U.S. Department of Energy
Office of Environmental Management

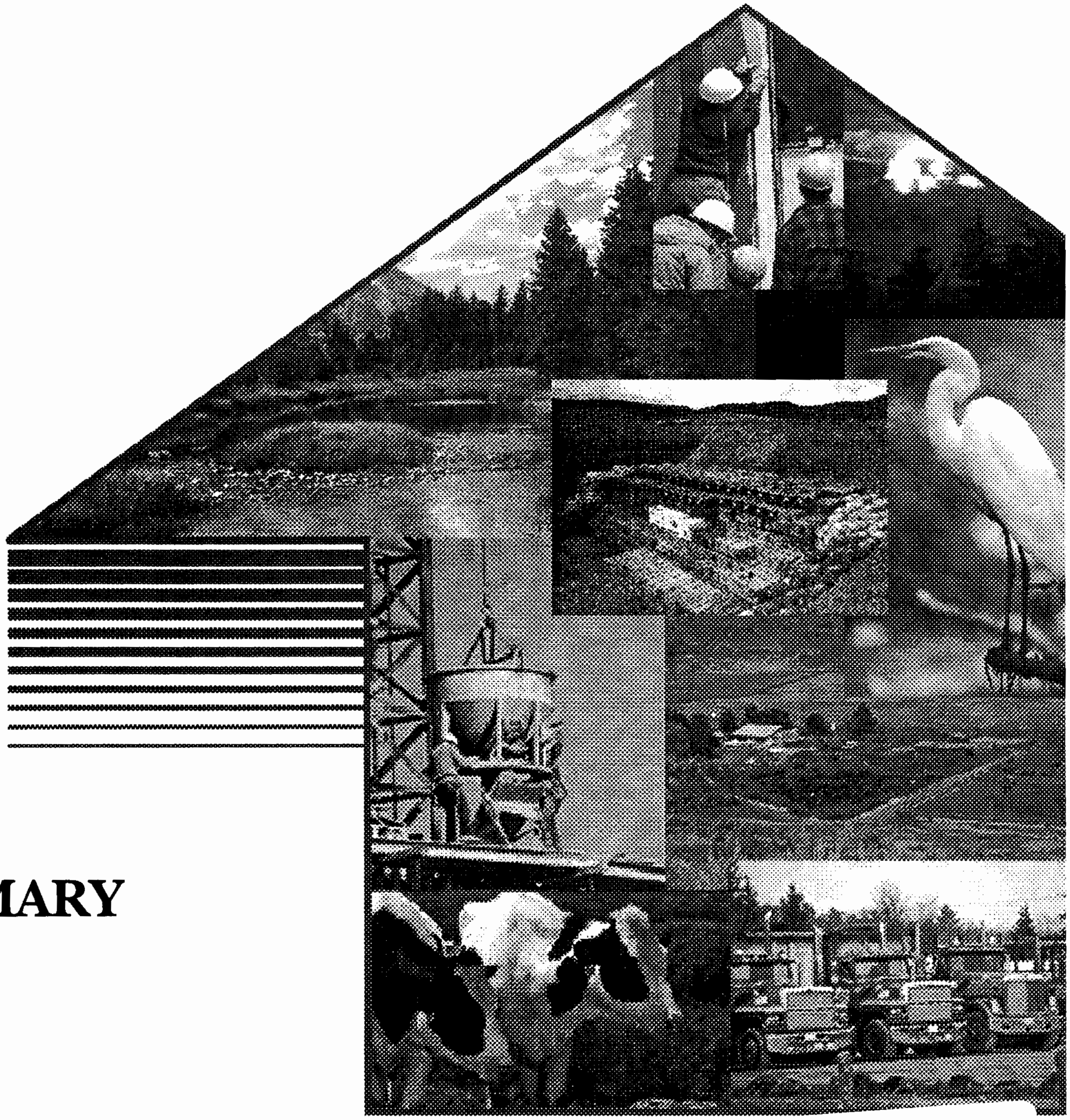
Ref

Summary

Draft Waste Management Programmatic Environmental Impact Statement

For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

DOE/EIS-0200-D



SUMMARY

August 1995

Department of Energy
Washington, DC 20585

September 1995

Dear Citizen:

This is a summary of the *Draft Waste Management Programmatic Environmental Impact Statement*, which has been prepared in accordance with the National Environmental Policy Act to evaluate management and siting alternatives for the treatment, storage and/or disposal of five types of radioactive and/or hazardous wastes. These waste types are: low-level radioactive waste; low-level mixed (with hazardous components) waste; transuranic waste; high-level radioactive waste; and hazardous waste. The alternatives were evaluated for waste stored, buried or to be generated from future operations over the next 20 years at 54 sites. For each waste type, the analyses contained in this document examined the potential health and environmental impacts of integrated waste management program alternatives involving multiple sites, as well as the potential cumulative impacts.

You are invited to comment on the draft programmatic environmental impact statement. Public input will be important in preparing the final document. Example topics on which the Department welcomes your input include:

- Technical adequacy of the document;
- What your preferences may be for alternatives evaluated for any or all waste types; and
- Criteria that the Department should consider in selecting preferred alternatives and making final decisions.

Comments may concern all or portions of the document and may be forwarded to:

U.S. Department of Energy
Waste Management PEIS Comments
P.O. Box 3790
Gaithersburg, Maryland 20885-3790

A complete copy of the draft environmental impact statement and reference documents are available in public reading rooms at the addresses to be listed in a Department of Energy Federal Register notice announcing the availability of the document for public review and comment. To request additional copies of all or portions of the document, please telephone the Center for Environmental Management Information at 1-800-736-3282 or in Washington, D.C. at 202-863-5084.

Comments may also be presented at public hearings at the times and locations listed in the Federal Register notice referenced above. We will carefully consider all comments in preparing the final environmental impact statement, which is scheduled to be issued in the summer of 1996. No decisions will be made until the final document is issued and a 30-day waiting period has elapsed.

Sincerely,

Thomas P. Grumbly
Assistant Secretary for
Environmental Management

Printed with soy ink on recycled paper

U.S. Department of Energy
Office of Environmental Management

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For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

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SUMMARY

August 1995

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Reader's Guide to the PEIS

The U.S. Department of Energy's (DOE's) Waste Management Programmatic Environmental Impact Statement (WM PEIS) is divided into two volumes:

- Volume I: entitled, "Draft Waste Management Programmatic Environmental Impact Statement—For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste."
- Volume II: entitled, "Draft Waste Management Programmatic Environmental Impact Statement— Site Data Tables."

Volume 1 of the PEIS contains the main text of the document. The Volume I introductory chapter describes the statutory and regulatory constraints under which DOE must operate in managing its waste, defines the five waste types analyzed in the PEIS, and discusses the waste management sites that are the focus of the document. Chapter 1 also outlines the decisions that DOE expects to make on the basis of the PEIS and the relationship of the PEIS to other ongoing and planned DOE actions and programs.

Following the Volume I introductory chapter, the purpose and need for DOE action is discussed in Chapter 2, the alternatives for each waste type are presented in Chapter 3, the affected environment for the major sites is presented in Chapter 4, and the impact analysis methodologies are summarized in Chapter 5.

Chapters 6 through 10 describe the health risks, environmental impacts, and costs associated with each of the alternatives for each waste type. Cumulative impacts for the alternatives and other major actions at each site are in Chapter 11. Mitigation measures are found in Chapter 12. Volume II consists of tables, organized by major site, that contain information regarding the potential impacts associated with all of the alternatives for the five waste types at those sites.

In addition to the supporting tables contained in Volume II, DOE has also prepared appendices and technical reports that provide supporting data as well as in-depth descriptions and explanations for a variety of issues. A list of these background documents is provided at the end of Volume I. DOE included all information that it believes to be relevant to stakeholders and decisionmakers in Volumes I and II of the WM PEIS. Review of the appendices or technical reports is not considered to be necessary for a full understanding of the issues.

Also provided in Volumes I and II is a glossary, index, and reference lists to further assist the reader. DOE has also established reading rooms and information locations across the United States where the technical reports may either be reviewed or obtained for review through interlibrary loan. The address and phone numbers for these reading rooms and information locations are provided in the Notice of Availability as published in the Federal Register.

Introduction

This Waste Management Programmatic Environmental Impact Statement (WM PEIS) is a nationwide study examining the environmental impacts of managing five types of radioactive and hazardous wastes that result primarily from nuclear defense activities—the development, production, and testing of nuclear weapons at a variety of sites located around the United States. The five waste types are: low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), and hazardous waste (HW).

DOE needs to enhance the management of its current and anticipated volumes of LLMW, LLW, TRUW, HLW, and HW in order to ensure safe and efficient management of these wastes and to comply with all applicable Federal and State laws and to protect public health and safety. Each waste type has unique physical and regulatory requirements and accordingly is managed separately. For each waste-type system, facilities are needed to treat, store, and dispose of the waste. For the first time, DOE has attempted not only to examine in an integrated fashion the impacts of complex-wide waste management decisions for each waste type but also the specific cumulative impacts for all the waste facilities at a given site. In this context, management of these wastes includes:

- Modifying existing waste management facilities or constructing new facilities at particular sites
- Operating modified or new waste management facilities at those sites
- Transporting waste among waste management facilities, as necessary
- Sampling and analyzing waste constituents as necessary

This study provides information on the impacts of various siting alternatives, which DOE will use in deciding where to locate additional treatment, storage, and disposal capacity for each waste type. However, the location of a facility at a selected site will not be decided until completion of a subsequent sitewide or project-specific environmental impact analysis.

Definitions of Wastes Analyzed in the WM PEIS

Low-level mixed waste: *Waste that contains both hazardous waste under the Resource Conservation and Recovery Act and source, special nuclear or byproduct material subject to the Atomic Energy Act of 1954 (42 USC 2011, et seq.).*

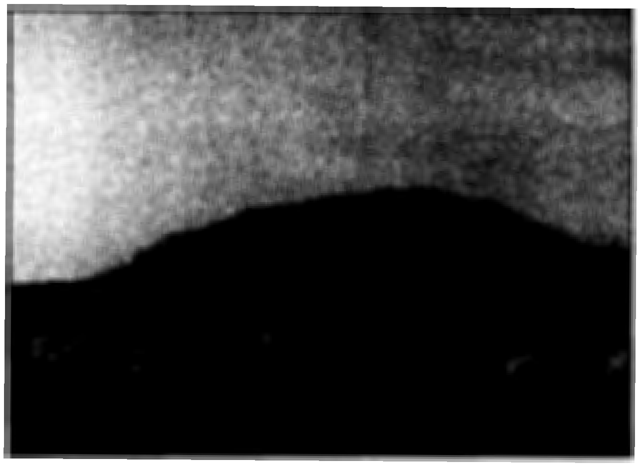
Low-level waste: *Wastes that contains radioactivity and is not classified as high-level waste, transuranic wastes, and spent nuclear fuel. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic is less than 100 nanocuries per gram of waste.*

Transuranic wastes: *Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, with half-lives greater than 20 years, per gram of waste, except for (a) high-level waste, (b) waste that DOE has determined, with the concurrence of the Administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation required by 40 CFR 191, or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.*

High-level waste: *The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. High-level waste may include other highly radioactive material that the U.S. Nuclear Regulatory Commission, consistent with existing law, determines by rule requires permanent isolation.*

Hazardous waste: *Under the Resource Conservation and Recovery Act, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Source, special nuclear material, and by-product material, as defined by the Atomic Energy Act, are specifically excluded from the definition of solid waste.*

To assist DOE in making decisions regarding the sites at which it should locate waste management facilities, this PEIS considers four categories of alternatives for each waste type: a no action alternative that is generally consistent with current practice, a decentralized alternative that would, in general, result in wastes being managed where they are generated or stored currently; a regionalized alternative that would locate waste management facilities at a lesser number of sites throughout the nation; and a centralized alternative that would locate large waste management facilities at only one or two sites. For certain waste types, DOE considers more than one regionalized or centralized alternative to present a wide variety of options on the number and location of sites having major waste management facilities and the sites at which the facilities could be located.



Haystack Mountain, near Grants, New Mexico, is the richest uranium-mining district in the United States. It was mined from 1950 to 1990.

1.1 Where Did DOE's Waste Come From? ... *The Legacy of Nuclear Weapons Production*

At its peak, the nuclear defense complex consisted of 16 "major" sites, including large reservations in Nevada, Idaho, Washington, and South Carolina. National laboratories in New Mexico and California designed weapons that were produced in Colorado, Florida, Missouri, Ohio, Tennessee, and Washington. Like most industrial and manufacturing operations, the production of nuclear weapons generated waste. However, many of the problems posed by DOE's nuclear operations are unlike those associated with most other industries. Among these problems are radiation hazards; structures with radioactive contamination, such as nuclear reactors; and chemical plants that processed nuclear materials.

Nuclear weapons have played an important role in national security, and the nation continues to maintain an arsenal of nuclear weapons and some production capability. Continued support to the nation's nuclear Navy has also been provided. However, since the end of the Cold War and the nuclear arms race, national priorities have shifted. Today, waste management and environmental restoration activities have become central to DOE's mission. DOE must provide for the proper management of its wastes within a complex and dynamic regulatory environment.

1.2 Understanding the Applicable Laws and Regulations Guiding DOE's PEIS Process

DOE must comply with numerous laws in undertaking its waste management and environmental restoration responsibilities. These laws include the National Environmental Policy Act (NEPA), the Resource Conservation and Recovery Act (RCRA), the Federal Facility Compliance Act (FFCAct), the Atomic Energy Act (AEA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

In addition to establishing a broad national policy on the environment, *NEPA* requires DOE and all other Federal Agencies to consider the potential environmental consequences related to proposed actions and requires them to prepare detailed statements on the environmental effects, alternatives to the action, and measures to avoid or minimize adverse effects.

RCRA establishes the framework for Federal[1] programs to achieve environmentally sound management of HW from "cradle to grave" and requires agencies, including

[1] Many states have been granted the authority by the Environmental Protection Agency (EPA) to administer and enforce RCRA requirements on a state-specific basis.

DOE, to follow specific regulations, procedures, and standards for managing HW, including the hazardous components of radioactive waste (mixed waste).

An amendment to RCRA, the *FFCAct* waives immunity for DOE and other Federal Agencies, allowing States and the EPA to impose penalties for non-compliance and requires DOE to develop plans for treating the hazardous components of radioactive wastes subject to RCRA requirements.

The *AEA* provides the authority for DOE to develop procedures and standards to ensure proper and safe management of radioactive materials.

Finally, *CERCLA* (also known as "Superfund") outlines the framework for liability, compensation, remediation, and emergency response for hazardous substances released into the environment and for remediation of HW disposal sites. CERCLA also provides the basis for many of the requirements affecting DOE's environmental restoration activities.

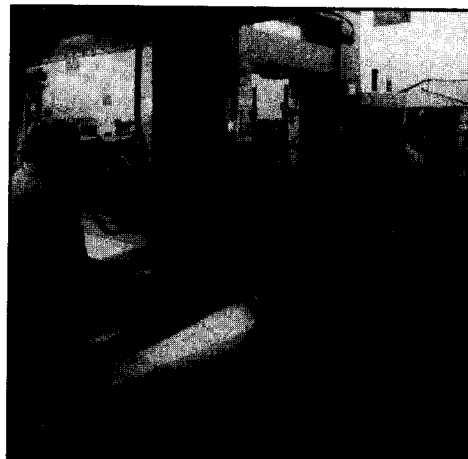
1.3 Waste Types Considered in the PEIS

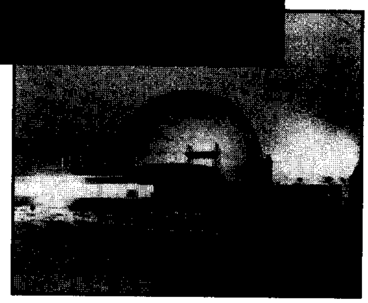
DOE is responsible for managing large inventories of LLMW, LLW, TRUW, HLW, and HW. DOE manages each of these waste types separately because they have different components, have different levels of radioactivity, and must meet different regulatory requirements. In a separate programmatic environmental impact statement and its subsequent Record of Decision, DOE addresses the management of spent nuclear fuel (see text box, page 10).

DOE defines its radioactive wastes based partially on how they are derived. Thus, waste types may share certain characteristics; for example, transuranic elements are found in LLMW, LLW, TRUW, and HLW.

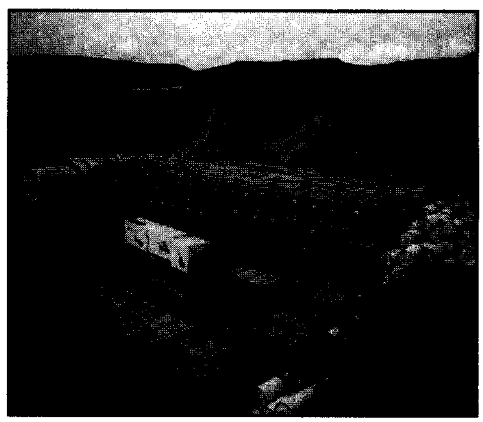
In addition, the wastes within each category come from diverse sources and can have different characteristics. Thus, some wastes within a waste type may need to be managed differently from other wastes within that same waste type. For example, LLMW and

Weapons Component Assembly.





Experimental Boiling Water Reactor, at ANL-E, December 31, 1956.



NTS disposal facility.

Contact- and Remote-Handled Wastes

Radioactive waste is classified as "contact-handled" (CH) or "remote-handled" (RH). ***Contact-handled*** *wastes are those with radiation levels less than or equal to 200 millirems per hour at the surface of a waste container and can be safely handled by direct contact.*

Remote-handled *wastes are those with radiation levels exceeding 200 millirems per hour at the surface of a container. Such material must be handled remotely, using such means as robotics, and must receive special shielding in treatment, storage, and disposal facilities.*

LLMW, LLW, and TRUW are comprised of both contact-handled or remote-handled waste.

LLW are categorized as alpha or non-alpha waste, depending on whether the waste contains materials emitting alpha particles at or above 10 nanocuries per gram (nCi/g). All TRUW is alpha waste. There are typically two categories of LLMW, LLW, and TRUW—"contact-handled" (CH) and "remote-handled" (RH). The difference between the two categories is due to the concentration of radioactive materials. Remote-handled waste typically requires additional shielding and containment to protect workers and the public. Most LLMW, LLW, and HW can be disposed of by near-surface burial, provided that these wastes are treated and disposed of in a properly regulated disposal facility. LLMW, HW, and some TRUW and HLW are all subject to the requirements of RCRA.

The following introductory sections define and discuss each of the waste types considered in this PEIS, current waste volumes, and provide more details for the four categories of alternatives. The figure below and Table 1.3–1 identifies the sites where wastes are generated or stored for each waste type under the alternatives evaluated in the WM PEIS.

Figure 1.3–1. Waste Management Sites

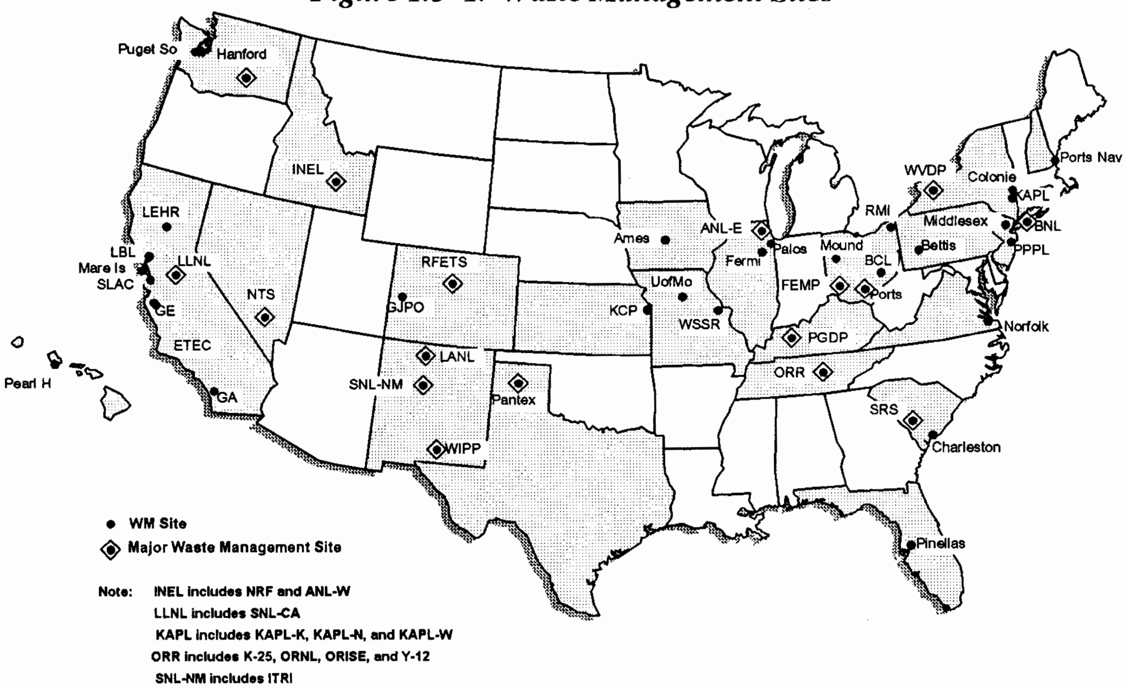


Table 1.3–1. Waste Management Sites

Sites	State	Symbol	Major Site[a]	Waste Type Managed				
				LLMW	LLW	TRUW	HLW	HW[b]
1. Ames Laboratory	IA	Ames		✓	✓			
2. Argonne National Laboratory–East	IL	ANL–E	✓	✓	✓	✓		✓
3. Battelle Columbus Laboratories	OH	BCL		✓				
4. Bettis Atomic Power Laboratory	PA	Bettis		✓	✓			
5. Brookhaven National Laboratory	NY	BNL	✓	✓	✓			
6. Charleston Naval Shipyard	SC	Charleston		✓				
7. Colonie	NY	Colonie		e				
8. Energy Technology Engineering Center	CA	ETEC		✓		✓		
9. Fermi National Accelerator Laboratory	IL	Fermi			✓			✓
10. Fernald Environmental Management Project	OH	FEMP	✓	✓	✓			
11. General Atomics	CA	GA		✓				
12. General Electric Vallecitos Nuclear Center	CA	GE		e				
13. Grand Junction Projects Office	CO	GJPO		✓				
14. Hanford Site	WA	Hanford	✓	✓	✓	✓	✓	✓
Idaho National Engineering Laboratory	ID	INEL	✓	✓	✓	✓	✓	✓
15. Idaho National Engineering Laboratory	ID	INEL		c	c	c	c	c
16. Argonne National Laboratory–West	ID	ANL–W		c	c	c		
17. Naval Reactor Facility	ID	NRF			c			
18. Kansas City Plant	MO	KCP		✓	✓			✓
Knolls Atomic Power Laboratory	NY	KAPL		✓	✓			
19. Knolls Atomic Power Laboratory (Kesselring)	NY	KAPL-K		c	c			
20. Knolls Atomic Power Laboratory (Niskayuna)	NY	KAPL		c	c			
21. Knolls Atomic Power Laboratory (Windsor)	CT	KAPL-W		c	c			
Knolls Atomic Power Laboratory	NY	KAPL		✓	✓			
22. Laboratory for Energy-Related Health Research	CA	LEHR		✓				
23. Lawrence Berkeley Laboratory	CA	LBL		✓	✓	✓		
Lawrence Livermore National Laboratory	CA	LLNL	✓	✓	✓	✓		✓
24. Lawrence Livermore National Laboratory	CA	LLNL	c	c	c		c	
25. Sandia National Laboratories (California)	CA	SNL–CA		c	c			
26. Los Alamos National Laboratory	NM	LANL	✓	✓	✓	✓		✓
27. Mare Island Naval Shipyard	CA	Mare Is		✓				
28. Middlesex Sampling Plant	NJ	Middlesex		d				
29. Mound Plant	OH	Mound		✓	✓	✓		
30. Nevada Test Site	NV	NTS	✓	✓	✓	✓		
31. Norfolk Naval Shipyard	VA	Norfolk		✓				

Table 1.3–1. Waste Management Sites—Continued

Sites	State	Symbol	Major Site[a]	Waste Type Managed				
				LLMW	LLW	TRUW	HLW	HW[b]
Oak Ridge Reservation	TN	ORR	✓	✓	✓	✓		✓
32. K–25 Site	TN	K–25		c	c			c
33. Oak Ridge Institute for Science and Education	TN	ORISE			c			
34. Oak Ridge National Laboratory	TN	ORNL		c	c	c		c
35. Y–12 Plant	TN	Y–12		c	c			c
36. Paducah Gaseous Diffusion Plant	KY	PGDP	✓	✓	✓	✓		
37. Palos Forest	IL	Palos		e				
38. Pantex Plant	TX	Pantex	✓	✓	✓			✓
39. Pearl Harbor Naval Shipyard	HI	Pearl H		✓				
40. Pinellas Plant	FL	Pinellas		✓	✓			
41. Portsmouth Gaseous Diffusion Plant	OH	Ports	✓	✓	✓			
42. Portsmouth Naval Shipyard	ME	Ports Nav		✓				
43. Princeton Plasma Physics Laboratory	NJ	PPPL		✓	✓			
44. Puget Sound Naval Shipyard	WA	Puget So		✓				
45. RMI Titanium Company	OH	RMI		✓	✓			
46. Rocky Flats Environmental Technology Site	CO	RFETS	✓	✓	✓	✓		
Sandia National Laboratories	NM	SNL-NM	✓	✓	✓	✓		✓
47. Sandia National Laboratories (New Mexico)	NM	SNL-NM		c	c	c		c
48. Inhalation Toxicology Research Institute	NM	ITRI		c	c			
49. Savannah River Site	SC	SRS	✓	✓	✓	✓	✓	✓
50. Stanford Linear Accelerator Center	CA	SLAC			✓			
51. University of Missouri	MO	U of MO		✓		✓		
52. Waste Isolation Pilot Plant	NM	WIPP	✓			✓		
53. Weldon Spring Site Remedial Action Project	MO	WSSR		d				
54. West Valley Demonstration Project	NY	WVDP	✓	✓	✓	✓	✓	
Total sites			17	37	27	17	4	11

Notes: ✓ = the facility is included in the indicated group. A site is listed under a waste type if it currently manages or is expected to manage that type of waste in the future. Joint DOE/Navy Nuclear Propulsion Program sites are: Bettis, Charleston, KAPL-K, KAPL-N, KAPL-W, Mare Is, Norfolk, NRF, Pearl H, Ports Nav, and Puget So. Former FUSRAP sites are Colonie and Middlesex.

[a] "Major" sites are those that are the focus of the WM PEIS because they are candidates to receive wastes generated offsite, to host disposal facilities (see Section 1.6.1) or manage HLW.

[b] Sites analyzed in the WM PEIS are those sites that generated more than 90% of DOE's HW for the year 1992. Other sites also manage HW but were not evaluated.

c For evaluating candidate sites for waste management facilities in this PEIS: ANL-W and NRF have been combined with INEL; ITRI has been combined with SNL-NM; K-25, ORISE, ORNL, and Y-12 have been combined under ORR; SNL-CA has been combined with LLNL; and KAPL-K, KAPL-N, and KAPL-W have been combined under KAPL.

d The site is included in the table because it is listed in data sources for LLMW; however, no programmatic waste management decision is required for the site, and it is excluded from the WM PEIS alternatives and waste totals.

e These sites are currently developing in the FFCAct site treatment plans, however, they do not report any LLMW in inventory or have projected generation rates.

17 Major Sites Analyzed in the WM PEIS

"Major" sites are those candidate locations that may receive wastes generated offsite, manage HLW, and/or host disposal facilities.

Argonne National Laboratory-East

Brookhaven National Laboratory

Fernald Environmental Management Project

Hanford Site

Idaho National Engineering Laboratory

Lawrence Livermore National Laboratory

Los Alamos National Laboratories

Nevada Test Site

Oak Ridge Reservation

Pantex Plant

Paducah Gaseous Diffusion Plant

Portsmouth Gaseous Diffusion Plant

Rocky Flats Environmental Technology Site

Sandia National Laboratories-New Mexico

Savannah River Site

Waste Isolation Pilot Plant

West Valley Demonstration Project

1.3.1 Low-Level Mixed Waste

Low-level mixed waste (LLMW) contains both hazardous and low-level radioactive components. The hazardous components in LLMW are subject to RCRA, whereas the radioactive components are subject to the AEA. LLMW is characterized as either CH or RH and as alpha or non-alpha.

LLMW results from a variety of activities, including the processing of nuclear materials used in nuclear weapons production, and energy research and development activities. The PEIS evaluates management of approximately 82,000 cubic meters of LLMW that are currently stored and an estimated 144,000 cubic meters that are expected to be generated over the next 20 years (excluding LLMW that could be generated as a result of environmental restoration activities) for a total of 226,000 cubic meters. Presently, commercial and DOE facilities are insufficient to treat DOE's inventory of LLMW. This PEIS addresses the treatment and disposal of LLMW; storage of LLMW is not addressed because RCRA land disposal restrictions prohibit storage of waste except to facilitate proper recovery, treatment, or disposal.

1.3.2 Low-Level Waste

Low-level waste (LLW) includes all radioactive waste that is not classified as HLW, spent nuclear fuel (a byproduct of nuclear reactors), or TRUW. Most LLW consists of relatively large amounts of waste materials contaminated with small amounts of radionuclides, such as contaminated equipment (e.g., gloveboxes, ventilation ducts, shielding, and laboratory equipment), protective clothing, paper, rags, packing material, and solidified sludges. LLW is further categorized as CH or RH and as alpha or non-alpha on the basis of the types and levels of radioactive emissions. DOE has an inventory of approximately 114,000 cubic meters of LLW in storage, and approximately 1,370,000 cubic meters are expected to be generated during the next 20 years (excluding LLW that could be generated as a result of environmental restoration activities), for a total of 1,484,000 cubic meters. This PEIS addresses the treatment and disposal of LLW.

1.3.3 Transuranic Waste

Transuranic waste (TRUW) is defined as waste materials contaminated with radionuclides from elements whose atomic numbers exceed 92 (that of uranium) with concentrations greater than 100 nCi/g of waste.[2] TRUW is generated during reactor fuel assembly, nuclear weapons production, and spent nuclear fuel reprocessing.

The Waste Isolation Pilot Plant (WIPP), Carlsbad, New Mexico.

TRUW, some of which also contains hazardous components, has radioactive components such as plutonium, with lesser amounts of neptunium, americium, curium, and californium. TRUW components have half-lives greater than 20 years. These radionuclides generally decay slowly by emitting alpha radiation. Like LLMW and LLW, TRUW also contains radionuclides that emit gamma radiation, requiring TRUW to be managed as either CH or RH. Approximately half of the TRUW analyzed is mixed waste containing both radioactive components and hazardous components regulated under RCRA.

DOE has approximately 69,000 cubic meters of retrievably stored TRUW, and about 38,000 cubic meters are expected to be generated over the next 20 years (excluding TRUW that could be generated as a result of environmental restoration activities), for a total of about 107,000 cubic meters. However, after characterization, some waste currently managed as TRUW may be reclassified as LLMW. DOE is currently proceeding with plans for TRUW disposal at a geologic repository called the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Before making a decision on whether or not to proceed to the WIPP disposal phase, DOE will prepare a supplemental WIPP EIS. Therefore, this PEIS addresses only the siting of treatment and storage facilities for TRUW.

Access to waste panel 1 in WIPP's underground facility. Continuous air monitors in foreground.

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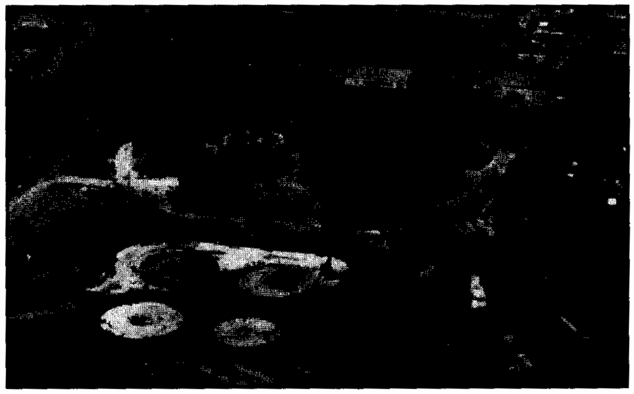
[2] LLW, LLMW, and HLW may also contain transuranic elements.

Types of Radioactivity

There are four principle types of radiation: alpha particles, beta particles, gamma rays, and neutrons. Alpha radiation can be stopped by a sheet of paper and will not penetrate skin, but it is harmful if ingested or inhaled. Beta radiation can pass through skin or an inch of water, but not through a thin sheet of aluminum, plywood or steel. Gamma rays and neutrons are the most penetrating radiation and can pass through many materials, including the human body. Dense materials like lead or thick concrete must be used to stop gamma rays and neutrons.



High-level waste tanks at SRS.

1.3.4 High-Level Waste

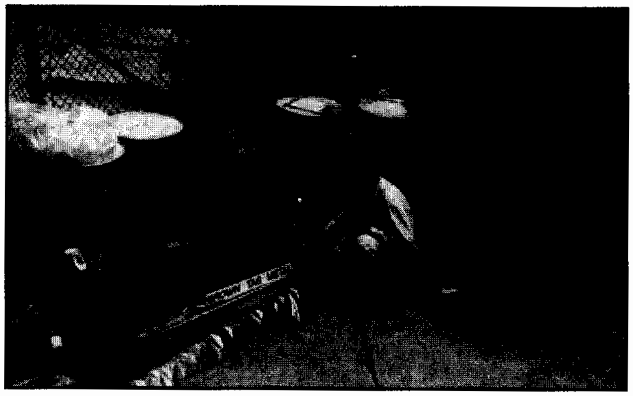
High-level waste (HLW) is the highly radioactive byproduct of reprocessing spent nuclear fuel and irradiated targets from reactors. Some of its elements will remain radioactive for thousands of years. DOE has about 399,000 cubic meters of HLW stored in large tanks.

DOE is proceeding with plans to treat HLW by processing it into a solid form that would not be readily dispersible into air or leachable into groundwater or surface water. This treatment process is called vitrification. The environmental impacts of vitrifying HLW have been analyzed in previous DOE environmental impact statements. Vitrification would result in the generation of approximately 28,400 canisters from the current inventory of HLW. The HLW canisters will be disposed of in a geologic repository. This PEIS addresses the storage of vitrified HLW canisters prior to its ultimate disposal in a geologic repository.

Spent Nuclear Fuel

"Spent nuclear fuel" is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

Initially, the management of spent nuclear fuel was to be analyzed in this PEIS. However, spent nuclear fuel has been analyzed in a separate PEIS—"Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement" published in April 1995. The impacts from managing spent nuclear fuel are included in the cumulative impacts of this WM PEIS.



Various low-level, mixed, and hazardous waste.

1.3.5 Hazardous Waste

Hazardous waste (HW) is defined under RCRA as a solid waste, or combination of solid wastes, that because of its quantity, concentration, or physical, chemical, or infectious characteristics may significantly contribute to an increase in mortality, or may pose a potential hazard to human health or the environment when improperly treated, stored, or disposed. RCRA defines a "solid" waste to include solid, liquid, semisolid, or contained gaseous material.

The quantities and types of HW generated as a result of DOE activities vary considerably and include acids, metals, solvents, paints, oils, and rags contaminated with hazardous cleaning compounds, and other hazardous materials that are byproducts of routine maintenance, degreasing, and machine shop operations. Almost 99% of DOE's HW is wastewater and is treated at DOE sites. The remaining 1%, predominantly solvents and cleaning agents, is treated at commercial facilities. The WM PEIS evaluates the treatment of the 1% of HW that is not wastewater. Over the next 20 years, approximately 69,000 cubic meters of nonwastewater HW are expected to be generated. Treated HW will continue to be disposed of at commercial facilities.

*Quantities of Waste**

Low-Level Mixed Waste. *The WM PEIS addresses approximately 82,000 cubic meters of LLMW that are currently stored and an estimated 144,000 cubic meters that are expected to be generated over the next 20 years.*

Low-Level Waste. *Approximately 114,000 cubic meters of LLW are stored, and an estimated 1,370,000 cubic meters are expected to be generated over the next 20 years.*

Transuranic Waste. *Approximately 69,000 cubic meters are retrievably stored, and an estimated 38,000 cubic meters are expected to be generated over the next 20 years.*

High-Level Waste. *Approximately 399,000 cubic meters of HLW are stored and when treated through vitrification will generate approximately 28,400 HLW canisters.*

Hazardous Waste. *Approximately 69,000 cubic meters of nonwastewater HW are expected to be generated in the next 20 years.*

* Volumes do not include environmental restoration wastes.

1.3.6 WM PEIS DECISIONS

The following table summarizes the range of decisions that DOE needs to make with respect to the treatment, storage, and disposal for the waste types discussed. The location of waste management facilities to implement these decisions are addressed in the alternatives.

DOE issued an Implementation Plan for this PEIS in January 1994 (DOE, 1994b). In that document, DOE identified the proposed action as the formulation and implementation of "an integrated environmental restoration and waste management program in a safe and environmentally sound manner and in compliance with applicable laws, regulations, and standards." However, since issuing the Implementation Plan, DOE has decided to shift the focus of the WM PEIS.

Table 1.3–2. Range of Decisions to be Supported by the PEIS

Decisions	Type of Waste and Whether PEIS Is To Support Decision (Yes or No)				
	Low-Level Mixed Waste	**Low-Level Waste**	**Transuranic Waste**	**High-Level Waste**	**Hazardous Waste**
Where to treat?	**YES** LLMW could be treated at 1 to 37 DOE sites.	**YES** LLW volume reduction and treatment could be conducted at 1 to 11 DOE sites.	**YES** If required, TRUW could be treated at 3 to 16 DOE sites.	No HLW will be treated at 4 DOE sites where it was generated.	**YES** HW could be treated at DOE sites, or DOE could rely on commercial treatment.
Where to store?	No LLMW will be stored on sites where generated until treatment and disposal.	No LLW will be stored at sites where generated until treatment and disposal.	**YES** TRUW could be stored at sites where generated until treated, and stored at treatment sites until disposal.	**YES** HLW canisters containing treated HLW could be placed into storage at 1 to 4 DOE sites.	No HW sent to commercial facilities will be stored for less than 90 days unless there is a permitted storage facility.
Where to dispose?	**YES** LLMW could be disposed at 1 to 16 DOE sites.	**YES** LLW could be disposed at 1 to 16 DOE sites.	No Separate evaluation of Waste Isolation Pilot Plant (WIPP) Disposal Phase to be prepared.	No Separate evaluation to be prepared pursuant to the Nuclear Waste Policy Act, as amended.	No Commercial HW disposal facilities will continue to be used.

Specifically, DOE has determined that its original plan to integrate waste management and environmental restoration decisions is not appropriate, primarily because of the site-specific nature of environmental restoration decisions. These decisions, including the level of site remediation, should reflect site-specific conditions and involve community based decision-making. Nonetheless, some national perspective and public participation is needed to help guide these site-specific decisions for two reasons. First, implementation of the national environmental restoration program will involve some broad strategic initiatives. Second, some consistency in site-specific decisions will be needed to ensure an adequate level of protection and adequate financial controls. DOE is considering some enhanced public participation to obtain input on these national environmental restoration issues.

In a *Federal Register* notice issued in January 1995, DOE proposed to modify the scope of the WM PEIS to eliminate the analysis of environmental restoration alternatives (DOE, 1995b). Appendix A of this PEIS contains a summary of the comments received in response to the proposed change in scope and DOE's responses to those comments. Appendix A also describes various means for public involvement in planning and decisionmaking for the Departments' environmental restoration activities.

As modified, the WM PEIS focuses on waste management facilities (those required to treat, store, or dispose of existing wastes and wastes that will be generated in the future as a result of DOE nuclear weapons stockpile stewardship and research programs). While this document does not analyze environmental restoration alternatives, it does contain information on the anticipated waste loads generated as a result of environmental restoration activities and a qualitative discussion of the extent to which those waste loads may affect waste management decisions.

1.3.7 Potential Decision Criteria for Preferred Alternative Selection

DOE intends to consider public comments as part of an evaluation of the alternatives during the course of the decision process. The process will include development of both screening and performance criteria. The following are examples of the factors and criteria DOE may use to screen, evaluate, and narrow the current alternatives to select a preferred alternative for each waste type considered in the WM PEIS.

Factor:	Criteria:
• DOE Mission	Favor management strategies that further mission objectives of safe and efficient treatment, storage, and disposal.
• Site Mission	Assure the alternative is consistent with site capabilities and availability of technologies.
• Environmental Impact	Favor selection of alternatives and sites to minimize adverse environmental impacts.
• Regulatory Compliance	Comply with all applicable regulatory requirements and commitments.
• Cost	Favor alternatives that would minimize cost.
• Technology Development	Provide for development of appropriate technologies for efficient waste management.
• Transportation	Balance the number of shipments with potential environmental risks, safety consequences, public concerns, mission needs, and costs.
• Implementation Flexibility	Maximize flexibility to implement and coordinate site activities that reduce overall risk through prioritized management strategies.
• Regulatory Risk	Consider the potential for more stringent future statutes and regulations when evaluating alternatives and siting options.

Alternatives

In this PEIS, an alternative is the configuration of sites for treating, storing, or disposing of a specific waste type. The alternatives analyzed in this PEIS for each waste type fall within four broad categories: the no action alternative, and decentralized, regionalized, and centralized alternatives.

2.1 *Four Categories of Alternatives*

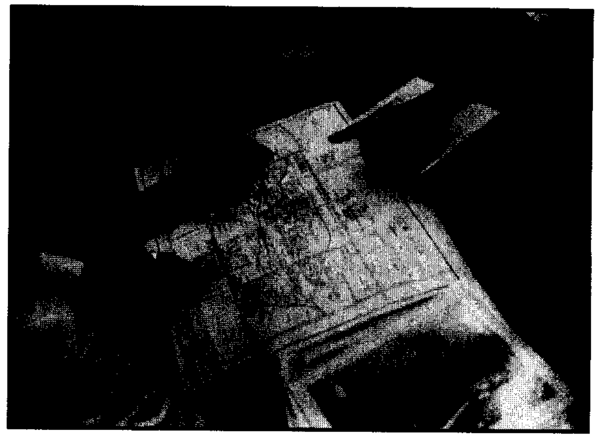
No action alternative: Selection of this alternative would involve using only currently existing or planned waste management facilities at DOE sites. According to NEPA regulations, a no action alternative, or "status quo" alternative may not necessarily comply with applicable laws and regulations, but it provides an environmental baseline against which the impacts of other alternatives can be compared.

Decentralized alternatives: Selection of these alternatives would result in managing waste where it is or where it will be generated, treated, or disposed of in the future. Unlike the no action alternative, the decentralized alternatives may require the siting, construction, and operation of new facilities or the modification of existing facilities. Under the decentralized alternatives, the waste management facilities would be located at a larger number of sites than under the regionalized or centralized alternatives.

Regionalized alternatives: Selection of these alternatives would result in transporting wastes to various numbers of sites (fewer than the number of sites considered for the decentralized alternatives but greater than the number of sites considered for the centralized alternatives). In general, those sites that now have the largest volumes of a given waste type were considered as regional sites for treatment, storage, or disposal. More than one regionalized alternative is considered for all waste types.

Centralized alternatives: Selection of these alternatives would result in transporting wastes to one or two sites for treatment, storage, or disposal. As with the regionalized alternatives, those sites that have the largest volumes of a given waste type were generally considered as sites for centralized treatment, storage, or disposal.

Planning for cleanup at the Hanford Site.



NEPA Regulations

The Council on Environmental Quality (CEQ) regulations implementing NEPA require Federal agencies to include a discussion of all reasonable alternatives to the proposed action in an environmental impact statement. An agency must provide sufficient information for each alternative so that reviewers may evaluate the comparative merits of those alternatives.

For alternatives that were eliminated from detailed study, the agency must briefly discuss the reasons for their elimination. Further, the agency must identify its preferred alternative or alternatives, if one exists, in the draft EIS, and must identify the preferred alternative in the final EIS unless another law prohibits the expression of such a preference.

These four broad categories of alternatives encompass the range of reasonable alternatives available to DOE for siting of facilities for the management of the five waste types that are considered in this PEIS. However, under each category of alternatives, there are many possible combinations for the number and location of DOE sites for treatment, storage, and disposal facilities. To narrow these combinations to a level where meaningful analysis could occur, DOE selected representative alternatives for analysis under each category. Table 2.1–1 presents the number of alternatives analyzed for each of the waste types considered in the WM PEIS.

Table 2.1–1. Number of Alternatives Analyzed by Waste Type

Alternatives	LLMW	LLW	TRUW	HLW*	HW	TOTAL
No Action	1	1	1	1	1	5
Decentralized	1	1	1	1	1	5
Regionalized	4	7	3	2	2	18
Centralized	1	5	1	1	0	8
TOTAL	7	14	6	5	4	36

* HLW alternatives are analyzed both in terms of final disposal beginning in 2015 and final disposal beginning at some later date. However, the decision of when HLW disposal will begin is not part of the WM PEIS. A separate NEPA document will be prepared in accordance with the HLW candidate program.

2.2 Developing the WM PEIS Alternatives

In order to determine reasonable proposed sites for waste management facilities, DOE determined where the largest waste volumes are located and where transportation requirements would be minimized. Treatment, storage, or disposal facilities were analyzed at those sites.

In addition, other criteria were used to select sites. The characteristics of the waste, specialized treatment requirements, and existing facilities were also taken into consideration. For example, some wastes that require special treatment were analyzed separately, and treatment sites were selected for analysis based on the volumes requiring special treatment rather than on total volumes.

In some cases, treatment facilities could be used for more than one waste type. Therefore, some sites were evaluated as candidate sites even where the volume of a particular waste type was not among the largest.

2.3 WM PEIS Preferred Alternatives

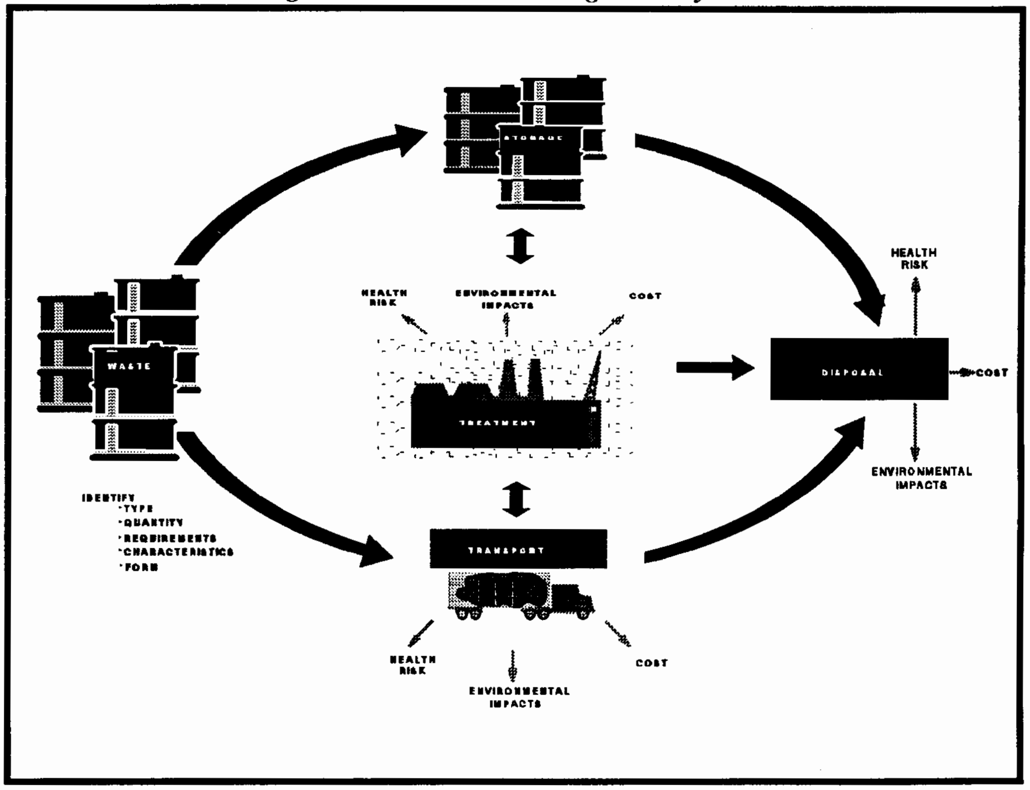
DOE has identified preferred alternatives for management of three of the five waste types.

- The No Action (status quo) Alternative is preferred for treatment of non-wastewater hazardous wastes, which continues use of commercial facilities. Treatment of hazardous wastewater would continue at DOE sites.
- DOE prefers to continue to store HLW on-site at the Hanford Site, INEL and SRS pending disposal in a geologic repository. This arrangement can be accommodated under the No Action, Decentralized, or Regionalized Alternatives. DOE does not yet have a preference on where to store WVDP HLW pending disposal in a geologic repository.
- The Regionalized Alternatives are preferred for LLMW treatment because they most closely approximate DOE's proposed site treatment plans. However, negotiations are underway with regulatory authorities regarding the proposed plans, and DOE's preference for LLMW treatment may be affected by these negotiations.

Analysis

To evaluate the potential environmental impacts of the alternatives, DOE first identified the type, characteristics, quantity, and special requirements (e.g., handling requirements) of each waste type. To frame the analysis within reasonable bounds and to make the analytical process more manageable, DOE developed and applied specific assumptions. DOE then determined the health risks, environmental impacts, and costs of waste management treatment, transport, storage, and disposal as applicable for each waste type. Figure 3.1–1 graphically depicts this framework.

Figure 3.1–1. Waste Management System



3.1 The WM PEIS Analytical Process

The treatment, storage, or disposal impacts for the five waste types were evaluated using an analytical process consisting of three phases, as shown in Figure 3.1–2, (page 18) for each of the alternatives under the four categories of alternatives. This three-phase approach was applied as applicable for each of the waste types, in the analysis of treatment, transportation, storage, and disposal activities.

In Phase I, Design, DOE made assumptions related to the volume of each waste type currently in inventory and anticipated from future operations of DOE facilities, and to the physical (gaseous, liquid, solid), chemical, and radiological characteristics of the waste. The different waste streams for each waste type were then combined into treatability groups for purposes of developing treatment system designs. Each treatability group was identified with one of the five waste types considered in the WM PEIS and with a treatment method, where appropriate, that EPA recognizes as meeting RCRA requirements.

Initially the waste types were grouped into six physical categories using common engineering criteria. DOE then used standard radiological profiles for each site and made assumptions about the concentrations of contaminants in each treatability group based on available data. Hazardous constituents were apportioned to the treatability groups on the basis of the most prevalent hazardous chemicals using an average composition for all DOE sites. The assumptions for both radioactive and hazardous constituents vary by waste type.

To develop conceptual facilities for the analysis, DOE considered all types of waste management facilities needed to process and transport each waste type and also examined the various technologies available for managing the specific waste type.

The generic waste management facilities were placed at selected locations on a DOE site—an existing waste management location or the geographic center of the DOE site—so that actual environmental data could be utilized in the analysis (e.g., data regarding distance to receptors and prevailing winds). The use of a specific location facilitated the computerized analysis of impacts using actual environmental settings for that site, and placement of facilities at sites was done only for analysis purposes. Decisions regarding the actual location of waste management facilities at particular DOE sites will not be made on the basis of this PEIS, but rather will be the subject of site-specific NEPA documents.

In Phase II, Output, the engineering features of the conceptual facility and the waste volumes "processed" through the facility formed the basis for the estimates of resources required, effluents released, and cost. In Phase III, Environmental Impact Evaluation, the releases, resources, and costs became the input for evaluating environmental impacts, socioeconomic impacts, and human health risks.

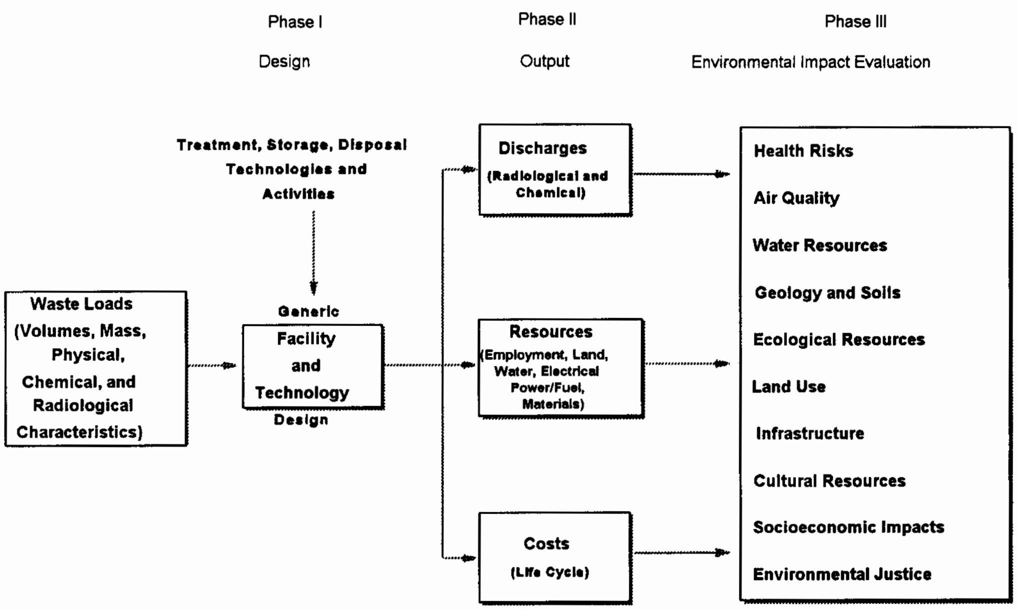
To conduct the analysis, DOE had to define the the "affected environment." In accordance with NEPA regulations, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." DOE characterized the affected environment to establish the baseline conditions at each of the major sites before the implementation of the WM PEIS alternatives. The baseline can then be compared with the level of impacts directly related to implementing a given alternative. Because of the national scope of this PEIS, DOE examined not only specific site characteristics, but defined broad regions of influence surrounding the sites as well as the interconnecting roadway and rail corridors among sites. The remainder of this section highlights the analysis performed for each of the impact areas considered in the WM PEIS.

Waste Treatability Groups

- ***Aqueous liquids****—Primarily water with organic content less than 1% (such as wastewater)*
- ***Organic liquids****—Liquids and slurries with organic content greater than 1% (such as solvents)*
- ***Organic and inorganic sludge and particulates****—Solid and semi-solid material other than debris (such as sludge from treatment plants, resins, and solids less than 2.5-inch diameter particle size)*
- ***Soils****—Contaminated soils (such as contaminated earth requiring remediation)*
- ***Debris****—Solid material exceeding 2.5-inch diameter particle size that is either (1) manufactured, (2) plant or animal matter, or (3) discarded natural or geological material (such as cobblestones)*
- ***Other****—Special waste streams (such as batteries, laboratory packs, reactive metals, and toxic metals, which include mercury, lead and beryllium)*

Four waste types used this basic framework analysis: LLMW, LLW, TRUW, and HW. For purposes of the WM PEIS analysis, HLW, also in the above treatability groups, is assumed to have been treated (vitrified). The WM PEIS only addresses the environmental consequences of storing and transporting vitrified HLW.

Figure 3.1–2. WM PEIS Analytical Process



3.2 *Impact Area Analyses*

Eleven impact areas were evaluated in the WM PEIS. They include Human Health Risks, Air Quality, Water Resources, Ecological, Economic, Social, Environmental Justice, Land Use, Infrastructure, Cultural Resources, and Cost.

Impact Areas Evaluated in the WM PEIS

Human Health Risks

Air Quality

Water Resources

Ecological

Economic

Population

Environmental Justice

Land Use

Infrastructure

Cultural Resources

Costs

3.2.1 Human Health Risks Analysis

Health risk impacts can result from exposure to radiation and chemicals and from physical trauma associated with constructing and operating treatment and disposal facilities or transporting waste. The WM PEIS evaluates risks associated with physical hazards over a 20-year period, whereas exposure risks were evaluated for a 70-year period because the health impacts could occur at any point over a lifetime.

For routine operations involving treatment, health effects were evaluated for the offsite population, the onsite worker population not involved in treatment, and waste management workers directly involved in treatment activities. Impacts were quantified using two approaches: analysis of *population* health risk impacts and analysis of *individual* health risk impacts. Population impacts focus on the *total number* of people in each population who would experience adverse health impacts if a particular alternative is implemented. These impacts include fatalities from physical hazards, cancer fatalities, cancer incidences, and genetic effects.

Individual impacts focus on the *probability* that the "maximally exposed individual" (MEI) within each receptor population would experience an adverse health impact. These impacts include the probability of a cancer fatality, the probability of cancer incidence, and the probability of genetic effects. Because the

Maximally Exposed Individual

In keeping with standard risk assessment methodology, DOE analyzed the impacts to a "maximally exposed individual." The MEI is the hypothetical person within the receptor group who has the highest exposure. This individual is assumed to be located at the point of maximum concentration of contaminants 24 hours a day, 7 days a week, for the 10-year period of treatment operations analyzed in the WM PEIS.

focus is on the MEI, the risk is presented as a probability (e.g., one-in-one million chance) of that individual experiencing an adverse health impact, rather than the total number of impacts for an affected population.

Health risks resulting from disposal were evaluated for LLMW and LLW. The analysis considered risks for workers handling the treated waste, risk to the onsite "hypothetical farm family" located 300 meters from the center of the disposal facility, and risk to a hypothetical "intruder" into the disposal facility after the facility has been closed. The risks to the hypothetical farm family were estimated over a 10,000-year period because the maximum exposure would occur in the future assuming leakage into groundwater from the disposal unit. Both population impacts (total number of people affected) and individual health risks (probability that the MEI would be affected) were quantified.

In addition to risks from construction and routine facility operations, health impacts from potential treatment and storage facility accidents were also evaluated. Information in safety analysis reports and DOE site EIS's were used as valid indicators of the predicted consequences for a range of waste storage facility accidents of varying frequency. For LLMW, LLW, TRUW, and HW treatment, the accident analysis focused on incineration Since significant incineration data are available, public interest is heightened, and accidents were considered representative and bounding of other treatment processes. For HLW, the accident analysis focused on the likelihood of dropping a HLW canister.

Transporting the wastes for treatment, storage, and disposal may affect the health of the truck or rail crew and the public along the transportation route. Impacts evaluated included radiation exposure during normal operations, accidents in which the waste containers are assumed to be opened, exposure to vehicle exhaust during transport, and physical injury from vehicle accidents.

Hypothetical Farm Family and Intruder

The "hypothetical farm family" is an imaginary family assumed to live 300 meters downgradient of the center of a waste disposal unit. The family engages in farming activities such as growing and consuming their own crops and livestock, and uses groundwater for watering the crops and animals. This is a worst-case scenario taking place in the future at a time when institutional controls no longer exist. The scenario is analyzed to determine potential upper-bound exposures by ingestion of contaminated groundwater.

The hypothetical "intruder" is an imaginary adult who drills a well directly through a disposal unit to the groundwater. As a result of the drilling, contaminated soil from within the unit is brought to the surface, where it mixes with the top layers of the surface soil. The individual farms the land and eats the crops. The intruder scenario occurs after the failure of institutional control. This is consistent with the analysis required for disposal facilities under DOE Order 5820.2A.

3.2.2 Air Quality Impacts Analysis

DOE evaluated air quality impacts at each proposed treatment, storage, and disposal site based on estimated increases in emissions of the six criteria air pollutants, hazardous air pollutants (which include radionuclides), and toxic air pollutants when applicable. Pollutant emission estimates were made for the construction, and operations and maintenance (O&M) activities of the waste facilities.

Criteria air pollutants can be emitted from construction equipment or from vehicles that workers use to drive to waste management facility construction sites. Both are considered to be "mobile" sources and thus subject to certain regulations. Criteria air pollutants are also emitted during O&M of LLMW, LLW, and TRUW facilities (stationary sources) and by vehicles that are driven by workers to the waste management facility or used to transport waste (mobile sources). DOE evaluated air quality impacts for these pollutants at each site by comparing estimated releases caused by the waste-type alternatives to the allowable emission limits.

For all wastes except HW, DOE also evaluated impacts from radionuclide emissions by comparing the dose to the offsite MEI to the 10 mrem per year standard under the National Emission Standards for Hazardous Air Pollutants. Concentrations of hazardous or toxic air pollutants were compared to Federal, State, or local air quality standards.

> ***Major Types of Air Pollutants***
>
> ***Criteria Air Pollutants**: carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxoide (NO_2), lead (Pb), ozone (O_3), and particulate matter less than or equal to 10 microns in diameter (PM_{10})*
>
> ***Hazardous Air Pollutants:** 189 hazardous substances (including radionuclides) whose emissions are regulated by the Clean Air Act*
>
> ***Toxic Air Pollutants**: Other toxic compounds regulated by EPA and state or local governments*

3.2.3 WATER RESOURCES IMPACTS ANALYSIS

DOE analyzed the impacts to onsite water resources for treatment, storage, and disposal activities. DOE evaluated the effects on water availability from constructing and operating waste management facilities. Increases of greater than 1% over the current water use were identified and the impacts analyzed.

DOE also evaluated the impacts to groundwater quality caused by the migration of radionuclides and chemicals that leach from disposal facilities over time. DOE calculated concentrations of radionuclides and hazardous components at a hypothetical well located 300 meters from the center of the disposal facility, and compared these to drinking water standards.

3.2.4 ECOLOGICAL IMPACTS ANALYSIS

DOE analyzed the effects of construction site clearing to build waste treatment, storage, and disposal facilities, and the O&M of waste management facilities on ecological resources at representative sites. DOE also considered the effects of accidental spills of waste during transportation. Sites where the proposed construction activities would disturb more than 1% of the available WM area were identified.

Although DOE intends to use the WM PEIS as a tool to help select sites for waste management activities, the agency will not select the specific location for a waste management facility at a site based on this PEIS. Specific locations will be selected on the basis of subsequent site-wide or project-specific NEPA documents. Potential impacts to sensitive species or habitats at particular locations within a site will be analyzed at that time.

3.2.5 ECONOMIC AND POPULATION IMPACTS ANALYSIS

DOE estimated the effects of expenditures for waste management activities on the local and national economies. Local economic effects were based on direct expenditures at each site for construction, O&M, and decontamination of waste management facilities. The region-of-influence (ROI), where local effects were evaluated, consists essentially of the counties of residence of site employees. The local economy at each site was represented by employment, personal income, and industry data for the ROI counties. Local increases in jobs and personal income were considered to be substantial benefits where the increases were 1% or greater above the 1990 baseline. Transportation expenditures were considered at the national level only.

The analysis also examined the potential for the WM alternatives to cause the types of social impacts that could result when any large industrial or public works project attracts workers and their families to an area. Potential population changes in the ROI were estimated using the direct labor requirement to calculate potential worker migration into the region.

3.2.6 Environmental Justice Analysis

Federal agencies have been directed by executive order to incorporate environmental justice as part of their missions. As such, Federal agencies are specifically directed to identify and address as appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

To perform this assessment for the WM PEIS, DOE first identified and mapped the distribution of minority and low-income populations at the 17 major sites. DOE then reviewed the human health effects and environmental impacts associated with alternatives for the five waste types. A minority population was defined as any census tract within a 50-mile zone of impact where minority individuals comprise 50% or more of the population. A low-income population was defined as a census tract with a median income to a family of four equal to or below the national poverty level of $12,674. Census tracts were included in the analysis if 50% of the area of the tract fell within the 50-mile radius. Native American Tribal lands within 50 miles of each site were also identified and mapped. The analysis focused on risks to the most-exposed individual (MEI) members of the offsite population at the sites, and other environmental impacts, such as air quality impacts, that are likely to directly affect offsite populations. If environmental impacts in general were low, then only in the instance of a specific impact being high at a particular site would there be a potential for disproportionately high and adverse impacts to minority or low-income groups. Where risks or environmental impacts were found to be significant at a particular site, mitigation measures are described that could minimize impacts.

3.2.7 Land Use Analysis

DOE examined the impacts on land use of the alternatives for each waste type by comparing the acreage required for new waste management facilities to the acreage either designated for waste operations or suitable for development. Suitable land is the total site acreage, minus the acreage required for known cultural resource areas, sensitive habitats (including wetlands and wildlife management areas), prohibitive topographic (surface) features, and surface waters. Where the acreage comparison showed a 1% (of the site) or greater land requirement for new facilities, further evaluation of impacts was conducted. Available site development plans were also used to identify potential conflicts among the proposed facilities required under each alternative and plans for future site uses.

Hillside 881, Rocky Flats, Colorado.

3.2.8 Infrastructure Impacts Analysis

DOE evaluated the impacts on site infrastructure by comparing requirements for water, wastewater treatment, and electrical power resulting from the implementation of the WM PEIS alternatives to existing onsite capacities. Offsite infrastructure impacts were evaluated using estimates of increased population from the proposed activities as an indicator of increased demand on the community infrastructure. The presentation of infrastructure impacts indicates where an increase of 5% or greater causes total demand to exceed 90% of capacity and where total demand remains below 90% of capacity, as an indicator of the significance of the increase in demand.

3.2.9 Cultural Resources Impacts Analysis

Cultural resources, including prehistoric, historic, Native American, and paleontological resources, may be affected at sites where waste management facilities are proposed to be built. However, the impacts of the construction of waste management facilities on cultural resources cannot be effectively analyzed at the programmatic level because the extent of those impacts depends upon their specific location at a site. These impacts will be examined in site-wide or project-specific NEPA documents.

3.2.10 Costs

DOE estimated costs for building and operating waste management facilities, and for transportation. DOE evaluated costs associated with waste management from both a life-cycle and process perspective, using 1994 dollars.

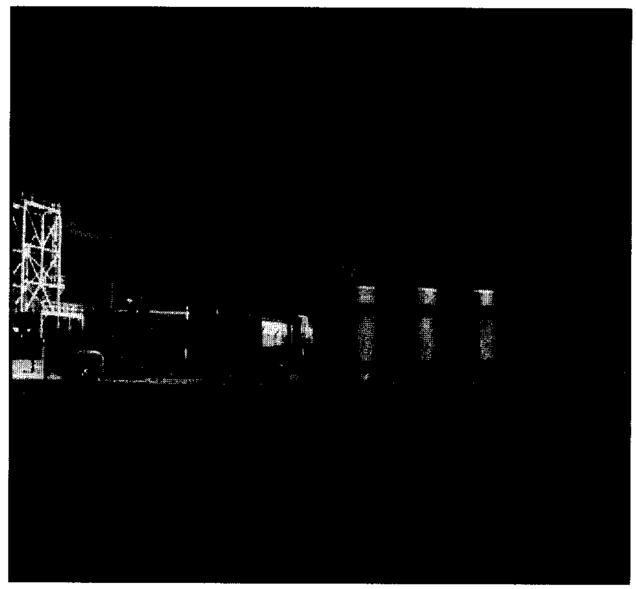
For life-cycle costs, DOE evaluated facility costs for four phases representing the life-cycle of the facilities and their operations over a 20-year period: pre-operations, construction, O&M, and decontamination and decommissioning. The only exception to this was HLW, which was costed using a two-phased life-cycle approach (construction and O&M) of the storage facilities.

Examples of life-cycle costs include:

- Costs for pre-operation activities: technology and site adaptation, statutory and regulatory permitting, plant setup, and related conceptual design
- Facility construction costs: building construction, equipment purchase and installation, construction and project management
- Operations and maintenance costs: annual operations costs for labor and materials, equipment, utilities, and overhead
- Decontamination and decommissioning costs: facility decontamination and demolition, environmental closure, post-closure, and monitoring activities

For process costs, DOE also analyzed costs based on treatment, storage, and disposal activities. Treatment costs include costs to build and operate treatment facilities and common support facilities. For most waste types, current storage capacity is assumed to be sufficient, except for the no action alternative where DOE estimated the costs to build and operate sufficient storage capacity. Disposal costs include costs to build and operate front-end administration and receiving facilities for disposal, as well as the actual disposal units.

Transportation costs include the costs associated with the physical movement of the waste among sites. Transportation costs were evaluated for both truck transportation and rail shipments.



TRUPACT-II demonstration containers show how transuranic wastes will be shipped.

Low-Level Mixed Waste

- *LLMW contains both radioactive and hazardous components.*
- *LLMW is generated, projected to be generated, or stored, at 37 DOE sites as a result of research, development, production, and testing of nuclear weapons.*
- *Waste management activities will require management of an estimated 226,000 cubic meters of LLMW over the next 20 years*
- *DOE must select treatment and disposal sites for LLMW.*

4.1 Low-Level Mixed Waste Analysis

The challenge in managing LLMW arises from its dual nature—it contains RCRA-classified hazardous components (or characteristics) and is radioactive. Due to the complex regulatory requirements governing the management of LLMW, DOE must define a waste management system focused on treating and disposing LLMW and minimizing the amount in storage.

LLMW is generated, projected to be generated, or stored at 37 DOE sites. According to DOE estimates, 226,000 cubic meters of LLMW will need to be managed over the next 20 years. Figure 4.1–1 (pages 26-27) presents the estimated total volume of LLMW from waste management activities at each of the 37 sites and illustrates its distribution across the country at the 16 major LLMW sites analyzed in the WM PEIS. WIPP, the 17th major DOE site, will manage only TRUW.

In addition to analyzing the impacts from treatment and disposal, DOE analyzed the transportation impacts associated with each alternative. Both truck and rail transportation were analyzed using routine models following the general principle of minimizing transportation time and shipping distance. Transportation routes were selected to be consistent with DOE's current routing practices and all applicable Department of Transportation routing regulations.

4.2 Low-Level Mixed Waste Alternatives

DOE analyzed seven alternatives for CH LLMW within the four categories of alternatives: no action, decentralized, regionalized, and centralized. Treatment and disposal activities vary by alternative and by site. Table 4.2–1 illustrates by site where LLMW would be treated and disposed of under each alternative.

The LLMW analysis considered treatment and disposal separately, first focusing on treatment and then using treatment residues (waste remaining after treatment) as the input volumes for the disposal analysis. Each alternative was developed in order to assess environmental impacts, human health risks, and costs associated with the range of LLMW treatment and disposal options, and to provide input for programmatic decisions about where to locate LLMW treatment and disposal facilities.

Although alpha LLMW is not a concern to workers or the public as a source of external radiation, precautions are taken when treating alpha LLMW in order to minimize the likelihood of inhalation or ingestion of alpha particles. Alpha LLMW exists at 10 sites. Sites where alpha LLMW are treated or disposed of are indicated in Table 4.2–1 by the alpha symbol (∝).

Remote-handled waste requires special handling facilities for treatment and disposal. Under all alternatives, RH LLMW is treated and disposed of at the same four sites where the majority of RH LLMW is located: the Hanford Site, INEL, ORR, and SRS.

Table 4.2–1. Low-Level Mixed Waste Alternatives

Alternatives	Number of Sites		ANL-E	BNL	FEMP	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP
	T	D																
No Action	3	0	S	S	S	S	TS	S	S	S	TS	S	S	S	S	S	TS	S
Decentralized	37	16	TD	TD	TD	TD	TD∝	TD∝	TD∝	D∝	TD	TD	TD	TD	TD∝	TD	TD∝	TD
Regionalized 1	11	12			TD	TD	TD∝	TD∝	TD∝	D∝	TD	TD	TD	TD	TD∝		TD∝	
Regionalized 2	7	6				TD	TD∝	TD∝		D∝	TD			T	T∝		TD∝	
Regionalized 3	7	1				T	T∝			D∝	T			T	T∝		T∝	
Regionalized 4	4	6				TD	TD∝	D∝		D∝	TD						TD∝	
Centralized	1	1				TD∝												

T = Treatment to meet land disposal restrictions.
D = Disposal.
S = Indefinite Storage.
All Sites have wastewater treatment capability as needed.

Remote-handled (RH) wastes would be treated and disposed onsite at the Hanford Site, INEL, ORR, and SRS in all alternatives except No Action. RH waste is stored under No Action. Facilities with the α symbol treat or dispose of contact-handled (CH) alpha and non-alpha waste.
Treatment and disposal facilities identified for one site with the α symbol can manage both alpha and non-alpha waste.

Facilities with the ∝ symbol treat or dispose of CH alpha and nonalpha waste.
Treatment and disposal facilities identified for a site with the ∝ symbol can manage both alpha and non-alpha waste.

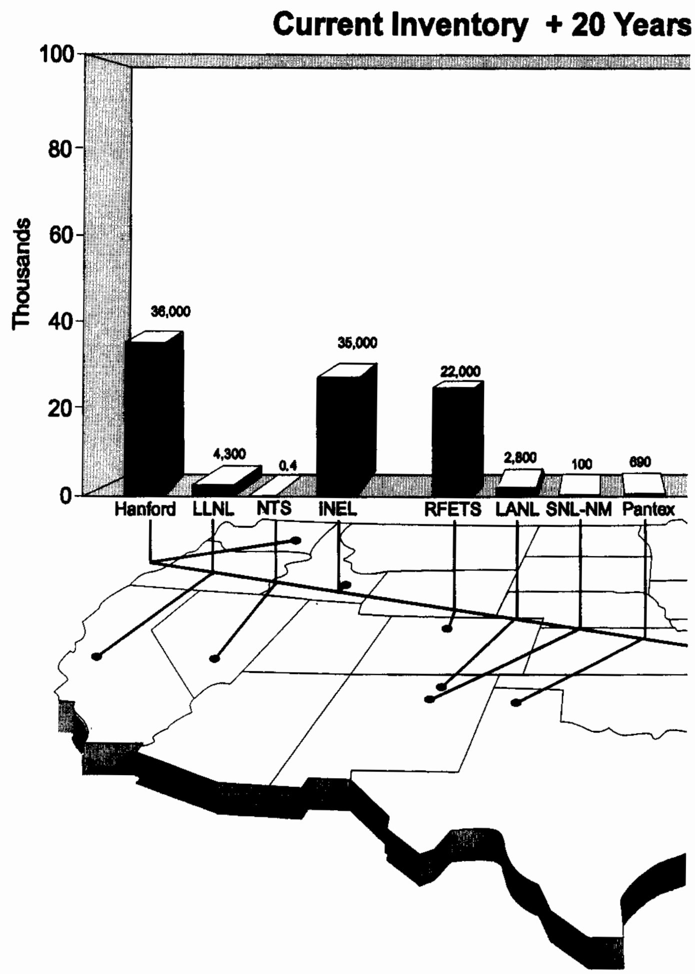
Low-Level Mixed Waste

*LLMW Volumes**

DOE Sites	Total Volumes (m^3)
1. Ames	0.4
2.ANL-E	8,400
3. Battelle	0.1
4. Bettis	48
5. BNL	190
6. Charleston	3
7. ETEC	4
8. FEMP	2,600
9. GA	42
10. GJPO	1.5
11. Hanford	36,000
12. INEL	35,000
13. KCP	0.8
14. KAPL	290
15. LEHR	7
16. LBL	280
17. LLNL	4,300
18. LANL	2,800
19. Mare Is	52

*Estimated LLMW volumes include current inventory plus 20-year projected volume. Waste volumes, used for WM PEIS analysis, are based on 1994 data and may vary from latest site estimates. (Current ANL-E and BNL projections reduce their waste to 140 m^3 and 40 m^3 respectively.)

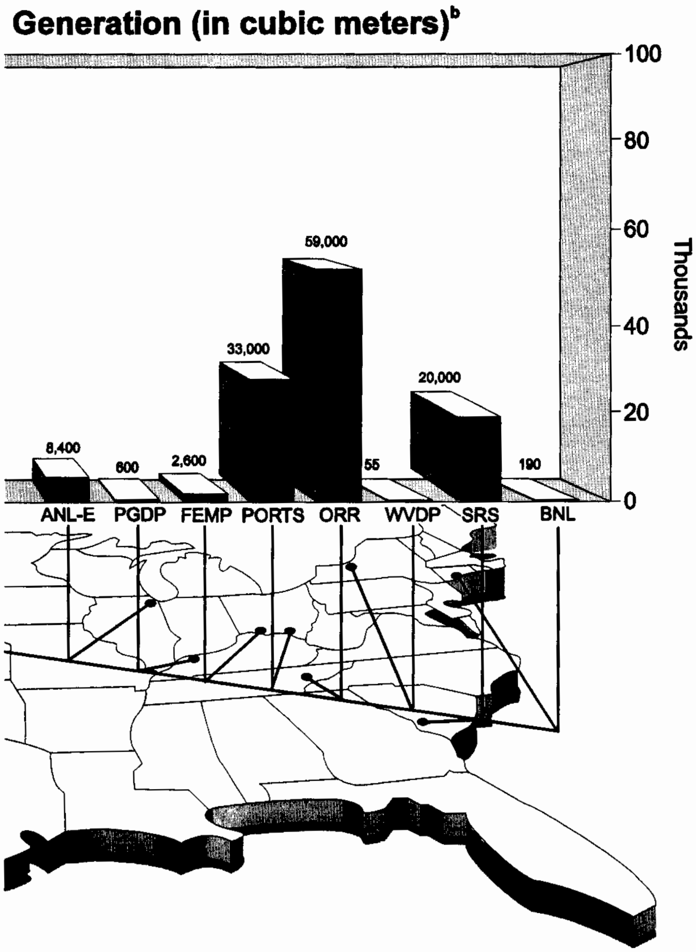
Figure 4.1–1 LLMW Total



[a] WIPP, the seventeenth major DOE site will manage only TRUW.

[b] Approximately 1,100 m^3 of LLMW exists at other sites within the complex. Hanford's total volume excludes 114 600 m^3 of wastewater to be generated and managed under the HLW program. ORR's total volume excludes 16,000 m^3 of pond sludge shipped to commercial disposal.

Volumes at the 16 Major Sites[a]



LLMW Volumes (Continued)*

DOE Sites	Total Volume (m^3)
20. Mound	80
21. NTS	0.4
22. Norfolk NS	6
23. ORNL	59,000
24. PGDP	600
25. Pantex	690
26. Pearl H	6
27. Pinellas	.02
28. PORTS	33,000
29. Portsmouth Nav	1
30. PPPL	.01
31. Puget So	230
32. RMI	30
33. RFETS	22,000
34. SNL-NM	100
35. SRS	20,000
36. Uof Mo	2
37. WVDP	55
TOTAL	**226,000**

*Estimated LLMW volumes include current inventory plus 20-year projected volume. Waste volumes, used for WM PEIS analysis, are based on 1994 data and may vary from latest site estimates.

Low-Level Mixed Waste

4.2.1 No Action Alternative

LLMW sampling at ORR.

The No Action Alternative provides a baseline for the analysis by considering treatment of LLMW at facilities that are currently capable of treating waste to U.S. EPA's hazardous waste land disposal restrictions (LDRs). The No Action alternative also analyzes the indefinite storage of the waste onsite at all LLMW sites. Three sites are currently capable of treating to meet LDRs: INEL, ORR, and SRS. Other sites may experience impacts from the construction of expanded storage, onsite shipping, or certification facilities (where the waste would be examined, characterized, and certified for shipment).

Under this alternative, no new treatment facilities would be built. The No Action Alternative would not comply with RCRA because all the waste would not be treated to meet LDRs and would be placed in storage for an indefinite period of time rather than in disposal facilities.

4.2.2 Decentralized Alternative

The Decentralized Alternative considers treatment of waste to meet RCRA requirements at all 37 LLMW sites. For purposes of analysis, DOE examined the impacts from treatment at the 16 major LLMW sites. Two of the 16 sites examined (BNL and SNL-NM) have relatively small amounts of LLMW (less than 200 m^3). The remaining 21 LLMW sites all have less than 200 m^3 of LLMW, therefore DOE estimated their health and environmental impacts based on BNL and SNL-NM. However, costs were calculated using data from all 37 sites.

4.2.3 Regionalized Alternatives

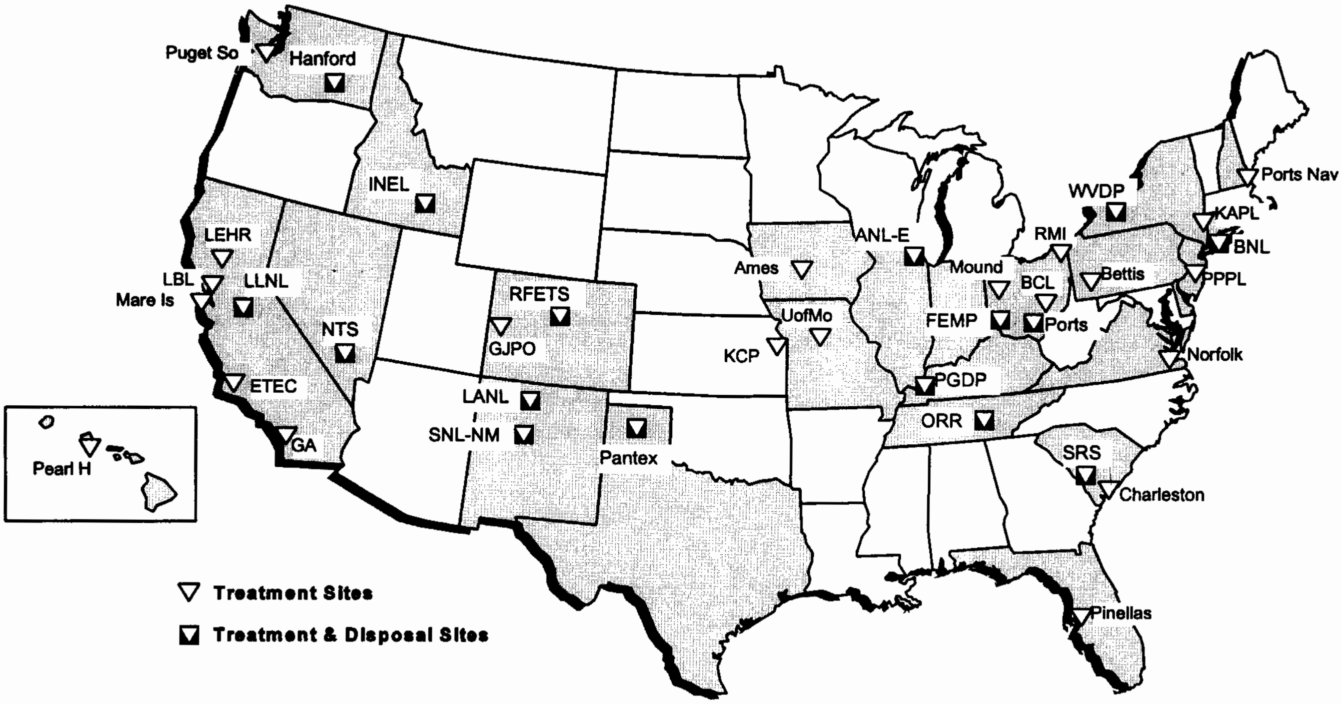
Consolidation of LLMW for treatment and disposal was considered under the four LLMW regionalized alternatives. The regionalized alternatives were developed to bound a reasonable range of intermediate variations for treatment and disposal.

Regionalized Alternative 1 considers treatment at 11 sites and disposal at 12 (those same 11 sites plus NTS). Regionalized Alternative 2 analyzes the impacts of treatment at seven sites with disposal at six sites. Under this alternative, two of the treatment sites (RFETS and Portsmouth) are not considered for disposal, but NTS is added for disposal only. Regionalized Alternative 3 analyzes the same seven treatment sites as Regionalized Alternative 2, but considers disposal only at NTS. Regionalized Alternative 4 considers treatment and disposal at four sites—the Hanford Site, INEL, ORR, and SRS, and disposal at six sites (the four treatment sites plus LANL and NTS).

4.2.4 Centralized Alternative

The Centralized Alternative considers LLMW treatment and disposal at a single site within the complex, the Hanford Site. However, other sites around the country may experience impacts from the construction of facilities where the waste would be examined, characterized, certified, and prepared for shipment. The impacts of centralizing disposal at NTS were also analyzed under Regionalized Alternative 3.

Figure 4.2–2. Location of the 37 LLMW Sites



Note: Maps display CH LLMW. RH LLMW is treated and disposed of onsite at the Hanford site, INEL, ORR, and SRS.

4.2.5 Rationale for Selecting Treatment and Disposal Sites

The seven LLMW treatment alternatives were developed to cover the range of reasonable alternatives. One to 37 sites as illustrated in Figure 4.2–2 are available for treatment (the centralized and decentralized alternatives respectively). DOE selected four intermediate alternatives treating LLMW at 4 to 11 sites (the regionalized alternatives). To select the variations of the regionalized alternatives, DOE focused on the sites where the largest volumes of LLMW are located. Alpha and RH LLMW would be sent to the closest facility capable of treating those wastes. For all alternatives, DOE assumed that some treatment capabilities could be available at every site for initial treatment of onsite aqueous liquids using treatment techniques such as evaporation, neutralization, precipitation, filtration, coagulation, or limited solidification.

The regionalized alternatives consider the impacts of treatment to meet LDRs at selected waste consolidation sites. Regionalized Alternative 1 considers treatment at 11 sites. This alternative was developed by identifying the location of most of the DOE LLMW and looking for logical site groupings. Eleven sites have 20-year projected quantities of LLMW that exceed 1,000 cubic meters.

Under Regionalized Alternative 2, seven sites are considered as potential treatment locations. DOE chose the six sites with the highest waste volumes, and added LANL. Due to an analysis of the concentration of radionuclides in a large volume of TRUW and subsequent reclassification as alpha LLMW, the volume of LLMW at LANL could be significantly increased.

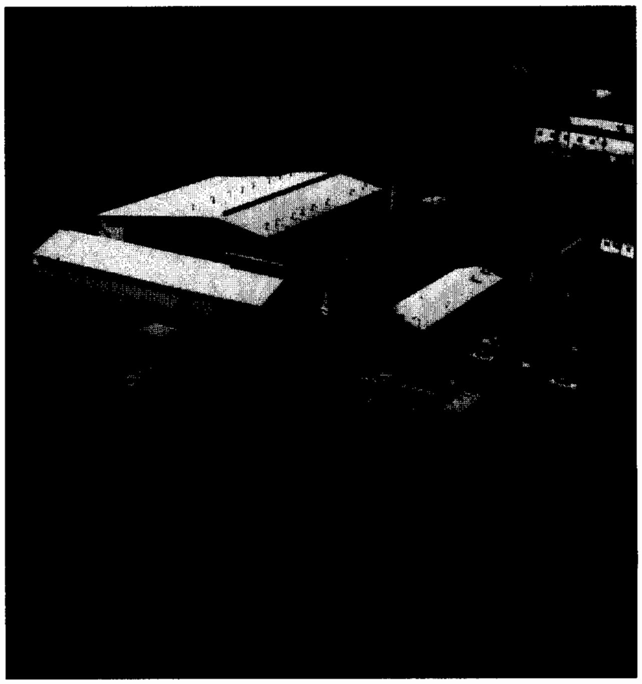
Regionalized Alternative 3 consists of the sites with the three highest volumes (the Hanford Site, INEL, and ORR), as well as SRS, which is the sixth largest in terms of volume. SRS was chosen because of its high volumes of alpha LLMW and TRUW, some of which eventually may be reclassified as LLMW. In addition, SRS has under construction an incinerator with an annual LLMW treatment capacity of 8,200 cubic meters.

In the Centralized Alternative, all LLMW would be shipped to the Hanford Site for treatment. The Hanford Site currently has the second largest volume of LLMW. However, as the Hanford Site HLW is treated substantial portion of the resulting waste will be managed as LLMW, thereby making the Hanford Site the largest LLMW site.

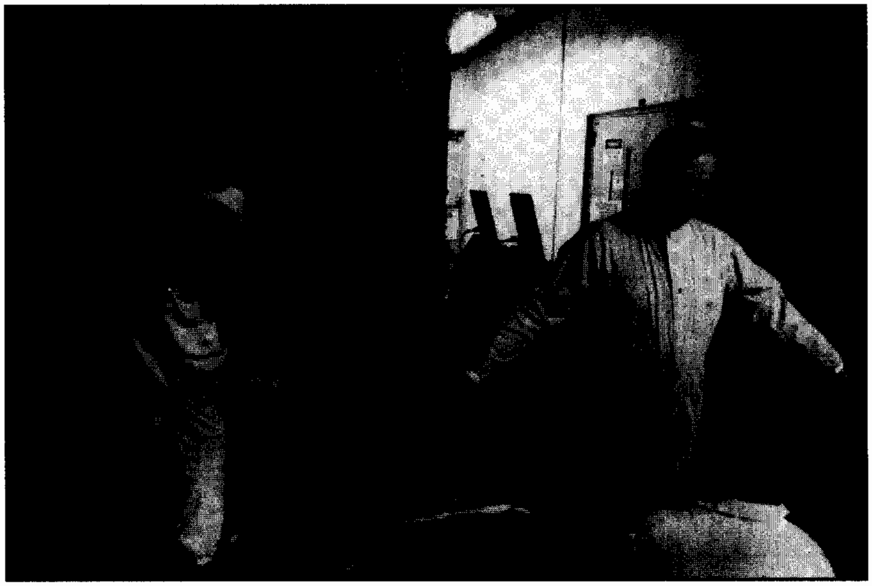
Candidate disposal sites were selected to reflect a reasonable range of alternatives. However, unlike the treatment analysis, the disposal analysis did not evaluate every site for disposal. Instead, 16 candidate sites were selected as the reasonable upper bound based on screening performed by DOE in coordination with the States under the Federal Facility Compliance Act. The screening applied three exclusionary criteria to the 37 sites: (1) sites could not be within a designated 100-year floodplain, (2) sites could not be within 200 feet of a seismic fault, and (3) sites were required to have sufficient area for a 100-meter buffer zone between the disposal structure and the site boundary. Additionally, other sites were removed with the concurrence of the States for technical and practical considerations.

Using the final 16 candidate disposal sites, the Decentralized Alternative looked at disposal at all 16 sites and the Centralized Alternative looked at disposal at one site—the Hanford Site. The Hanford Site was analyzed because it is expected to have the largest volume of LLMW.

DOE selected two intermediate alternatives, disposing at 12 and 6 sites (under the regionalized alternatives). To select these regionalized alternatives, DOE focused on the 11 sites with the largest volume of LLMW and added NTS because it has a LLMW disposal facility that has a pending permit. The next logical consolidation point for LLMW disposal was a six-site alternative, to be consistent with the six currently operating LLW disposal facilities—the Hanford Site, INEL, LANL, NTS, ORR, and SRS. NTS was considered in Regionalized Alternative 3 to provide a comparison and an alternative to the single disposal location selected under the Centralized Alternative.



TSCA Incinerator at ORR.



Radiation-safety technicians check workers at a Rocky Flats production building, now undergoing cleanup.

4.3 The Impacts of Managing LLMW

The LLMW impacts were evaluated across all the LLMW alternatives to identify trends and to compare alternatives. Although some impact areas, including cost, illustrated clear trends across the alternatives, most did not. Rather, the analysis of the impacts illustrated sensitivities at particular sites, regardless of the alternative.

The following discussion focuses on the impact areas that would be affected by the management of LLMW under the WM PEIS alternatives identifying trends when appropriate, and highlighting noteworthy findings at particular sites.

4.3.1 Human Health Risks Results

The number of worker fatalities is about three times higher than for noninvolved workers or the offsite public, primarily resulting from physical injury hazards. As the number of treatment and disposal sites decrease, facilities at the remaining sites become larger and program-wide physical injuries decrease, reflecting an economy of scale and fewer numbers of total workers. There are no notable national trends for offsite population risks from treatment; however, some sites, such as LLNL, would probably require different technologies to minimize treatment risks.

For disposal, concentrations of radionuclides and chemicals in the groundwater near disposal facilities exceed applicable standards at several sites, demonstrating the need for waste acceptance criteria. More extensive pretreatment of chemicals than assumed for the WM PEIS analysis and careful management of radionuclide concentrations and waste forms would be required to assure acceptable water quality and human health risks. Intruder risks (see text box, page 20) are generally higher at sites where the waste has both high radioactivity and long-lived radionuclides. Risks generally decrease with time, reflecting the decay of some elements. Treatment facility accident risks were low in all alternatives, with no sites experiencing cancer fatalities equal to or greater than one in the exposed worker or offsite populations over the 70 year period analyzed. Transportation risks were also low in all alternatives, reflecting relatively low vehicle miles traveled. Rail transport results in slightly less risk than truck transport. Table 4.3–1 presents selected risk results for the LLMW alternatives.

Table 4.3–1. Selected Risk Results for LLMW

Alternative	Number of Sites		Treatment Worker Physical Hazard Fatalities	Treatment Worker Cancer Fatalities	Offsite Population Cancer Fatalities	Disposal Worker Physical Hazard Fatalities	Disposal Worker Cancer Fatalities	Truck[a] Radiation Fatalities	Truck[b] Non-Radiation Fatalities
	T	D							
No Action[c]	3	-	2	1	*	NA	NA	NA	NA
Decentralized	37	16	4	1	*	*	1	*	*
Regionalized 1	11	12	4	1	*	*	1	*	*
Regionalized 2	7	6	3	1	*	*	1	*	*
Regionalized 3	7	1	3	1	*	*	*	*	1
Regionalized 4	4	6	3	1	*	*	1	*	*
Centralized	1	1	3	1	*	*	*	*	1

T = treatment. D= disposal.
* = Greater than 0 but less than 0.5.

[a] Fatalities are from radiation-induced cancer over a 70-year period.
[b] Greatest number of fatalities are from physical hazards such as traffic accidents that occur within a 20-year analysis period.
[c] Treatment results under the No Action Alternative include the impacts of sites storing LLMW.

4.3.2 Air Quality Impacts Results

The management of LLMW does not affect the air quality at most sites. However, centralization of treatment at the Hanford Site and disposal at NTS (Regionalized Alternative 3) could cause adverse air quality impacts requiring special emission control measures for criteria air pollutants. Emissions at RFETS and ANL-E could result in adverse air quality impacts if waste at these sites are treated or disposed of onsite, as proposed in the Decentralized and Regionalized 1 Alternatives. Emission of hazardous air pollutants, including radionuclides, were estimated to be below the applicable standards at every site.

4.3.3 Water Resources Impacts Results

Impacts to water availability tend to decrease as the LLMW management facilities are centralized. Major impacts to water availability from increased water use at the sites are unlikely, although there is the potential for adverse impacts at LLNL Site-300.

4.3.4 Economic and Population Impacts Results

Nationwide, the largest economic benefits resulting from LLMW management would be for the Decentralized Alternative and generally decrease as the alternatives become more centralized. The greatest benefit at any site occurs when LLMW is managed at that site. The greatest number of regional jobs due to LLMW management would occur to regions containing the Hanford Site in the Centralized Alternative and INEL in Regionalized Alternative 4. The national economy would not be affected by total project expenditures for the construction, operation, or transportation associated with any of the LLMW alternatives. No region experienced a population increase of 1% or greater.

4.3.5 INFRASTRUCTURE IMPACTS RESULTS

Although no offsite infrastructure impacts are expected to occur, proposed LLMW activities would affect the onsite infrastructure at 10 sites. Eight sites experience increased requirements for water, wastewater treatment, or electrical power of 5% or greater of current system capacity. Greatest increases are at RFETS in the Decentralized and Regionalized Alternative 1, and the Hanford Site in the Centralized Alternative, when waste is consolidated for treatment and disposal at these sites. Construction of additional storage under the No Action Alternative also impacts RFETS and INEL. However, only the wastewater requirement at the Hanford Site (under the Centralized Alternative) is estimated to exceed the existing treatment capacity. Onsite transportation infrastructure would be affected at thirteen sites because of site employment increases of 5% or more above current levels.

4.3.6 COSTS

Costs decrease as the number of treatment and disposal sites decrease, ranging from $13 billion for the Decentralized Alternative to $8 billion for the Centralized Alternative. Transportation costs are much lower than facility costs, making shipment to available facilities at another site generally less expensive than building a new facility on site. Table 4.3–2 provides the estimated cost to manage LLMW for each of the WM PEIS LLMW alternatives over the 20-year analysis period.

Table 4.3-2. LLMW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternative	Number of Sites		Total (Including Truck Transport)	Transportation Costs	
	T	D		Truck	Rail
No Action	3	0	5.2	0	0
Decentralized	37	16	12.6	.001	.0007
Regionalized 1	11	12	11.1	.004	.002
Regionalized 2	7	6	9.4	.02	.005
Regionalized 3	7	1	8.3	.06	.02
Regionalized 4	4	6	8.3	.006	.005
Centralized	1	1	7.5	.03	.01

T = treatment; D = disposal.

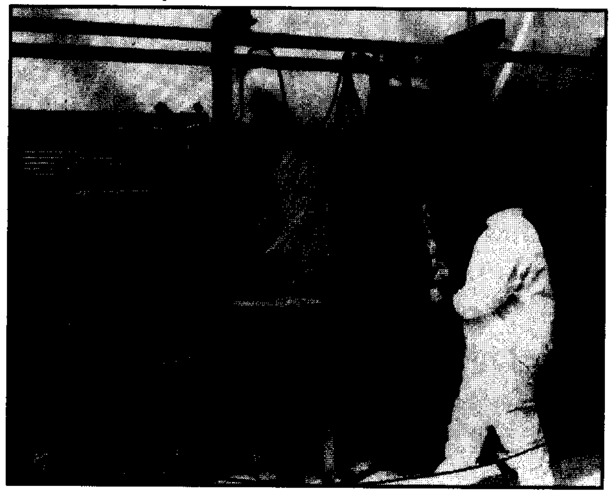
4.3.7 ECOLOGICAL RESOURCES, ENVIRONMENTAL JUSTICE, LAND USE, AND CULTURAL RESOURCES IMPACTS RESULTS

The WM PEIS analysis did not identify discriminators among the alternatives in these four impact areas nor reveal any major impacts in any alternative. However, impacts to ecological and cultural resources are dependent to some degree on specific technologies and their location at each site and would be evaluated when such site-level details are evaluated. Assessment of potential environmental justice impacts from management of LLMW indicated that minority and low-income populations at the LLMW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the LLMW alternatives. Land use is not a discriminator because the LLMW alternatives do not use much land compared to the amount available at every site.

Low-Level Waste

- *LLW is material that is not classified as High-Level Waste, Transuranic Waste, Spent Nuclear Fuel, or byproduct tailings.*
- *LLW is currently generated, projected to be generated, or stored at 27 DOE sites as a result of nuclear weapons technology production, nuclear reactor operations, environmental restoration activities, and research.*
- *DOE will need to manage an estimated 1.5 million cubic meters of LLW over the next 20 years.*
- *DOE must select treatment and disposal sites for LLW.*

Some LLW is compacted to 1/5th its size.

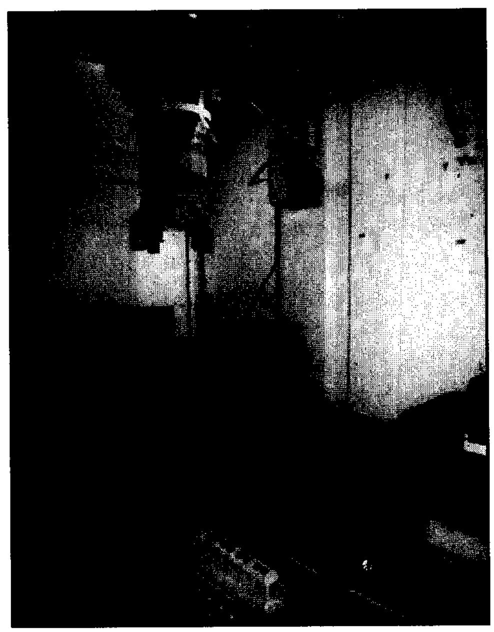


5.1 Low-Level Waste Analysis

The character of the waste is as important as waste volume in determining the potential impacts resulting from LLW management. LLW can contain many different radionuclides in many combinations and can be present in many physical forms ranging from dilute liquids to activated metal equipment.

Approximately 1.5 million cubic meters of LLW is generated, projected to be generated, or stored at 27 DOE sites. Although 27 DOE sites manage LLW, 7 sites generate more than 80%—the Hanford Site, INEL, LANL, ORR, Paducah, Portsmouth, and SRS. Figure 5.1-1 (pages 36-37) presents the total estimated LLW volumes at all 27 sites. The distribution of LLW at the 16 major sites is illustrated by the bar chart and map.

DOE also has the responsibility for two other classes of waste frequently categorized as LLW: special case waste, which is waste generated by DOE that does not fit into any typical LLW management, and commercially generated Greater-Than-Class-C (GTCC) LLW. However, because



LLW in 71 gallon, square cement filled drums to be stored in specially designed above ground vaults.

special case waste has unique site-specific considerations and the GTCC LLW program has not been fully defined, these LLW groups are excluded from the WM PEIS analysis and will be addressed in separate NEPA documents or as a supplement to the WM PEIS.

For the purposes of analysis, DOE categorized LLW by radiological and physical properties, and assigned the waste into an appropriate treatability category to calculate risk, costs, and other impacts.

DOE analyzed two treatment strategies for LLW:

- Minimum Treatment, defined as the least amount of treatment required prior to either onsite disposal or transport to another site for disposal. Minimum treatment includes solidification of liquids and fines, and packaging.
- Volume Reduction, which reduces the overall disposal volume of LLW using a variety of treatment techniques. Volume reduction uses several different available technologies, including thermal destruction, compaction/supercompaction, size reduction, and evaporation/concentration. For LLW disposal, DOE evaluated the impacts associated with both shallow land burial and engineered disposal facilities.

DOE analyzed transportation impacts associated with each alternative. Both truck and rail transportation were analyzed using routing models following the general principle of minimizing distance and transportation time. Transportation routes were selected to be consistent with DOE's current routing practices and all applicable Department of Transportation routing regulations.

5.2 Low-Level Waste Alternatives

The WM PEIS LLW analysis considers 14 alternatives for treatment and disposal facilities within the four categories of alternatives: no action, decentralized, regionalized, and centralized. Treatment and disposal activities vary by alternative and by site. Each of the 14 alternatives was developed in order to estimate the human health risks, environmental impacts, and costs associated with the range of LLW treatment and disposal options available to DOE, and to provide input for decisions about where to locate LLW treatment and disposal facilities. Table 5.2–1 (page 38) shows the sites where LLW would be treated and disposed of under each alternative.

5.2.1 No Action Alternative

The No Action Alternative provides a baseline for the analysis that approximates the current DOE program. Under the No Action Alternative, LLW would be treated using existing facilities and shipped to one of six authorized DOE disposal sites. Today, most offsite LLW disposal occurs at NTS and the Hanford Site. The six sites currently operating have sufficient unused designated disposal area onsite for the proposed LLW disposal operations; thus, no new construction was assumed to be necessary.

5.2.2 Decentralized Alternative

The Decentralized Alternative considers disposal at 16 DOE sites following minimum treatment at all 27 LLW sites.

5.2.3 Regionalized Alternatives

The Regionalized Alternatives consider treatment at 11, 7, and 4 sites and disposal at 12, 6, and 2 sites. Regionalized Alternative 1 considers disposal at 12 sites, after minimum treatment at 11 sites. Regionalized Alternative 2 analyses the impacts resulting from disposal at the same 12 sites after volume reduction at the same sites as those in Regionalized Alternative 1. In addition to the Decentralized Alternative, Regionalized Alternatives 1 and 2 are the only alternatives that propose treatment or disposal activities at FEMP, LLNL, the Pantex Plant, and Paducah.

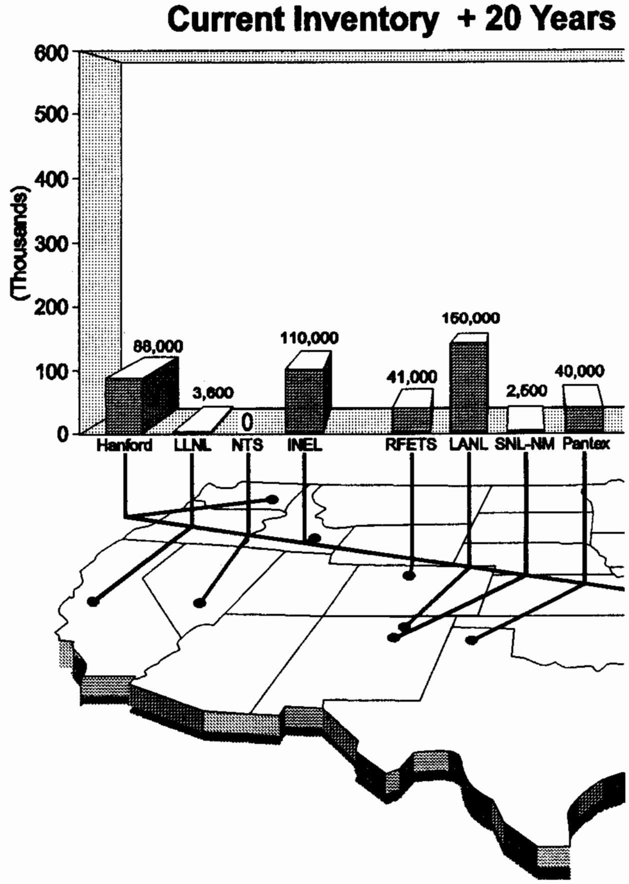
Low-Level Waste

*LLW Volumes**

DOE Sites	Total Volumes (m^3)
1. Ames	110
2.ANL-E	6,700
3. Bettis	12,000
4. BNL	**
5. Fermi	1,500
6. FEMP	0
7. Hanford	88,000
8. INEL	110,000
9. KCP	23
10. KAPL	19,000
11. LBL	1,300
12. LLNL	3,600
13. LANL	150,000

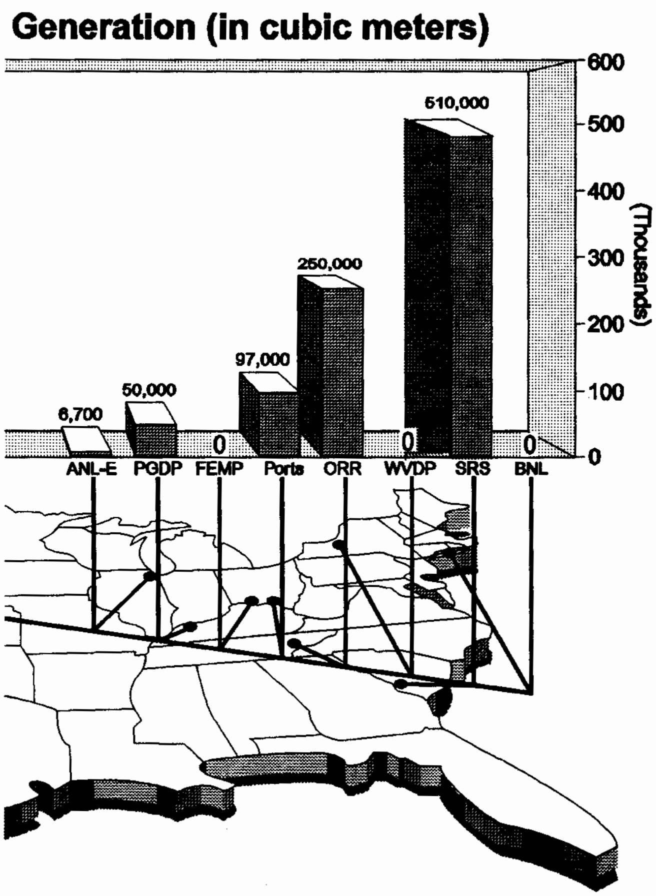
*Estimated LLW volumes include current inventory plus 20-year projected volume. Waste volumes used for the WM PEIS analysis are based upon 1992 data and may vary from latest site estimates.
**BNL volumes were not reported in 1992 data.

Figure 5.1-1 LLW Total



[a] WIPP, the seventeenth major DOE site will manage only TRUW.

Volumes at the 16 Major Sites[a]



LLW Volumes (Continued)*

DOE Sites	Total Volumes (m^3)
14. Mound	38,000
15. NTS	**
16. ORNL	250,000
17. PGDP	50,000
18. Pantex	40,000
19. Pinellas	1,300
20. PORTS	97,000
21. PPPL	220
22. RMI	51,000
23. RFETS	41,000
24. SNL-NM	2,500
25. SRS	510,000
26. SLAC	2,500
27. WVDP	**
TOTAL	**1,480,000**

*Estimated LLW volumes include current inventory plus 20-year projected volume. Waste volumes used for the WM PEIS analysis are based upon 1992 data and may vary from latest site estimates.

**LLW volumes were not reported in 1992 data.

Table 5.2–1. Low-Level Waste Alternatives

Alternative	Number of Sites		ANL-E	BNL	FEMP	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	Pantex	Ports	RFETS	SNL-NM	SRS	WVDP
	T	D																
No Action	10*	6				TD	TD	D	T	D	TD	T			T		TD	
Decentralized		16	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Regionalized 1		12			D	D	D	D	D	D	D	D	D	D	D		D	
Regionalized 2	11	12			TD	TD	TD	TD	TD	D	TD	TD	TD	TD	TD		TD	
Regionalized 3		6				D	D	D		D	D						D	
Regionalized 4	7	6				TD	TD	TD		D	TD			T	T		TD	
Regionalized 5	4	6				TD	TD	D		D	TD						TD	
Regionalized 6		2				D											D	
Regionalized 7		2								D							D	
Centralized 1		1				D												
Centralized 2		1								D								
Centralized 3	7	1				TD	T	T			T			T	T		T	
Centralized 4	7	1				T	T	T		D	T			T	T		T	
Centralized 5	1	1				TD												

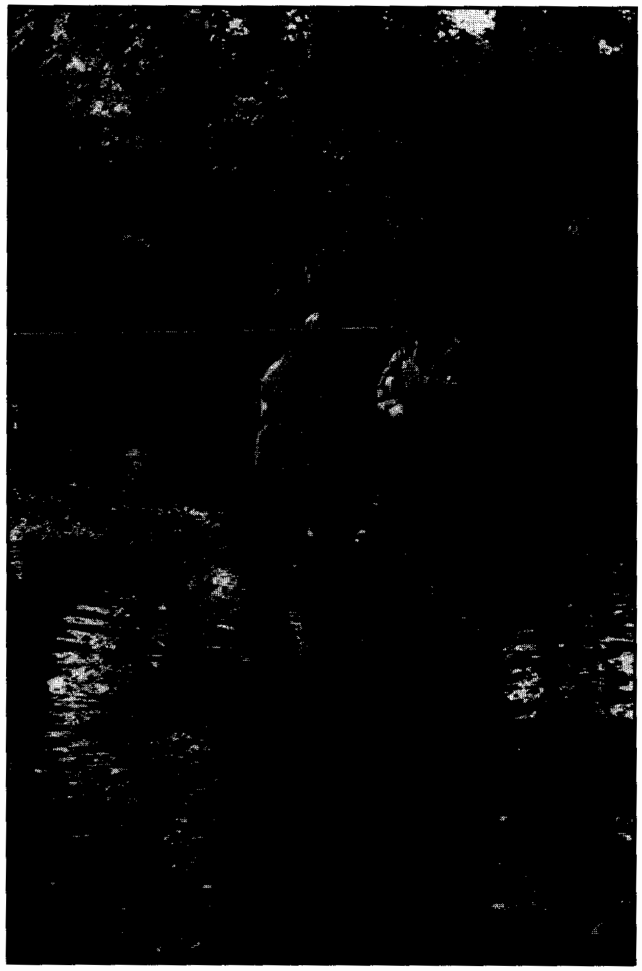
*Ten sites use existing facilities for Volume Reduction. Three sites (LBL, RMI, and Mound) not listed as major sites above include volume reduction facilities.

T=Treat. "Treat" in the context of LLW means volume reduction using thermal organic destruction, size reduction, and compaction followed by solidification. All sites do "minimum treatment," in all alternatives which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment.

D=Dispose. Each of the 6-site disposal cases uses the same sites; each of the 12-site disposal cases uses the same 12 sites.

The remainder of the LLW regionalized alternatives (Regionalized Alternatives 3 through 7) focus most LLW treatment and disposal activities at eight sites: the Hanford Site, INEL, LANL, NTS, ORR, Portsmouth, RFETS, and SRS. Although the sites are the same for most of the regionalized alternatives, impacts at the sites vary because of the use of different treatment technologies and incoming waste volumes. For example, Regionalized Alternatives 3 and 4 would dispose of waste at the same six sites. However, Regionalized Alternative 3 would conduct only minimum treatment before disposal, whereas Regionalized Alternative 4 would use volume reduction techniques on the waste that can be reduced, in addition to conducting minimum treatment prior to disposal. Because Portsmouth and RFETS would become waste consolidation sites for volume reduction before disposal in Regionalized Alternative 4, they would have a greater potential to experience impacts than under the minimum treatment scenario in Regionalized Alternative 3, although both configurations use the same six sites for disposal.

Regionalized Alternative 5 considers volume reduction at four sites and disposal at six, compared to volume reduction at seven sites under Regionalized Alternative 4. Regionalized Alternatives 6 and 7 each consider disposal at two sites after minimum treatment: the Hanford Site and SRS, under Regionalized Alternative 6 and NTS and SRS, under Regionalized Alternative 7.



Environmental Monitoring.

5.2.4 CENTRALIZED ALTERNATIVE

DOE analyzed disposal at one site under the centralized alternatives. Five alternatives were considered. Centralized Alternatives 1 and 2 would dispose of LLW at the Hanford Site and NTS, respectively, after minimum treatment at all DOE sites. Centralized Alternative 3 evaluates disposal at the Hanford Site after volume reduction treatment at seven sites. In Centralized Alternative 4, NTS would be the single disposal site after volume reduction at the same seven sites considered in Centralized Alternative 3. Centralized Alternative 5 considers both the consolidation of LLW for volume-reducible treatment and disposal at the Hanford Site.

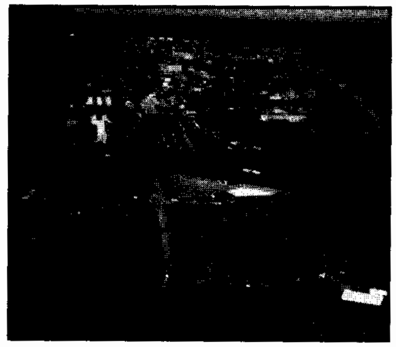
5.2.5 Rationale for Selecting Treatment and Disposal Sites

DOE generally selected LLW sites as candidates for treatment facilities if the sites had large volumes of waste. In addition, the alternatives were formulated to consolidate LLW for treatment and disposal at locations which minimized offsite transportation by shipping to the closest available treatment or disposal site.

INEL Central facilities area.

Because of the interrelationship between LLW and LLMW, DOE used the same treatment (volume reduction) and disposal locations for LLW as those identified for the LLMW alternatives in Chapter 6.

The number of disposal sites considered covers a reasonable range of sites—from 1 to 16 with intermediate numbers of 2, 6, and 12. Sixteen candidate sites were identified to be consistent with those under consideration for LLMW. Likewise, the actual sites used for each LLW alternative mirror those for comparable LLMW alternatives.



ORR- Y-12 Plant looking west.

5.3 The Impacts of Managing LLW

The LLW impacts were evaluated across all the LLW alternatives to identify trends and compare the alternatives. Some impact area results illustrated clear trends across the alternatives, others show sensitivities at particular sites regardless of the alternative. The following discussion focuses on the impact areas that would be affected by the management of LLW under the WM PEIS alternatives, identifying alternative trends when appropriate, and highlighting noteworthy findings at particular sites.

Savannah River Site.

5.3.1 HUMAN HEALTH RISKS RESULTS

The greatest facility risk is to waste management workers, primarily for physical hazards. Radiation exposure risks to noninvolved worker and offsite populations are a function of the treatment technology and the DOE site. The highest risks to offsite populations would occur at FEMP, LLNL, and Portsmouth when thermal treatment of tritium-contaminated waste is assumed. The greatest potential consequences for facility accidents occur at sites treating waste with higher concentrations of radionuclides however, only LLNL and the Hanford Site have potential fatalities exceeding one in any alternative. Concentrations of radionuclides in the groundwater near disposal facilities exceed applicable standards at several sites, demonstrating the need for waste acceptance criteria. Management of radionuclide concentrations and waste forms would be required to assure acceptable water quality and human health risks. Transportation risks from both traffic accidents and radiation exposure would be greatest under the centralized alternatives, which involves the largest number of vehicle miles travelled. Travel by rail, rather than truck, would reduce transportation risk. Table 5.3–1 presents selected LLW risk results.

Table 5.3–1. Selected Risk Results for LLW

Alternative	Number of Sites		Treatment Worker Physical Hazard Fatalities	Treatment Worker Cancer Fatalities	Offsite Population Cancer Fatalities	Disposal Worker Physical Hazard Fatalities	Disposal Worker Cancer Fatalities	Truck[a] Radiation Fatalities	Truck[b] Non-Radiation Fatalities
	T	D							
No Action	10+	6	3	1	*	4	3	5	12
Decentralized		16	2	1	*	6	2	*	*
Regionalized 1		12	2	1	*	6	2	*	1
Regionalized 2	11	12	5	1	1	4	2	*	1
Regionalized 3		6	2	1	*	5	2	2	3
Regionalized 4	7	6	5	1	*	4	2	2	3
Regionalized 5	4	6	5	1	*	4	2	2	4
Regionalized 6		2	3	1	*	6	2	3	10
Regionalized 7		2	3	1	*	6	2	4	10
Centralized 1		1	3	1	*	1	3	16	37
Centralized 2		1	3	1	*	1	3	15	37
Centralized 3	7	1	5	1	*	1	2	15	35
Centralized 4	7	1	5	1	*	1	2	14	37
Centralized 5	1	1	4	2	*	1	2	15	37

T = Treat; D = Dispose. "Treat" in the context of LLW means volume reduction using thermal organic destruction, size reduction, and compaction followed by solidification. All sites do "minimum treatment," in all alternatives which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment.
\+ = Ten sites use existing facilities for volume reduction. Three sites (LBL, Mound, and RMI) not listed as major sites above include volume reduction facilities.
* = Greater than 0 but less than 1.

[a] Fatalities are from radiation-induced cancer over a 70-year period.
[b] Greatest number of fatalities are from physical hazards such as traffic accidents that occur within a 20-year analysis period.

5.3.2 Air Quality Impacts Results

The management of LLW does not affect the air quality at most sites. However, decentralized or regionalized treatment and disposal at Paducah or centralizing disposal at NTS could cause adverse air quality impacts (from construction equipment at Paducah and vehicular traffic at NTS) requiring additional emission control measures for criteria pollutants. Emissions of radionuclides were estimated to be below the applicable standards at every site.

5.3.3 Water Resources Impacts Results

Major impacts to water availability from increased water use at the sites are unlikely, although there is the potential for adverse impacts at LLNL Site-300 and the Pantex Plant.

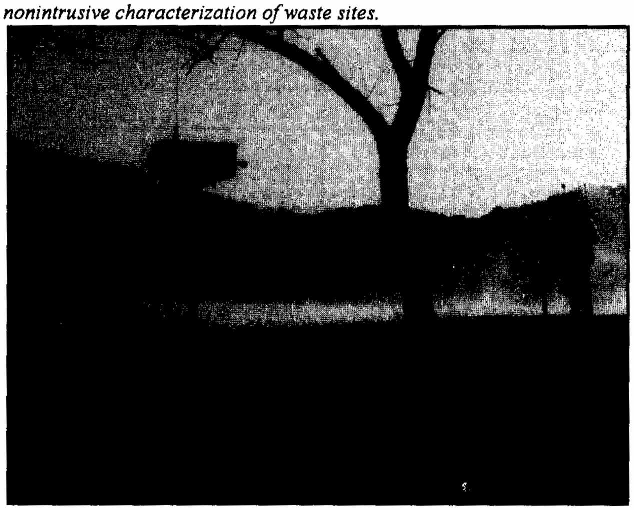
5.3.4 Economic and Population Impacts Results

Total jobs in the regional economies would exceed 1% of the regional baseline at seven of the 16 major sites in one or more alternatives. The largest employment benefit is approximately 3% to the region surrounding the Hanford Site under the Centralized Alternative 5. None of the LLW alternatives would affect the national economy. Regions surrounding five sites experience population increases exceeding 1%, with the largest being the region surrounding INEL, at 3.2% for Regionalized Alternative 5.

5.3.5 Infrastructure Impacts Results

Proposed LLW activities would affect onsite infrastructure at 11 of the major sites, although no offsite infrastructure impacts are expected. New requirements for wastewater treatment or electrical power for proposed LLW facilities equal or exceed 5% of current system capacity at seven sites. The most significant increases are at INEL in Regionalized Alternative 5 (when volume reduction and disposal is consolidated at that site) and at NTS (Centralized Alternatives 2 and 4) and the Hanford Site (Centralized Alternatives 1, 3, and 5) when disposal is consolidated at these sites. However, only the Hanford Site would approach or exceed the total site wastewater treatment capacity (new LLW treatment requirements plus current treatment load) in the alternatives where the Hanford Site accepts offsite waste for both treatment and disposal. Eleven sites would have employment increases of 5% or more of current site employment during construction which could lead to traffic increases that would affect the onsite transportation infrastructure.

Integration of remote sensing and computer technology is used for nonintrusive characterization of waste sites.



5.3.6 Costs

Costs decrease as the number of treatment and disposal sites decrease, ranging from approximately $16 to $12 billion for minimum treatment, and $20 to $15 billion for volume reduction treatment. The increased cost of volume reduction treatment more than offsets the disposal savings from reduced volume achieved. Transportation costs are lower than facility costs, making shipment to available facilities at another site generally less expensive than building new onsite facilities. Table 5.3–2 provides the estimated costs to manage LLW for each of the WM PEIS LLW alternatives over the 20-year analysis period.

5.3.7 Ecological Resources, Environmental Justice, Land Use, and Cultural Resources Impacts Results

The WM PEIS analysis did not identify discriminators among the alternatives in these four impact areas nor reveal any major impacts in any alternative. However, impacts to ecological and cultural resources are dependent to some degree on specific technologies and the location of waste management activities at each site and would be evaluated when such site-level details are evaluated. Assessment of potential environmental justice impacts from management of LLW indicated that minority and low-income populations at the LLW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the LLW alternatives. Land use is not a discriminator because the LLW alternatives do not use much land compared to the amount available at every site.

Table 5.3–2. LLW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternatives	Number of Sites		Total (including Truck Transportation)	Transport Costs	
	T	D		Truck	Rail
No Action	10*	6	17.9	0.07	0.14
Decentralized		16	16.3	0.05	0.02
Regionalized 1		12	16.2	0.06	0.02
Regionalized 2	11	12	20.0	0.06	0.02
Regionalized 3		6	14.7	0.23	0.07
Regionalized 4	7	6	19.7	0.22	0.07
Regionalized 5	4	6	19.6	0.34	0.08
Regionalized 6		2	12.7	0.65	0.17
Regionalized 7		2	13.6	0.67	0.18
Centralized 1		1	11.9	2.46	0.44
Centralized 2		1	11.8	2.25	0.43
Centralized 3	7	1	17.9	2.34	0.43
Centralized 4	7	1	17.8	2.15	0.43
Centralized 5	1	1	14.9	2.45	0.43

T = Treat. "Treat" in the context of LLW means volume reduction using thermal organic destruction, size reduction, and compaction followed by solidification. All sites do "minimum treatment," in all alternatives which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment.
D = Dispose. Each of the 6-site disposal alternatives use the same sites; each of the 12-site disposal alternatives use the same 12 sites.
** Ten sites use existing facilities for volume reduction. Three sites (LBL, Mound, and RMI) not listed as major sites above include volume reduction facilities.*

Transuranic Waste

- *TRUW is material produced during research and development, nuclear weapons production, and fuel reprocessing. It contains man-made elements with atomic numbers greater than that of uranium, which is 92.*
- *TRUW is managed, or may be managed in the future, at 17 DOE sites.*
- *Waste management activities will require management of approximately 107,000 cubic meters of TRUW over the next 20 years.*
- *Although approximately 55% of TRUW contains both radioactive and hazardous components, DOE assumes that all TRUW is mixed waste for purposes of the WM PEIS analysis.*
- *DOE must select sites for the treatment and storage of TRUW.*

6.1 Transuranic Waste Analysis

Transuranic waste is defined as radioactive waste having concentrations greater than 100 nanocuries per gram of transuranic elements (elements which have atomic numbers greater than 92) with half-lives greater than 20 years. The radioactive nuclides in TRUW emit alpha radiation, which requires minimal shielding when outside the body but can severely damage lung tissue if inhaled. TRUW require long-term isolation from the environment. It is produced during research and development, nuclear weapons production, and fuel reprocessing. TRUW radioactive components such as plutonium, with lesser amounts of neptunium, americium, curium, and californium. For the purpose of analysis, DOE analyzed all TRUW as mixed waste (containing both radioactive and hazardous components), subject to both radioactive waste and hazardous waste regulations.

The radiological profiles at each site were assigned uniformly to each waste stream based on the volume of the waste stream at the site. These radiological profiles identify the radionuclides likely to be encountered and ultimately determine risk and impacts. TRUW is also categorized as either CH or RH. DOE analyzed CH and RH TRUW separately in the WM PEIS to account for their different handling and treatment requirements.

TRUW generated from defense-related activities and retrievably stored since 1970 is intended to be disposed of at a geologic repository called WIPP, located near Carlsbad, New Mexico. TRUW generated and managed before 1970 is being examined as part of DOE's environmental restoration program. Disposal of TRUW cannot begin until DOE meets a series of regulatory requirements imposed under the Waste Isolation Pilot Plant Land Withdrawal Act. Before shipment for disposal, all TRUW will be required to meet WIPP waste acceptance criteria (WAC) that will be established by DOE in consultation with EPA and the State of New Mexico. WIPP-WAC are not yet final, and treatment (such as reducing the potential for gas generation in the repository) could be required to safely dispose of waste at WIPP.

Further, DOE plans to submit a petition to EPA, to demonstrate that mixed TRUW disposed of at WIPP will not migrate beyond the WIPP boundary, and therefore the waste would not need to be treated to meet RCRA LDRs. Should EPA deny this petition, DOE would be required to treat mixed TRUW to LDRs prior to disposal at WIPP.

Seventeen sites have or are expected to generate or manage TRUW. Thirteen of those are major sites analyzed in the WM PEIS. Of the sites listed in Table 6.1–1, DOE did not conduct specific site evaluations for ETEC, LBL, Mound, and the University of Missouri (UofMo), which also manage TRUW; however, costs were calculated for actions at these four sites to provide total costs for all 17 TRUW sites for each alternative. In addition, the TRUW from these 4 sites was included in calculating waste processed or stored at regionalized or centralized facilities.

Figure 6.1–1 (pages 46-47) presents the estimated total volume of TRUW from waste management activities at the 16 sites where TRUW is currently located. TRUW is not currently present at WIPP, the 17th TRUW site.

6.2 Transuranic Waste Alternatives

The PEIS TRUW analysis considered six alternatives for both CH TRUW and RH TRUW within the four categories of alternatives: no action, decentralized, regionalized, and centralized. Treatment and storage activities vary by alternative and by site. Table 6.1–1 shows the sites where TRUW would be treated and stored under each alternative.

Each of the alternatives was developed to estimate the human health risk, environmental impacts, and costs associated with the range of TRUW treatment and storage activities available to DOE, and to provide input for a decision about where to locate TRUW treatment and storage facilities.

Table 6.1–1. Transuranic Waste Alternatives

Alt.	CH Treat	RH Treat	Treat Stand	ANL-E	ETEC	Hanford	INEL	LANL	LBL	LLNL	Mound	NTS	ORR	PGDP	RFETS	SNL-NM	SRS	UofMO	WIPP	WVDP
No Action	11	5	WIPP WAC	TS	S	TS	TS	TS	TS	TS	TS	S	TS	S	TS	S	TS	TS		S
D	16	5	WIPP-WAC	TS	T	TS	TS	TS	T	TS	TS	TS	TS	T	TS	T	TS	T		T
R-1	5	2	Reduced Gas			T[a]	T	T					T[b]		T		T			
R-2	5	2	LDRs			T[a]	T	T					T[b]		T		T			
R-3	3	2	LDRs			T[a]	T						T[b]				T			
C	WIPP	2	LDRs			T[c]							T[b]						T	

T=Treatment to one of three standards: process to current WIPP-WAC; shred and grout to reduce potential for gas generation in the repository (Reduced Gas); and treat to meet LDRs using thermal organic destruction and complete treatment train.
S=Storage after treatment under No Action and Decentralized Alternatives or store current inventory under No Action Alternative.

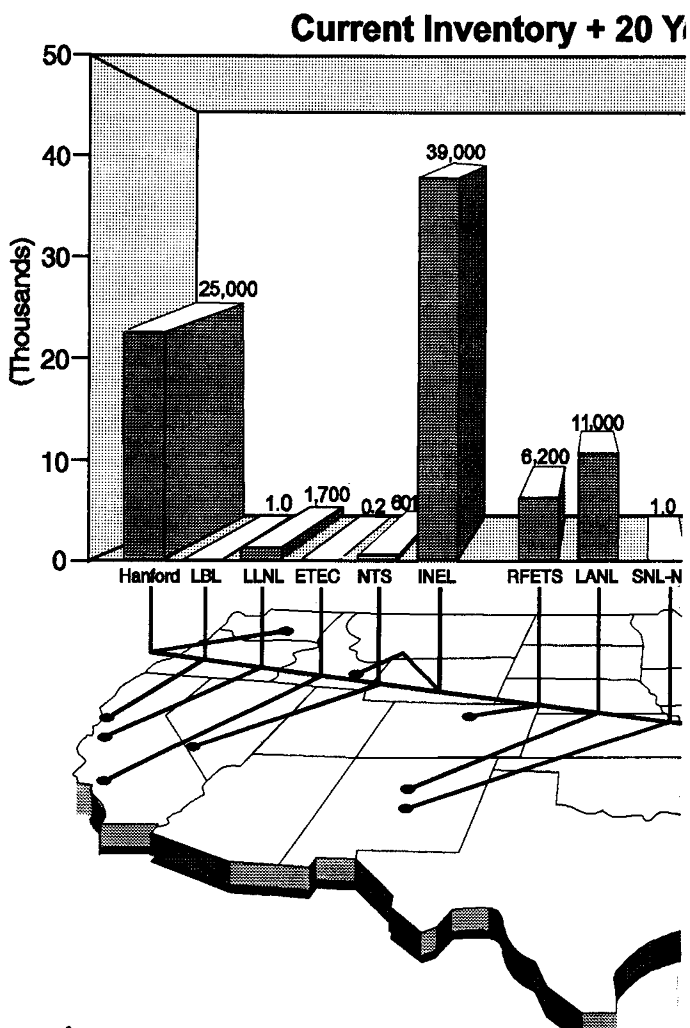
[a] The Hanford Site treats both CH and RH waste.
[b] ORR treats RH waste only.
[c] The Hanford Site treats RH waste only.

*TRUW Volumes**

DOE Sites	Total Volumes (m^3)
1.ANL-E	1,300
2. ETEC	0.02
3. Hanford	25,000
4. INEL	39,000
5. LANL	11,000
6. LBL	1
7. LLNL	1,700
8. Mound	1,500
9. NTS	610

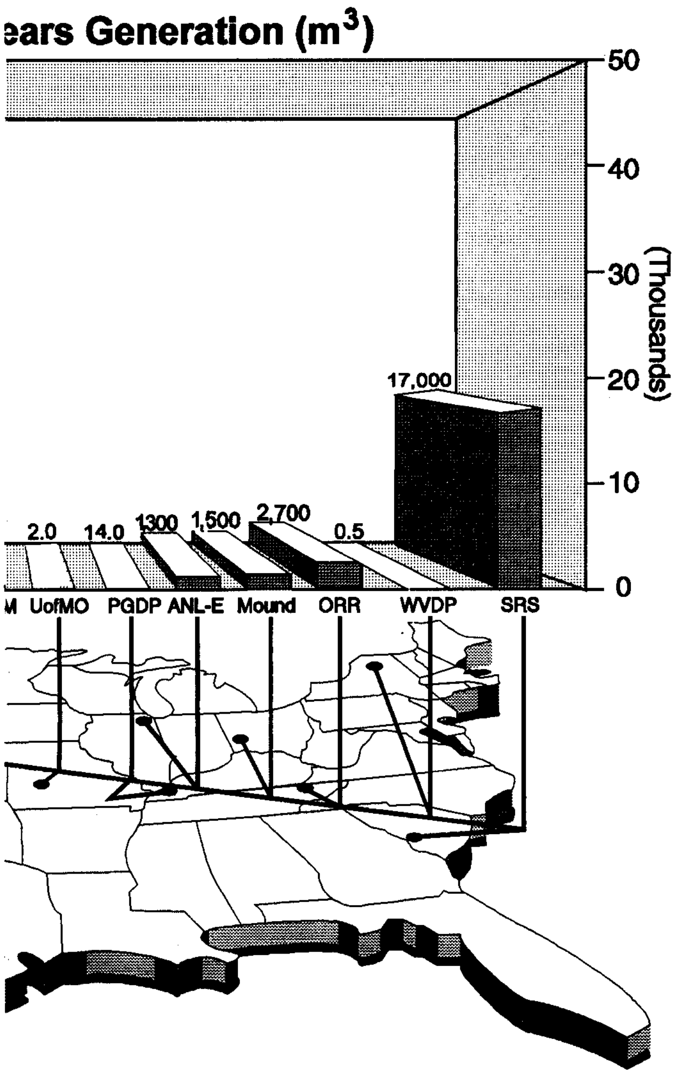
*Estimated TRUW volumes include current inventory plus 20-year projected volume. Waste volumes used for the WM PEIS analysis are based upon 1993 or earlier data and may vary from latest site estimates.

Figure 6.1–1 TRUW Total



*WIPP, the seventeenth major DOE site is the planned TRUW disposal site.

Volumes at the 16 Major Sites[a]



TRUW Volumes* (Continued)

DOE Sites	Total Volumes (m^3)
10. ORNL	2,700
11. PGDP	14
12. RFETS	6,200
13. SNL-NM	1
14. SRS	17,000
15. Uof Mo	2
16. WIPP	
17. WVDP	0.5
TOTAL	**107,000**

*Estimated TRUW volumes include current inventory plus 20-year projected volume. Waste volumes used for the WM PEIS analysis are based upon 1993 or earlier data and may vary from latest site estimates.

6.2.1 No Action Alternative

Under the No Action Alternative, DOE would continue to characterize, process, and package TRUW based on current WIPP-WAC for storage at sites where existing or planned facilities are available. DOE would continue to store TRUW in existing storage facilities for the duration of this analysis and would not ship TRUW for offsite storage or disposal. All sites are assumed to have adequate capabilities to package and store future-generated TRUW. Eleven sites have projected future TRUW generation, including five sites generating both CH and RH TRUW. The No Action Alternative does not assess the health risks, environmental impacts, or costs of removing TRUW from retrievable storage and repackaging it.

6.2.2 Decentralized Alternative

Under the Decentralized Alternative, DOE would, as needed, treat and package TRUW to meet the current WIPP-WAC at the 16 major sites. After treatment, CH TRUW would be shipped from the 6 sites with smaller amounts to the nearest of the 10 sites with the largest amount of TRUW for storage prior to disposal. All TRUW would be shipped to WIPP for disposal.

6.2.3 Regionalized Alternatives

The regionalized alternatives consider the consolidation of TRUW for treatment and storage prior to disposal at WIPP. Three TRUW regionalized alternatives were analyzed, with varying degrees of treatment at 6 and 4 sites, and storage at those sites prior to disposal.

Under Regionalized Alternative 1, CH TRUW would be shipped from the 10 smallest generators to the 4 sites with the largest volumes of TRUW (the Hanford Site, INEL, LANL, and SRS). In addition, RFETS would continue to treat its own waste, but would not receive waste from offsite. RH TRUW would be shipped from ANL-E, INEL, and LANL to the Hanford Site or ORR for treatment. At all six treatment sites, TRUW would be treated to an intermediate level to reduce gas generation potential and shipped from those sites to WIPP for disposal. The six treatment sites proposed under this alternative have 95% of current and anticipated TRUW inventories.

Under Regionalized Alternative 2, DOE would use the same waste consolidation configuration as in Regionalized Alternative 1, except that TRUW would be treated to meet LDRs and then shipped to WIPP for disposal. With this alternative, DOE can compare the impacts of intermediate treatment in Regionalized Alternative 1 to the impacts of LDRs treatment; the impacts from both Regionalized Alternatives 1 and 2 can be compared to meet current WIPP-WAC in the Decentralized Alternative (where 98% of the waste would be treated at the same six sites).

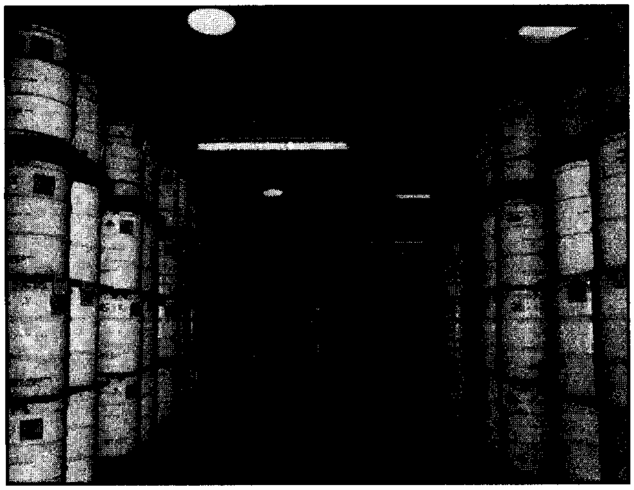
Regionalized Alternative 3 considers the consolidation of waste for treatment at four sites (the Hanford Site, INEL, ORR, and SRS) where approximately 80% of TRUW is already located or is expected to be generated. CH TRUW would be treated at the Hanford Site, INEL, and SRS; RH TRUW would be treated at the Hanford Site and ORR. Under this alternative, TRUW would be treated to meet LDRs and shipped to WIPP for disposal.

6.2.4 Centralized Alternative

Under the Centralized Alternative, DOE would ship all CH TRUW to WIPP for treatment to meet LDRs and for disposal. RH TRUW would be shipped to the Hanford Site and ORR for treatment to meet LDRs and then shipped to WIPP for disposal.

6.2.5 Rationale for Selecting Treatment Sites

TRUW treatment configurations were developed to cover the range of reasonable alternatives. Thus, the Decentralized Alternative considers treatment of TRUW at all 16 sites where TRUW is currently located, and the Centralized Alternative considers treatment of all CH TRUW at one site and all RH TRUW at two sites. For the regionalized alternatives between those ranges, DOE focused on the six sites where 95% of the waste is located or expected to be generated, and on the four sites where approximately 80% of the waste is located or expected to be generated. Under these alternatives, DOE assumed that the waste from other generating sites would be shipped to the closest site for treatment.



Mixed TRUW Assay and Shipping Area.

In addition, DOE assumed that it would not be practical or reasonable for sites with small volumes of TRUW (less than 15 cubic meters) to treat TRUW onsite to either intermediate or LDRs. Onsite activities to meet current WIPP-WAC was considered for all 16 sites, including the small volume sites, under the Decentralized Alternative.

Most RH TRUW requires extensive treatment (but not necessarily to LDRs) before it can be shipped, and therefore consolidation of RH TRUW at one site for treatment was not considered. Thus, under the Centralized Alternative, DOE would treat RH TRUW at the two sites—the Hanford Site and ORR—where approximately 90% of current and projected inventory would be located.

6.3 The Impacts of Managing TRUW

The impacts were evaluated across all the TRUW alternatives to identify trends and ultimately the preferred alternative. Some impact areas illustrated clear trends across the alternatives whereas others illustrated sensitivities at particular sites, regardless of the alternative.

The following discussion focuses on the impact areas that would be affected by the management of TRUW under the WM PEIS alternatives.

6.3.1 HUMAN HEALTH RISK RESULTS

The most adverse health risks result from alternatives where TRUW is treated to meet LDRs—in Regionalized Alternatives 2 and 3, and the Centralized Alternative. These alternatives assume the use of thermal destruction of organic wastes which results in emissions of radionuclides, particularly Pu-238 and Am-241 that are the most responsible for offsite cancer risks and increase the probability of cancer to the MEI at SRS, LANL, and WIPP. Although waste management worker fatalities primarily result from physical hazard, fatalities are lower when TRUW is treated to WIPP-WAC or to reduce gas generation potential, than to meet LDRs. Estimated transportation fatalities are low in all alternatives; rail transportation fatalities are lower than truck. Table 6.3-1 presents selected risk results for the TRUW alternatives.

Table 6.3–1. Selected Risk Results for TRUW

Alternative	Number of Sites		Treatment Standard	Treatment Worker Physical Hazard Fatalities	Treatment Worker Cancer Fatalities	Offsite Population Cancer Fatalities	Truck[a] Radiation Fatalities	Truck Non-Radiation Fatalities
	CH Treat	RH Treat						
No Action	11	5	WIPP-WAC	*	*	*	0	0
Decentralized	16	5	WIPP-WAC	3	1	*	4	3
Regionalized 1	5	2	Reduce Gas	3	1	*	3	3
Regionalized 2	5	2	LDRs	5	1	3	3	3
Regionalized 3	3	2	LDRs	4	1	3	3	3
Centralized	WIPP	2	LDRs	4	1	1	3	3

CH = Contact Handled TRUW; RH = Remote Handled TRUW; LDRs= Land Disposal Restrictions; WIPP-WAC = Waste Isolation Pilot Plant Waste Acceptance Criteria. * = Greater than 0 but less than 0.5.

[a] Fatalities are from radiation-induced cancer over a 70-year period.

6.3.2 Air Quality Impacts Results

The management of TRUW would not affect the air quality at most sites; however, emissions of radionuclides were estimated to exceed the applicable standards at LANL and WIPP in the alternatives involving LDRs treatment at these sites (Regionalized Alternative 2 and the Centralized Alternative). The exceedances at these sites may require additional control measures to reduce the emissions to acceptable levels. Emissions of other hazardous air pollutants and criteria pollutants were estimated to be below the applicable standards at all sites.

6.3.3 Economic and Population Impacts Results

Nationwide, the largest economic benefits of TRUW management would be for the Decentralized Alternative and would generally decrease as the alternatives become more centralized. The greatest benefit to the region surrounding any site occurs when TRUW is managed at that site. The greatest number of regional jobs as a percent of overall regional employment would occur to regions surrounding INEL and WIPP under Regionalized Alternative 3 and the Centralized Alternative, respectively. None of the TRUW alternatives would substantially affect the national economy, although some 1,900 to 12,000 jobs would be directly or indirectly financed. No regions experience population increases of 1% or more.

6.3.4 Infrastructure Impacts Results

Infrastructure impacts on water use, wastewater treatment, and electrical power are comparable for the decentralized and regionalized alternatives, but are much greater at WIPP in the Centralized Alternative. Impacts generally increase as the intensity of treatment increases, with greater impacts at several sites utilizing treatment to meet LDRs, and with the greatest impacts at WIPP for the Centralized Alternative.

6.3.5 Costs

Costs increase as the level of treatment increases. Processing to WIPP-WAC and treatment to reduced gas generation costs approximately the same. Treatment to meet LDRs costs approximately 25% more. Transportation costs are lower than facility costs, making shipment to available facilities at another site generally less expensive than building a new facility on site. Table 6.3–2 provides the estimated costs to manage TRUW for each of the WM PEIS TRUW alternatives over the 20-year analysis period.

6.3.6 Water Resources, Ecological Resources, Environmental Justice, Land Use, and Cultural Resources Impacts Results

Major impacts to these resources at the sites are unlikely for treatment of TRUW under any of the alternatives. However, ecological and cultural impacts analysis would receive further site-specific studies prior to the selection of specific facility locations. Assessment of potential environmental justice impacts associated with TRUW management indicated no substantive potential for disproportionately high and adverse health risks or environmental impacts to minority and low-income groups at any of the TRUW sites except WIPP. The potential at WIPP can be mitigated by selection of an alternative treatment technology or employment of more efficient emissions controls.

Table 6.3–2. TRUW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternative	Number of Sites		Treatment Standard	Total (including truck transport)	Transportation Costs	
	CH Treat	RH Treat			Truck	Rail
No Action	11	5	WIPP-WAC	1.7	0	0
Decentralized	16	5	WIPP-WAC	7.4	0.56	1.44
Regionalized 1	5	2	Reduce Gas	7.7	0.51	1.40
Regionalized 2	5	2	LDRs	9.0	0.45	1.24
Regionalized 3	3	2	LDRs	8.5	0.49	1.29
Centralized	WIPP	2	LDRs	7.9	0.51	1.33

High-Level Waste

- *HLW is highly radioactive waste material that results from the reprocessing of spent nuclear fuel and irradiated targets in nuclear defense, research, and production activities.*
- *The WM PEIS only analyzes the impacts of stored vitrified HLW.*
- *HLW will be treated and packaged for disposal in a licensed geologic repository.*
- *HLW is currently stored at the Hanford Site, INEL, SRS, and WVDP.*
- *Approximately 398,700 cubic meters of HLW have been generated. Treated HLW will require an estimated 28,372 canisters for packaging.*
- *DOE must decide where to store the HLW canisters.*

7.1 High-Level Waste Analysis

High-level waste is the highly radioactive waste material that results from the chemical reprocessing of spent nuclear fuel and irradiated targets that contains fission products in concentrations sufficient to require permanent isolation.

Government operations from 1944 to the present have generated approximately 398,700 cubic meters of HLW. Only four sites either store or manage HLW—the Hanford Site, INEL, SRS, and WVDP.

DOE is proceeding with plans to treat HLW by processing it into a solid form that would not be readily dispersible into air or leachable into ground or surface water. This process is called vitrification. When the existing inventory of HLW is vitrified, the vitrified material will fill an estimated 28,372 canisters. The WM PEIS only analyzes the impacts of the stored vitrified HLW.

Table 7.1–1 shows the HLW inventory at the Hanford Site, INEL, SRS, WVDP, and the projected total of vitrified HLW canisters that will be generated as a result of treating the entire HLW inventory.

Table 7.1–1. High-Level Waste Volumes and Projected Number of HLW Canisters

Site	HLW Volume (m^3)	Total Number of Estimated Canisters to be Generated
Hanford	258,800	15,000
INEL	11,400	8,500
SRS	126,900	4,572
WVDP	1,600	300
Total	398,700	28,372

The impacts of HLW disposed of in a repository are not within the scope of this PEIS, but will be analyzed in a subsequent DOE NEPA document relating to the geologic repository. Because the Yucca Mountain site is the only candidate repository site being studied DOE used this location to analyze the impacts of transporting the HLW to a potential disposal facility.

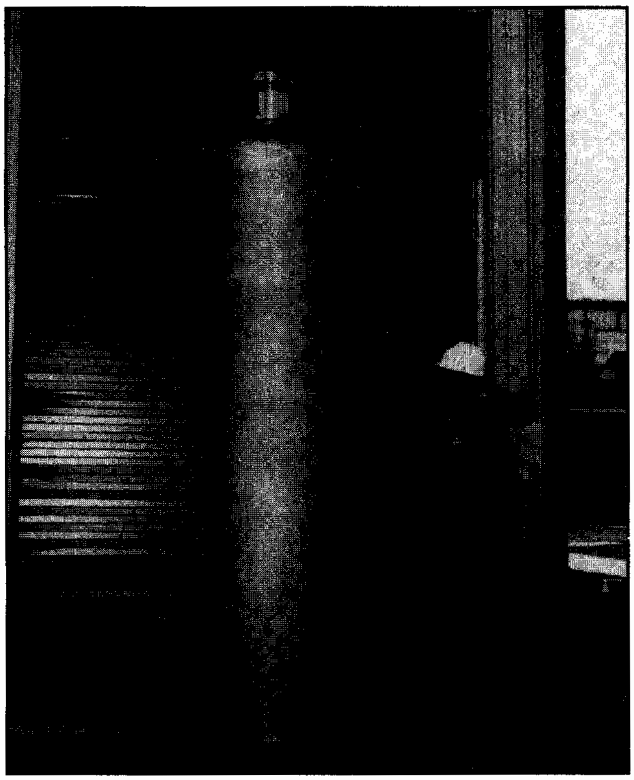
Each alternative considered in this PEIS for storage of HLW canisters involves three major facilities and features: the HLW canisters, the facilities for the storage of HLW canisters, and the packages for transporting HLW canisters.

7.2 High-Level Waste Alternatives

DOE analyzed five alternatives for HLW within the four categories of alternatives: no action, decentralized, regionalized, and centralized. Each of the alternatives was developed in order to estimate human health risks, environmental impacts, and costs associated with the range of HLW storage options, and to provide input for a decision about where to store HLW. For each of the five alternatives, DOE assumed that the the candidate geologic repository would begin accepting DOE-managed HLW in 2015 at the rate of 800 canisters per year. For purposes of analysis, DOE also evaluated a scenario that assumed that there would be a subsequent delay in acceptance of DOE-managed HLW by the candidate repository until some time later than 2015, but at the same rate of acceptance of 800 canisters per year. The schedule for acceptance of DOE-managed HLW at the repository is out of scope for this PEIS. Table 7.2–1 presents the alternatives in tabular form. Figure 7.2–1 illustrates the location of the HLW sites.

7.2.1 No Action Alternative

Under the No Action Alternative, only existing and approved HLW storage facilities would be used. Each site would store only those canisters produced at that site. Under this alternative, the Hanford Site would run out of HLW canister storage capacity before HLW canister acceptance begins at the geologic repository in 2015. Therefore, production of HLW canisters under the No Action Alternative would be phased due to both the lack of existing storage capacity at most of the sites and the assumed acceptance rate of 800 canisters per year by the candidate repository.



Typical high-level waste canister.

7.2.2 Decentralized Alternative

Under the Decentralized Alternative, storage capacity equal to the anticipated total production of HLW canisters would be constructed at each site. This would allow each site to start generating HLW canisters as soon as the treatment facilities were available, prior to acceptance by the geologic repository. With adequate storage capacity at all four sites until canister acceptance begins at the candidate repository in 2015, no delays in the production of HLW canisters would occur.

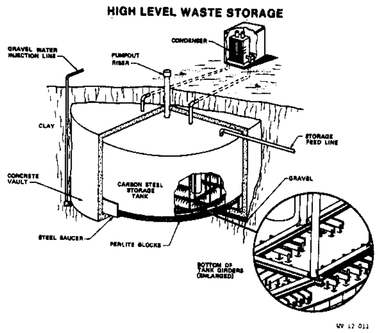
Table 7.2–1. High-level Waste Alternatives

Alternative	Number of Storage Sites	Hanford	INEL	SRS	WVDP
No Action	4	S	S	S	S
Decentralized	4	S	S	S	S
Regionalized 1	3	S	S	S	
Regionalized 2	3	S	S	S	
Centralized*	1	S			

* Canisters generated at WVDP, SRS, and INEL prior to acceptance at the candidate repository in 2015 would be shipped to the Hanford Site for storage. Canisters generated at SRS and INEL after 2015 would be shipped directly to the candidate repository. If acceptance of the DOE-managed HLW is delayed past 2015, then all HLW canisters would be shipped to Hanford for storage.

S= Storage.

Figure 7.2–1. HLW Sites

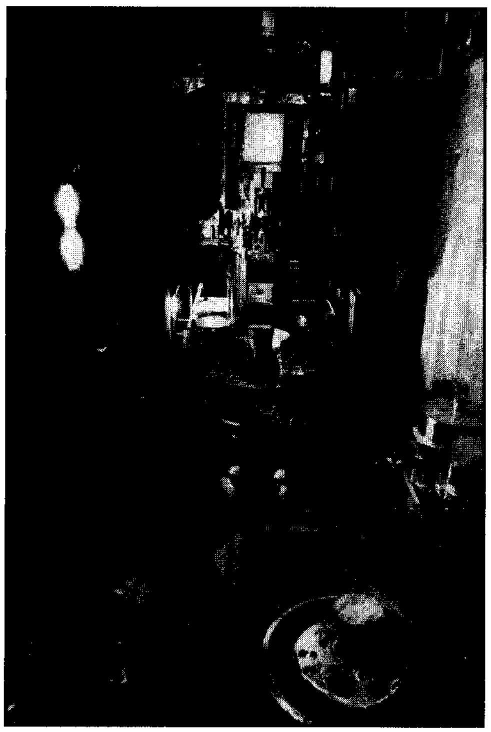


HLW storage tank design.

7.2.3 Regionalized Alternatives

Two regionalized alternatives were analyzed for HLW canister management. Under Regionalized Alternative 1, the HLW canisters generated at WVDP would be transported to SRS for storage in approved transportation casks. Adequate storage capacity for HLW canisters would be provided at the Hanford Site, INEL, and SRS until HLW canisters were accepted at a geologic repository.

Under Regionalized Alternative 2, the HLW canisters produced at WVDP would be transported to the Hanford Site in approved transportation casks. Adequate storage capacity for HLW canisters would be provided at the Hanford Site, INEL, and SRS until HLW canisters were accepted at a geologic repository.



Vitrification facility at SRS.

7.2.4 Centralized Alternative

Under the Centralized Alternative, the HLW canisters produced at INEL, SRS, and WVDP would be transported to the Hanford Site in approved transportation casks, for storage until the canisters were accepted at a geologic repository.

Because the WM PEIS analyzed two different timing assumptions for acceptance of HLW at the geologic repository, the assumptions for this alternative vary. The WM PEIS assumed only that HLW canisters generated before the repository begins accepting HLW in 2015 would be shipped to the Hanford Site for centralized storage. The remaining canisters generated at SRS and INEL after 2015 would be shipped directly to the repository. WVDP generates all its canisters prior to 2015, and therefore all 300 canisters would be shipped to the Hanford Site. This is the basis for only a fraction of the total number of canisters being centrally stored at the Hanford Site.

For the scenario where acceptance at the geologic repository is delayed past 2015, all canisters generated at WVDP, SRS, and INEL would be shipped to the Hanford Site for storage prior to shipment to the geologic repository once it begins accepting HLW.

If the Centralized Alternative were selected, the Hanford Site Tri-Party Agreement may have to be modified to include a provision for the storage of INEL, SRS, and WVDP HLW canisters and modify the start-up and completion construction dates for the Hanford Site canister storage facility.

7.2.5 Rationale for Selecting Storage Sites

The five HLW storage alternatives were developed to cover the range of reasonable alternatives. From one to four sites are available for storage of HLW (the centralized and decentralized alternatives, respectively). DOE selected two intermediate alternatives, transporting the relatively small amount of WVDP HLW to either Hanford or SRS. To select the regionalized alternatives, DOE focused on the sites with the largest amount of HLW (the Hanford Site) and where transportation would be minimized (SRS). INEL was eliminated from consideration as a regionalized alternative site because it has no existing or approved storage facilities.

In the Centralized Alternative, all HLW would be shipped to the Hanford Site for storage. The Hanford Site was selected because it has the greatest volume of HLW and provided a reasonable estimate of the potential impacts. The major variable is the total miles transportation between existing DOE sites, the central storage site and the repository. Consolidating all HLW canisters at the Hanford Site bounds the impacts due to transportation for centralized storage. Although choosing an eastern site would bound the transport impacts from the central storage facility to the repository, this is not considered to be reasonable given the Yucca Mountain Site Characterization Project. WVDP was eliminated from consideration for the Centralized Alternative because it has the smallest volume of HLW, only 0.4% of the total HLW and would be inconsistent with the West Valley Demonstration Project Act.

7.3 The Impacts of Managing HLW

The impacts were evaluated across all the HLW alternatives to identify trends and ultimately the preferred alternative. The following discussion focuses on the impact areas that would be affected by the management of HLW canisters under the PEIS alternatives.

7.3.1 Human Health Risk Results

Both fatalities and cancer incidences for waste management workers are comparable for the decentralized, regionalized, and centralized alternatives and do not favor one alternative over another. Worker cancer fatalities from radiation exposure exceed fatalities from physical hazards. The decentralized, regionalized, and centralized alternatives each have 3 estimated cancer fatalities and 1 estimated fatality from physical hazards. Truck transportation risks are slightly higher for the Centralized Alternative than for other alternatives if the repository is delayed. Rail risks are lower in general than truck risks. Fatalities from facility accidents are less than 1 for each of the HLW alternatives.

Table 7.3–1. Selected Risk Results for HLW

Alternative	Number of Sites Storing	Worker Physical Hazard Fatalities	Worker Cancer Fatalitie s	Truck Radiation Fatalities	Truck Non-Radiation Fatalities
No Action	4	*	1	4	2
Decentralized	4	1	3	4	2
Regionalized 1	3	1	3	4	2
Regionalized 2	3	1	3	4	2
Centralized 1	3	1	3	4	2
Centralized 2**	1	1	3	6	3

* = Greater than 0 but less than 0.5.
** = Acceptance at Repository delayed past 2015.

7.3.2 Economic and Population Impacts Results

HLW storage facility construction and operations expenditures would minimally benefit the local economy at the four HLW sites because estimated job and personal income growth are well below 1% at all sites under all the alternatives. None of the HLW alternatives would affect the national economy, although 300 to 1,400 jobs would be directly or indirectly financed. The overall population remains relatively constant under all proposed alternatives and does not incur a major increase at any site.

7.3.3 Infrastructure Impacts Results

Proposed HLW activities show a potential for effects to onsite infrastructure only at the Hanford Site although the effects would be minor. No offsite infrastructure impacts are expected at any other site. Estimated new requirements for wastewater treatment at the Hanford Site increases current demand in all alternatives, except No Action. Employment increases do not approach or exceed 5% of current site employment needed to build HLW facilities at any site. Traffic increases would be minimal during construction, and would not affect onsite transportation infrastructure.

7.3.4 Costs

The costs of storage remain relatively stable at approximately $3.5 billion, for all alternatives. Costs do rise slightly when storage is centralized. Delay in disposing the waste at the geologic repository causes the life-cycle costs to increase at a rate of 0.4 - 0.7% per year of delay. Table 7.3–1 presents the estimated costs for each of the HLW alternatives.

7.3.5 Air Quality, Water Resources, Ecological Resources, Environmental Justice,Land Use, and Cultural Resources Impacts Results

The management of HLW canisters would not appreciably affect the air quality or water resources at any site. Operation of HLW storage facilities should not affect ecological resources because airborne emissions, liquid effluents and loss of habitat are expected to be negligible. Additionally, no impacts to current onsite or offsite land uses would result because for all alternatives, no sites exceeds 1% of designated or suitable lands. Assessment of potential environmental justice impacts from management of HLW indicated that minority and low-income populations at the HLW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the HLW alternatives. DOE would conduct additional site-specific analyses to assess cultural resource impacts.

Table 7.3–2. HLW Life–Cycle Estimated Costs (Billions of 1994 Dollars)

Alternatives	Description	Total Cost (Including Transportation Costs)	Transportation Cost	
			Truck	Rail
No Action	Current Program	1.73	0.38	0.56
Decentralized	Acceptance at Repository begins in 2015	3.50	0.49	0.69
Regionalized 1	Acceptance at Repository begins in 2015	3.52	0.49	0.70
Regionalized 2	Acceptance at Repository begins in 2015	3.54	0.49	0.70
Centralized	Acceptance at Repository begins in 2015	3.59	0.54	0.83

Hazardous Waste

- *HW is non-radioactive chemical waste.*
- *HW is generated as a result of research and development and as a byproduct of nuclear weapons production.*
- *HW is generated or exists at about 45 sites.*
- *Most non-wastewater DOE HW is treated commercially.*
- *DOE needs to decide whether to develop additional capacity of its own to treat HW.*

8.1 Hazardous Waste Analysis

Hazardous waste consists of non-radioactive chemical waste generated as a result of nuclear weapons production and other research and development activities. HW has been generated, or is projected to be generated at approximately 45 DOE sites. Although HW generation from the production of nuclear weapons has essentially stopped, many chemicals and chemical residues were abandoned or left in containers and process lines. These wastes must be properly treated and disposed of to eliminate the existing storage inventory.

Most DOE HW consists of wastewater which contains less than a 1% concentration of organic HW materials. Hazardous wastewater is similar to industrial wastewater and is generated as a result of operations such as metal cleaning, etching, and plating. DOE currently treats hazardous wastewater onsite and will continue to do so in the future because wastewater is not difficult to treat, but is difficult and expensive to transport.

Nonwastewater HW consists of sludges, solids, and organic liquids (water containing higher concentrations of organic chemicals than wastewater). DOE currently ships most of this HW offsite to commercial facilities for treatment and disposal, although two sites (ORR and INEL) have the capability to treat nonwastewater HW by incineration. DOE needs to decide the extent to which it should continue its reliance on the offsite commercial treatment and disposal of nonwastewater HW.

DOE estimates that more than 90% of the total HW (wastewater and nonwastewater) in a given year is generated by 11 of the 45 DOE sites. Table 8.1–1 provides the quantities of HW at the 11 large HW generators used for the evaluation of the WM PEIS alternatives. The focus of the WM PEIS alternatives is on the RCRA-defined waste shipped offsite and that waste incinerated or used for fuel burning onsite—approximately 3,339 metric tons.

Table 8.1–1. HW at 11 Large DOE Generators (metric tons[a]/year)

DOE Site	Wastewater Treated Onsite[b]	Onsite Incineration and Fuel Burning[b]	Other Onsite Treatment and Storage[b]	Offsite Commercial Treatment[c]
ANL-E	0	0	2	206
Fermi	0	0	12	49
Hanford	0	0	140	303
INEL	33,000	35	80	160
KCP[d]	343,000	0	80	601
LANL	0	0	40	246
LLNL	250	0	230	629
ORR	624,000	66	14,600	207
Pantex	3,000	0	2,700	512
SNL-NM	130,000	0	0	153
SRS[d]	59,000	0	50	273
TOTAL	1,192,250	101	17,934	3,339

[a] Metric Ton = 1,000 kilograms = 2,205 lb. One metric ton of HW is approximately one cubic meter in volume.
[b] Based on 1991 data taken from biennal and annual reports.
[c] Based on FY 1992 manifests. Includes only RCRA-defined waste; an additional 6,600 metric tons of TSCA State-regulated, and ER generated HW was shipped to commercial treatment in FY 1992.
Excludes wastewater treatment of groundwater remediation waste reported in KCP and SRS biennial reports.

8.2 Hazardous Waste Alternatives

The PEIS HW analysis considered four alternatives for treatment facilities within the three categories of alternatives: no action, decentralized, and regionalized. No centralized alternative was analyzed because of the associated cost and risk, regulatory constraints, and practical considerations of attempting to centrally manage all the diverse DOE waste classified as hazardous.

Each of the alternatives was developed in order to estimate the human health risks, environmental impacts, and costs associated with the range of HW treatment options available to DOE and to provide input for a decision about whether to continue to rely on offsite treatment of HW.

8.2.1 No Action Alternative

Under this alternative, the current operations would be maintained. Some of the HW that is currently being treated onsite at DOE facilities (i.e., incineration of organic materials at ORR and INEL) will continue to be treated onsite, and other HW will continue to be treated and disposed offsite at commercial facilities.

8.2.2 Decentralized Alternative

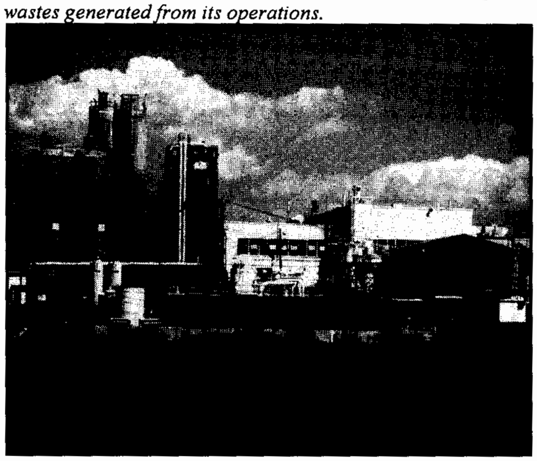
Under this alternative, DOE would implement its current plan to start incineration at LANL, ORR, and SRS, and to place the incinerator at INEL in a standby status. In addition, the use of commercial facilities would continue as needed. Most wastes generated by the other major sites would also be sent to commercial facilities except for wastes to be incinerated or treated through fuel burning at LANL, ORR, and SRS.

8.2.3 Regionalized Alternatives

Under Regionalized Alternative 1, 50% of the HW generated by the 11 major DOE HW sites would be retained and treated at five onsite treatment centers or "hubs" (the Hanford Site, INEL, LANL, ORR, and SRS). Each regional hub would be permitted under RCRA and onsite treatment facilities would be constructed for incineration and organic removal/recovery. Under this alternative, the hub sites would treat two-thirds of the received HW and send the other one-third to a commercial facility. For HW that could be treated through incineration, two-thirds would be sent to the regional hubs from the generating sites, and the other third would be sent directly to commercial incineration facilities from the generating sites. Approximately 50% of the estimated 3,440 metric tons considered for onsite incineration or offsite commercial treatment of HW would be treated at DOE HW facilities.

Under Regionalized Alternative 2, DOE would build facilities at INEL and ORR for organic treatment and deactivation/neutralization. Metal recovery and recycling, battery recycling, stabilization, and land

Sludge treatment facility at ORR charged with managing wastes generated from its operations.



disposal would continue to be provided by offsite commercial establishments. Approximately 90% of HW would be treated at DOE HW facilities.

8.2.4 Centralized Alternative

A single site Centralized Alternative for the management of HW was not evaluated in this PEIS because of the associated cost and risk, regulatory constraints, and practical considerations of attempting to centrally manage all the diverse DOE waste classified as hazardous.

Table 8.2–1. Hazardous Waste Alternatives

Alternative	Treat	ANL-E	FERMI	Hanford	INEL	KCP	LANL	LLNL	ORR	Pantex	SNL-NM	SRS
No Action	2				T				T			
Decentralized	3						T		T			T
Regionalized 1	5			T	T		T		T			T
Regionalized 2	2				T				T			

T=Treatment.

Interior of 709-G hazardous waste storage facility at SRS.

Hazardous waste withdrawal alleys and vaults.

Waste oil shipment to TSCA Incinerator.

8.2.5 Rationale for Selection of Treatment Sites

The HW treatment alternatives selected were developed to cover the range of reasonable alternatives based on two primary criteria: (1) site experience with key HW treatment technologies, and (2) location of sites. As in the case of evaluating alternatives for the management of the radioactive waste types, consideration was given to avoiding the introduction of HW to DOE sites that do not generate HW. These criteria and considerations serve to minimize the costs and impacts associated with the alternatives and sites selected.

The technologies evaluated for onsite treatment of HW are incineration, fuel burning, and deactivation. Of all the sites evaluated for the No Action Alternative, five of the sites—the Hanford Site, INEL, LANL, ORR, and SRS—have operated or plan to operate treatment incinerators.

Regionalized Alternative 1 uses the five DOE sites with the operational and planned treatment incinerators, satisfying the criterion for site technology experience. The location criterion is addressed in that the five sites are somewhat regionally distributed which serves to minimize transportation of HW and associated risks.

Regionalized Alternative 2 is based on using two sites for HW treatment. The two sites proposed, INEL and ORR, satisfy the technology experience criterion since they are part of the five sites discussed above, and their locations (western and eastern United States) require the least transportation of HW compared to other site combinations. Onsite deactivation, or neutralization, also considered in this alternative, is planned for the two hub.

8.3 The Impacts of Managing HW

Impacts were evaluated across all the HW alternatives to identify trends and ultimately the preferred alternative. Some impact areas illustrated clear trends across the alternatives, others show sensitivities at particular sites, regardless of the alternative.

The following discussion focuses on the impact areas that would be affected by the management of HW under the WM PEIS alternatives, identifying alternative trends when appropriate and highlighting noteworthy findings at particular sites.

8.3.1 Human Health Risks Results

Incidences of cancer to the offsite population for both routine operation and accidents were also less than one for all alternatives. Noncancer risks to the maximally exposed individual also are low.

The regionalized alternatives result in greater worker exposure to HW chemicals than the no action and decentralized alternatives because DOE treats more HW under the regionalized alternatives. This analysis did not evaluate the risk to workers at commercial facilities which are the principal HW treatment facilities under the no action and decentralized alternatives. It is expected that HW worker risk would be the same regardless of whether commercial or DOE facilities are used. In view of this, there is no significant difference between the alternatives with regard to HW worker risk.

Although HW can be transported both by truck and rail, truck transportation is the predominant method for shipping HW. The risk estimates include a fraction of a single fatality for each of the proposed HW alternatives from vehicle accidents associated with HW transportation.

8.3.2 Air Quality Impacts Results

The management of HW would not appreciably affect the air quality at most sites. No criteria pollutants would exceed standards at any site. However, regionalization of treatment facilities at LANL and ORR would cause adverse air quality impacts requiring additional emission control measures for vinyl chloride. The exceedances at LANL and ORR are primarily due to emissions from incineration.

8.3.3 Other Environmental Impacts

Results for the water resources, ecological, economic, infrastructure, cultural, and land use impacts analysis did not indicate significant impacts for any of the HW alternatives, and therefore no meaningful discriminators between alternatives were determined for these impact areas. Assessment of potential environmental justice impacts from management of HW indicated that minority and low-income populations at the HW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the HW alternatives.

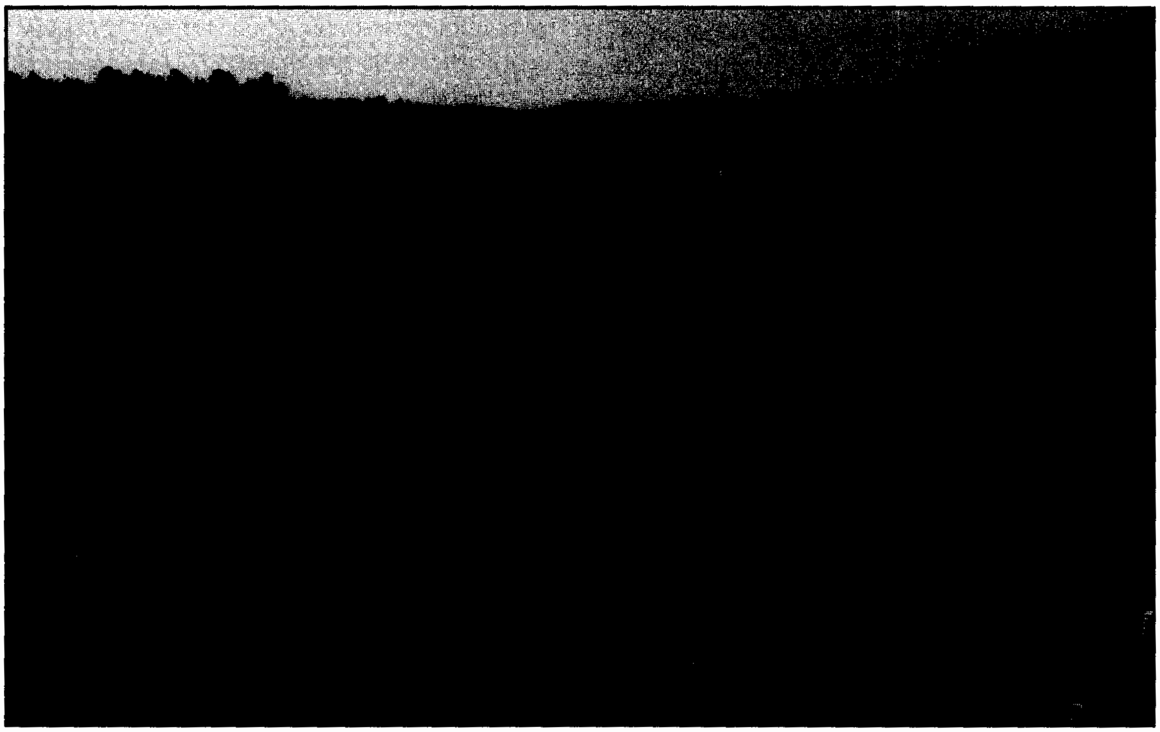
8.3.4 Costs

The No Action Alternative is the least costly of the alternatives at an estimated $144 million, followed by the decentralized alternative at $194 million. Regionalized Alternative 1 is the most expensive at $376 million, closely followed by Regionalized Alternative 2 at a cost of $318 million. Conversely, commercial treatment costs are highest for the No Action Alternative and lowest for the Regionalized Alternative 2.

The fundamental differences among the alternatives involve transportation and the implementation costs of the HW alternatives. Table 8.3–1 presents a summary of the transportation and cost differences among the alternatives over the 20-year analysis period.

Table 8.3-1. Summary Comparison of the HW Alternatives

Category	Measurement Units	HW Alternatives			
		No Action	Decentralized	Regionalized	
				1	2
Shipments—Mileage	Millions of Miles	20	18	35	19
Shipments—Number	Thousands of Shipments	34	41	50	34
Transportation costs	$ in millions	49	45	87	47
Project Life-Cycle Costs	$ in millions	95	149	289	271
Total Transport and Project Costs	$ in millions	144	194	376	318



Monitoring of air, water, vegetation, and plant life is routinely conducted at DOE sites to ensure safety and regulatory compliance.

Cumulative Impacts

9.1 Cumulative Impacts Analysis

Cumulative impacts are those impacts that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. **Combined impacts**, in this PEIS, are the subset of cumulative impacts resulting from the siting of more than one waste type facility at one site. Both Council on Environmental Quality and DOE regulations for implementing NEPA require the assessment of cumulative impacts because significant impacts can result from several smaller actions that, individually, may not have significant impacts.

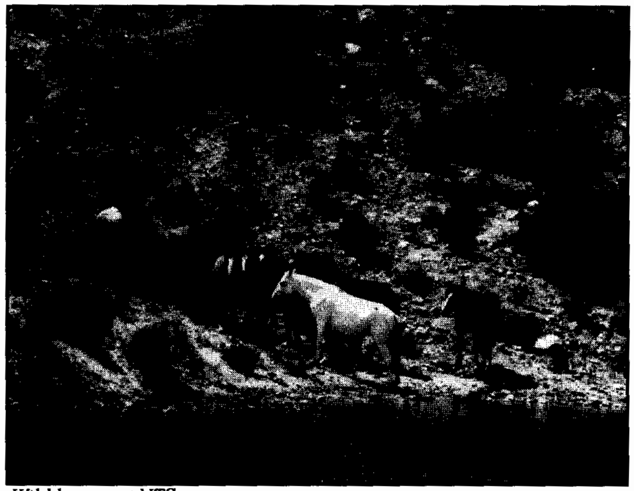
To conduct the cumulative impacts analysis, DOE first examined the combined impacts of siting waste management facilities for more than one waste type at each of the 17 major sites. DOE then added the impacts of other past, present, and reasonably foreseeable future actions to these combined impacts in the region in order to assess the cumulative impacts.

The combined and cumulative impact analysis considers the following impact areas:

- Offsite population human health risks
- Offsite maximally exposed individual health risks
- Air quality exceedances
- Infrastructure resources
- Socioeconomic impacts

In addition, health risks to onsite workers and total costs for the waste management alternatives are presented as well as analysis of both combined and cumulative transportation impacts.

Because the alternatives for the five waste types can be combined in numerous ways (for some sites, there are thousands of possible combinations of alternatives across all the waste types), the combined impacts of placing multiple facilities at each site are presented in the form of minimum and maximum values for each of the combined impact areas for each waste type. The values are then summed for each impact area to determine the combined minimum and maximum impacts for each site.



Wild horses at NTS.

Following the combined impacts analysis, the minimum and maximum impacts are then considered together with the impacts of other past, present, and reasonably foreseeable actions at and in the region of each of the 17 major sites. The cumulative impact assessment for these sites includes the consideration of the actions that DOE is taking or considering for near-term spent nuclear fuel management, tritium supply and recycling, and the consolidation of non-nuclear functions. Other site-specific projects such as vitrification of HLW at the Hanford Site and SRS, and the operation of WIPP, are also discussed for each of the 17 major sites where applicable.

Tables of combined and cumulative impacts containing the impact categories and the major elements comprising the cumulative impacts (i.e., combined, existing, and other reasonably foreseeable actions) are presented for each of the 17 major sites and for transportation impacts. These tables are contained in Chapter 11 of the PEIS. These data allow the decisionmaker, when evaluating alternatives for a specific waste type such as LLMW, to consider the range of additional impacts that might occur at any site caused by implementation of alternatives for other waste types or other activities.

9.2 Cumulative Impacts Results

The analysis of combined and cumulative effects considers only those impacts that are additive. Impact areas for waste-type alternatives which were not considered for combined and cumulative effects, include:

- groundwater risks and contamination from disposal, because it is assumed that the contaminants from each disposal site are separated and do not merge nor co-mingle;

- risks from accidents, because it is assumed that events initiating accidents for each waste type are independent (common-initiated events are more appropriately analyzed in site-specific reviews); and

- waste management worker risks, because it is assumed that each waste type worker is dedicated to that waste type and would not work simultaneously in another waste-type facility.

Also, the No Action Alternative was not considered in calculating minimum and maximum impact values for LLMW, TRUW, and HLW because "no action" would not comply with existing law.

The following sections briefly summarize the key results of the cumulative impacts analysis:

- Even though locating waste management facilities at sites would increase the health risks to offsite populations surrounding the sites, cumulative atmospheric radiological releases would not exceed EPA standards, except at LANL as a result of Regionalized Alternative 2 for TRUW and at WIPP as a result of the Centralized Alternative for TRUW. Exceedance of the EPA standard for the Regionalized 2 and Centralized Alternatives for TRUW indicate that either mitigation measures would need to be implemented to achieve compliance or these two TRUW alternatives should not be selected.

- Eight of the 17 sites could exceed one or more air pollutant standards as a result of maximum cumulative atmospheric emissions. Selection of the waste type alternatives will need to consider the potential cumulative air quality impacts of the alternatives for these sites in combination with potential mitigation measures.

- Eight of the 17 sites could require improvements to onsite water, wastewater, and electric power systems. Five of these eight sites (INEL, NTS, ORR, the Pantex Plant, and SRS) could require improvements directly as a result of the possible location of tritium supply and recycling facilities rather than as a result of the waste management alternatives considered in the WM PEIS. The remaining three sites, the Hanford Site, WIPP and WVDP, would require improvements resulting from maximum demands resulting from the waste management alternatives.

- Nine sites could require potential mitigation measures to reduce offsite infrastructure and institution demands due to possible employment increases as a result of the waste management alternatives and other actions considered in the cumulative impacts analysis. These sites are the Hanford Site, INEL, LANL, NTS, ORR, the Pantex Plant, Portsmouth, SRS, and WIPP.

- The largest number of waste shipments to or from a single site could occur at the NTS as a result of the shipment of LLMW and LLW under Centralized Alternatives and the shipment of HLW and Spent Nuclear Fuel if Yucca Mountain is found to be suitable as a geologic repository. A combined total of more than 295,000 truck shipments or more than 106,000 rail shipments of waste occur at the NTS.

- Over the 93-year period from 1943 through about 2035, the total number of radiation-related cancer fatalities as a result of transporting radioactive materials and waste is estimated at 315, or about 3 latent cancer fatalities per year. The total number of potential radiation-related latent cancer fatalities associated with the waste management alternatives are about 7% of this cumulative number of fatalities.

At a Glance:

Low-Level Mixed Waste

No Action Alternative:

- Continue treatment at existing facilities with indefinite storage.
- Alternative does not include disposal and does not comply with RCRA.

Decentralized Alternative:

- Treatment at all 37 sites and disposal at 16.

Four Regionalized Alternatives:

- Treatment at 11, 7 or 4 sites with disposal at 12, 6 or 1 site(s).

Centralized Alternative

- Treatment and disposal at 1 site.

Preferred alternative: Regionalized Alternative (most closely approximates Proposed Site Treatment Plans under the FFCAct).

LLMW Data and Major Assumptions:

- 37 sites generate or store LLMW.
- Waste management activities will require management of an estimated 226,000 cubic meters of LLMW over the next 20 years.
- All LLMW facilities are designed to treat waste to meet RCRA requirements.
- New facilities would be constructed during a 10-year period; LLMW currently in inventory and newly generated would be treated during 10-year period following construction of facilities.
- Wastewater treatment activities would continue at every site.
- No waste acceptance criteria were imposed on disposal sites.

What Did We Learn from the Results:

- Highest risks in LLMW are to waste management workers associated with construction activities.
- Individual site environmental impacts exist in the Centralized Alternative.
- Costs range from $8 billion for Centralized Alternative to $13 billion for Decentralized Alternative.
- Centralized Alternative utilizes lowest number of workers.
- Radionuclide- and/or chemical- specific limits will be required for disposal at most sites.

At a Glance: Low-Level Waste

No Action Alternative:

- Disposal at 6 sites under current arrangements. Sites use existing treatment facilities.

Decentralized Alternative:

- Disposal at 16 sites. A minimum level of treatment at each site is assumed.

Seven Regionalized Alternatives:

- Disposal at 12, 6, or 2 sites. In three alternatives, treatment to reduce volumes is also assumed, using 11, 7, or 4 regional sites.

Five Centralized Alternatives:

- Disposal at one site (either Hanford or NTS). In three alternatives, treatment to reduce volumes is also assumed.

LLW Data and Major Assumptions:

- LLW is currently generated, projected to be generated, or stored at 27 DOE sites.
- The PEIS evaluates management of 1.5 million cubic meters of LLW over the next 20 years.
- New facilities would be constructed during a 10-year period; LLW currently in inventory and newly generated would be treated during 10-year period following construction.
- Wastewater treatment activities would continue at every site.
- No waste acceptance criteria were imposed on disposal sites.

What Did We Learn from the Results:

- At National level, costs, risks and impacts are greater for volume reduction than minimum treatment.
- Centralized disposal results in a large transportation volume with commensurately greater transport risk from both traffic accidents and radiation exposure. Rail transport has significantly lower risks than truck transport.
- Transportation poses highest risks to public.
- Radionuclide-specific limits will be required for disposal at most sites.

At a Glance:
Transuranic Waste

No Action Alternative:

- Continue storage in existing facilities.

Decentralized Alternative:

- TRUW would meet current WIPP criteria. Sites with small amounts would transport to 10 largest sites until disposal at WIPP.

Three Regionalized Alternatives:

- Contact-handled TRUW treated at 3 or 5 sites and remote-handled TRUW treated at 2 sites, then transported to WIPP for disposal.
- Two levels of treatment are evaluated. One alternative examines treatment to an intermediate level and two to more stringent levels to meet RCRA LDR.

Centralized Alternative:

- Contact-handled TRUW would be transported to WIPP for treatment to meet LDR and disposal. Remote-handled TRUW would be transported to ORR and Hanford for treatment to meet LDR and then to WIPP for disposal.

TRUW Data and Major Assumptions:

- TRUW is managed, or may be managed in the future, at 17 DOE sites.
- Waste management activities will require management of approximately 107,000 cubic meters of TRUW over the next 20 years.
- All TRUW is evaluated as mixed waste.
- For the transportation analysis WIPP is assumed to be the geologic repository.
- Disposal impacts were not evaluated.
- Both defense and non-defense TRUW would be accepted at WIPP.
- New facilities would be constructed during a 10 year period; waste in storage and newly generated would be treated during 10 years following construction.
- Characterization facilities are constructed at each site before shipment.

What Did We Learn from the Results:

- LDR treatment of TRUW poses greater risks, air quality impacts, and costs than lesser levels of treatment.
- Transportation risks and costs were roughly equivalent for all alternatives shipping to WIPP.

At a Glance:
High-Level Waste

No Action Alternative:

- HLW canisters would be stored at Hanford, SRS, and WVDP until acceptance at geological repository. HLW at INEL would be stored as calcine or liquid.

Decentralized Alternative:

- HLW canisters would be stored at all four sites generating canisters until acceptance at a geological repository.

Two Regionalized Alternatives:

- Canisters from WVDP would be transported to SRS or Hanford; canisters would be stored at Hanford, SRS, and INEL until acceptance at a geological repository.

Centralized Alternative:

- Canisters would be transported from WVDP, INEL, and SRS to Hanford; canisters would be stored at Hanford until acceptance at geological repository.

Preferred alternative: Store treated HLW onsite at SRS, the Hanford Site, and INEL. No preference for storage of treated HLW at WVDP.

HLW Data and Major Assumptions:

- HLW is currently stored at Hanford, INEL, SRS, and WVDP.
- Approximately 398,700 cubic meters of HLW have been generated. Treated HLW will require an estimated 28,372 canisters for packaging.
- Glass Waste Storage Building for SRS (2,286 canisters) is a model for storage at Hanford and INEL.
- For transportation impacts analysis, the candidate repository at Yucca Mountain was assumed.
- Repository can accept 800 canisters per year.
- The PEIS evaluates canister storage. Treatment and disposal of HLW are not analyzed.
- Two sets of timing assumptions were analyzed—acceptance of canisters at the candidate repository beginning in 2015 and acceptance beginning at some later date.

What Did We Learn from the Results:

- Although costs and risks are slightly higher for centralized storage at Hanford; differences are not significant. Alternatives are roughly equivalent from standpoint of environmental impacts and costs.
- Acceptance rate at the candidate repository controls length of storage time.

At a Glance: Hazardous Waste

No Action Alternative:

- Nonwastewater HW would continue to be transported to commercial facilities. Two DOE sites would treat organic materials.

Decentralized Alternative:

- Nonwastewater HW would continue to be transported to commercial facilities. Three DOE sites would treat organic materials.

Two Regionalized Alternatives:

- 50% of nonwastewater HW would be treated at five DOE sites; 50% would be treated at commercial facilities.
- 90% of nonwastewater HW would be treated at two DOE sites; 10% would be treated at commercial facilities.

Centralized Alternative:

- None.

Preferred alternative: No Action (continue use of commercial sector).

HW Data and Major Assumptions:

- HW is generated or exists at about 45 sites.
- The PEIS evaluates treatment of 69,000 cubic meters of RCRA-regulated hazardous waste generated over the next 20 years. Totals do not include wastewater.
- Analysis of RCRA HW shipped to commercial treatment from top 11 sites in fiscal year 92 provides representative sample to compare onsite DOE treatment versus offsite commercial treatment.
- Wastewater HW continues to be treated onsite.

What Did We Learn from the Results:

- Risks and impacts are similar for each alternative.
- Costs favor commercial treatment.

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