Valley Toxics Coalition Campaign for Responsible Technology
Tom Camara, Mill Valley, Ca.
Vina Colley, Portsmouth/Piketon Residents for Environmental Safety and Security
Wells Eddleman, NC Citizens Research Group Inc.
Wendy Oser, Nuclear Guardianship Project for Responsible Care of Nuclear Materials

Brokering, Assaying, and Releasing "Potentially Clean" Waste

Presented By: Al Johnson,
Duratek, Inc

Presented To: NAS

March 27, 2001

Duratek

Duratek Vision Statement

The employees of Duratek will create the company customers trust and consistently choose to manage their radiological and radioactive material challenges. We will achieve this goal by continuously delivering exceptional safety, regulatory, technical, and cost-effective results for our customers and financial performance for our investors. Furthermore, we will profitably apply the company's talent and technology to enter closely related markets where Duratek can achieve a similar leadership role.

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Presentation Outline

Brokering, Bulk Assaying and Releasing "Potentially Clean" Waste For Disposal Versus Recycling:

- Part 1 - Brokering/Centralized Waste Processing
- Part 2 - Demolition Waste and Metals Recycling

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Presentation Outline

Part 1 - Brokering/Centralized Waste Processing:

- Radioactive Waste Brokering
- Centralized Radioactive Waste Processing
- Duratek's GIC Bulk Assay & Release Program
  - Program Description
  - Processing Steps
  - Technology

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What is Brokering?

A Broker is defined as one who transports, collects or consolidates shipments of radioactive waste or processes radioactive waste; the Broker definition does not apply to carrier whose sole function is to transport radioactive waste.

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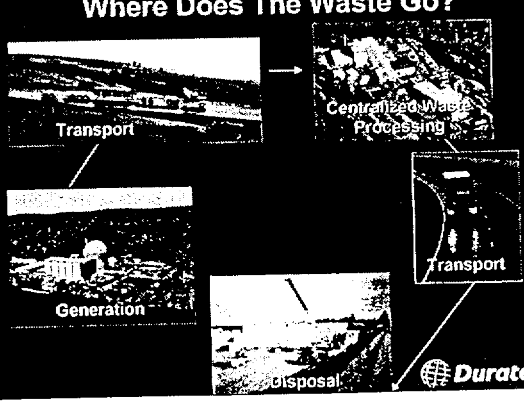
Where Does The Waste Go?



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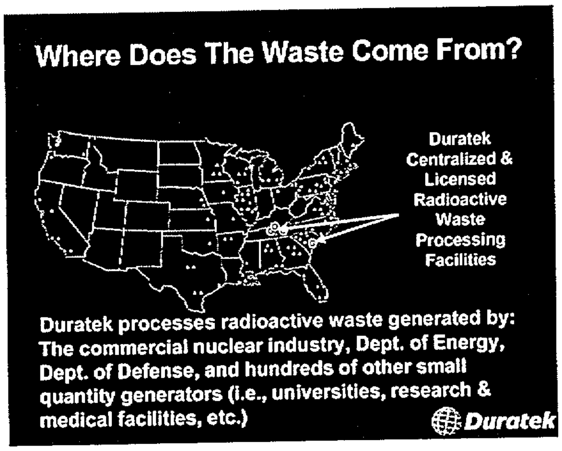
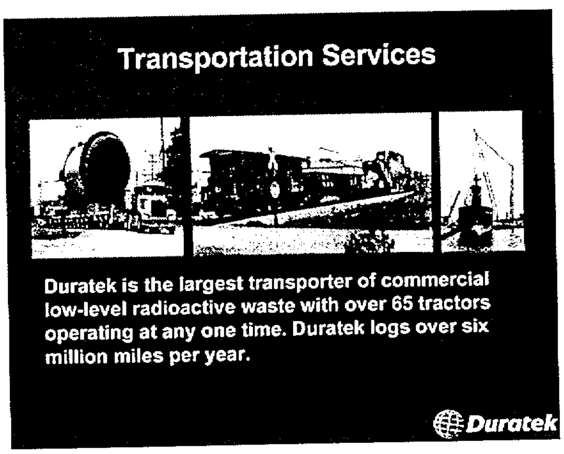
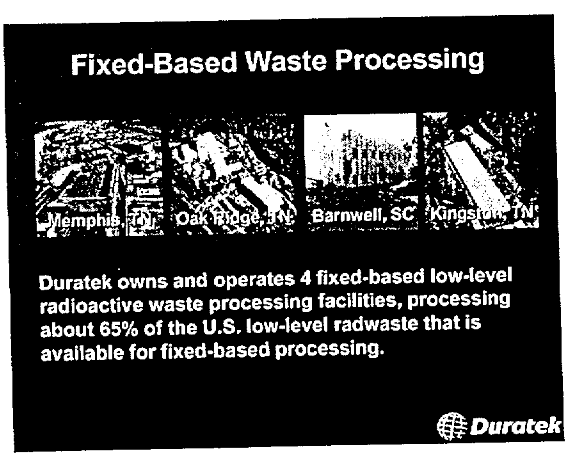
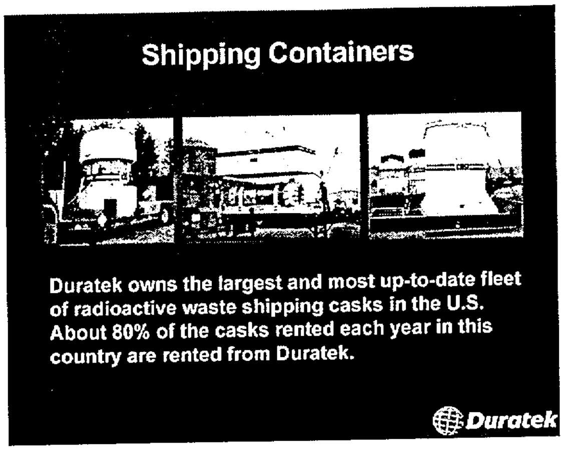
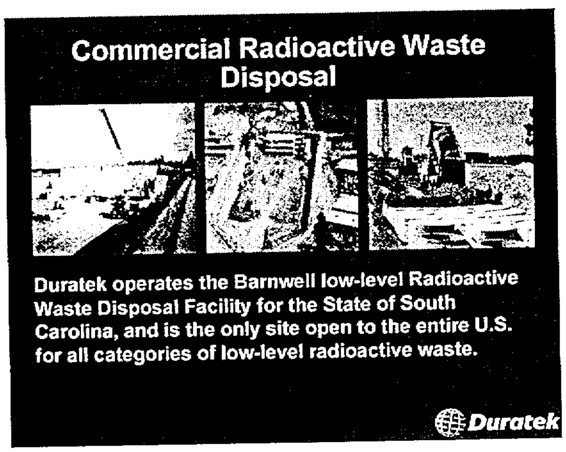
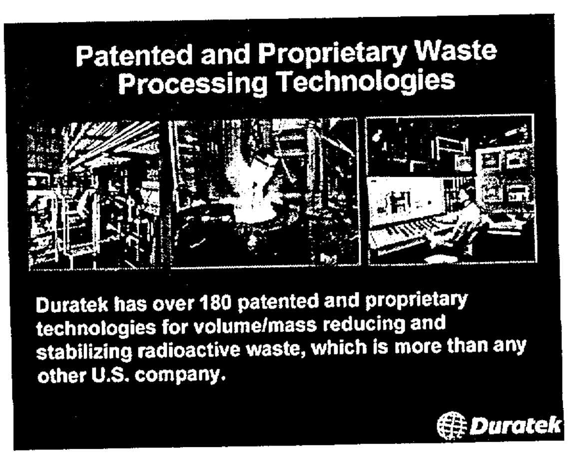

Where Does The Waste Come From?
Duratek Centralized & Licensed Radioactive Waste Processing Facilities
Duratek processes radioactive waste generated by: The commercial nuclear industry, Dept. of Energy, Dept. of Defense, and hundreds of other small quantity generators (i.e., universities, research & medical facilities, etc.)
Duratek


Transportation Services
Duratek is the largest transporter of commercial low-level radioactive waste with over 65 tractors operating at any one time. Duratek logs over six million miles per year.
Duratek

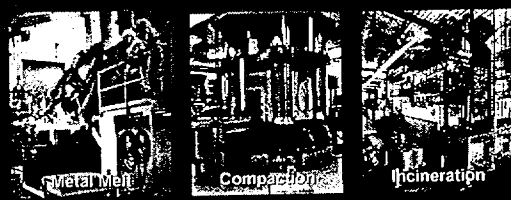

Fixed-Based Waste Processing
Memphis, TN
Oak Ridge, TN
Barnwell, SC
Kingston, TN
Duratek owns and operates 4 fixed-based low-level radioactive waste processing facilities, processing about 65% of the U.S. low-level radwaste that is available for fixed-based processing.
Duratek


Shipping Containers
Duratek owns the largest and most up-to-date fleet of radioactive waste shipping casks in the U.S. About 80% of the casks rented each year in this country are rented from Duratek.
Duratek


Commercial Radioactive Waste Disposal
Duratek operates the Barnwell low-level Radioactive Waste Disposal Facility for the State of South Carolina, and is the only site open to the entire U.S. for all categories of low-level radioactive waste.
Duratek


Patented and Proprietary Waste Processing Technologies
Duratek has over 180 patented and proprietary technologies for volume/mass reducing and stabilizing radioactive waste, which is more than any other U.S. company.
Duratek

Waste Processing Technologies



Total Radioactive Waste Received For Processing By Duratek In 2001 - 62 million pounds

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What is the Duratek GIC Program and How Does It Work?

- Duratek's Green is Clean (GIC) program is a multi-step, bulk assay and release process that relies on advanced assay technology to determine the presence of radioactive materials in potentially "clean" waste generated within a radiologically controlled area or licensed facility.
- The GIC program incorporates specific conditions for waste assay and release criteria for landfill disposal that has been approved by the State of Tennessee (as a NRC Agreement State), on a case specific basis, and specifically incorporated as a condition of our Radioactive Material Licenses.

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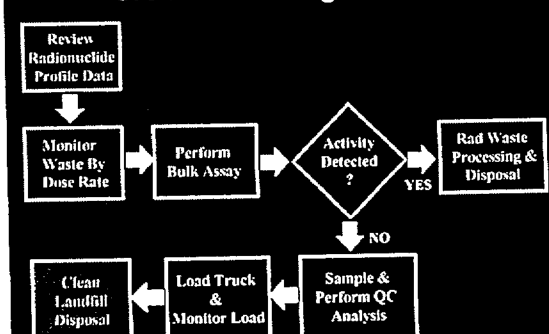
GIC Process Logic Flow



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GIC Drum Assay System

- Standard Design
- HPGe Detectors for Gamma Spectroscopy
- Drum Rotated Inside "Safe-Like" Shield During Counting
- Maximum Drum Weight- Approx. 1,200 Pounds

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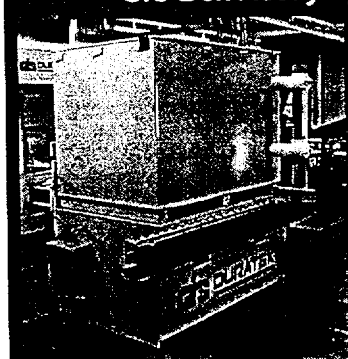
GIC Box Assay System



- Custom Duratek Design - US Patent Pending
- HPGe Detectors For Gamma Spectroscopy
- NaI Detectors for Micro-Dose Rate Scanning
- Maximum Box Weight - Approx. 10,000 pounds

Duratek

GIC Processing Features

- Reduced radioactive waste burial by segregating "clean" waste from "radioactive" waste
- Saved radioactive burial space
- Lowered customer costs for operations, decommissioning, etc.
- No residual waste or fill material left on site (Allows clean materials to be removed to gain access to rest of radioactive materials)
- Special waste disposal permits needed for commercial landfill usage (already done in TN)
- Special residual radioactivity disposal licensing review/approval needed (already done in TN)

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Presentation Outline

Part 2 - Demolition Waste and Metals Recycling:

- Final Disposition & Release Options For D&D Demolition Waste (i.e., Concrete)
- Example of a Large Scale Demolition and Off-site Bulk Assay and Release Project
- Metal Processing Options For Decontamination, Release, Beneficial Reuse and Recycle
- Lessons Learned
- Conclusion

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D&D of Commercial Nuclear Power Plants

4 Plants Have Been Decommissioned:

- Shoreham
- Shipping Port
- Ft. St. Vrain
- Pathfinder

7 Plants Are In Decommissioning:

- Big Rock
- Connecticut Yankee
- Maine Yankee
- Rancho Seco
- Trojan
- SONGS
- Yankee Rowe

Note: Since 1990, Duratek has had an active role in brokering and processing waste from all commercial plant decommissioning projects.

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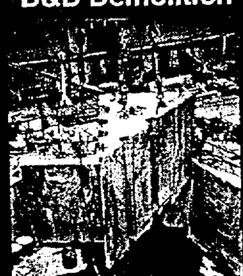
D&D Demolition Waste Generation



Large quantities of concrete demolition waste are generated during D&D activities by cutting support structures, decontaminating surfaces and removing concrete rubble.

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Demolition Debris/Concrete Waste - Final Disposition (Release) Options

1. License termination surveys with structures intact (MARSSIM final survey approach).
2. Demolition followed by license termination surveys and onsite disposal/fill (rubblization approach).
3. Demolition followed by onsite release surveys and offsite landfill disposal prior to license termination (10 CFR20.2002 approach).
4. Demolition followed by off-site bulk assay and offsite landfill disposal prior to license termination (GIC Bulk Assay & Release Approach).

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Example GIC Project Review

Concrete demolition equipment employed to break up concrete walls, floors and other structures inside of containment building.

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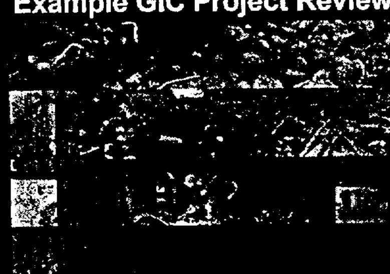
Example GIC Project Review



The concrete demolition process produces large quantities of concrete rubble and structural metal.

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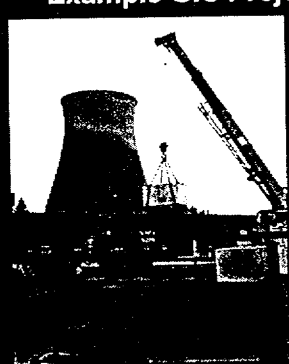
Example GIC Project Review

Various excavation and loading equipment used to transfer concrete rubble into metal boxes.

Duratek

Example GIC Project Review



Boxes of concrete rubble loaded directly into gondola-type rail cars at the customer site for shipment to Duratek facilities in Tennessee.

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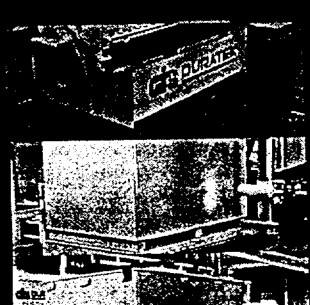
Example GIC Project Review



Bulk assaying the concrete in accordance with the Duratek "Green is Clean" program

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Example GIC Project Review

A truck monitoring station checks each truck of concrete waste, after GIC bulk assay, but prior to release from the licensed Duratek facility.

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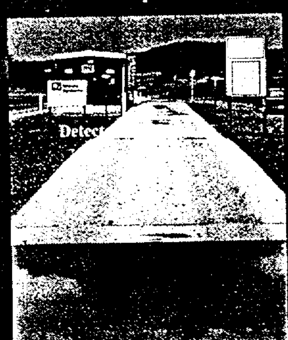
Example GIC Project Review



Identical truck monitoring station and detectors used by commercial landfill (Sub Title D) disposal operator monitors waste prior to disposal

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Example GIC Project Review

The "clean" concrete waste is disposed at the State approved industrial landfill

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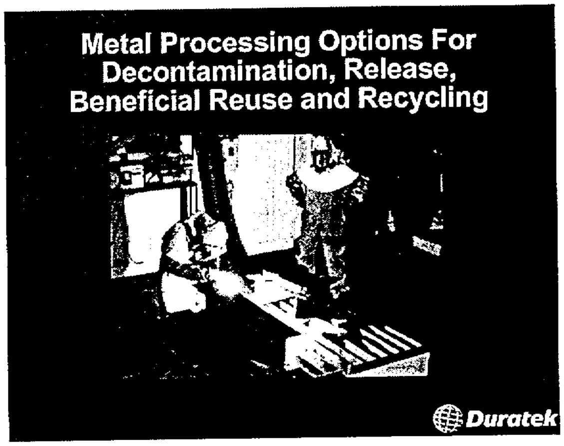
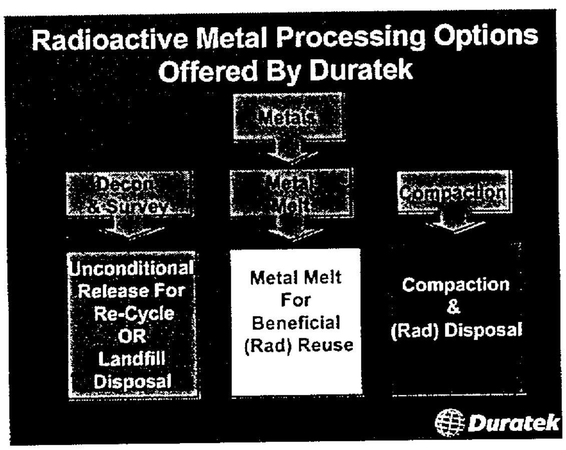
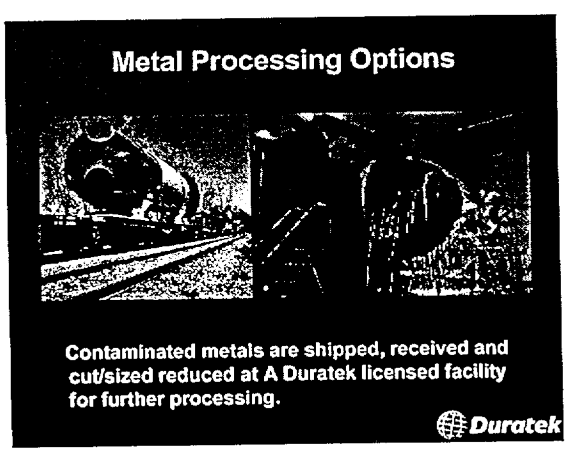

Metal Processing Options For Decontamination, Release, Beneficial Reuse and Recycling
Duratek


Radioactive Metal Processing Options Offered By Duratek
Metals
Decon & Survey
Metal Melt
Compaction
Unconditional Release For Re-Cycle OR Landfill Disposal
Metal Melt For Beneficial (Rad) Reuse
Compaction & (Rad) Disposal
Duratek


Metal Processing Options
Contaminated metals are shipped, received and cut/sized reduced at A Duratek licensed facility for further processing.
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Metal Processing Options

Surface contaminated metals can be decontaminated and/or surveyed for release (including recycling) if all contamination is removed and verified by surveys.

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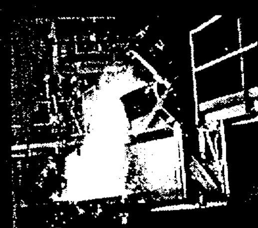
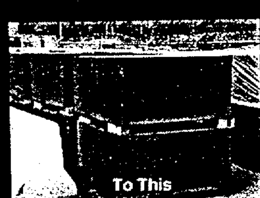
Metal Processing Options



Contaminated metals can be re-melted but still controlled as radioactive material (beneficial reuse)

Duratek

Metal Processing Options



Contaminated metals can be recycled into radioactive products for controlled and beneficial reuse. They are/should NOT be released for recycling into the "clean" scrap metal market.

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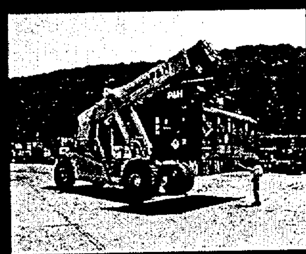
Metal Processing Options



Contaminated metals that can not be efficiently decontaminated are compacted (to minimize volume) and packaged for transport/radioactive waste disposal

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Lessons Learned and Conclusions

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Lessons Learned

1. While there is currently no set of comprehensive U.S. standards governing the free release of solid materials, release of solid materials from radiologically controlled areas and facilities occur every day. These releases are made on a case by case basis, in compliance with licensee programs, and consistent with existing NRC regulations.

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Lessons Learned

2. The implementation of any program that involves the release of any amount of radioactive materials from a licensee's control will always be subject to intense scrutiny by the regulatory agencies involved, the general public, scrap metal recyclers, land fill operators or any other recipients of the subject material.

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Conclusion

A national standard for unconditional release would be useful and can be technically justified but may not be politically achievable.

- The case by case regulatory approach to licensing will typically result in a kind of conditional release program that places additional restrictions on the process and end point (recycling versus reuse versus landfill disposal).
- A single, unconditional release standard that fits for all radionuclides (including NORM), all scenarios (including recycling) and satisfies all stakeholders (i.e., regulators, users and the general public) will require unprecedented negotiation and compromise.

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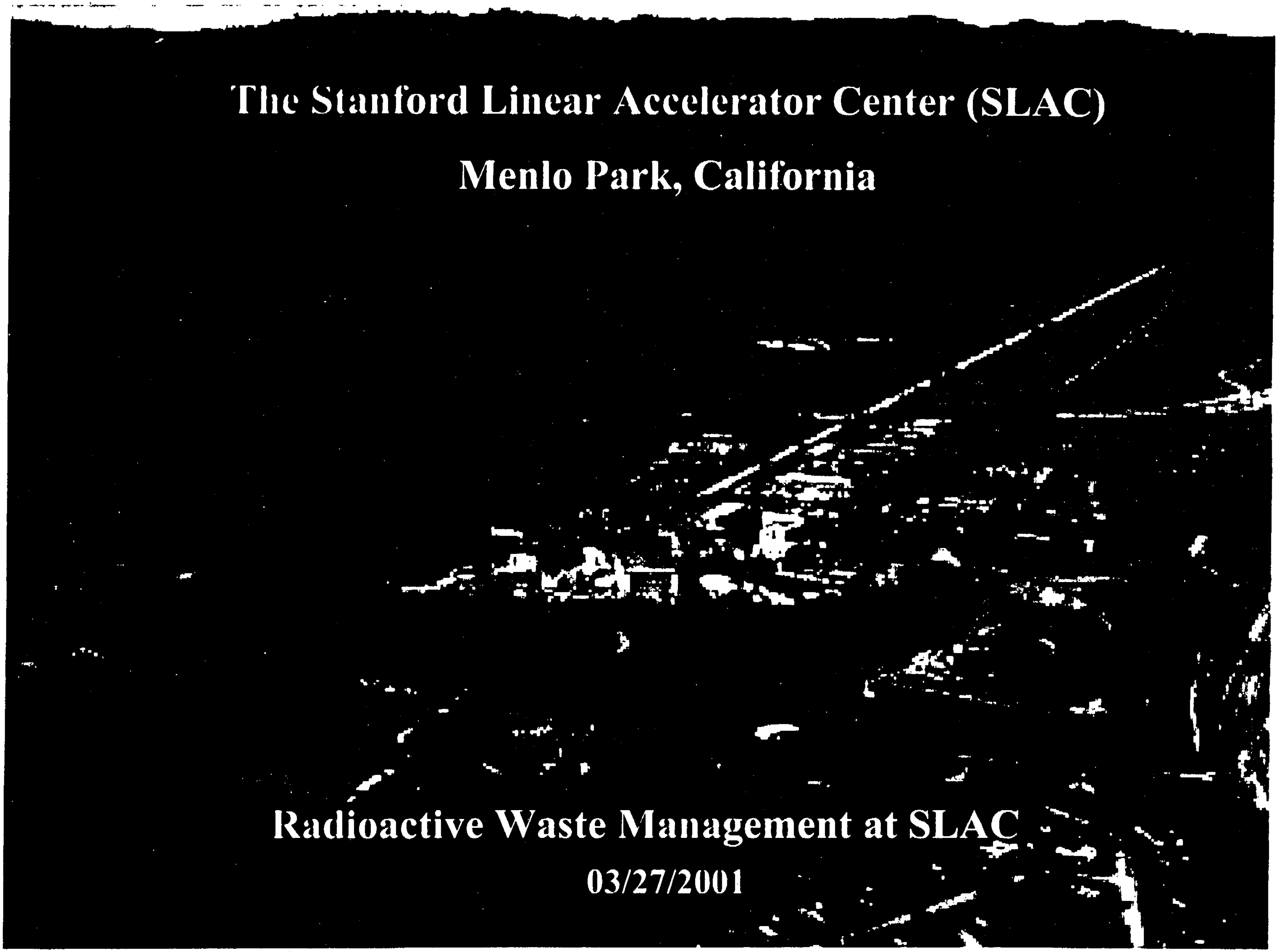
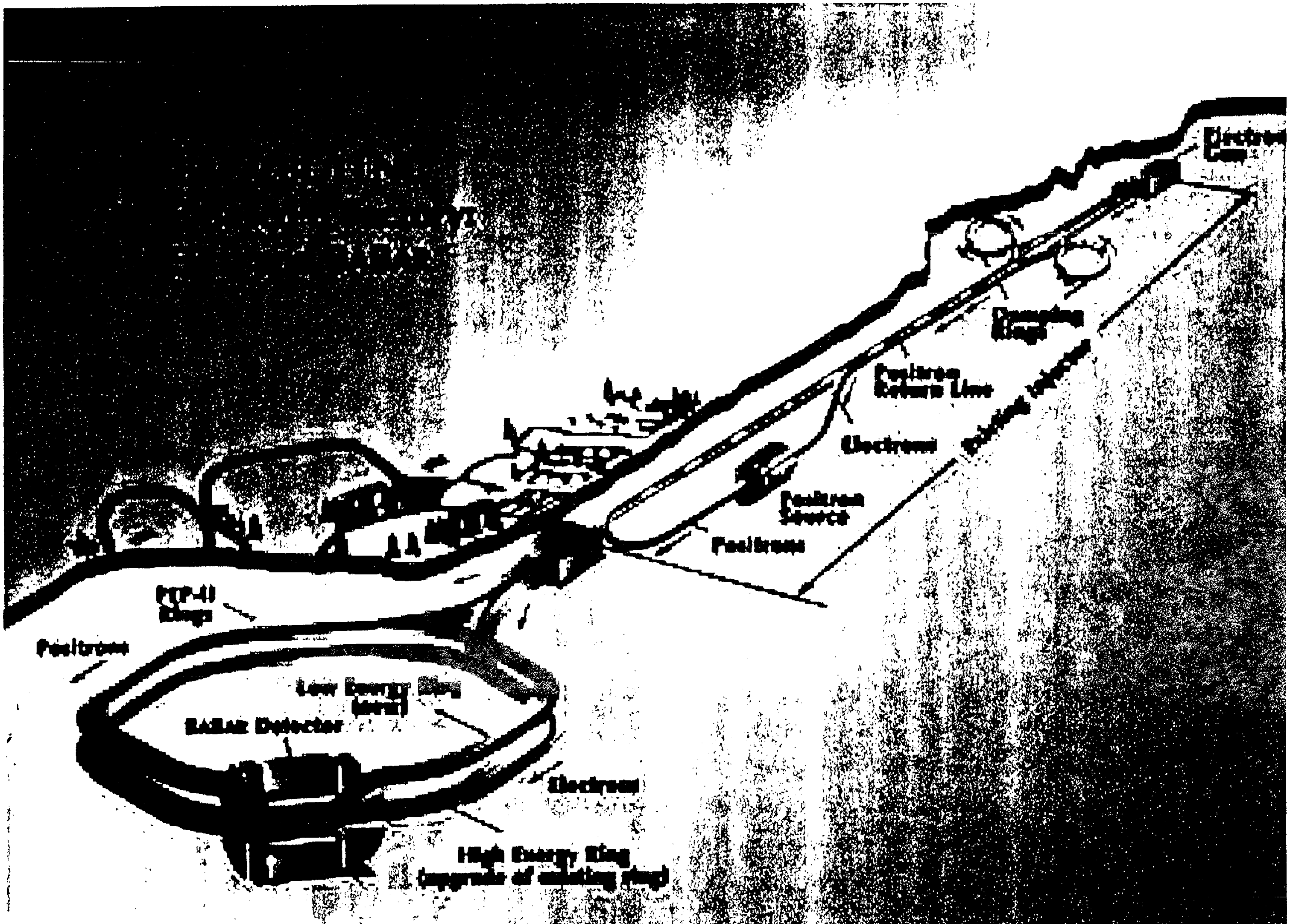

The Stanford Linear Accelerator Center (SLAC)
Menlo Park, California
Radioactive Waste Management at SLAC
03/27/2001



Both Rings Housed in Current PEP Tunnel

SLAC

View From East End of the Research Yard Looking West

Photo by Ray Russ, OHP Department

SLAC

Radiological Profile of SLAC

SLAC is a 50 GeV leptonic particle (e.g., electrons and positrons) accelerator. Its operation produces the following types of radiation:

Prompt – radiation directly produced by the operating beam; consists of x-rays, neutrons, electrons, positrons, and muons.

Residual – radiation from radioactive materials produced by beam operation. The materials include solids, liquids, and/or gases emitting gamma rays, x-rays, and beta particles.

SLAC

Prompt radiation creates radioactivity in nearby materials via neutron activation; i.e.,

$$\mathbf{{}^{a}Atom_{z} + {}^{1}neutron_{0} = {}^{a+1}Atom_{z} \Rightarrow Radiotransformation}$$

Holding of these solid materials for two years at SLAC permits short-lived radionuclides to radiotransform, or in other words, decay away, leaving behind only the longer-lived, or residual radionuclides. Residual radioactivity tends to exist in low concentrations, is insoluble, and is immobilized within the materials in which it was created, With proper controls, SLAC solid materials having residual radioactivity pose little risk to the health of the site workers, the public, and to the integrity of the environment.

SLAC

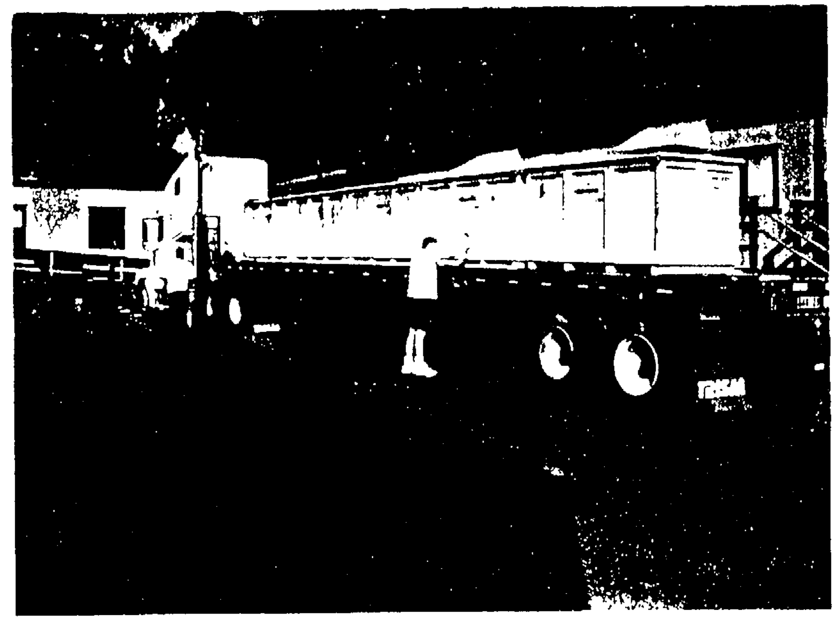
Residual Radionuclides in SLAC Solid Low-Level Radioactive Waste (LLRW)

Type of Radionuclide	Form	Half-Life	Material
Na-22	Volumetric, Insoluble	2.62 years	Concrete
Sc-46	Volumetric, Insoluble	84 days	Iron/Steel
Mn-54	Volumetric, Insoluble	303 days	Iron/Steel
Co-56	Volumetric, Insoluble	77 days	Iron/Steel
Co-57	Volumetric, Insoluble	270 days	Iron/Steel
Co-58	Volumetric, Insoluble	71 days	Iron/Steel
Co-60	Volumetric, Insoluble	5.26 years	Iron/Steel
Zn-65	Volumetric, Insoluble	245 days	Iron/Steel
W-181	Volumetric, Insoluble	140 days	Tungsten
Re-184	Volumetric, Insoluble	38 days	Rhenium
Re-184m	Volumetric, Insoluble	169 days	Rhenium

SLAC

Radioactive Waste Management

Joe Christy, James Dayton, Billy Dick,
Quang Le, and Carleton Washington



Five B-96 boxes being readied for
shipment to Hanford on 09/12/2000.

SLAC typically generates, collects, packages, and ships about 450 ft^3 of routinely-generated low-level radioactive waste (LLRW) for disposal per year. In CY 2000, SLAC also disposed of about 400 ft^3 of 'legacy' LLRW. Much smaller volumes of 'mixed waste' are generated; proactive efforts to minimize generation of both LLRW and 'mixed waste' are now practiced sitewide.

SLAC

Options for disposal of SLAC LLRW

- Recycling for onsite use,
- Hold for radiodecay to background levels and then release as non-radioactive materials,
- Dispose as LLRW at an approved DOE site, and
- Release for offsite use per regulatory approval per DOE 5400.5 or ROI Program.

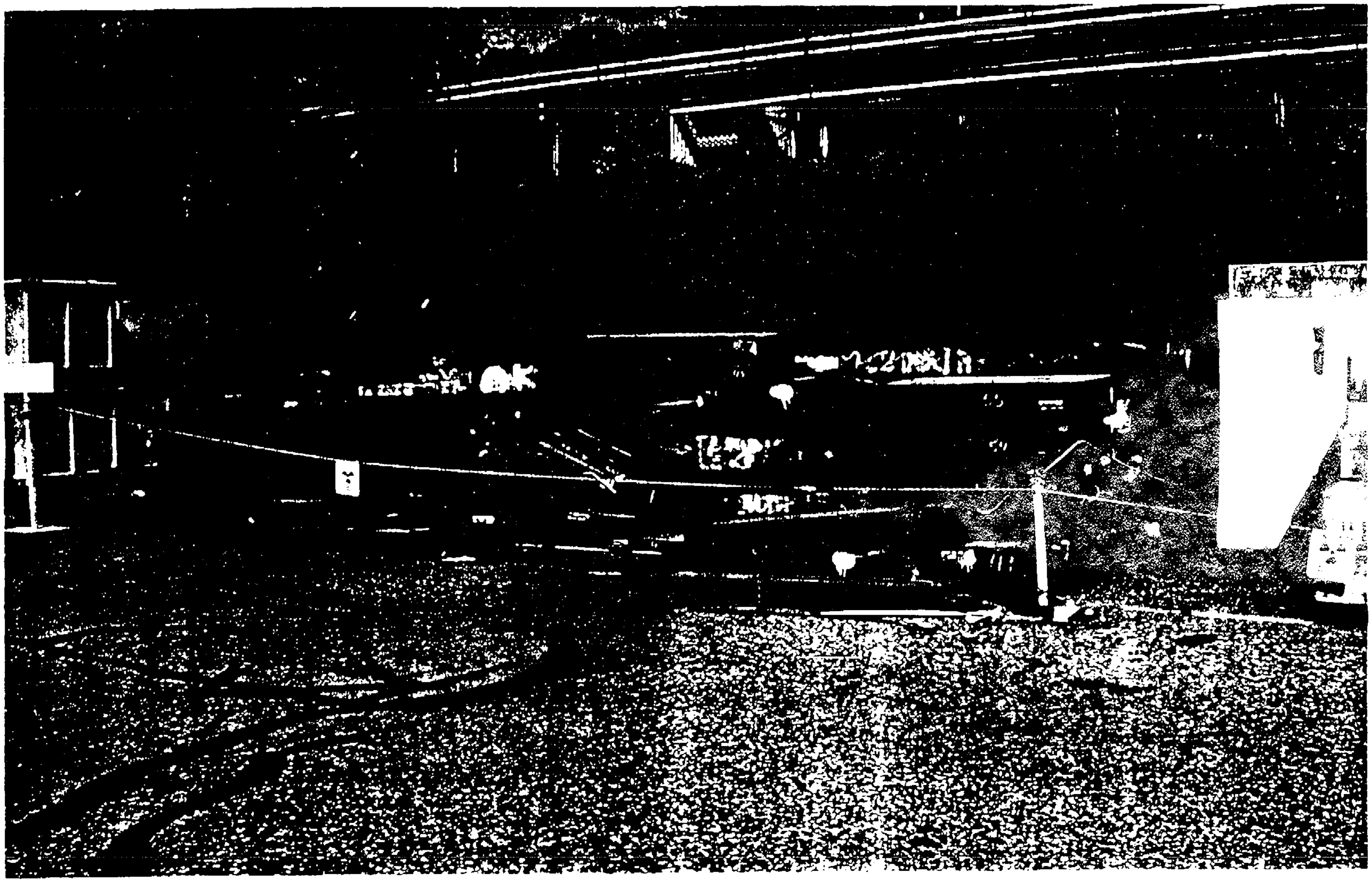
For bulk metals and concrete, disposal as LLRW can be very expensive. DOE 5400.5 provides some relief for items that have only surface-radioactivity at insignificant levels. In recent years, DOE has tried to provide a vehicle for release of slightly volumetrically-radioactivated metals known as the Return On Investment (ROI) Program.

First-Generation ROI Candidate Metals at SLAC

(113 tons total mass); Picture 1 of 2

First-Generation ROI Candidate Metals at SLAC

(113 tons total mass); Picture 2 of 2



SLAC

Using a contractor* to characterize the first-generation of ROI metals, the following alternatives were examined:

(*Environmental Management Services. Date of report: 06/11/1998)

Alternatives (Evaluated via NRC-approved RESRAD-RECYCLE using assumption of average of 50 pCi/gm Co-60)	Maximum Public Individual Dose Rate (mrem/year)	Overall Collective Public & Worker Dose for One-Year Release (person-rem)	Cost of Project ($)	Cost of Impact (assumes $5,000 per person-rem) ($)	Total Cost ($)
Unrestricted Use	8.84 E-2	9.5	95,500	47,500	143,000
Release for Designated Use after Melt Refining	8.40 E-1	1.25 E-2	485,937	63	486,000
Burial as LLRW at a DOE Disposal Facility	1.34 E-1	2.03 E-3	631,520	10	631,530 ~~631,520~~
DOE Authorized Limits	1	10	N/A	N/A	N/A

SLAC

Sequence of SLAC ROI Events

- The ROI alternative study for the first-generation of SLAC ROI scrap metals was compiled and submitted to DOE for selection of the preferred alternative in 1998 shortly after the submittal of the characterization from the contractor.

- DOE has taken no action on it to date.

- Presently, the scrap metals moratorium enacted by DOE in CY2000 effectively blocks further progress on the first-generation of SLAC ROI metals and stalls the program for future generations of ROI metals.

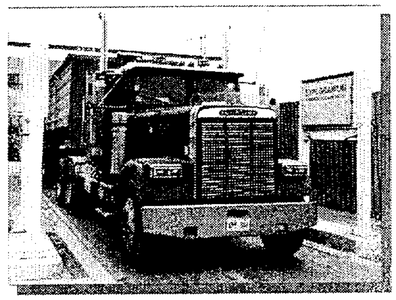
Presented To:

NATIONAL ACADEMIES
NATIONAL RESEARCH COUNCIL
DIVISION ON ENGINEERING AND PHYSICAL SCIENCES
BOARD ON ENERGY AND ENVIRONMENTAL SYSTEMS

Committee On:

ALTERNATIVES FOR CONTROLLING THE RELEASE OF SOLID MATERIALS FROM NUCLEAR REGULATORY COMMISSION-LICENSED FACILITIES

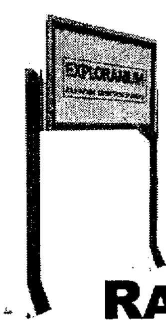
March 2001



Presented by:

Dr. Jens Hovgaard

EXPLORANIUM RADIATION DETECTION SYSTEMS



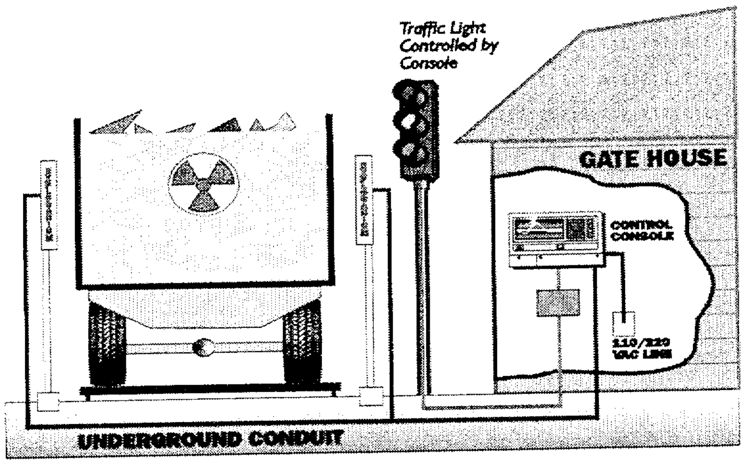
VEHICLE RADIATION Monitoring SYSTEMS

From

EXPLORANIUM

RADIATION DETECTION SYSTEMS

Principles of VEHICLE MONITORING SYSTEMS



VEHICLE MONITORING SYSTEM DETECTOR PORTAL

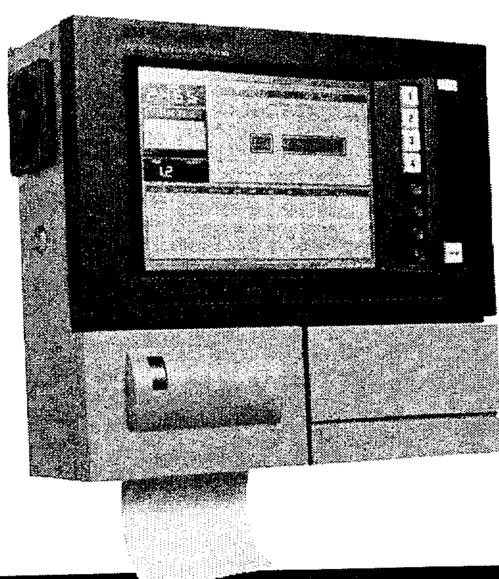
Detectors

- Large Slap Plastic Scintillators (PVT)
- 2200 CI
- 4400 CI
- 6000 CI

- Insulated and Housed In Aluminum Box

- Shielded on All Sides Except Front Face to Reduce Background Radiation

Vehicle Monitoring System
Operator Console



CONSOLE

- •Controls Detectors and Signals
- •Aiding Operator
- •Records System History
- •Records Alarms
- •Facilitates Connection to Outer World

MONITORING

Assumptions

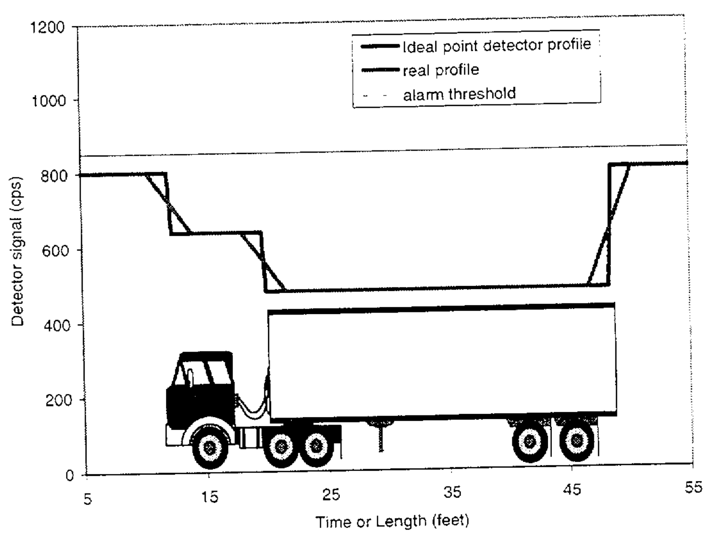
1. Radioactive Material Present in Vehicle by Accident
2. Radioactive Material Emits Gamma Radiation

Challenges And Complications

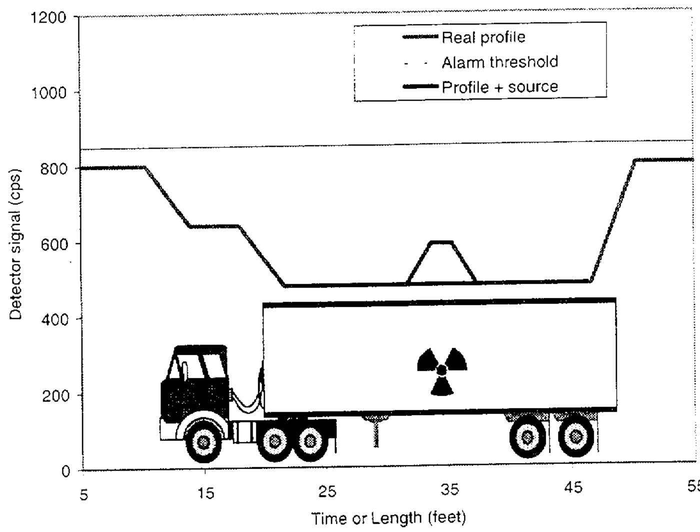
1. Vehicle Load Attenuation
2. Environmental Complications
3. Energy loss through load
4. Vehicle Related Challenges
5. Minimum Impact on Plant Operation

Vehicle Profiles

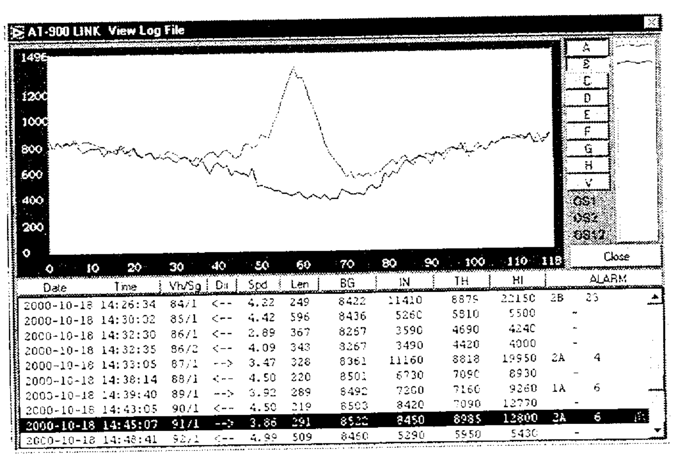
Radiation Profiles of a "Clean" Vehicle



Radiation Profiles of a Vehicle With Source

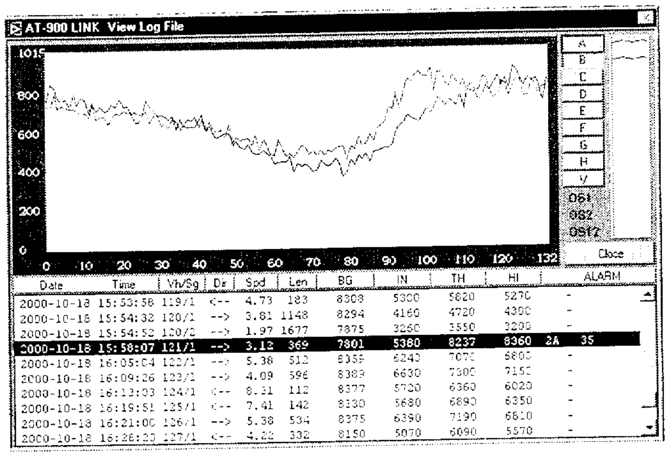


Real Radiation Profiles of a Vehicle With Source



Date	Time	Vh/Sg	Dir	Spd	Len	BG	IN	TH	HI	ALARM	
2000-10-18	14:26:34	84/1	<--	4.22	249	8422	11410	8879	22150	2B	23
2000-10-18	14:30:02	85/1	<--	4.42	596	8436	5260	5910	5500	-	
2000-10-18	14:32:30	86/1	<--	2.89	367	8267	3590	4690	4240	-	
2000-10-18	14:32:35	86/2	<--	4.09	343	8267	3490	4420	4000	-	
2000-10-18	14:33:05	87/1	-->	3.47	328	8361	11160	8818	19950	2A	4
2000-10-18	14:38:14	88/1	<--	4.50	220	8501	6730	7090	8930	-	
2000-10-18	14:39:40	89/1	-->	3.92	289	8492	7260	7160	9260	1A	6
2000-10-18	14:43:05	90/1	<--	4.50	219	8503	8420	7090	12770	-	
2000-10-18	14:45:07	91/1	-->	3.86	291	8522	8450	8985	12800	2A	6
2000-10-18	14:48:41	92/1	<--	4.99	509	8460	5290	5950	5430	-	

Real Radiation Profiles of a Vehicle With Small Source

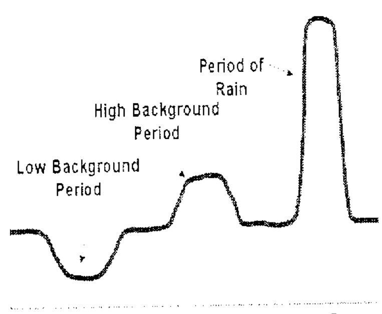


Date	Time	Vh/Sg	Dir	Spd	Len	BG	IN	TH	HI	ALARM	
2000-10-18	15:53:58	119/1	<--	4.73	183	8308	5300	5820	5270	-	
2000-10-18	15:54:32	120/1	-->	3.81	1148	8294	4160	4720	4300	-	
2000-10-18	15:54:52	120/2	-->	1.97	1677	7875	3260	3550	3200	-	
2000-10-18	15:58:07	121/1	-->	3.12	369	7801	5380	8237	8360	2A	35
2000-10-18	16:05:04	122/1	-->	5.38	512	8355	6240	7070	6800	-	
2000-10-18	16:09:26	123/1	-->	4.09	596	8389	6630	7300	7150	-	
2000-10-18	16:13:03	124/1	<--	8.31	112	8377	5720	6360	6020	-	
2000-10-18	16:19:51	125/1	<--	7.41	142	8330	5680	6890	6350	-	
2000-10-18	16:21:00	126/1	-->	5.38	534	8375	6390	7190	6810	-	
2000-10-18	16:26:23	127/1	<--	4.22	332	8150	5070	6090	5570	-	

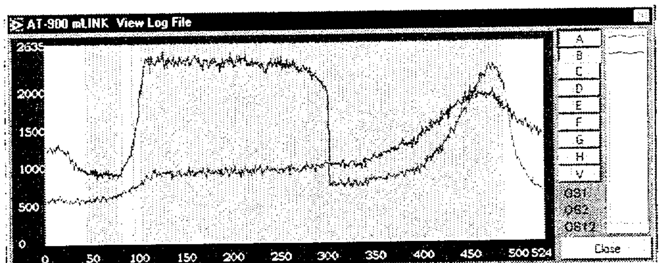
2. Environmental Complications

Background Radiation:

- *Varies with geography*
- *Changes continuously, daily, hourly, by the minute*
- *Rises dramatically with rainfall*



Manmade Changes Changes to The Background Radiation
(Non destructive testing, X-ray machines, etc..)

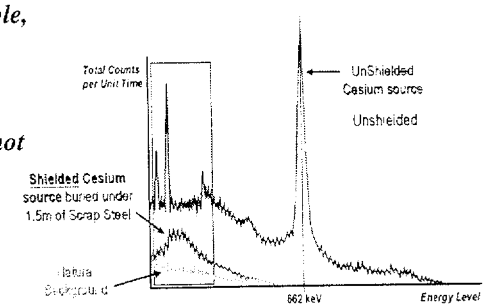


Date	Time	Vh/Sg	Dir	Spd	Len	BG	IN	TH	HI	ALARM		
2001-03-14	12:05:05	168/1	<--	2.91	164	12830	12470	13950	12900	-		
2001-03-14	12:06:25	169/1	<--	3.00	499	12837	12360	13770	12750	-		
2001-03-14	12:18:02	170/1	-->	2.52	415	12832	12350	13730	12710	-		
2001-03-14	12:20:02	171/1	-->	5.07	334	12871	12590	14100	13050	-		
2001-03-14	12:28:18	172/1	-->	3.95	113	12865	12380	13720	12670	-		
2001-03-14	12:32:17	173/1	<--	3.23	359	5801	5900	6563	6360	-		
2001-03-14	12:32:40	173/2	<--	3.26	2000	12836	23470	13968	24020	2B	193	
2001-03-14	12:33:18	173/2	<--	3.47	1829	5801	12240	6029	23060	1A	171	NDT
2001-03-14	12:35:44	174/1	<--	2.64	509	12849	12290	13630	12610	-		
2001-03-14	12:36:16	175/1	-->	3.15	169	12839	11880	13260	12260	-		

3. Energy Reduction Due To Scrap Loading

•Sources emit radiation at specific energy levels - Cesium for example, emits gamma rays at 662 keV

•The primarily photon energy is not the energy that the detector sees



Evaluation Of Possible Detector Materials

•SODIUM-IODIDE
Excellent performance in the Upper Spectrum but very expensive and fragile

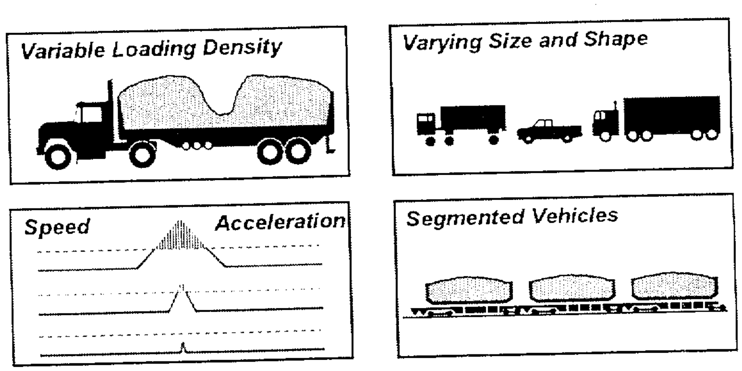
•CESIUM-IODIDE
Even better Upper Spectrum performance but even more expensive than NaI

•HIGH PURITY GERMANIUM
The ultimate detector for high-resolution spectrometers - but liquid Nitrogen?

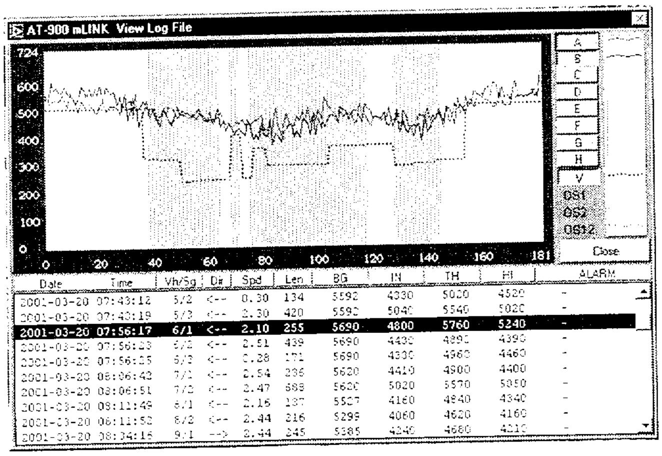
•GEIGER-MUELLER TUBES
Reasonably cost effective but seriously lacking in sensitivity

•PLASTIC (PVT)
Rugged, relatively low in cost, high sensitivity so
CLEARLY THE ONLY PRACTICAL CHOICE.

4. Vehicle Related Challenges

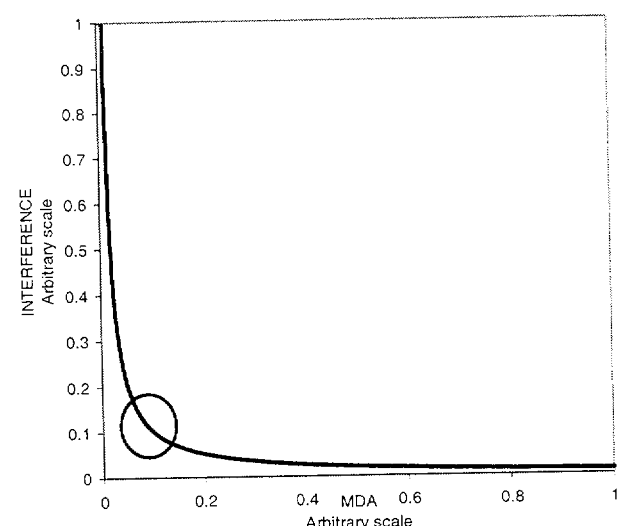


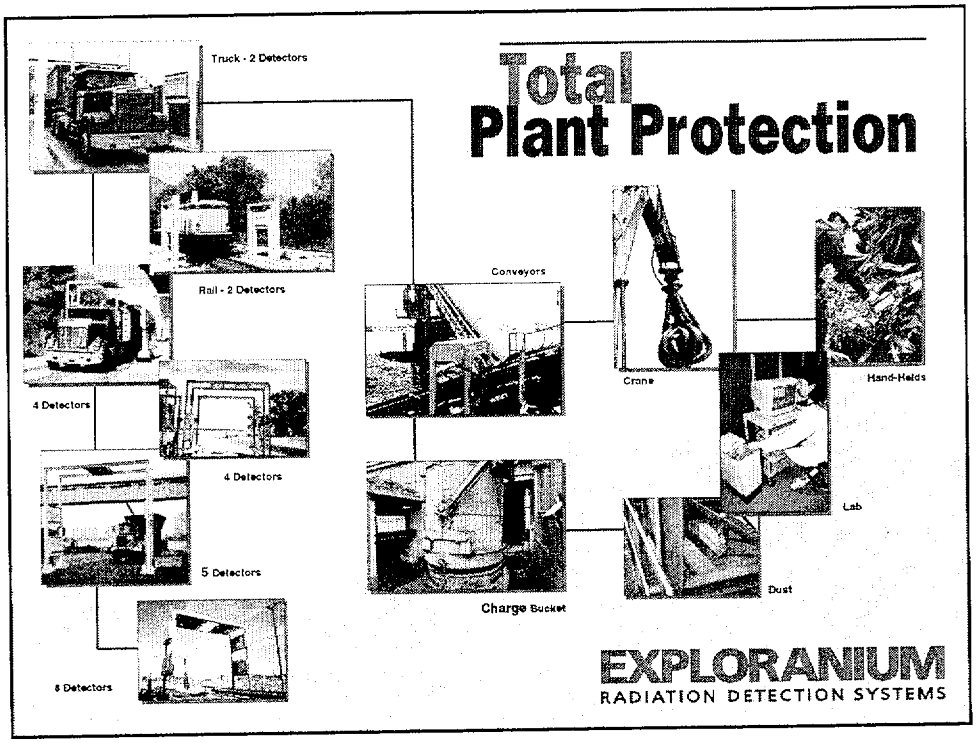
Sonar Scanning of Vehicle Load Profile

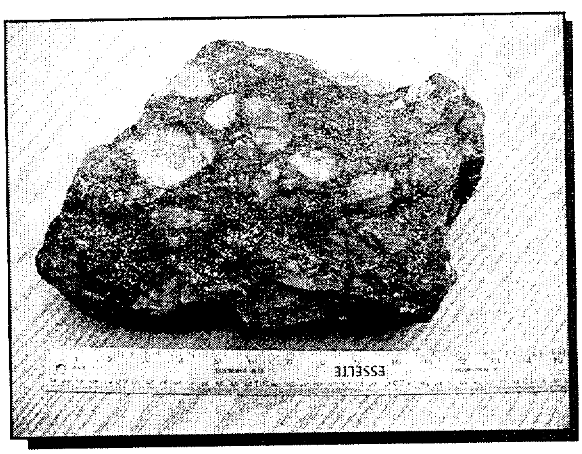


5. Minimum Impact on Plant Operation

- *Balance between sensitivity and interference*

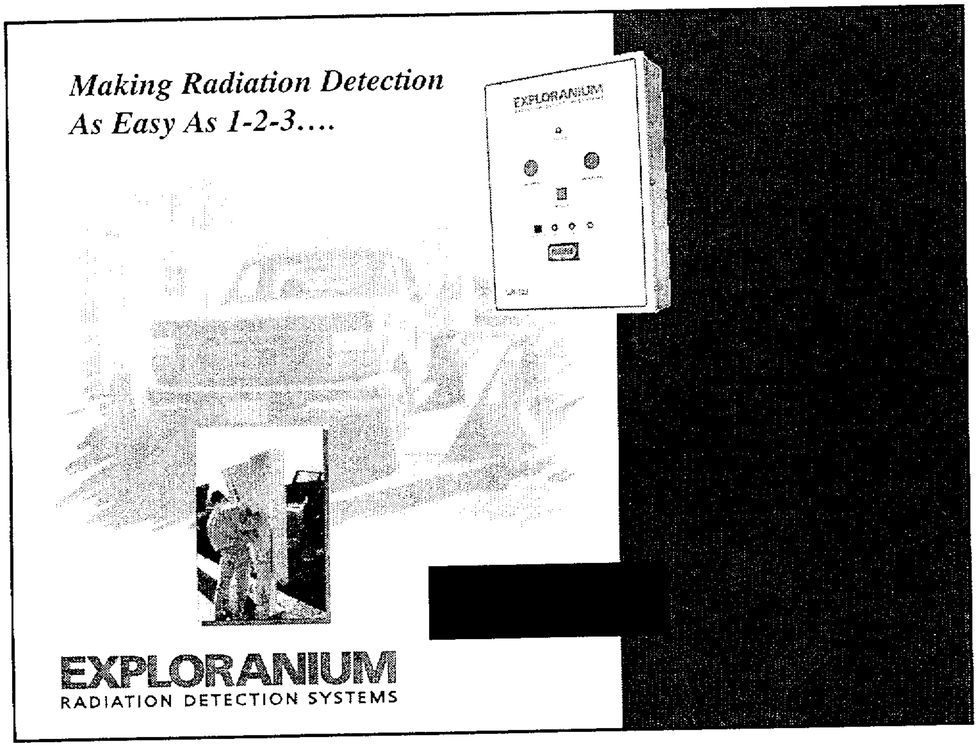


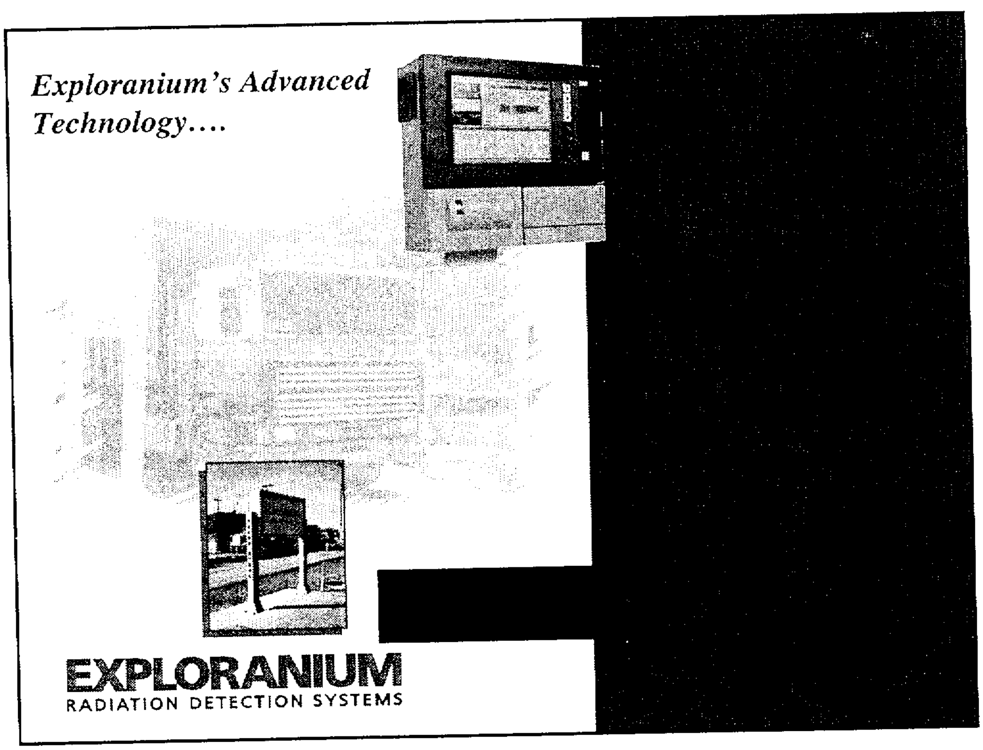




- Gamma dose rate 1 mrem/hr
- Clearly identified Pb-214, Bi-214, Tl-210 and U-238

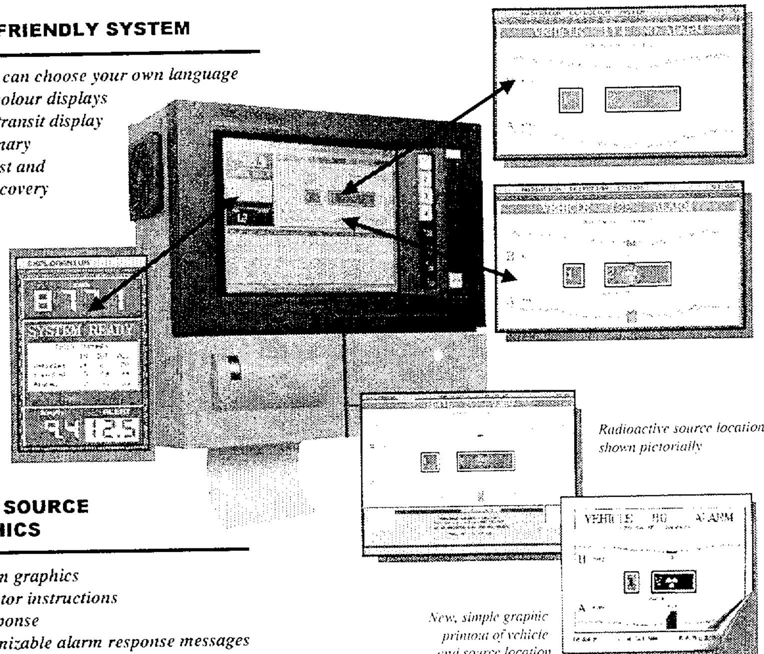
EXPLORANIUM


Making Radiation Detection
As Easy As 1-2-3....
EXPLORANIUM
EXPLORANIUM
RADIATION DETECTION SYSTEMS


Exploranium's Advanced
Technology....
EXPLORANIUM
RADIATION DETECTION SYSTEMS

AT-900, USER FRIENDLY SYSTEM

- *Multilingual - you can choose your own language*
- *Big, easy-to-read colour displays*
- *Real time vehicle-transit display*
- *Instant daily summary*
- *Continuous self-test and automatic error recovery*



Radioactive source location shown pictorially

New, simple graphic printout of vehicle and source location

RADIOACTIVE SOURCE ALARM GRAPHICS

- *Easy to view alarm graphics*
- *Customized operator instructions*
- *Single-button response*
- *Three user-customizable alarm response messages*
- *Quiet self-loading printer - large printouts*

www.exploranium.com

EXPLORANIUM
RADIATION DETECTION SYSTEMS

Corporate Head Office
6108 Edwards Blvd. Mississauga, Ontario CANADA L5T 2V7
Tel. (905) 670-7071 Fax (905) 670-7072

RSO,Inc.

National Academy of Sciences

Committee on Alternatives for Controlling the Release of Solid Materials From NRC Licensed Facilities

Overview

- RSO, Inc. provides a full range of services to to NRC and Agreement State Licensees.
- This includes services to investigate radioactive materials found in municipal waste and recycle materials.

RSO, Inc.

- Radiation Safety services and products
- Founded in 1974 and incorporated as RSO, Inc. in 1982
- Offices and facilities in Laurel, MD
- Staff of comprised of health physicists, project managers, HP Technicians, radioactive waste brokers, radioactive material service technicians, laboratory technicians and administrative personnel

Customers/Clients

- University Radiation Safety Departments
- Clinics, Community Hospitals and Medical Centers
- Biotechnology Research and Development Laboratories
- Fixed and Portable Gauge Users
- General Licensees

License preparation

- ❑ Radiation Safety Surveys
- ❑ Survey Meter Calibration
- ❑ Training
- ❑ Radioactive Waste Broker
- ❑ Sealed Source Warehouse
- ❑ License Decommissioning
- ❑ X-ray Machine compliance
- ❑ Medical Health Physics

Rad Investigation Contractor to:

- Waste Transfer Station in DC
- Waste Transfer Station and Municipal Waste Incinerator for a county in Maryland
- Medical Waste Incinerator in Baltimore
- Municipal Waste Incinerator in Baltimore
- Scrap Metal Dealers in Hagerstown (2) and Baltimore (1)

Typical Investigation

- Waste related to Nuclear Medicine procedures (all short $T_{1/2}$)
  - Usually I-131 but also Tc-99m, Tl-201, In-111, Ga-67
  - Often from hospitals (4 in 2000)
  - Often from the patients homes or nursing homes (3 in 2000)
  - Occasionally from Veterinary Clinics (none in 2000)

Items found in loads rejected by Scrap Metal Dealers

- **Ra-226 parachute pull cord (found by scrap metal dealer/shredder operator) ~ 5 uCi Ra-226**
- **Grinding stones in Scrap steel with Ra-226 (used to grind rails (90 used stones @ ~ 3 pCi/g Ra-226)**
- **Th-nat boiler refractory brick (rejected by Md. landfill returned to DC university), less than 5 pCi/g**

Investigations

- Other items for 2000
  - **FRP with Ra-226 pipe scale from waste water treatment plant**
  - **Truck trailer made with Ra-226 contaminated Al (sections ~ 30 cm length 20 uR/h @ 5 cm)**
- Scrap Steel (turnings)
  - Rejected by smelting facility with radiation levels 20% above bkg (nothing found following resurvey)

Investigations

- Municipal Waste Incinerator Ash
  - ~5 g of ash ~0.5 mR/h at 5 cm....Tc-96? Believed to be remains of T-99m generator core?
- Scrap Metal Dealer
  - General Licensed gauge (Kr-85)
  - Returned to generator (s/n of source determined by RSO)

Medical Waste Incinerator

- Boxes and carts monitored
  - Patient room waste not controlled by the hospital placed in the "red bag" waste
  - Same radionuclides as found in Municipal Waste since source is the same

Detection Systems

- Municipal Waste
  - Bicron (LFM-2) or Ludlum NaI detector systems
  - Not sophiticated
  - Set to alarm at ~2X or 3X BKG
- Scrap metal Dealers
  - Typically Bicron ASM-3000 or 6000 systems
  - Set at 20% above bkg
  - These systems are 5 to 10 times more sensitive than simple systems based on 2" or 3" NaI detectors
  - Also better installations

Municipal Waste Facility Response to Alarms

- Initial Response
  - May Hold for 1 day and try again
  - If the equipment (trash truck) is needed call RSO
  - Call generator/customer or hauler
  - Who will be the responsible party?
  - Call Rad Control Program
- RSO's Procedure
  - Measure rad levels on the vehicle
  - Gamma spec, ID radionuclide
  - Dump load
  - Isolate bags
  - Dispose of waste thru RSO or return to generator (if hospital)

Detection Sensitivity Issues

- Installation and operator training greatly effects sensitivity (especially true for simple systems that require a response on the part of the "operator"
- More sensitivity will find more medical waste
- Find more NORM

Motivation for Monitoring

- Facility "downstream" has a detection system and is rejecting loads
- e.g.: System Installed at a landfill means need system at Transfer Station
- This leads to installation of systems at hospitals and monitoring of all solid waste leaving the hospital
- e.g.: System Installed at a smelter means dealer needs a system

Motivation for Monitoring

- Scrap Metal Dealer that operates a shredder needs a system to protect operation
- Corporate or Facility Policy
- Regulators want hospitals as licensees to control all rad from the hospital

Experience

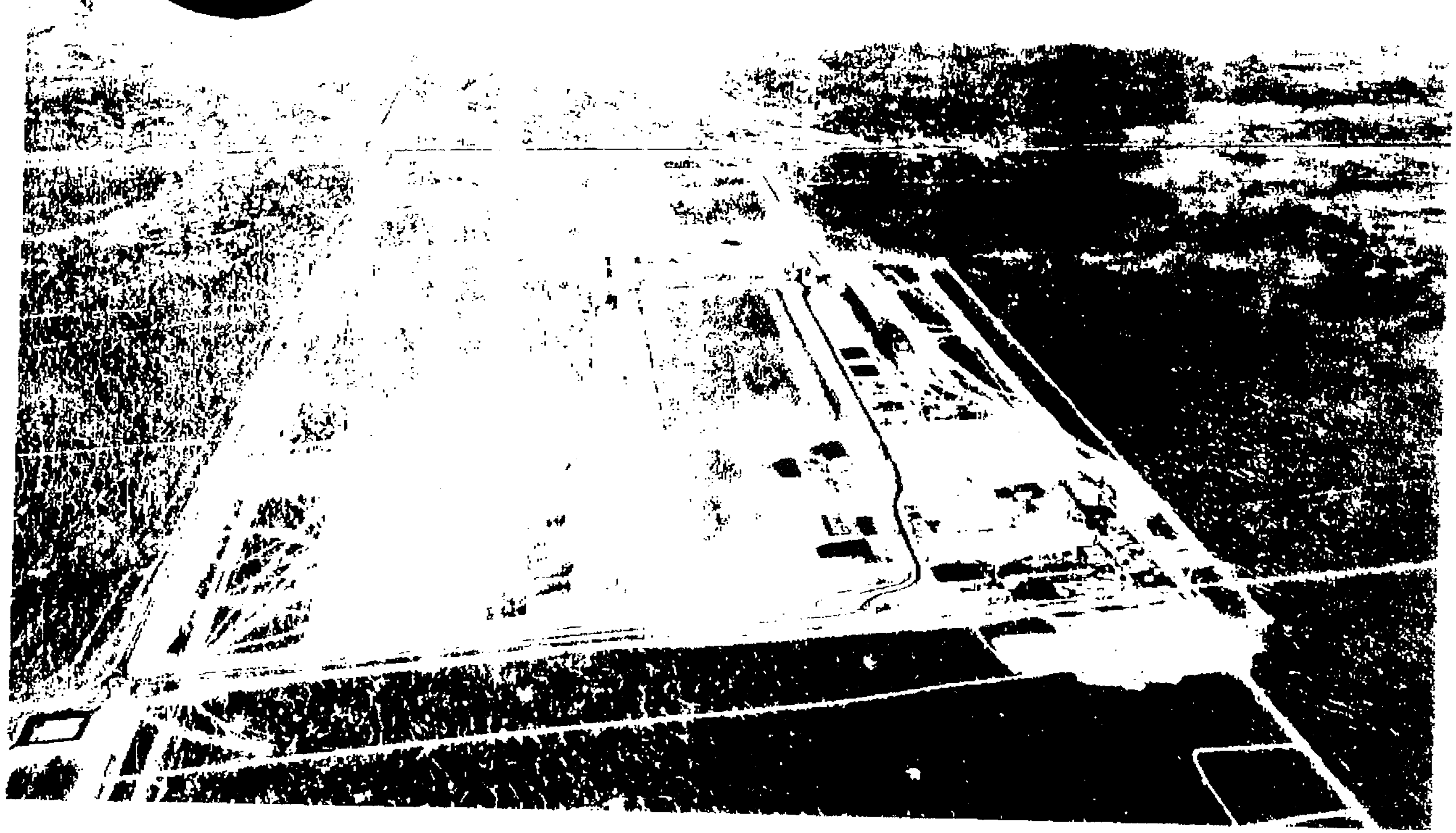
- Transfer stations, landfills and incinerators need to keep the municipal waste moving
- Rejected loads disrupt daily operations
- Usually the most suitable location to conduct the investigations is the "tipping floor" of the facility
- Exposures of personnel to the waste materials, and vehicular traffic is a greater risk than the radioactive material

Experience

- State regulatory agencies do not have practical policy on dealing with nuclear medicine waste from residences
- State regulatory agencies do not have policy on NORM materials such as refractory brick, minor volumes of pipe scale

ENVIROCARE OF UTAH, INC.

THE SAFE ALTERNATIVE



History of Clive, Utah

- Roots going back to the 1970s, with DOE's site search for the Vitro Tailings disposal project.
  - Vitro moved 2.5 million cubic yards of radioactive soil out of the populated Salt Lake County
- Of 29 potential locations, this Tooele County site was determined to be the most favorable.
  - Remote area - 40 miles from nearest community
  - Stable geology
  - Poor quality ground water
- In 1987, when Vitro was complete, Envirocare bought the land around the government site.

Low-Level Nuclear Waste

There are 3 types of low-level nuclear waste – Class A, B & C.

- We all benefit from the many modern products and industries that create low-level waste:
  - Medical diagnosis and treatment
  - Research and development of new medicines
  - Generation of electricity
  - Manufacture or use of many consumer products
    - sterilization of children's toys
    - production of teflon-coated cooking pans
    - household smoke detectors
    - emergency exit signs
    - production of plastic shrink wrap

Class A Low-Level Waste

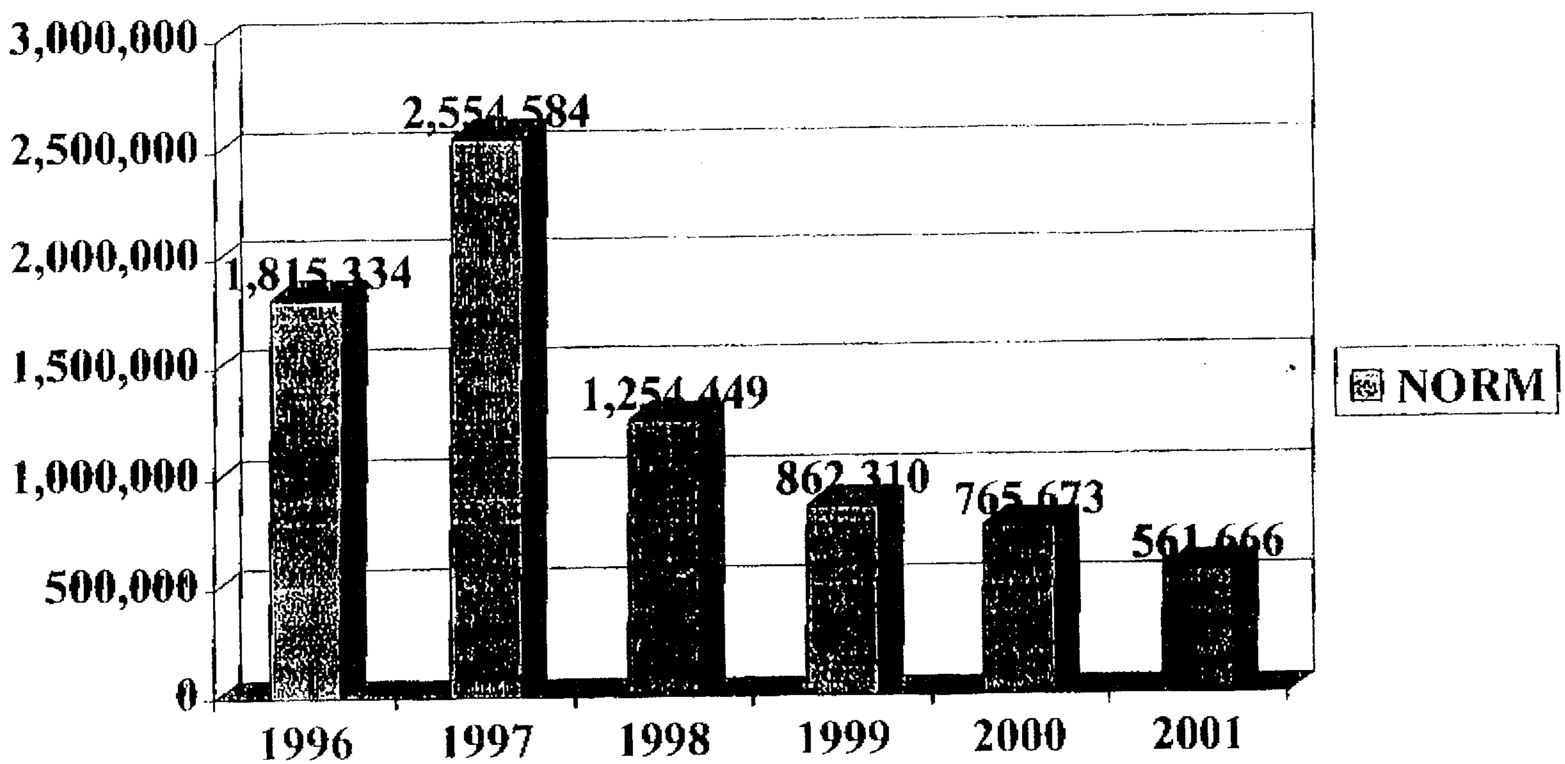
- Envirocare is currently licensed to receive most types of Class A low-level waste.
- Most Class A waste is in solid form.
  - Naturally radioactive material, like granite and uranium
  - Contaminated soil from residential and commercial areas
  - Building debris from contaminated sites
  - Disposable clothing and trash from facilities that handle radioactivity
  - Worn out metal parts and tools

Declining & Competitive Market

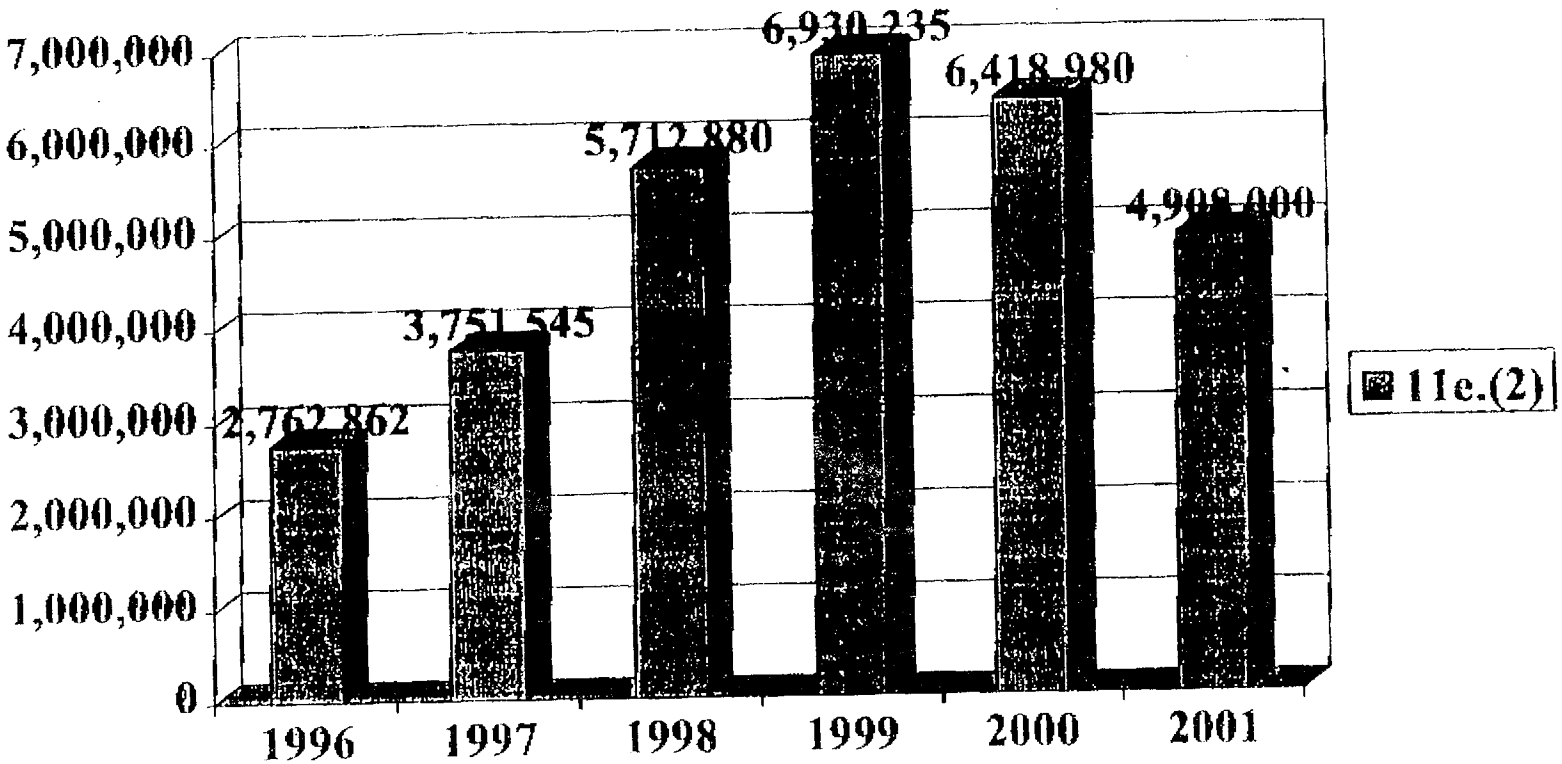
Envirocare must find new market opportunities to remain in business.

- Envirocare currently receives 4 types of low-level wastes: NORM, 11(e)2, Class A and mixed waste.
- Existing volumes of these wastes have peaked and are declining quickly.
  - NORM volumes have declined significantly
  - 11(e)2 and Class A volumes are beginning to decline
  - Mixed waste volumes remain steady, but represent a small percentage of total volumes

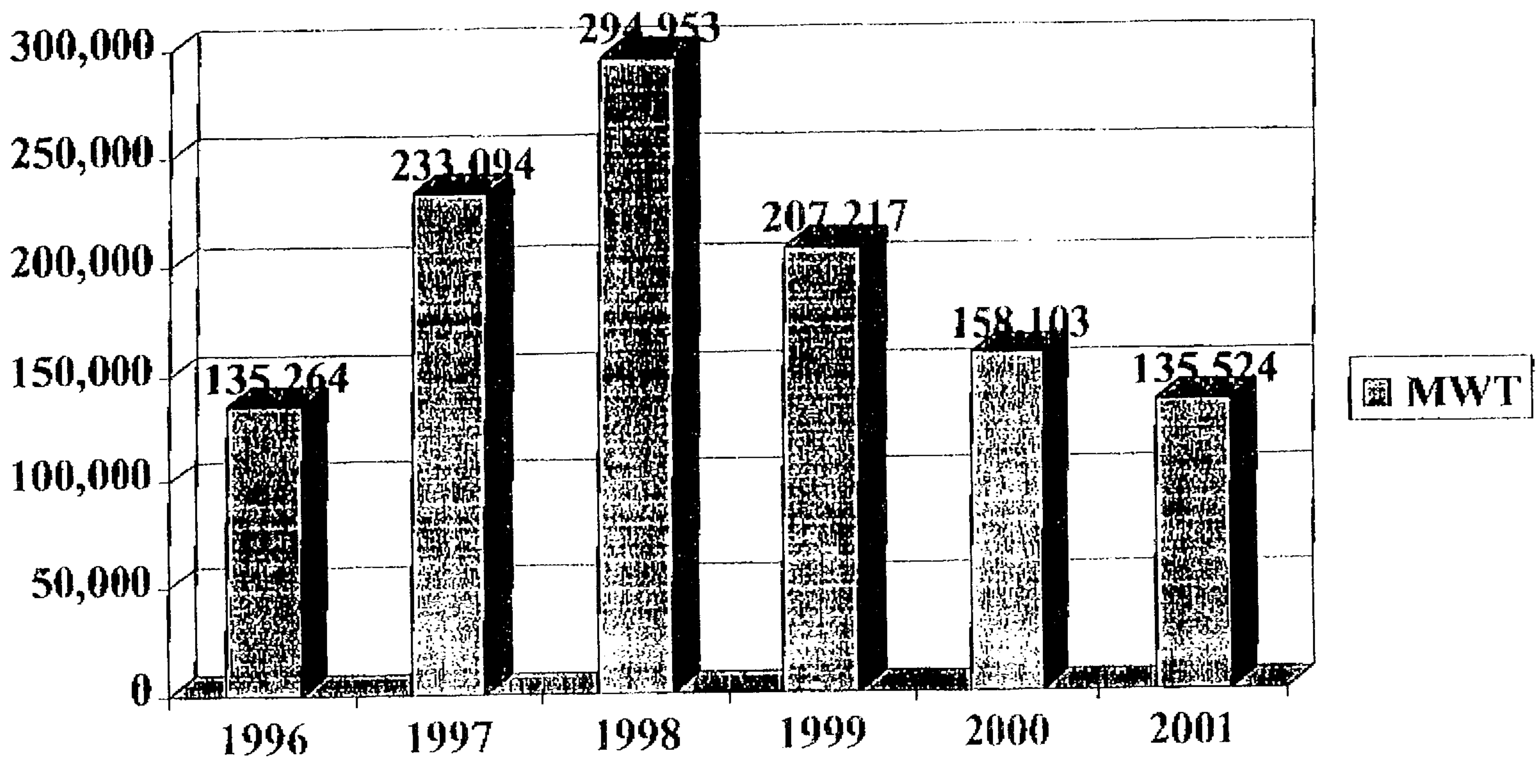
NORM Total Volumes



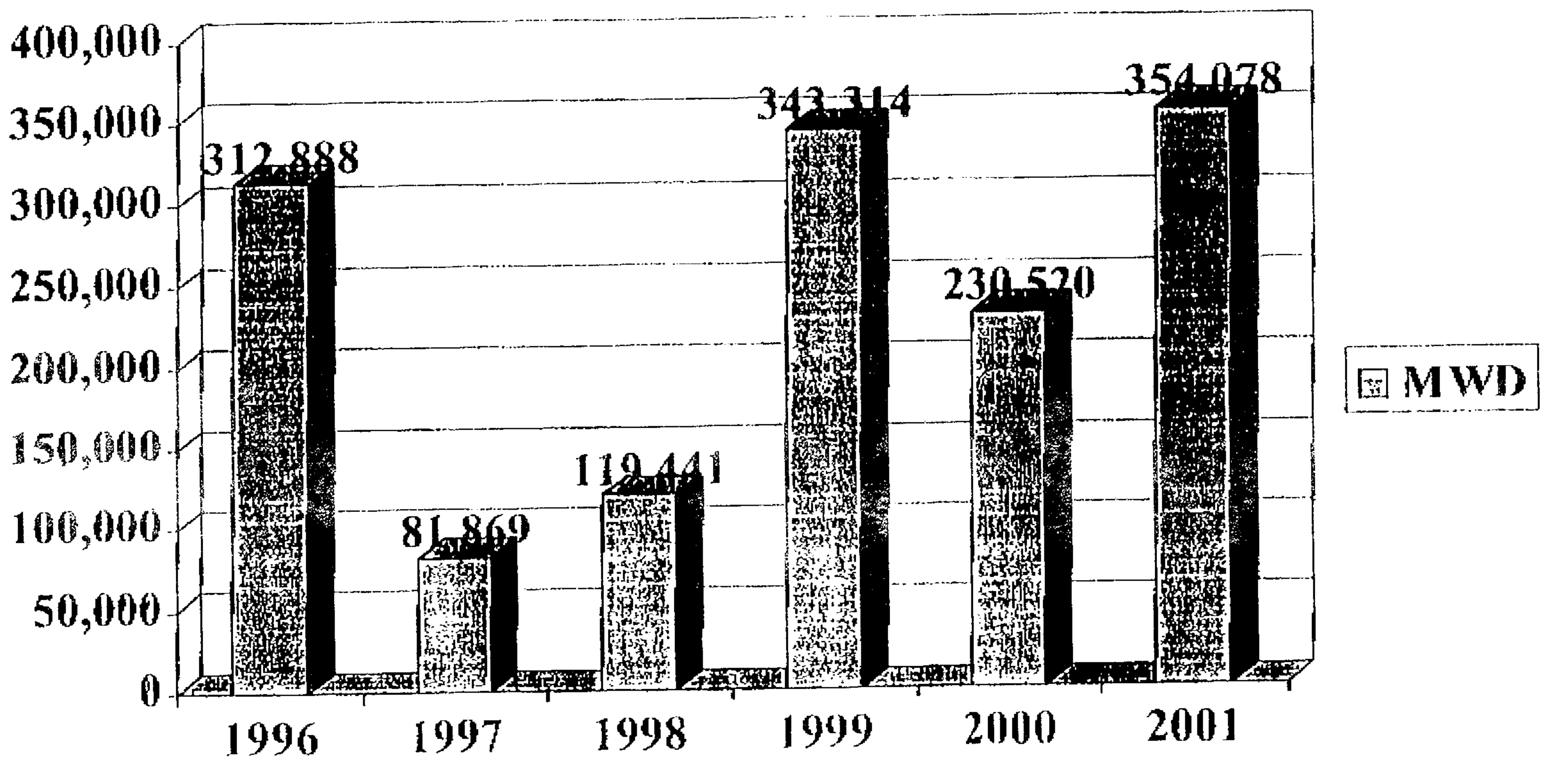
11e.(2) Total Volumes



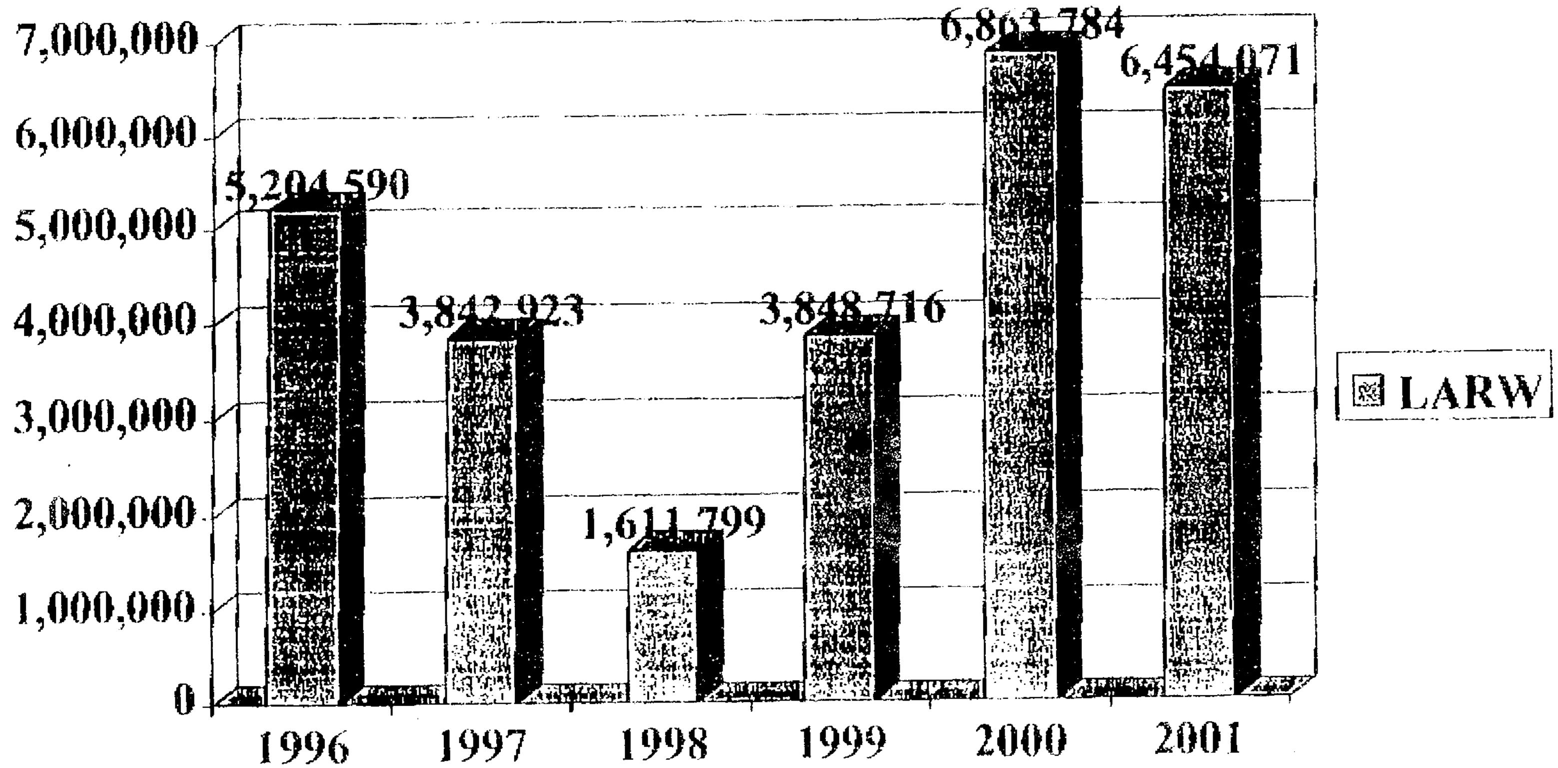
MWT Total Volumes



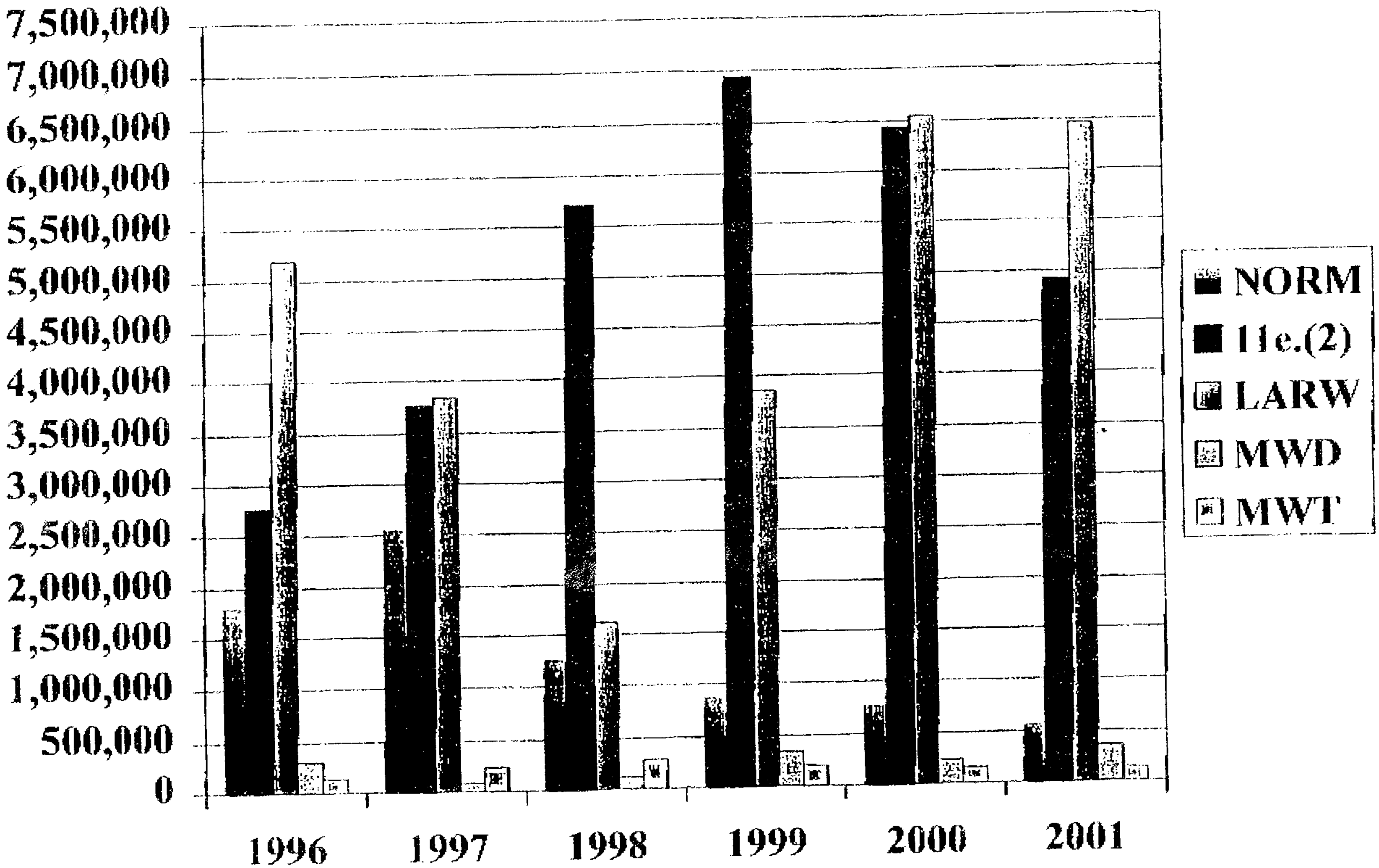
MWD Total Volumes



LARW Total Volumes



Total Waste Volumes



A Safe & Beneficial Solution

Envirocare provides a valuable service, safely disposing of the low-level waste we create.

- We all benefit from radioactivity: cancer treatment, x-rays, new medicines, making household products.
- Government said this is the most suitable location within Hazardous Industry District.
- Envirocare has a 12-year history of public and environmental safety.
- Class B & C license provides continued economic benefits to Tooele County and the State of Utah.

Government Oversight

Thirteen federal, state and local government agencies regulate and monitor Envirocare, including:

- Tooele County
- Utah Department of Environmental Quality (DEQ)
- U.S. Environmental Protection Agency (EPA)
- U.S. Nuclear Regulatory Commission (NRC)

Inspectors are on site daily.

Safety Is Top Priority

The safety of employees, the environment and the public is Envirocare's top priority.

- Significant resources devoted to safety programs.
  - Full-time safety officer
  - 55,000 hours spent on safety training last year
  - Health Physics Department devoted to employee safety
  - Aggressive environmental testing programs exceed government requirements

In 12 years, Envirocare has never had a radiation exposure incident.