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# Information Package on Pending Low-Level Waste and Mixed Low-Level Waste Disposal Decisions

to be made under the
*Final Waste Management Programmatic Environmental Impact Statement*

U. S. Department of Energy

September 1998

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## TABLE OF CONTENTS


Page

1. Executive Summary . . . . . 1
2. Frequently Asked Questions and Answers . . . . . 3
3. Introduction and Overview . . . . . 5
   - 3.1 Purpose . . . . . 6
   - 3.2 Supplement Analysis . . . . . 6
   - 3.3 Context for WM PEIS Disposal Decisions . . . . . 7
     - 3.3.1 Brief History of LLW Management within DOE . . . . . 7
     - 3.3.2 Overview of Regulatory Framework . . . . . 8
     - 3.3.3 Scope of WM PEIS Decisions . . . . . 8
       - 3.3.3.1 Onsite Disposal of Contaminated Media: Not in WM PEIS Scope . 10
       - 3.3.3.2 Commercial Disposal: Not in WM PEIS Scope . . . . . 10
   - 3.4 Why These Decisions Must Be Made . . . . . 10
4. LLW and MLLW Disposal Options . . . . . 12
   - 4.1 WM PEIS Generator Sites . . . . . 12
   - 4.2 WM PEIS Disposal Alternatives . . . . . 12
   - 4.3 WM PEIS Preferred Alternatives . . . . . 13
   - 4.4 Preferred Candidate Disposal Sites . . . . . 15
     - 4.4.1 Hanford . . . . . 15
     - 4.4.2 Idaho National Engineering and Environmental Laboratory . . . . . 15
     - 4.4.3 Los Alamos National Laboratory . . . . . 15
     - 4.4.4 Nevada Test Site . . . . . 16
     - 4.4.5 Oak Ridge Reservation . . . . . 16
     - 4.4.6 Savannah River Site . . . . . 16
     - 4.4.7 Summary of Candidate Disposal Site Characteristics . . . . . 16
   - 4.5 Current Disposal Options . . . . . 17
     - 4.5.1 LLW Disposal Options . . . . . 19
       - 4.5.1.1 LLW Disposal Option 1 . . . . . 20
       - 4.5.1.2 LLW Disposal Option 2 . . . . . 20
       - 4.5.1.3 LLW Disposal Option 3 . . . . . 21
       - 4.5.1.4 LLW Disposal Option 4 . . . . . 21
       - 4.5.1.5 LLW Disposal Option 5 . . . . . 22
       - 4.5.1.6 LLW Disposal Option 6 . . . . . 22
     - 4.5.2 MLLW Disposal Options . . . . . 24
       - 4.5.2.1 MLLW Disposal Option A . . . . . 24
       - 4.5.2.2 MLLW Disposal Option B . . . . . 24
       - 4.5.2.3 MLLW Disposal Option C . . . . . 25
       - 4.5.2.4 MLLW Disposal Option D . . . . . 25
       - 4.5.2.5 MLLW Disposal Option E . . . . . 26

## TABLE OF CONTENTS (Continued)

Page

5. Decision Criteria ..... 28
   5.1 Mission Compatibility ..... 29
   5.2 Environment, Safety and Health (ES&H) ..... 29
   5.3 Transportation ..... 30
   5.4 Cost ..... 30
   5.5 Stakeholder Acceptance ..... 32
6. Summary ..... 34

## FIGURES

Page

Figure 1. Discussions with States, Tribes, and Stakeholders ..... 5
Figure 2. WM PEIS Waste Types, Decisions, Decision Dates, and Preferred Alternatives .. 9
Figure 3. Type of Sites Evaluated in WM PEIS ..... 12
Figure 4. From 16 Major Sites to 6 Preferred Sites ..... 13
Figure 5. LLW Volumes Disposed at Candidate Disposal Sites by End of Fiscal Year 1996 13
Figure 6. Summary of Candidate Disposal Site Physical Characteristics ..... 14
Figure 7. Site Roles in Current DOE LLW and MLLW Disposal Options ..... 18
Figure 8. Projected LLW and MLLW Disposal Volumes ($m^3$) Subject to WM PEIS Decisions ..... 19
Figure 9. LLW Disposal Option 1 ..... 20
Figure 10. LLW Disposal Option 2 ..... 20
Figure 11. LLW Disposal Option 3 ..... 21
Figure 12. LLW Disposal Option 4 ..... 21
Figure 13. LLW Disposal Option 5 ..... 22
Figure 14. LLW Disposal Option 6 ..... 22
Figure 15. MLLW Disposal Option A ..... 24
Figure 16. MLLW Disposal Option B ..... 24
Figure 17. MLLW Disposal Option C ..... 25
Figure 18. MLLW Disposal Option D ..... 25
Figure 19. MLLW Disposal Option E ..... 26
Figure 20. Summary of Decision Criteria Ratings for LLW and MLLW Disposal Options . 28

## APPENDICES

A. LLW and MLLW Volume Projections
B. ES&H and Transportation Impacts Scaling Analysis
C. Cost Analysis
D. Cumulative Impacts

September 22, 1998

## 1. Executive Summary

The Department of Energy (DOE) continues to face a legacy of wastes needing disposal. During much of the Department's history, DOE did not dispose of its waste streams in a timely manner, allowing these wastes to accumulate in storage. Now, DOE must make responsible waste disposal decisions to support ongoing and new missions. The Department has recently analyzed alternatives for low-level waste (LLW) and mixed low-level waste (MLLW) treatment and disposal in an environmental impact statement, prepared according to the National Environmental Policy Act (NEPA). The Department of Energy's *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS) was issued on May 30, 1997. In the WM PEIS, the preferred alternatives for LLW and MLLW disposal narrowed the number of potential regional disposal locations, but did not select preferred sites. This was in fulfillment of a commitment the Department made to have further discussions with States, stakeholders, and Tribal Nations before announcing which sites will be designated to receive waste for disposal from other sites (i.e, regional disposal sites). The six candidate sites for LLW disposal and MLLW disposal are the same: Hanford, Idaho National Environmental and Engineering Laboratory (INEEL), Los Alamos National Laboratory (LANL), Nevada Test Site (NTS), Oak Ridge Reservation (ORR) and Savannah River Site (SRS).

To enable the selection of preferred sites, DOE has analyzed six options for LLW disposal and five options for MLLW disposal. These options focus on where to dispose the LLW and MLLW that cannot be disposed of onsite. Each option varies where that waste is sent.

This document puts the LLW and MLLW disposal decisions in context with other Departmental activities, describes each option, and provides results of the quantitative analysis for the criteria DOE will use to makes its decision. They are:

- Mission compatibility
- Environment, safety, and health
- Transportation
- Cost

These criteria were derived from those used in the final WM PEIS. The following is a synopsis of how each option was evaluated against those criteria.

*Mission Compatibility:* This is a qualitative measure of how compatible sites' roles are in each option with respect to existing site infrastructure and other issues such as technical feasibility and operational flexibility. The Department considers all the LLW and the MLLW options to be generally compatible with existing and projected missions. Three LLW options are considered less compatible because of the need to construct new facilities, as are two of the MLLW options. Options that include only one regional disposal site are also considered less compatible.

*Environment, Safety, and Health (ES&H):* Specific impacts evaluated in the criterion include potential facility worker fatalities and the number of sites in each option that could exceed air and water standards. Overall, the potential ES&H impacts are very low, and do not vary

significantly among the options. The potential impacts for the options are always within the range analyzed in the WM PEIS. Consequently, this criterion is not a discriminator for selection among the options.

*Transportation:* This criterion estimates potential worker and public fatalities associated with waste transportation by either truck or rail. Overall, the potential transportation impacts are very low, and do not vary significantly among the options. The potential impacts for the options are always within the range analyzed in the WM PEIS. Consequently, this criterion is not a discriminator for selection among the options.

*Cost:* This is an estimate of the expenses DOE would incur to carry out a given option. When compared with the current baseline of continued storage, the single most significant cost savings to the Department would be to carry out ***any*** disposal option for LLW or MLLW and be able to eliminate extended and costly interim storage. The most costly options are those requiring construction of new disposal facilities. For LLW these are the options including onsite disposal at Oak Ridge or regional disposal at Savannah River. For MLLW these are the options that include regional disposal at Savannah River.

The Department also recognizes the importance of stakeholder acceptance as a decision criterion, but realizes this important criterion cannot be evaluated without the direct input of the States, stakeholders, and Tribal Nations. The purpose of this document is to serve as an information resource so those interested parties may:

- have full knowledge of the options,
- have access to the analysis DOE has done concerning the options,
- evaluate the options
- inform DOE of their preferences and perspectives on those options.

Through this and other discussions DOE can gain insight on stakeholder acceptance for each option, and factor that into its decision making.

Pending completion of a NEPA Supplement Analysis and a determination on whether a Supplemental EIS is needed, the Department is preparing to issue decisions on LLW and MLLW regional disposal locations in late 1998 - early 1999. This document has summarized information from the original WM PEIS analyses and more recent analysis of current LLW and MLLW disposal options. This document does not present the Department's preference. At this time such a statement of preference would be premature. DOE is committed to incorporating input from interested States, stakeholders, and Tribal Nations into its decision making process. The feedback and continuing discussions with States, Tribal Nations, and stakeholders will be key to the final decision making process.

If disposal decisions do not get made, the ability to move forward with all other missions is affected. Waste disposal is an integral part of DOE programs and missions. All radioactive waste generated by the Department must ultimately be disposed.

## 2. Frequently Asked Questions and Answers

***What waste was considered in the scope of the WM PEIS?***
The WM PEIS analyzed five waste types: high level waste, transuranic waste, hazardous waste, low-level waste (LLW) and mixed low-level waste (MLLW). The LLW and MLLW analyzed were those wastes generated from legacy operations of the nuclear weapons production, energy research activities, and newly generated wastes for those missions over the next 20 years. The question posed by the WM PEIS was "for the various DOE sites, should these wastes be disposed of on-site or off-site?" The WM PEIS decisions will not determine how much contaminated soil, groundwater, and buildings from environmental restoration activities will be removed for cleanup purposes.

***How are the wastes from environmental restoration cleanup activities accounted for?***
The disposal of LLW and MLLW contaminated soil, groundwater, and buildings is addressed in various site-specific Comprehensive Environmental Response Compensation and Liability Act (CERCLA) decisions. Such decisions are made at the local site level, in conjunction with State regulators and EPA, based on land uses that reflect local conditions and, to the extent possible, the preferences of local stakeholders. Waste managed through an on-site CERCLA disposal cell is not within the scope of the WM PEIS. The CERCLA decisions will also analyze, as appropriate, the tradeoffs of disposal on-site, off-site at a waste management facility, and/or off-site at a commercial disposal facility. Therefore, DOE has analyzed the potential impacts associated with disposing these cleanup-generated wastes at WM facilities.

***What were the WM PEIS Preferred Alternatives for LLW disposal and for MLLW disposal?***
The WM PEIS preferred alternatives for LLW disposal and MLLW disposal are the same: to select two or three regional disposal sites from the following six candidate DOE sites -- Hanford, Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Nevada Test Site (NTS), Oak Ridge Reservation (ORR) and Savannah River Site (SRS). Sites not selected as regional facilities could continue to dispose of on-site waste. The sites selected for disposal of LLW do not necessarily have to be the same as those selected for disposal of MLLW.

***Why weren't specific disposal locations named?***
Because of the permanence of disposal decisions, the Department made a commitment to the States, stakeholders, and Tribal Nations to further evaluate the options and discuss all pertinent aspects of the disposal configurations before identifying the preferred sites for regional disposal.

***How many options is DOE now evaluating?***
DOE has analyzed six options for LLW disposal and five options for MLLW disposal. These options are based on varying the roles of the six candidate disposal sites identified in the WM PEIS preferred alternatives.

***What criteria will the DOE use to evaluate the options?***
The DOE will consider five criteria in its evaluation of the disposal options. These criteria were derived from those used in the final WM PEIS. These criteria are *mission compatibility, environment/safety/health, transportation, cost,* and *stakeholder acceptance*. Of these, DOE cannot evaluate stakeholder acceptance without the direct participation and input of States, Tribal Nations, and stakeholders. The purpose of this document is to serve as an information resource so interested parties may: have full knowledge of the options, have access to the analysis DOE has done concerning the options, evaluate the options, and inform DOE of their preferences and perspectives on those options. Through this and other discussions, the Department can gain insight on stakeholder acceptance for each option, and factor that into its decision making.

***Do the results of the analyses used to evaluate the criteria point to a clear preferred alternative?***
From a technical perspective, which includes consideration of all the criteria *except* stakeholder acceptance, no single option stands out for either LLW or MLLW disposal. While there are some differences in the cost criteria, the single most significant cost savings to the Department would be to implement ***any*** disposal option versus continuing to incur costs inherent with ongoing storage of wastes awaiting disposal.

***How much waste cannot be disposed until these disposal decisions are made?***
Approximately 95,000m$^3$ of LLW and 43,000m$^3$ of MLLW from waste management operations are dependent upon these decisions for disposal. These estimates represent waste currently in storage and projected to be generated over the next 20 years.

***What about waste going to commercial disposal facilities?***
The WM PEIS does not analyze alternatives that involve use of commercial facilities for managing LLW and MLLW waste. DOE's policy for LLW and MLLW has a preference for disposal at DOE sites. However, exceptions for the use of commercial disposal are allowed on a case-by-case basis. The WM PEIS will not make programmatic decisions on the Department's use of commercial disposal facilities.

***When will the Records of Decision be issued?***
The Department is continuing its discussions with States, Tribal Nations, and stakeholders to gather input to its final decisions. In early Fall 1998, DOE will issue a NEPA Supplement Analysis of the WM PEIS -- an analysis of the significance of updated LLW and MLLW disposal volumes. Assuming DOE decides it does not need to prepare a Supplemental PEIS, based on the Supplement Analysis, the summarized analyses results and gathered feedback received on these decisions will be presented to the Secretary of Energy for decision making in late 1998. Prior to issuing the Records of Decision (ROD), DOE will publish a notice in the *Federal Register*, notifying the public which specific sites it prefers for LLW disposal and which for MLLW disposal. Then, no less than 30 days after this notification, the Department will issue its formal Records of Decision on LLW and MLLW treatment and disposal. This is expected in late 1998 or early 1999.

***Is the Department reopening its public comment period on the WM PEIS?***
The Department is currently in the stage of furthering its evaluation of costs and discussing other pertinent aspects with stakeholders before identifying preferred disposal sites. This document contains the results of these evaluations. However, this does not constitute a reopening of the WM PEIS public comment period. The formal public comment period on the WM PEIS extended from September 22 through December 21, 1995. During the public comment period, more than 1,200 individuals and organizations provided DOE with comments, which were responded to in the final WM PEIS.

***Once the decisions get made, what will happen next?***
Although DOE will select sites for waste disposal as a result of this *programmatic* EIS, DOE will take a closer look (including site-specific impacts) in *site-wide* or *project-level* NEPA reviews. During these reviews, local DOE offices will work with other agency, State, and Tribal representatives, as well as members of the interested public, to identify and analyze specific site and facility impacts, such as those related to transportation modes and routes.

## 3. Introduction and Overview

The Department has recently analyzed alternatives for LLW and MLLW treatment and disposal in an environmental impact statement, prepared in accordance with NEPA. The Department's final WM PEIS was issued on May 30, 1997. The WM PEIS preferred alternative for LLW treatment is for minimum treatment at all sites, with additional treatment as required. For MLLW treatment, the preferred alternative is regionalized treatment at four sites (Hanford, INEEL, ORR and SRS). The Department intends to select the treatment preferred alternatives for the records of decision.

The WM PEIS preferred alternatives for LLW disposal and MLLW disposal are the same: to select two or three regional disposal sites from the following six candidate DOE sites -- Hanford, INEEL, LANL, NTS, ORR and SRS. Sites not selected as regional facilities could continue to dispose of onsite waste. DOE may also continue to use commercial disposal facilities, consistent with the DOE Radioactive Waste Management Order and policy. The sites selected for disposal of LLW do not necessarily have to be the same as those selected for disposal of MLLW. Because the WM PEIS was not specific in its Preferred Alternative, the DOE must now evaluate various options for LLW and MLLW disposal, considering differing roles for each of the six candidate disposal sites.

States, Tribal Nations, regulators and stakeholders have requested a period of dialogue on the possible disposal options before the Department issues its final decision(s). In the WM PEIS, the Department committed that, following consultations, it will notify the public as to which specific sites it prefers for disposal of LLW and MLLW by publishing a notice in the *Federal Register*. The Department will not issue a ROD for LLW or MLLW disposal until at least 30 days after the publication of its preferred disposal sites in the *Federal Register*. To initiate the dialogue concerning disposal options, DOE has participated in several workshops and meetings with various interested parties. **Figure 1** lists the activities completed and planned to further the dialogue.

***Figure 1.*** *Discussions with States, Tribes, and Stakeholders*

| ***Meeting Date*** | ***State, Tribal, or Stakeholder Group*** |
|---|---|
| March 1998 | National Governors' Association |
| April 1998 | National Association of Attorneys General |
| June 1998 | Intersite Discussions convened by the League of Women Voters |
| July 1998 | Transportation External Coordination Working Group |
| August 1998 | Site-Specific Advisory Board LLW Seminar |
| October 1998 | State and Tribal Governments Working Group |
| October 1998 | Energy Communities Alliance |
| October 1998 | National Governors' Association |

3.1 *Purpose*

The purpose of this document is to serve as an information resource for States, stakeholders, regulators, and Tribal Nations so that they may:

- have full knowledge of the options;
- have access to the analysis DOE has done concerning the options,
- evaluate the options; and
- inform DOE of their preferences and perspectives on those options.

This document puts the LLW and MLLW disposal decisions in context with other Departmental activities, describes each option, and provides results of the quantitative analysis for the criteria which DOE will use to make its decision. These criteria were derived from those used in the final WM PEIS. These four criteria are:

- Mission compatibility
- Environment, safety, and health
- Transportation
- Cost

DOE is looking to States, stakeholders, and Tribal Nations to provide input towards qualitative criteria such as equity and stakeholder acceptance.

This document does not present the Department's preference. At this time such a statement of preference would be premature. DOE is committed to incorporating input from interested States, stakeholders, and Tribal Nations into its decision making process. The feedback received on the document will be instrumental in the decision making process.

3.2 *Supplement Analysis*

In addition to the analyses presented in this document, DOE is also preparing a Supplement Analysis to the WM PEIS. DOE's NEPA regulations require a Supplement Analysis to determine if new circumstances or information relevant to environmental concerns that bear on the proposed action or its impacts are significant, such that DOE must prepare a Supplemental PEIS. Since the WM PEIS was issued, DOE has updated its estimates of the volume of LLW and MLLW requiring disposal over the 20-year analysis period. These new estimates are derived from the life cycle estimates presented in "*Accelerating Cleanup: Paths to Closure*" and have been used to develop the options currently under evaluation. The volumes are summarized in **Appendix A**. DOE considers the changes in waste volumes as new circumstances and information, and will formally document those changes in the Supplement Analysis. The Supplement Analysis will also document whether or not the potential impacts from the options currently being considered are bounded by those of the WM PEIS. The Supplement Analysis will be released in early October with an accompanying notice in the Federal Register. Based on the Supplement Analysis, DOE will decide whether or not to prepare a Supplemental PEIS.

## 3.3 *Context for WM PEIS Disposal Decisions*

### 3.3.1 Brief History of LLW Management within DOE

From the early 1960's until 1979, sites used either their own on-site disposal, or, other DOE sites or commercial disposal facilities. However, in 1979, the Governors of the States hosting the three operating commercial disposal sites took several actions (including shut downs and restrictions) that affected the commercial disposal of LLW, resulted in new policies at DOE for disposal of its LLW, and generated legislation affecting both DOE and commercial disposal of LLW (the category of MLLW had not yet been defined). Following the Governor of South Carolina's 1979 restrictions upon the volume of waste allowed to go to the Barnwell facility, DOE consulted with each of its sites that were using commercial disposal. Seeking to minimize possible impacts to its LLW disposal operations from commercial disposal restrictions, the Department decided to revise its disposal policy. In October 1979, DOE directed its sites to stop using commercial disposal facilities.

In November 1979, DOE issued a memorandum clarifying and implementing the policy announced in October. The memorandum assigned to the generator sites who were previously using a commercial disposal facility, two Field Operations Offices managing DOE LLW disposal sites to arrange for disposal. The generators of low-level waste from DOE defense-related activities were assigned to the Nevada Test Site. The generators of low-level waste from DOE non-defense (e.g., energy research) activities were assigned to the Hanford Site. The memorandum also stated that no additional DOE LLW should be sent to the Oak Ridge National Laboratory due to severely limited disposal capacity.

Another policy memorandum was issued by DOE in June 1980 addressing management of LLW. This memorandum reiterated that the November 1979 memorandum continued to be DOE policy, and provided further guidance on implementing the policy for LLW that was difficult to define as either "commercial" or "DOE" LLW.

DOE has a current policy concerning disposal of LLW and MLLW which is stated in DOE Order 5820.2A Radioactive Waste Management (September 26, 1998).[1] The Order provides that LLW and MLLW "...shall be disposed of on the site at which it is generated, if practical, or if on-site disposal is not available, at another Department disposal facility."[2] Exemptions from the requirements of this Order may be granted.[3] Additional guidance on exemptions to use non-DOE

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[1] DOE Order 5820.2A is being revised and is expected to be issued by October 1998 as DOE O 435.1.

[2] DOE Order 5820.2A, 1988, Chapter III, paragraph 2.c.

[3] DOE Order 5820.2A, 1988, Section 9 - Exemptions.

facilities for disposal of LLW and MLLW is provided in a memorandum from the Assistant Secretary for Environmental Management[4]:

- The use of a non-Federal facility for LLW disposal must meet applicable Federal, State, and local requirements and have the necessary permits, licenses, and approval;
- The activity must be sufficiently characterized and verified to meet facility's waste acceptance criteria;
- The activity must be cost effective and in the best interest of the Department;
- Appropriate NEPA review must be completed.

In addition, host States and State Compacts must be consulted before approval of the exemption.

As a consequence of these actions, DOE disposal of operations LLW occurs at the six sites currently identified in the Preferred Alternative, with only two, the Hanford Site and the Nevada Test Site, disposing off-site generated waste.

### 3.3.2 Overview of Regulatory Framework

In 1989, the Environmental Management (EM) Program was formed and charged with the cleanup activities at over 30 DOE facilities. These cleanup actions are being conducted according to U.S. Environmental Protection Agency (EPA) regulations and guidelines for either the Resource Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA, also known as Superfund), or in some cases both RCRA and CERCLA (Rocky Flats, for example). To date using the CERCLA cleanup process, two RODs[5] have been issued resulting in construction and operation of two on-site disposal cells, one at Hanford, the other at Fernald. These cells are dedicated to receiving contaminated media[6] (soil, rubble, etc.) collected during cleanup of the respective sites. DOE is proposing to construct on-site CERCLA disposal cells at the Oak Ridge site and another at INEEL. These decisions will be made by regulators and DOE, with stakeholder input, using the CERCLA process.

### 3.3.3 Scope of WM PEIS Decisions

The WM PEIS analyzed five waste types (hazardous, TRU, LLW, MLLW, and HLW) for management at DOE waste management facilities. **Figure 2** lists the preferred alternative for each of the WM PEIS waste-type decisions and gives the date for each decision, either actual or planned. For the WM PEIS LLW and MLLW disposal decisions, DOE is analyzing the disposal

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[4]Assistant Secretary Alm to Field Office Managers, October 24, 1996.

[5]CERCLA RODs have also been issued for the management of 11e(2) byproduct material at Weldon Springs and at Monticello.

[6]Materials such as soil, sediment, surface water, groundwater, and other in-place materials (such as sludge and rubble debris that have been disposed of and/or intermixed with soil) that are contaminated at levels requiring further assessment to determine whether an environmental restoration action is warranted.

of 520,000m³ of LLW and 110,000m³ of MLLW. These volumes represent 20-year estimates derived from the life cycle estimates presented in *Paths to Closure*. Tables and figures in **Appendix A** identify the volumes of LLW and MLLW estimated from waste management operations subject to the WM PEIS decisions. In addition, Appendix A displays LLW and MLLW volumes which could be transferred to waste management facilities through CERCLA site-specific cleanup decisions or RCRA corrective action decisions. The WM PEIS decisions will not determine how much contaminated media will be removed for cleanup purposes. However, site-specific CERCLA or RCRA decisions could be made to dispose the media at a waste management facility. Therefore, DOE has analyzed the potential impacts associated with disposing these cleanup-generated wastes at WM facilities.

***Figure 2.*** *WM PEIS Waste Types, Decisions, Decision Dates, and Preferred Alternatives*

| WASTE TYPE | DECISION | DECISION DATE | WM PEIS PREFERRED ALTERNATIVE[7] |
|---|---|---|---|
| TRU | Storage<br>Treatment | January 1998 | Treat and store TRU on-site, except Sandia ships TRU to LANL |
| HAZ | Treatment | July 1998 | Continue to use commercial facilities to treat non-wastewater HAZ |
| LLW | Treatment | Proposed December 1998 | Minimally treat LLW on-site, though each site may perform additional treatment to decrease costs/ transportation by reducing volume of LLW for disposal |
| | Disposal | | Regionally dispose LLW at two or three of the following six candidate sites: Hanford, INEEL, LANL, NTS, ORR, and SRS |
| MLLW | Treatment | Proposed December 1998 | Regionally treat MLLW, allowing sites with small amounts of MLLW to send their MLLW to other sites for treatment[8] |
| | Disposal | | Regionally dispose MLLW at two or three of the following six candidate sites: Hanford, INEEL, LANL, NTS, ORR, and SRS |
| HLW | Storage | Proposed Late 1998 -Early 1999 | Store HLW on-site at site where it is treated |

There are two major portions of DOE LLW and MLLW which are not subject to the WM PEIS disposal decisions. These two portions are:

[7]Preferred alternative for those decisions not yet made; decisions for those already made.

[8]Consistent with Site Treatment Plans prepared under the Federal Facility Compliance Act.

3.3.3.1 *Onsite Disposal of Contaminated Media: Not in WM PEIS Scope*
All CERCLA cleanup decisions are made at the local site level, in conjunction with State regulators and EPA, based on land uses that reflect local conditions and, to the extent possible, the preferences of local stakeholders. Consequently, determining the amount of contaminated media that may be placed in a CERCLA disposal cell (if one is located at the site), is outside the context of the LLW and MLLW disposal decisions presently being made.

*3.3.3.2 Commercial Disposal: Not in WM PEIS Scope*
The WM PEIS does not analyze alternatives that involve use of commercial facilities for managing LLW and MLLW waste. DOE's policy for LLW and MLLW disposal is contained in its Radioactive Waste Management Order.[9] This Order provides that LLW and MLLW "...shall be disposed of on the site at which it is generated, if practical, or if on-site disposal capability is not available, at another Department disposal facility." The Order also allows exemptions from the Orders' requirements to be granted, on a case-by-case basis. The Department announced in the March 1998 *Federal Register* its intent to analyze its existing policy for use of commercial disposal facilities. That analysis is expected to be completed in September 1998. Regardless, the WM PEIS will not make programmatic decisions on the Department's use of commercial disposal facilities. **Appendix A** identifies LLW and MLLW volumes that, based on current planning, could be disposed of at a commercial facility. As additional waste stream information becomes available, more waste may become eligible for commercial disposal.

3.4 *Why These Decisions Must Be Made*
The Department of Energy continues to face a legacy of environmental and process wastes that require disposal. Over the years, many DOE sites did not dispose of their waste streams in a timely manner, allowing these wastes to accumulate in storage. This may have been a result of programmatic priorities, regulatory constraints, or a combination of both.

Now, the Department must make waste disposal decisions to support ongoing and new missions and to address this backlog of stored waste. In general, the WM PEIS LLW disposal decision will allow sites to regionally dispose stored LLW in a configuration that efficiently supports the Department's current and future missions. The WM PEIS MLLW disposal decision will give sites access to regional disposal capacity that for all intents and purposes is now unavailable, since only Hanford and NTS have MLLW disposal capability and it is limited to on-site waste.

There are several important drivers for making these decisions in this time frame:
- Avoid potential health and safety concerns associated with continued indefinite storage;
- Allow sites to complete EM cleanup missions in the short term;
- Avoid unnecessary construction of new storage facilities at those sites; and
- Avoid associated long-term operating and maintenance costs.

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[9]Ibid, 1.

At Rocky Flats, access to MLLW disposal is needed to meet its 2006 closure goal. Delaying the closure of Rocky Flats is projected to result in an estimated added cost of $1.5 million per day. Ramifications have also emerged at sites that do not currently have access to a disposal site. For example, the State of Tennessee has restricted other sites' access to MLLW treatment at ORR's Toxic Substance Control Act (TSCA) Incinerator until ORR can access off-site LLW disposal. Other sites needing access to off-site disposal in the near-term include West Valley and Paducah. While commercial disposal has been providing relief for disposal of some MLLW, commercial disposal is not an available option for that MLLW having higher radioactivity, i.e. an activity level of more than 1 nano curies/gram. This represents approximately 40 percent of the MLLW needing disposal within the next 20 years. In addition to Rocky Flats, MLLW storage will continue at ORR, Paducah, Portsmouth, Sandia, SRS and West Valley until the MLLW disposal ROD is issued.

If disposal decisions are not made in the near future, the ability to move forward with all other missions is affected. While the annual costs associated with disposal appear low, disposal operations may have a much larger impact on operating programs, missions, and schedules. In addition, several smaller cleanup sites (e.g., Battelle Columbus and Brookhaven National Laboratory) rely on other sites to supply disposal capability. All radioactive waste generated by Departmental programs must ultimately be disposed.

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## 4. LLW and MLLW Disposal Options

4.1 *WM PEIS Generator Sites*

The WM PEIS evaluated 54 sites of the types shown in **Figure 3** which generate or have in inventory substantial quantities of radioactive or hazardous waste. To determine reasonable sites for potential regional/central waste management facilities, DOE determined where the largest waste volumes were located, where existing facilities were located, and where transportation requirements would be minimized.[10] For purposes of WM PEIS analyses, DOE considered only 16 of the 54 sites as candidate disposal sites[11]. These 16 sites would store or generate the bulk of the waste, have capability for future disposal of LLW or MLLW, or have existing or planned waste management facilities.

***Figure 3.*** *Type of Sites Evaluated in WM PEIS*

| | ***54 WM PEIS Generator Sites*** |
|---|---|
| 40 | DOE Sites |
| 11 | Joint DOE/Navy Nuclear Propulsion Program Sites |
| 2 | Formerly Utilized Sites Remedial Action Program (FUSRAP) Sites |
| 1 | Waste Isolation Pilot Plant |

4.2 *WM PEIS Disposal Alternatives*

After selecting the 16 candidate sites, the WM PEIS evaluated four broad categories of alternatives: No Action, Decentralized, Regionalized, or Centralized. In total, the WM PEIS analyzed 14 alternatives for managing LLW and 7 for managing MLLW. For each waste type, a No Action alternative provided a baseline for analysis that approximated DOE's current program. The three "action" categories encompassed the range of reasonable alternatives available to DOE for siting its waste management facilities. Decentralized alternatives considered waste management facilities at all 16 sites, Centralized alternatives considered waste management facilities at one or two sites, and Regionalized alternatives considered waste management facilities at a number of the sites between all 16 and just one.[12]

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[10]U.S. Department of Energy. 1997. *Final Waste Management Programmatic Environmental Impact Statement*. DOE/EIS-0200-F. May. Washington, DC: Office of Environmental Management, p. 3-8.

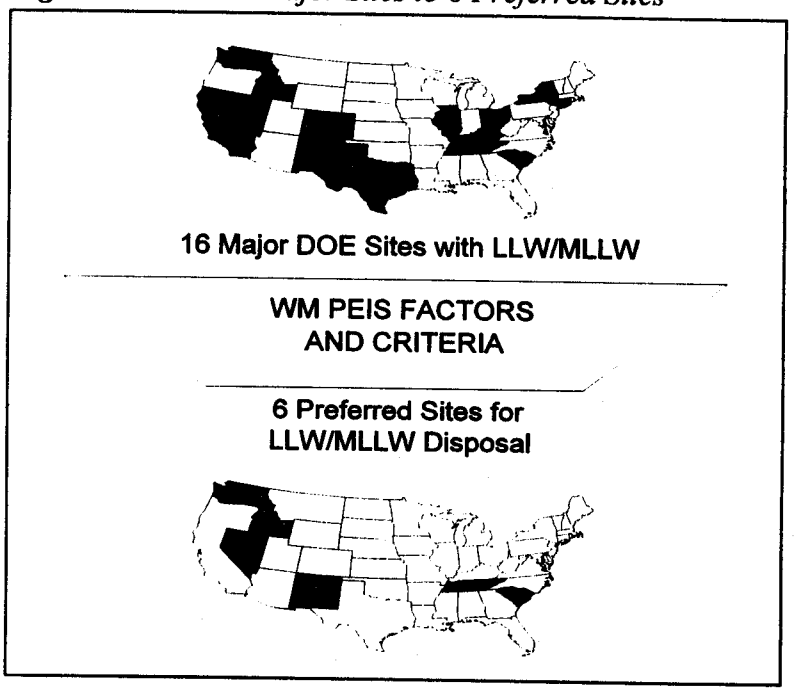
[11]The WM PEIS acknowledges a seventeenth major site, adding WIPP in New Mexico. However, since WIPP is to receive only transuranic waste, this document focuses on the 16 major sites with LLW and/or MLLW.

[12]Ibid., 12.

4.3 *WM PEIS Preferred Alternatives*

The Department selected its preferred alternatives after considering the analyses in the WM PEIS. Then, DOE excluded sites within a 100-year flood plain, within 16 meters of an active fault, or those unable to accommodate a 100-meter buffer zone around a potential disposal cell. DOE's preferred alternative for LLW disposal is the same as that for MLLW disposal: to select two to three regional disposal sites from the following six: Hanford, INEEL, LANL, NTS, ORR, and SRS. **Figure 4** shows the location of the six preferred sites. Sites selected for LLW disposal do not need to be the same as those for MLLW disposal.

***Figure 4.*** *From 16 Major Sites to 6 Preferred Sites*




The WM PEIS notes that DOE is not limited to disposal configurations represented by WM PEIS alternatives; DOE may select a configuration that incorporates components from one or more of the WM PEIS alternatives.

The six candidate disposal sites currently, and have historically, disposed DOE LLW. **Figure 5** displays the LLW volumes historically disposed at each of the candidate sites. For most sites the disposal volume shown represents disposal of on-site generated waste.

***Figure 5.*** *LLW Volumes Disposed at Candidate Disposal Sites by End of Fiscal Year 1996*[13]

| | CANDIDATE DISPOSAL SITE | | | | | |
|---|---|---|---|---|---|---|
| | Hanford | INEEL | LANL | NTS | ORR | SRS |
| Historic Disposal Volume | 640,000 | 150,000 | 230,000 | 510,000 | 210,000 | 690,000 |

The list below summarizes the six site characteristics that the WM PEIS concluded would likely cause or be associated with future levels of off-site population risk from LLW/ MLLW

[13]U.S. DOE. 1997. *Integrated Database Report -- 1996.* DOE/RW-0006, p. 4-7. In addition to the candidate sites, Fernald has disposed 340,000m$^3$ of LLW. Eight other sites have collectively disposed 270,000 m$^3$ of LLW (includes LLW from Brookhaven, Lawrence Livermore, Paducah, Portsmouth, Sandia, Y-12 and ETTP.)

disposal.[14] These characteristics are summarized for each of the candidate disposal sites in **Figure 6**.

- Population within 50 Miles: A general index of potential populations at risk from contaminated groundwater; it is not a specific estimate of future populations at risk.
- Total Site Acreage: An indirect measure of two associated characteristics:
  (1) *Size of Potential Populations at Risk* because larger sites exclude population growth on extensive areas; and
  (2) *Likelihood Contaminants in Down-Gradient Groundwater Would Appear in Publicly-Accessible Well Water Source* because of the relationship between proximity of off-site population centers to site locations where disposal facilities likely would be constructed.
- Annual Rainfall: A measure of the average annual rainfall at the site; together with Aquifer Depth and Annual Aquifer Recharge, this characterizes the surface and groundwater hydrology of a site and influences the speed, duration and extent of dispersal of potential contaminants from disposal facilities.
- Aquifer Depth: A measure of the average depth from the earth's surface to groundwater; as above, this measure influences dispersal of potential contaminants from disposal facilities.
- Annual Aquifer Recharge: A measure of the net increase in aquifer depth in an average year; as above, this influences dispersal of potential contaminants.
- Time of Travel of Water to Down-Gradient Well: An indicator of how rapidly site geology lets rain water to reach well water downstream from a disposal facility. This estimate is based on physical properties of site soils, the aquifer depth, and the groundwater velocity at each site.

***Figure 6.*** *Summary of Candidate Disposal Site Physical Characteristics*

| SITE CHARACTERISTIC[15] | CANDIDATE DISPOSAL SITE | | | | | |
|---|---|---|---|---|---|---|
| | Hanford | INEEL | LANL | NTS | ORR | SRS |
| Population within 50 Miles | 378,000 | 153,000 | 159,000 | 14,000 | 895,000 | 621,000 |
| Total Site Acreage | 371,000 | 572,000 | 28,000 | 864,000 | 35,000 | 193,000 |
| Annual Rainfall (in) | 6 | 9 | 19 | 7 | 55 | 48 |
| Aquifer Depth (ft) | 236 | 600 | 749 | 787 | 26 | 110 |
| Annual Aquifer Recharge (ft/yr) | 0.16 | 0.23 | 0.05 | <0.001 | 0.60 | 1.30 |
| Time of Travel of Water to Down gradient Well (years) | 191 | 298 | 411 | 1,352 | 11 | 23 |

[14]Ibid. 12, Volume I, Chapter 5.4.1.2.3 "Collective Offsite Population," pp. 5-31-33.

[15]Ibid. 12, pp. 5-33.

4.4 *Preferred Candidate Disposal Sites*

Now that the Department has announced its preferred alternatives for LLW and MLLW disposal, the Department must further evaluate the six candidate sites and make its final decision on which sites will provide regional (i.e. off-site) waste disposal. The following paragraphs describe each of the six candidate sites.[16]

4.4.1 Hanford

The Hanford Site occupies approximately 560 square miles of semi-arid desert land in southeastern Washington State, approximately 119 miles southwest of Spokane and 150 miles east of Seattle. The Federal Government acquired the Hanford Site in 1943, and for almost 50 years, Hanford's facilities were dedicated to plutonium production and to the storage and disposal of the resulting waste products. Hanford has existing disposal facilities for both LLW and MLLW. Hanford continues to dispose other sites' nondefense-related LLW. The site's MLLW disposal facility, though constructed, has yet to be permitted to begin disposal operations. Hanford also hosts an existing MLLW treatment facility. Local geology and climatology allow disposal of a wide range of radionuclides. Approximately 6,000 acres could potentially be available for future waste management activities. With a large site, potential for expanded disposal, and flexibility in the types and quantities of radionuclides that can be disposed, Hanford disposal facilities also could support future and expanded disposal missions.

4.4.2 Idaho National Environmental and Engineering Laboratory

INEEL occupies 890 square miles of desert in the southeastern portion of Idaho, approximately 42 miles west of Idaho Falls. INEEL was established in 1949 as a site where DOE could safely build, test and operate various types of nuclear facilities. Included within the boundaries of INEEL are two sites, the Naval Reactors Facility and Argonne National Laboratory-West. INEEL hosts a MLLW treatment facility as well as an existing LLW disposal facility. However, the LLW facility's remaining disposal capacity is limited. The groundwater underlying the INEEL is part of the Snake River Plain Aquifer, which became an EPA-designated sole-source aquifer in 1991, and supplies all drinking water consumed within the Eastern Snake River Plain. An alternative drinking water source or combination of sources is not available in this area. INEEL's existing LLW disposal facility would have to be expanded to dispose of all of the waste expected to be generated from on-site operations. Remaining INEEL disposal capacity is primarily limited to supporting the specialized needs of the Naval Reactor Facility program.

4.4.3 Los Alamos National Laboratory

LANL occupies 43 square miles in arid north central New Mexico and is approximately 25 miles north of Santa Fe on Pajarito Plateau, a series of arid mesas separated by deep canyons. Since its inception in 1943, LANL's primary mission has been nuclear weapons research and development and related projects. LANL hosts an existing LLW disposal facility, and though the site has good physical and performance attributes, its overall physical capacity is limited by the size of the

[16]Ibid 12, Chapter 4.

mesa upon which it is located. Because of this limitation and the present estimates of future waste generation from Defense Programs and National Laboratory missions, LANL will likely need to ship a portion of its LLW to other DOE sites for disposal. LANL also has the ability to handle small quantities of unique wastes (e.g., nuclear sources) from other sites.

4.4.4 Nevada Test Site

NTS occupies 1,350 square miles of desert valley and Great Basin mountain terrain in southern Nevada, 65 miles northwest of Las Vegas. The NTS has been the primary location for testing the Nation's nuclear explosive devices since 1951. The site hosts existing LLW and MLLW disposal facilities. NTS continues to dispose other sites' defense-generated LLW, as it has historically. The MLLW facility, on the other hand, is presently limited to on-site waste and does not yet dispose waste. NTS's physical characteristics provide great flexibility in the types and quantities of radionuclides that can be disposed there. The local geology virtually eliminates the potential for contamination to move into the groundwater.

4.4.5 Oak Ridge Reservation

ORR occupies 58 square miles in the valley and ridge province of eastern Tennessee. The ORR property was acquired in 1942 for the wartime Manhattan Project. ORR contains three major facilities: Oak Ridge National Laboratory, the Y-12 Plant, and the K-25 Site (now the East Tennessee Technology Park). Also located on the ORR Site is the Oak Ridge Institute of Science and Education, with an area of 340 acres. ORR hosts a MLLW treatment facility (the TSCA incinerator) which has treated other sites' MLLW. ORR also hosts an existing waste management LLW disposal facility, though the capacity is limited and largely unsuitable for expansion. The disposal facility employs a high-cost, engineered, concrete pad with concrete boxes, which are filled with waste and encapsulated in concrete (known as the tumulus design).

4.4.6 Savannah River Site

SRS is approximately 25 miles southeast of Augusta, Georgia, and 20 miles south of Aiken in southwest-central South Carolina. It is on approximately 300 square miles of land in a principally rural area. SRS was established in 1950 by the Atomic Energy Commission. SRS hosts a MLLW treatment facility (the Central Incineration Facility) and a privatized MLLW vitrification facility, though these facilities currently treat only on-site wastes. SRS also operates a LLW disposal facility. SRS disposes LLW in both engineered vaults and slit trenches (shallow land burial). The site geology permits use of trenches for slightly contaminated soil, rubble, and oversized equipment/packages. Although current LLW capacity is limited, expansion is planned. Currently, SRS projects to generate and dispose on-site more LLW than any other DOE site. Siting a MLLW disposal facility would require a waiver from current South Carolina RCRA requirements.

4.4.7 Summary of Candidate Disposal Site Characteristics

INEEL, LANL, and ORR are all limited in their expansion capability. At INEEL, the existing disposal facility would have to be expanded to dispose of all of the waste expected to be

generated from on-site operations. Remaining INEEL disposal capacity is primarily limited to supporting the specialized needs of the Naval Reactor Facility program. The proximity to the Snake River Plain Aquifer further impacts expansion potential. At LANL, the physical capacity is limited by the size of the mesa upon which it is located. The available expansion capacity is dedicated to supporting the waste disposal needs of the on-site Defense Programs and National Laboratory missions. At ORR, the capacity of the existing facility is limited and largely unsuitable for expansion. The local hydro geology limits disposal to a narrow range of radionuclides, and expansion at ORR would require the siting of a new facility.

At SRS, the use of engineered vaults allows the disposal of a wide range of radionuclides. Expansion at the current disposal location is feasible and planned. Additionally, SRS projects to generate and dispose on-site more LLW than any other DOE site. Siting a MLLW disposal facility would require a waiver from State requirements.

Both NTS and Hanford provide the environmental benefits inherent to an arid site, where evaporation rates exceed rainfall by approximately 10 to 1 or more. The local geology at the NTS greatly restricts the potential for any contamination to move into the groundwater. Both have expansion capability and the ability to dispose of a wide range of radionuclides.

### 4.5 *Current Disposal Options*

At each of the six candidate sites, DOE has already established LLW or MLLW disposal operations. Except for NTS and LANL (for MLLW), each site has large waste volumes for disposal. Because these six sites together would have more than adequate capacity (either existing or planned) for the amounts of LLW and MLLW the Department will need to dispose of, there is no need to establish additional candidate sites.

With this, DOE has developed several options for LLW and MLLW disposal. These options focus on where to dispose of the LLW and MLLW that cannot be disposed of on-site. Each option varies where that waste is sent. Thus, the options vary concerning their cost, technical feasibility, or perceived balance of shared disposal burdens among sites. However, together, the options currently being considered by the Department provide a reasonable range of configurations for which the Department can evaluate potential impacts, leading to final decisions on disposal sites. **Figure 7** overviews the site roles which form the basis for current disposal options. **Figure 8** lists the sites that generate LLW and MLLW subject to the WM PEIS decisions. Appendix A contains similar tables for environmental restoration waste that could be disposed at a waste management facility and for CERCLA disposal cells.

***Figure 7.*** *Site Roles in Current DOE LLW and MLLW Disposal Options*

| DISPOSAL ROLES | CANDIDATE DISPOSAL SITE | | | | | |
|---|---|---|---|---|---|---|
| | Hanford | INEEL | LANL | NTS | ORR | SRS |
| LLW DISPOSAL OPTIONS | | | | | | |
| Dispose On-Site LLW | All Options | Partial in All Options | Partial in All Options | All Options | Some Options | All Options |
| Dispose Off-Site LLW (Regional Disposal Site) | Some Options | No Options | No Options | All Options | No Options | Some Options |
| MLLW DISPOSAL OPTIONS | | | | | | |
| Dispose On-Site MLLW | All Options | No Options | No Options | All Options | No Options | Some Options |
| Dispose Off-Site MLLW (Regional Disposal Site) | Some Options | No Options | No Options | Some Options | No Options | Some Options |

***Figure 8.*** *Projected LLW and MLLW Disposal Volumes ($m^3$) subject to WM PEIS Decisions*

| GENERATOR SITE | LLW DISPOSAL VOLUME | MLLW DISPOSAL VOLUME |
|---|---|---|
| Ames | 30 | 0 |
| Argonne East | 3,700 | 0 |
| Brookhaven | 4,800 | 0 |
| Hanford | 148,500 | 69,200 |
| INEEL | 30,700 | 0 |
| Inhalation Toxicology Research Institute | 700 | 0 |
| LANL | 129,700 | 0 |
| Lawrence Berkeley | 200 | 0 |
| Lawrence Livermore | 11,000 | 0 |
| NTS | 400 | 0 |
| Oak Ridge | 73,000 | 25,500 |
| Paducah | 4,400 | 2,700 |
| Pantex | 1,200 | 0 |
| Portsmouth | 2,000 | 2,800 |
| Princeton | 700 | 0 |
| Rocky Flats | 20,200 | 7,400 |
| Sandia | 1,400 | 160 |
| SRS | 78,600 | 4,100 |
| West Valley | 11,300 | 30 |
| TOTAL | 522,530 | 111,800 |

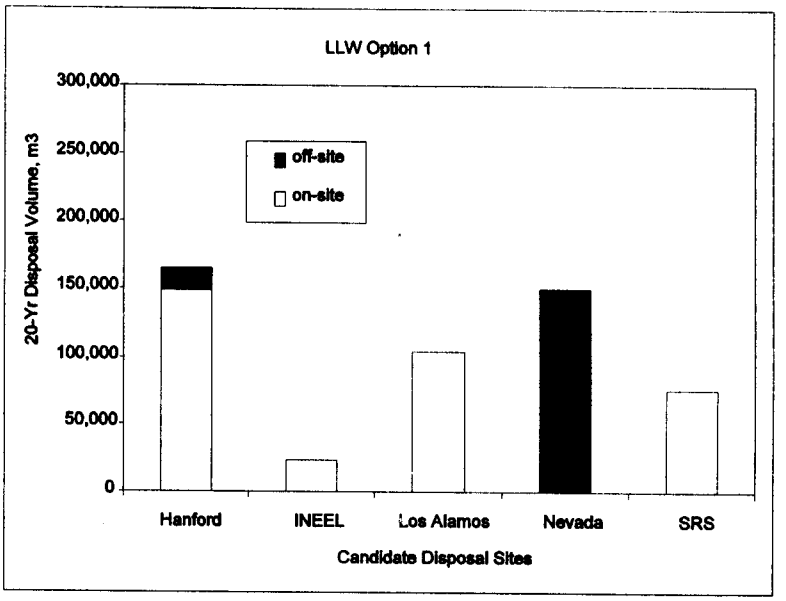
4.5.1 LLW Disposal Options

For each option, the following sections describe the sites' roles and include a graphical depiction of how much on-site and off-site waste disposal each site would perform. The bullets following each description provide some general observations about the option. Some of the waste currently estimated to be disposed off-site could be disposed of in commercial facilities, based on further analysis under DOE's Radioactive Waste Management Order[17] and economic analysis.

[17] Ibid, 1.

4.5.1.1 *LLW Disposal Option 1*

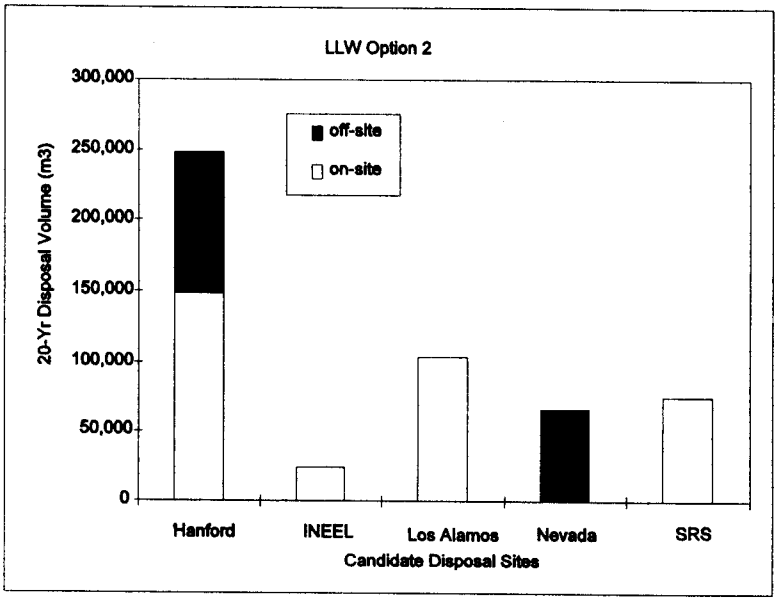
**Figure 9** depicts site roles for this option. In Option 1, two sites (INEEL and LANL) dispose part of their own LLW on-site, one site (SRS) disposes only its own LLW on-site, and two sites (Hanford and NTS) dispose their own LLW on-site plus provide regional disposal for other sites' LLW.




- Approximately 166,000m$^3$ requires off-site disposal; NTS takes 90%, Hanford takes 10%.
- Disposes LLW at five of the six sites currently disposing LLW
- Requires more transportation than East/West options (3, 4 or 5)
- Provides DOE flexibility by maintaining two regional LLW disposal sites
- Overall, NTS and Hanford dispose similar total (i.e, on-site plus off-site) volumes

4.5.1.2 *LLW Disposal Option 2*

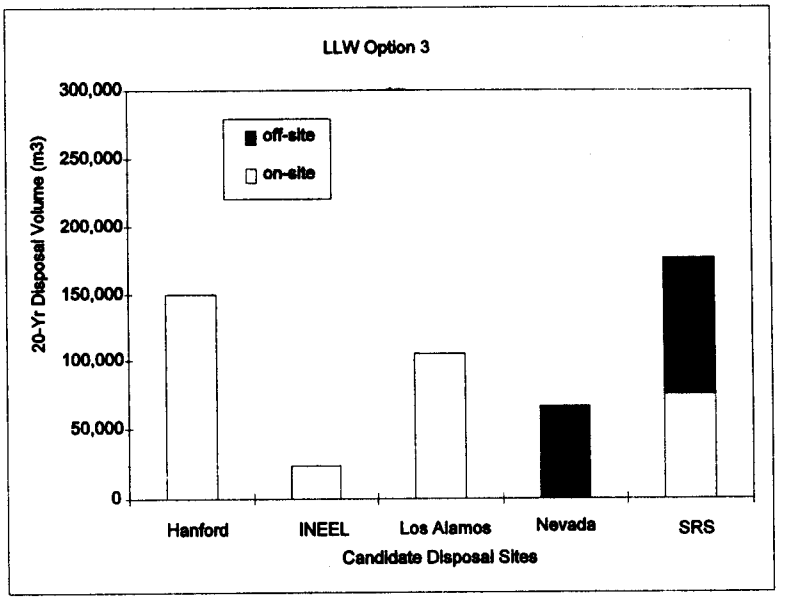
Option 2 is shown in **Figure 10**. In this option, the same two sites (INEEL and LANL) dispose part of their own LLW on-site, SRS still disposes only its own LLW on-site, and the same two sites (Hanford and NTS) dispose their own LLW on-site plus provide regional disposal for other sites' LLW. In this option, Hanford disposes more off-site waste (60%) than NTS (40%).




- Approximately 166,000m$^3$ requires off-site disposal
- Uses five of the six sites currently disposing LLW (omitting ORR)
- Requires more transportation than East/West options (3, 4 or 5)
- Provides DOE flexibility by maintaining two regional LLW disposal sites

4.5.1.3 *LLW Disposal Option 3*

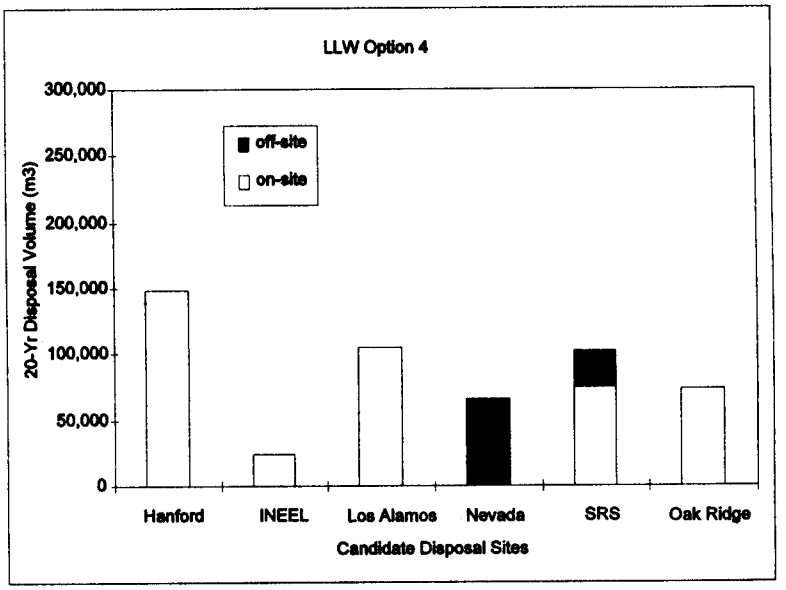
**Figure 11** illustrates Option 3, in which two sites (INEEL and LANL) dispose part of their own LLW on-site, one site (Hanford) disposes only its own LLW on-site, and two sites dispose on-site waste and provide regional disposal for other sites' waste (NTS receives 40% and SRS receives 60%)




- Approximately 166,000m$^3$ requires off-site disposal
- Disposes LLW at five of the six sites currently disposing LLW
- Requires less transportation than West-only options (1, 2 or 6)
- Provides DOE flexibility by maintaining two regional sites
- SRS receives the most off-site LLW, but SRS and Hanford dispose similar total volumes
- Requires construction of additional disposal capacity at SRS

4.5.1.4 *LLW Disposal Option 4*

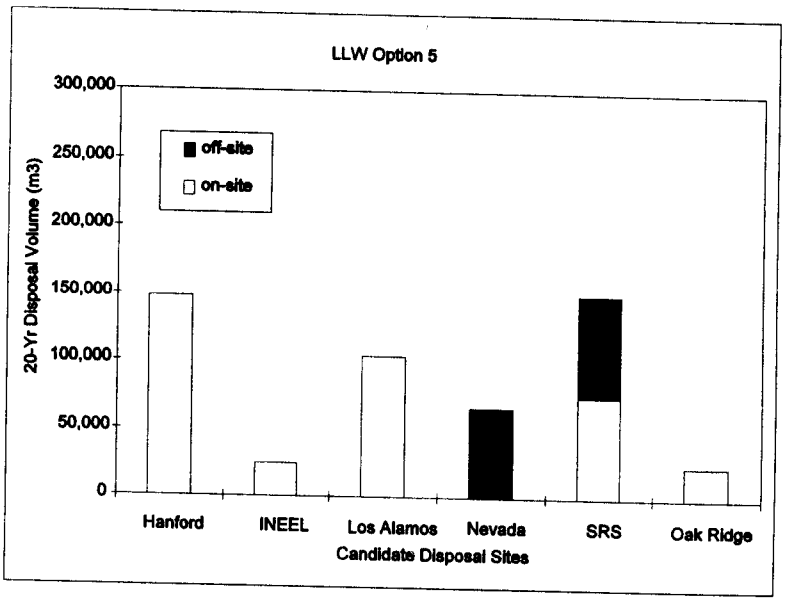
As shown in **Figure 12**, Option 4 adds ORR as a disposal site. ORR and Hanford dispose all their own LLW on-site. INEEL and LANL dispose part of their LLW on-site. NTS and SRS each dispose on-site waste and provide regional disposal for other sites' waste (NTS receives 70% and SRS receives 30%)




- Approximately 93,000m$^3$ requires off-site disposal
- Disposes LLW at all six sites
- Requires the least transportation
- Provides DOE flexibility by maintaining two regional sites
- Requires construction at ORR; expansion at the current disposal location (IWMF) is technically infeasible

4.5.1.5 *LLW Disposal Option 5*

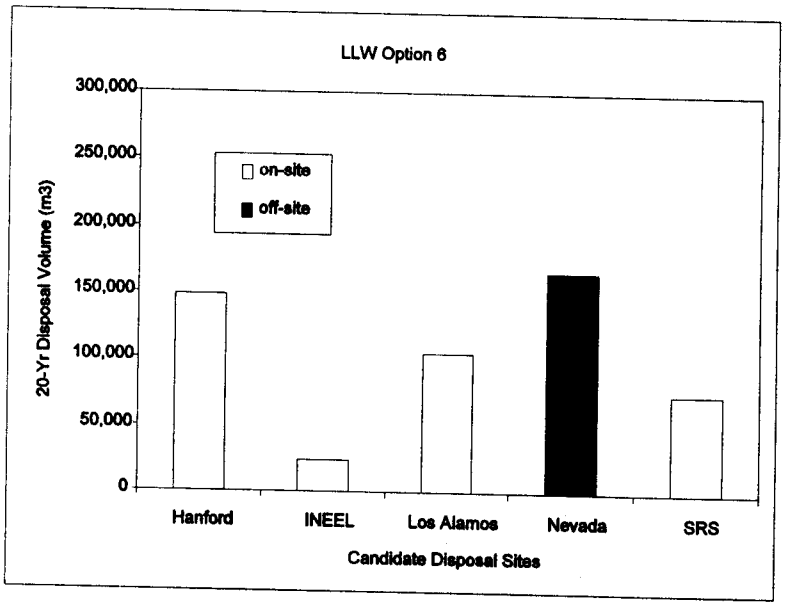
**Figure 13** illustrates the difference between this option and Option 4. As seen, Option 5 varies from Option 4 in the amount of on-site waste ORR disposes (~30% in this option, versus 100% in Option 4). Thus, ORR joins INEEL and LANL as sites disposing part of their own LLW on-site. Hanford disposes all its own LLW on-site; and NTS and SRS dispose their own LLW on-site and provide regional disposal for other sites' waste (NTS receives 47% and SRS receives 53%)




- Disposes LLW at all six sites currently disposing LLW; approximately 141,000m³ requires off-site disposal
- Requires less LLW transportation than West-only options (1, 2, or 6)
- Provides DOE flexibility by maintaining two regional LLW disposal sites
- Hanford and SRS take almost equal LLW disposal loads, with NTS and SRS disposing almost equal off-site LLW volumes, while Hanford disposes only waste generated onsite
- Requires construction of additional disposal capacity at SRS and ORR

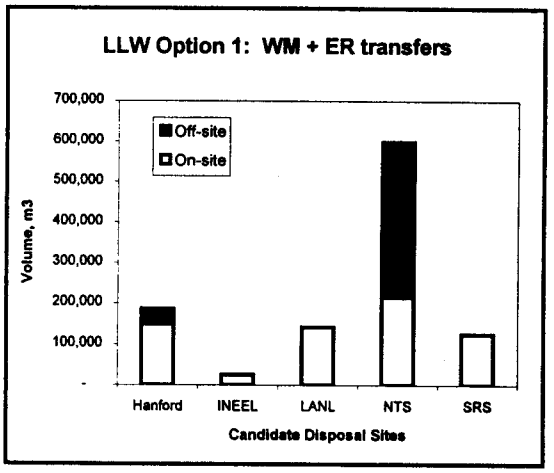
4.5.1.6 *LLW Disposal Option 6*

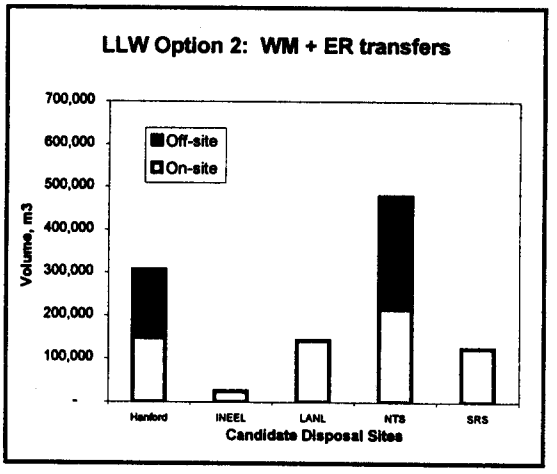
Option 6, shown in **Figure 14**, drops ORR as a disposal site, with INEEL and LANL disposing part of their own LLW on-site, and Hanford and SRS disposing all of their own waste on-site. Only NTS provides regional disposal for other sites' waste.

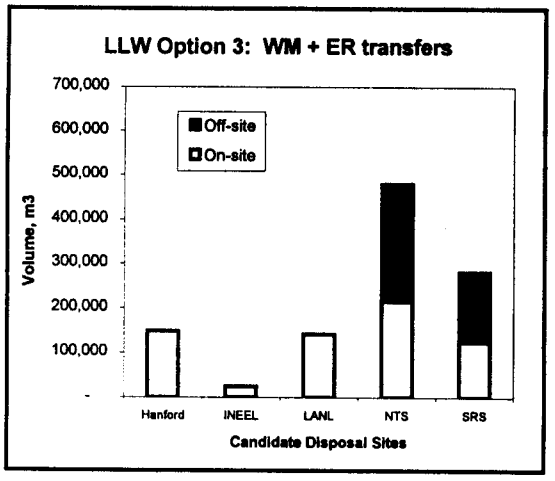


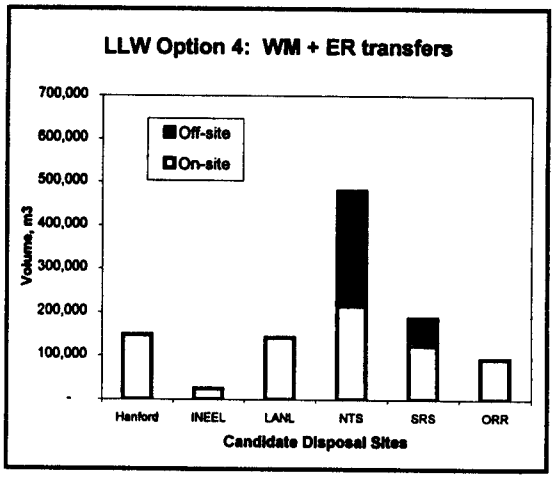

- Disposes LLW at five of the six sites currently disposing LLW; approximately 166,000m³ requires off-site disposal
- Requires more LLW transportation than East/West options (3, 4 or 5)
- Reduces DOE flexibility by maintaining one regional site
- NTS disposes more LLW (all off-site) than any other site; Hanford disposes the next most (all its own)

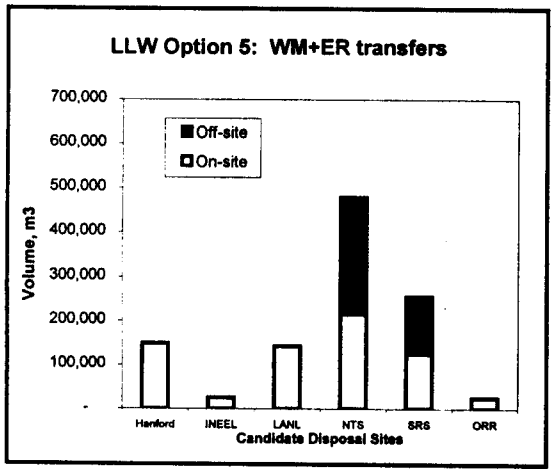
The following charts illustrate the LLW Options with the addition of waste that could be transferred to waste management disposal facilities from environmental restoration cleanups.

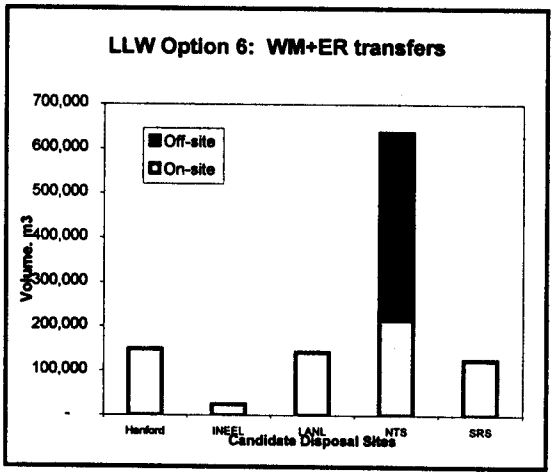


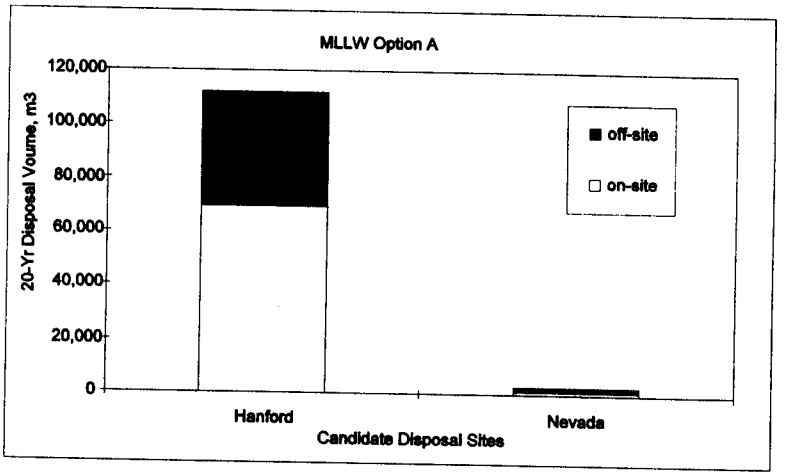



4.5.2 *MLLW Disposal Options*

Based on the disposal roles described in **Figure 7**, DOE has developed five options for MLLW disposal. The following paragraphs describe each option, focusing on sites' disposal roles and illustrating each with a graphical depiction of the amount of on-site and off-site waste to be disposed at each site.

4.5.2.1 *MLLW Disposal Option A*

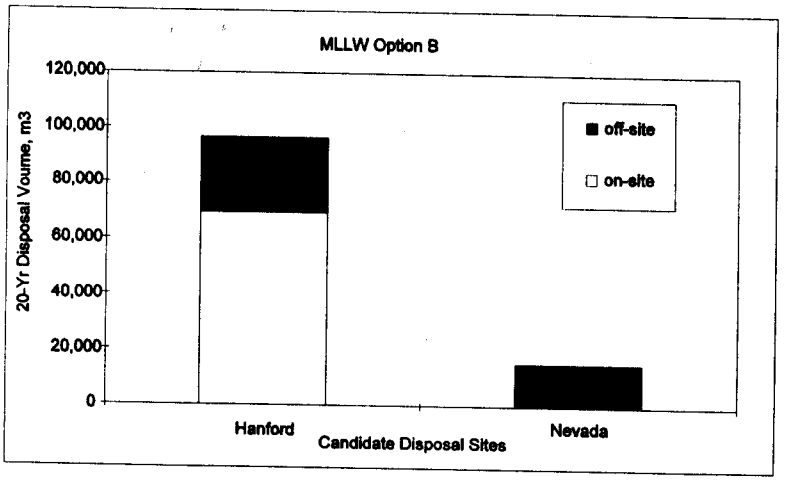
In Option A, shown in **Figure 15**, both Hanford and NTS dispose on-site waste and provide regional disposal for other sites' waste. Hanford disposes nearly all MLLW and NTS disposes only specific waste streams).




- Disposes MLLW at both DOE sites with existing MLLW disposal capacity; approximately 43,000m$^3$ requires disposal off-site
- Requires more transportation than Option C
- Provides DOE flexibility by maintaining two regional MLLW disposal sites
- Hanford disposes the most MLLW and receives the most off-site MLLW (nearly 100%)

4.5.2.2 *MLLW Disposal Option B*

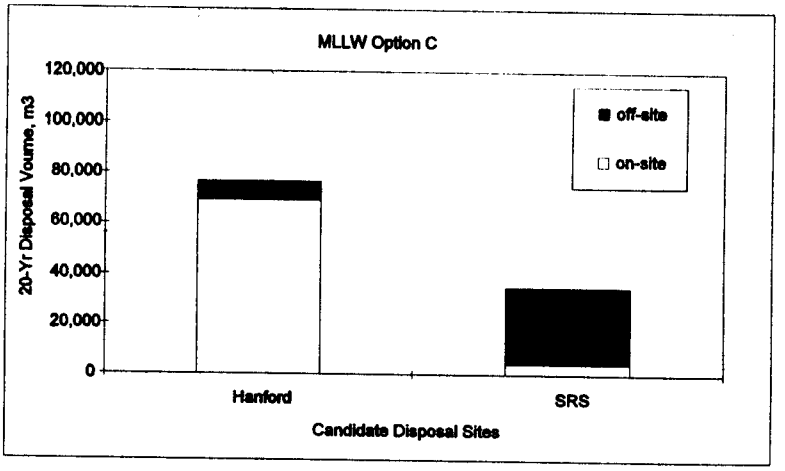
**Figure 16** depicts Option B, which expands NTS's role from that in Option A. In Option B, Hanford and NTS dispose on-site waste and provide regional disposal for other sites' waste. Hanford disposes 65% of the MLLW needing off-site DOE disposal; NTS disposes 35%.




- Disposes MLLW at both DOE sites with existing MLLW disposal capacity; approximately 43,000m$^3$ requires off-site disposal
- Requires more MLLW transportation than Option C
- Provides DOE flexibility by maintaining two regional MLLW disposal sites
- Hanford disposes the most MLLW and still receives the most off-site MLLW

4.5.2.3 *MLLW Disposal Option C*

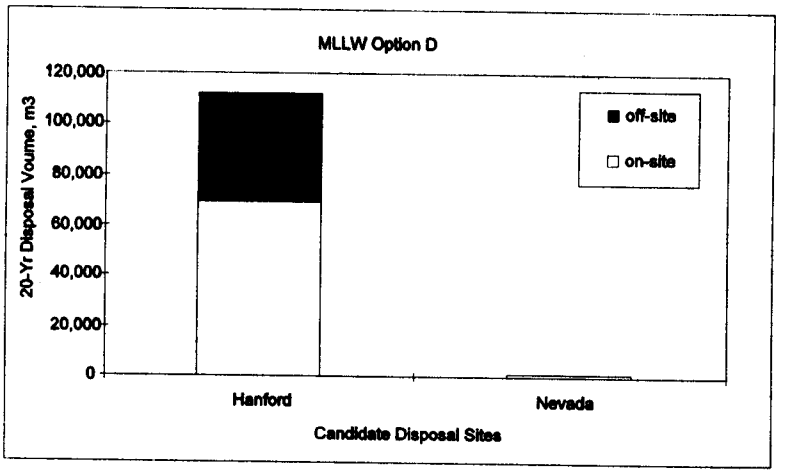
As seen in **Figure 17**, Option C introduces an East-West configuration. In Option C, both Hanford and SRS dispose on-site waste and provide regional disposal for other sites' waste. Hanford receives 20% of MLLW requiring off-site disposal, SRS receives 80%.




- Requires construction of MLLW disposal capacity at SRS and a waiver from South Carolina siting requirements
- Requires less MLLW transportation than West-only options (A, B, D, or E)
- Provides DOE flexibility by maintaining two regional MLLW disposal sites
- Hanford disposes the most MLLW; SRS receives the most off-site MLLW

*4.5.2.4 MLLW Disposal Option D*

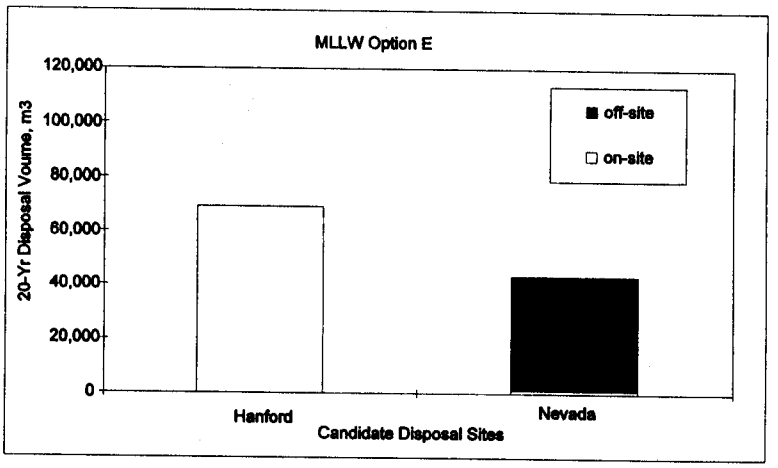
**Figure 18** illustrates Option D which provides only one regional disposal site for MLLW. NTS disposes on-site waste only. Hanford disposes on-site waste and provides regional disposal for all the waste requiring off-site disposal (approximately 43,000m$^3$).




- Disposes MLLW at both DOE sites with existing MLLW disposal capacity
- Requires more MLLW transportation than Option C
- Reduces DOE flexibility by maintaining only one regional MLLW disposal site
- Hanford receives all the off-site MLLW

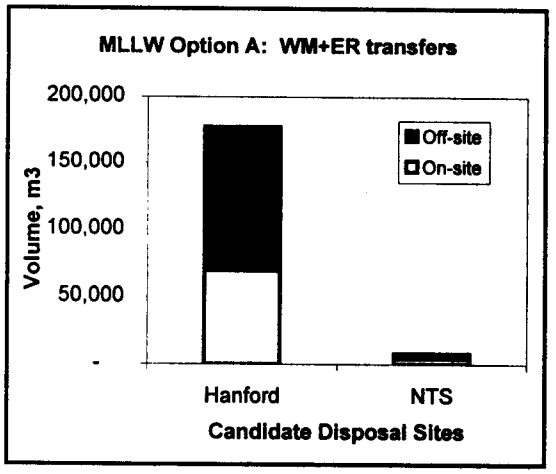
*4.5.2.5 MLLW Disposal Option E*

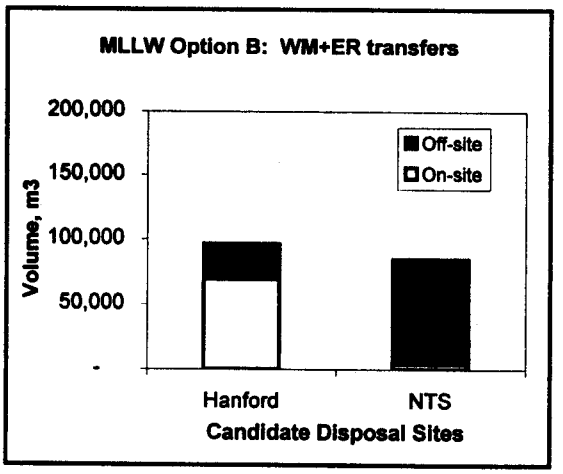
Similar to Option D, **Figure 19** shows Option E, which also provides a single regional disposal site. Under Option E, Hanford disposes on-site waste only. NTS disposes on-site waste and provides regional disposal for all the waste requiring off-site disposal (approximately 43,000m³).

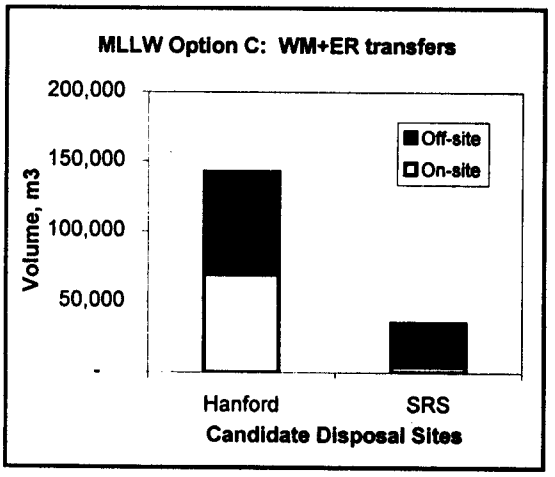


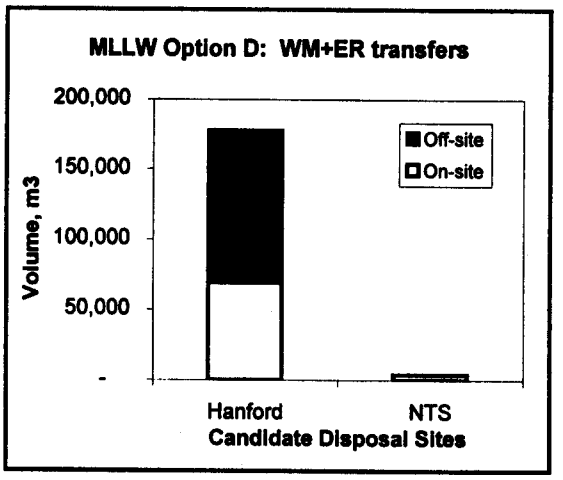

- Disposes MLLW at both DOE sites with existing MLLW disposal capacity
- Requires more MLLW transportation than Option C
- Reduces DOE flexibility by maintaining only one regional MLLW disposal site
- Hanford and NTS dispose approximately the same volume of MLLW, although Hanford does not receive any off-site waste

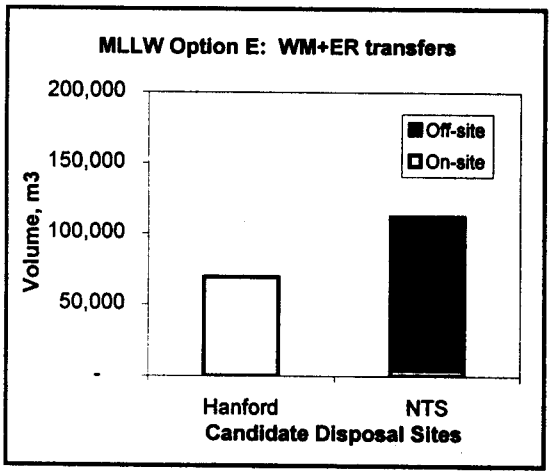
The charts on the following page illustrate the MLLW Options with the addition of waste that could be transferred to waste management disposal facilities from environmental restoration cleanups.


MLLW Option A: WM+ER transfers
200,000
150,000
100,000
50,000
-
Volume, m3
Off-site
On-site
Hanford
NTS
Candidate Disposal Sites


MLLW Option B: WM+ER transfers
200,000
150,000
100,000
50,000
-
Volume, m3
Off-site
On-site
Hanford
NTS
Candidate Disposal Sites


MLLW Option C: WM+ER transfers
200,000
150,000
100,000
50,000
-
Volume, m3
Off-site
On-site
Hanford
SRS
Candidate Disposal Sites


MLLW Option D: WM+ER transfers
200,000
150,000
100,000
50,000
-
Volume, m3
Off-site
On-site
Hanford
NTS
Candidate Disposal Sites


MLLW Option E: WM+ER transfers
200,000
150,000
100,000
50,000
-
Volume, m3
Off-site
On-site
Hanford
NTS
Candidate Disposal Sites

## 5. Decision Criteria

The Department has identified five decision criteria which it plans to consider in making the final selection of regional disposal sites. These criteria were derived from those used in the final WM PEIS. **Figure 20** summarizes the results of each option's evaluation against four of those criteria. The fifth criterion is stakeholder acceptance, which the Department realizes it cannot presuppose. Following the table is a description of each criterion and a discussion of the results. For potential fatalities, the number shown is the total which could occur over 20 years of LLW or MLLW disposal operations -- this is not an estimate of annual fatalities. The Department intends to use this analysis, as well as input from stakeholders, States and Tribal Nations to make its final decisions on regional disposal sites.

***Figure 20.*** *Summary of Decision Criteria Ratings for LLW and MLLW Disposal Options*

| DOE DISPOSAL OPTION | DECISION CRITERIA | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mission Compatibility | Environment, Safety and Health | | | Transportation | | Cost, in Millions of Dollars to Implement Each Option[18] |
| | | Potential Worker Fatalities | No. Sites Exceeding Air Standards | No. Sites Exceeding Water Standards | Potential Fatalities from Truck Accidents | Potential Fatalities from Rail Accidents | |
| LLW DISPOSAL OPTIONS | | | | | | | |
| Option 1 | Yes | 2 | 0 | 2 | 2 | <1 | 600 |
| Option 2 | Yes | 2 | 0 | 2 | 2 | <1 | 590 |
| Option 3 | Less | 2 | 0 | 2 | <1 | <1 | 580 |
| Option 4 | Less | 2 | 0 | 2 | <1 | <1 | 840 |
| Option 5 | Less | 2 | 0 | 2 | <1 | <1 | 700 |
| Option 6 | Least | 2 | 0 | 2 | 2 | <1 | 600 |
| MLLW DISPOSAL OPTIONS | | | | | | | |
| Option A | Yes | <1 | 1 | 1 | <1 | <<1 | 140 |
| Option B | Yes | <1 | 1 | 1 | <1 | <<1 | 140 |
| Option C | Less | 1 | 1 | 2 | <1 | <<1 | 180 |
| Option D | Least | <1 | 1 | 1 | <1 | <<1 | 130 |
| Option E | Least | <1 | 1 | 1 | <1 | <<1 | 130 |

[18]DOE's 20-year cost of implementing its current LLW baseline, including storing LLW pending disposal, is $1,280 million; so all LLW disposal options offer significant savings off the current baseline. For MLLW, the current baseline is $420 million, so again, each MLLW option offers significant savings over continued MLLW storage, complex-wide.

5.1 *Mission Compatibility*

Mission compatibility is a measure of how compatible sites' roles are in each option, with respect to existing site infrastructure and other compatibility issues such as technical feasibility and operational flexibility. For this criterion, the Department has subjectively evaluated options based on site physical characteristics, rather than numerical measurers . Options score worse on this criterion if, for example, current site infrastructure is inadequate to support a given role; a site's physical characteristics make a given role less technically feasible; or the option provides a single regional disposal site which could limit DOE's operational flexibility in the event the site must cease disposal for any reason.

The Department considers all LLW and MLLW options to be compatible with existing and projected missions. However, seven options (four LLW and three MLLW) are deemed less compatible than others, primarily because of this criterion's consideration of existing site infrastructure and technical/operational feasibility. The following provides the rationale for considering seven options "less compatible" than others. LLW Options 3, 4 and 5 all require SRS to construct additional disposal cells (beyond those already planned) to allow SRS to regionally dispose LLW. Similarly, in LLW Options 4 and 5, ORR continues on-site disposal, necessitating facility modifications or expansion. LLW Option 6 is considered less compatible because it limits DOE's operational flexibility by naming a single regional LLW disposal site (NTS); any interruption of disposal activities at the single regional disposal site would impact DOE sites across the complex. For MLLW, Option C requires construction, granting of a waiver from State siting requirements, and permitting of a new MLLW disposal facility at SRS, posing both cost and timing concerns. MLLW Options D and E again limit DOE flexibility by identifying only one regional MLLW disposal site (Hanford in Option D and NTS in Option E). Of these seven options considered "less" compatible, those that identify only one regional disposal facility are considered "least" compatible (Option 6 for LLW, Option D and E for MLLW).

5.2 *Environment, Safety, and Health (ES&H)*

This criterion measures the potential ES&H impacts associated with site roles in each option. Specific impacts evaluated under this criterion include potential facility worker fatalities, and the number of sites in each option which could exceed air and water standards. For this criteria, the Department has calculated potential impacts for each option based on estimates made in the WM PEIS. The methodology is referred to as a scaling analysis and is based on the amount of waste each site would dispose. **Appendix B** details the methodology the Department has used to scale WM PEIS impacts. Options score worse on this criterion if the option's potential ES&H impacts are higher than they are for other options.

**Figure 20** summarizes the potential ES&H impacts over 20 years for each LLW and MLLW option. Overall, the values for LLW options are slightly higher than for MLLW options because of the larger quantities of LLW being analyzed compared to MLLW (i.e., 520,000 $m^3$ LLW versus 110,000 $m^3$ MLLW). An analysis of potential LLW ES&H impacts indicates no

distinction among options. For each LLW option, there are potentially two worker fatalities; no sites are expected to exceed clean air standards; and two sites (Hanford and SRS) may exceed drinking water standards. Similarly, the impacts differ little among MLLW options. For each MLLW option, there are one or fewer anticipated worker fatalities and only one site that may exceed air standards. For water standards, only Option C sees an increase, with two sites (SRS and Hanford) potentially exceeding water standards versus just one (Hanford) in all other options. **Appendix B** provides more detailed breakouts of ES&H impacts for each option.

Some readers may have noted this analysis does not evaluate potential off-site population fatalities. This is because, in all MLLW WM PEIS alternatives and all but one LLW WM PEIS alternative, potential off-site fatalities were estimated at less than one. Since LLW volumes have dropped now compared to the volumes analyzed in the WM PEIS, potential off-site fatalities would further decrease in all current LLW disposal options. For MLLW, though volumes have increased slightly, potential off-site population impacts are still on the order of one fatality over the entire 20 years of disposal operations, for all current MLLW disposal options.

5.3 *Transportation*

The transportation criterion estimates potential worker and public fatalities associated with waste transportation by either truck or rail. As for ES&H, DOE has calculated potential transportation impacts for each option by scaling WM PEIS impacts based on the amount of waste to be transported among sites in each option. Options score worse on this criterion if the option's potential transportation impacts are higher than for other options. **Appendix B** also discusses transportation impacts.

**Figure 20** presents impacts in terms of potential fatalities associated with truck and rail transportation modes for each option. For LLW, Options 3, 4 and 5 -- which have regional disposal locations in both the East and the West -- pose slightly lower transportation impacts than those which dispose only in the West. This is because disposing LLW in the same general geographic region in which it is generated and stored reduces the total transportation mileage. For MLLW, there is no apparent difference among options' transportation impacts, with all options posing less than one fatality over the 20-year period of analysis. In **Appendix B**'s more detailed analysis results, one can see that there are, in fact, similar decreases in transportation impacts for MLLW Option C, which disposes MLLW in an East-West configuration. However, since the impacts for all MLLW options are less than a single fatality, this slight decrease for Option C is not significant. **Appendix B** also presents anticipated annual shipments associated with each LLW and MLLW option, for comparison purposes.

5.4 *Cost*

The cost criterion estimates the expenses DOE would incur to implement a given option. Unlike for potential ES&H and transportation impacts, the Department did not scale costs from WM PEIS cost estimates, since many costs (e.g., the expense of constructing a new disposal facility) do not change equally with changes in the amount of waste to be disposed. **Appendix C** presents

the methodology and assumptions used to evaluate the cost effectiveness of each option. Since site closures are premature absent final decisions on land use at the candidate disposal sites, the cost estimates exclude site closure costs. Options score worse on this criterion if the option's costs are greater than for other options.

The analysis of this criterion supports a few general trends dealing with costs. The cost of direct disposal operations are a very small portion of the Environmental Management program's total budget. Therefore, the changes between cases are very small when considered against the overall Department budget.

The single most significant cost savings to the Department would be to implement ***any*** disposal option versus continuing to incur costs inherent to ongoing storage of wastes awaiting disposal. DOE's 20-year cost of implementing its current LLW baseline, including storing LLW pending disposal, is $1,280 million; so all LLW disposal options offer tremendous savings off the current baseline. Even the most costly LLW option to implement (Option 4 at a cost of $840 million) saves $440 million over DOE's current LLW baseline over the next 20 years. Similarly, for MLLW, the current baseline is $420 million; so again, each MLLW option offers significant savings over continued MLLW storage, complex-wide. Even the most expensive MLLW option to implement (Option C at $180 million) saves $240 million over DOE's current MLLW baseline over the next 20 years.

As discussed in **Appendix C** which presents the detailed cost analysis, a large portion of the total cost of disposal, possibly as much as 60 percent, is associated with generator packaging, certification, and acceptance costs. Of the remaining costs associated with the disposal facilities alone, fixed costs represent approximately 71 percent of the total DOE disposal program costs projected for FY 1998, with the remaining 29 percent representing variable operations and maintenance costs. Since the disposal facility operating costs are largely fixed costs, as the number of disposal sites decrease, system costs decrease due to the elimination of the fixed costs (economies of scale).

In general, the unit cost per volume disposed is lowest at facilities with the largest volumes disposed, representing economies of scale. The type of disposal facility (trench versus engineered vault) is also a driver of unit cost, which is closely linked with site geology, climate, and other site-specific factors. For example, humid sites with near-surface groundwater (more characteristic of eastern sites) require engineered vaults, as compared with arid western sites where trenches are used. Since the Department has no cost basis for operating MLLW disposal facilities, unit costs for MLLW disposal are assumed to be higher due to additional RCRA requirements for hazardous waste constituents and proportional to site LLW disposal costs.

The cost differences between options are due to operating costs in three of the LLW Options ( 1, 2, and 3) and five of the MLLW Options (A, B, D, and E). The differences in the other options are mainly due to capital costs. LLW Options 3 and 4 include capital costs for a new facility at

ORR, and Option 5 includes additional capital for expansion at SRS. MLLW Option C will require design and construction costs for a project not currently planned. In 1989, the design and construction cost of a hazardous and mixed waste disposal facility at SRS was estimated at approximately $33 million.[19] Assuming 3 percent per year escalation, now this cost could be on the order of $40 - $45 million.

There is little cost discrimination among options that rely on disposal at arid western sites (Options 1, 2, or 6 for LLW and Options A, B, C, or D for MLLW), since unit costs for disposal at Hanford and NTS are very close. Shifting off-site waste disposal away from SRS and ORR has the advantage of closing one LLW disposal facility (ORR) plus sending waste to a less expensive disposal site. Preliminary cost estimates indicate that closing the ORR LLW disposal site could save $70 million over 20 years. In addition, as storage facilities are emptied, storage costs are eliminated. Preliminary cost estimates indicate a cost savings of $10 -$30 million per year once the backlog of waste is eliminated.

5.5 *Stakeholder Acceptance*

As mentioned at the start of this section, the Department intends to use input from stakeholders, States and Tribal Nations to help make its final decisions on the location for regional disposal sites. This is the sole decision criterion for which the Department can perform no independent analyses or measurement. Rather, the Department has been sharing information about the pending decisions with various stakeholders, States and Tribal groups to gather input. These LLW and MLLW disposal decisions are among those presented at the National Governors' Association meeting in March, the National Association of Attorneys General meeting in April, the Intersite Discussions on Nuclear Material and Waste convened by the League of Women Voters Education Fund in June, discussed with the Transportation External Coordination Working Group in July, and considered during the LLW Seminar sponsored by the Nevada Citizens' Advisory Board in August.

The Department has, to date, received some feedback concerning principles the Department should consider in its decision making process. This feedback has focused on transportation, site conditions, cost effectiveness, consolidation, and compensation. So far, DOE has heard the following comments:

- Address urgent risks
- Seek to minimize transportation of nuclear waste and materials
- Pursue limited consolidation of nuclear waste and materials to address risks and allow site closures
- Consider sites' suitability and their surrounding populations in deciding which sites should receive wastes

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[19]Westinghouse Savannah River Company for the U.S. Department of Energy. 1989. *Title I Design Summary for Hazardous Waste/Mixed Waste Disposal Facility, Line Item 89-D-175, Project S-2944.* September.

- Consider cost effectiveness in deciding which sites should receive waste
- Compensate receiving sites for receiving other sites' waste
- Continue ongoing discussion with the public about nuclear waste and materials issues, including transportation routes and implementation details (*note: transportation routes and the use of truck or rail will not be decided in these programmatic records of decisions).*

The Department is planning additional meetings with State and Tribal Nations representatives in October. The Department intends to use input from these various discussions, as well as present any input received directly from representatives and advisory boards, to inform decision makers on this subjective criterion.

## 6. Summary

The Department is preparing to issue decisions on LLW and MLLW regional disposal locations, from the *Final Waste Management Programmatic Environmental Impact Statement*. This document has summarized information from the original WM PEIS analyses, as well as more recent analysis of current LLW and MLLW disposal options. There are several steps to the upcoming decision making process.

First, based on the results of these analyses, the Department is continuing its discussions with States, Tribal Nations, and stakeholders to gather input to its final decisions. Also, DOE will issue a NEPA Supplement Analysis of the WM PEIS -- the Department's analysis of the significance of updated LLW and MLLW disposal volumes -- in early Fall 1998. Then, the summarized analysis results and gathered feedback received on the LLW and MLLW decisions will be presented to the Secretary of Energy for decision making in late 1998.

As committed in the WM PEIS, prior to issuing its programmatic RODs, DOE will publish a notice in the *Federal Register*, notifying the public which specific sites it prefers for LLW disposal and which for MLLW disposal. Then, no less than 30 days after this notification, the Department will issue its formal RODs on LLW and MLLW treatment and disposal.

The decision-making process will follow a "tiered" approach. The WM PEIS analyses are screening-level assessments, focusing mainly on alternatives addressing national-level strategic issues related to waste management. The objective of the assessment is to provide a relative comparison of the potential suitability of sites for disposal of MLLW and LLW, as waste management activities are varied.

Based on the WM PEIS, DOE will make broad decisions about which sites will manage which wastes. DOE will follow these broad decisions with an analysis of narrower proposals for the implementation of the programmatic decisions, in related site-specific NEPA reviews. Although DOE intends to identify a configuration (i.e., select sites for waste management activities) as a result of this *programmatic* EIS, DOE will take a closer look (including site-specific design, facility location on a site, and site-specific impacts) in *site-wide* or *project-level* NEPA reviews. During these reviews, local DOE offices will work with other agency and tribal representatives, as well as members of the interested public, to identify and analyze specific facilities (versus sites) and specific impacts, such as those related to transportation modes and routes. It is during this next level of planning and project-level implementation that more specific values and environmental impacts will be considered.[20]

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[20]Ibid. 12, pp. 1-3, 1-23, 1-47-49.

Also, in the actual siting and design of a disposal facility, more detailed, site-specific analyses would be conducted in accordance with the requirements for a performance assessment as specified in DOE Radioactive Waste Management Order.[21] These performance assessments better address site-specific issues such as commingling of groundwater plumes from multiple units and existing groundwater contamination. Such studies investigate these issues more rigorously than could a programmatic document.

DOE guidance also requires that the performance assessment process be supplemented with a composite analysis. Composite analyses develop reasonably conservative estimates of cumulative impacts from active and planned disposal facilities and other sources of radioactive contamination that could interact with a disposal facility to affect the dose to future members of the public.[22] A further discussion of site cumulative impacts is included in **Appendix D** .

This "tiering" nature of Department decisions leads to another aspect of programmatic decisions: they are subject to iterative modification. As DOE completes its next level of NEPA analyses and completes other assessments (such as site performance assessments and radiological composite analyses), additional new information may come to light which seem to affect the WM PEIS decisions. The Department is aware of this, and would react to such new information just as it has for the updated LLW and MLLW volumes discussed in this document -- the Department would prepare a NEPA Supplement Analysis to determine the significance of the new information in terms of new impacts versus those analyzed in the WM PEIS.

The type and level of environmental evaluations conducted through the WM PEIS and updated in the Supplement Analysis, are appropriate for making decisions on broad agency actions, such as the adoption of a regional strategy for LLW and MLLW disposal. Ultimately, all radioactive waste generated by Departmental programs must be disposed. Thus, over the next several months, DOE intends to move forward on waste disposal decisions -- to support ongoing and new missions, allow site closures, and reduce the expense associated with long-term storage of wastes in lieu of disposal.

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[21]Ibid. 1

[22]Ibid. 12, Volume V, pp. 250 and 254.

September 22, 1998

# APPENDIX A

# LLW AND MLLW VOLUME PROJECTIONS

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# LLW and MLLW Volume Projections

## 1.0 OVERVIEW

This appendix presents information on waste volumes subject to the pending WM PEIS LLW and MLLW disposal decisions, as well as information on additional waste volumes subject to other decision-making processes.

**Figure A-1** illustrates the volumes of all the waste and contaminated media that DOE presently estimates in inventory and to be generated over the next 20 years. The figure shows the volumes associated with hazardous waste, TRU, LLW, MLLW, and HLW, including contaminated media, cleanup wastes disposed on-site from CERCLA decisions, 11(e)2 byproduct wastes[1], and the low-activity fraction wastes from HLW processing. The figure also indicates which sites generate these wastes. From this diagram, the amount of LLW and MLLW waste subject to WM PEIS disposal ROD can be seen, versus that subject to site-specific cleanup decisions under CERCLA. **Figure A-2** further illustrates how the LLW and MLLW will be managed.

## 2.0 DATA SOURCE FOR LLW AND MLLW VOLUMES

Except as footnoted in Figure A-1, the source for all volume estimates in this appendix is the March 1998 database underlying the *Accelerating Cleanup: Paths to Closure* document. However, the estimates presented in this appendix will not match the disposition maps in the site specific *Paths to Closure* reports for two reasons:

- the estimates presented here are for the 20-year analysis period of the WM PEIS, whereas the *Paths to Closure* disposition maps represent life-cycle estimates; and
- the appendix's estimates are rounded for ease of presentation.

## 3.0 VOLUME TABLES

Tables A-1 through A-8 present LLW and MLLW disposal volumes either currently in storage or expected to be generated over the next 20 years. Following is a description of the headings common to each table:

<u>Generator Sites</u>. Each table, down the left column, lists sites which generate LLW and/or MLLW. In some tables, sites listed have no projected waste volumes; these sites remain in the tables, however, so all tables in this appendix have the same list of generator sites.

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[1]Section 11e(2) of the *Atomic Energy Act*, as amended, defines 11e(2) byproduct material as the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material (i.e, uranium or thorium) content.

*Disposal Sites*. Across the top of each table are listed all possible disposal sites for DOE-generated LLW and/or MLLW.

DOE Disposal. Seven DOE sites are included in the tables. Included are the six candidate disposal sites subject to the WM PEIS decision, as well as the Fernald site. The Fernald site has an existing CERCLA on-site disposal cell.

"To Be Decided" Disposal. The disposal site labeled "TBD, " or "To Be Decided," represents wastes which currently do not have a disposal path forward. This is the volume of waste which is dependent upon either the WM PEIS records of decision to establish its disposal pathway, or upon site-specific CERCLA or RCRA corrective action decisions. The disposal options presented in this document are primarily looking at how this "TBD" waste can be dispositioned.

Commercial Disposal. The disposal site labeled "Commercial" represents wastes currently projected to be disposed in a commercial disposal facility. As additional waste stream information becomes available, more waste may become eligible for commercial disposal.

3.1 *WM PEIS Disposal Decisions*. Tables A-1 and A-5 show each site's projected disposal volumes of LLW and MLLW, respectively, generated from waste management operations over the 20-year analysis. **The LLW and MLLW volumes shown in Tables A-1 and A-5 are the only volumes subject to the WM PEIS programmatic disposal decisions.**

3.2 *CERCLA/RCRA Decisions: Potential Transfers to Waste Management Facilities*. Tables A-2 and A-6 show each site's projected disposal volumes of LLW and MLLW, respectively, generated from environmental restoration activities over the 20-year analysis, which could potentially be transferred to waste management facilities for disposal. These wastes are subject to CERCLA site-specific cleanup decisions or RCRA corrective action decisions. The WM PEIS decisions will not determine how much contaminated media will be removed for cleanup purposes. However, site-specific CERCLA or RCRA decisions could be made to dispose the media at a waste management facility. Therefore, DOE has analyzed the potential impacts associated with disposing these cleanup generated wastes at WM facilities. All the estimates focus on future disposal. Therefore, the disposal volumes do not represent the amount of waste already disposed in waste management disposal facilities. In addition, the volumes shown represent current planning estimates; the volumes may change as individual decisions are made.

3.3 *CERCLA/RCRA Decisions: On-Site Disposal*. Tables A-3 and A-7 show each site's projected disposal volumes of LLW and MLLW, respectively, generated from environmental restoration activities over the 20-year analysis, which are expected to be disposed of on-site. As above, these wastes are subject to CERCLA site-specific cleanup decisions or RCRA corrective action decisions. All the estimates focus on future disposal. Therefore, the disposal volumes do not represent the amount of waste already disposed in CERCLA on-site disposal cells. In

addition, the volumes shown represent current planning estimates; the volumes may change as individual decisions are made.

3.4 *Summary Tables*. Tables A-4 and A-8 summarize each site's projected disposal volumes of LLW and MLLW, respectively, from:

- Waste Management Operations;
- Environmental Restoration Activities, for Potential Transfer to Waste Management Facilities; and
- Environmental Restoration Activities, for On-Site Disposal.

For the first two of the above categories, the table summarizes the amount of waste to be disposed at each disposal site from on-site versus off-site generation activities.

***Table A-1.*** *Projected 20-Year LLW Disposal Volumes ($m^3$) Subject to WM PEIS Decisions (from Waste Management Operations)*

| Generator Sites | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[2] |
| Ames | | 30 | | | | | | | |
| Argonne East | | 3,700 | | | | | | | 400 |
| Battelle Columbus | | | | | | | | | |
| Brookhaven | | 4,800 | | | | | | | |
| ETEC | | | | | | | | | |
| Fernald | | | | | | | | | |
| General Atomics | | | | | | | | | |
| GE Vallecitos | | | | | | | | | |
| Grand Junction | | | | | | | | | |
| Hanford | | 148,500 | | | | | | | |
| INEEL | | | 24,300 | | | | | 6,400 | |
| ITRI | | | | | 700 | | | | |
| LANL | | | | 129,700 | | | | | |
| Lawrence Berkeley | | 200 | | | | | | | 200 |
| Lawrence Livermore | | | | | 11,000 | | | | 2,400 |
| Mound | | | | | | | | | |
| NTS | | | | | 400 | | | | |
| Oak Ridge | | | | | | | | 73,000 | |
| Paducah | | | | | | | | 4,400 | |
| Pantex | | | | | 1,200 | | | | |
| Portsmouth | | 2,000 | | | | | | | |
| Princeton | | 700 | | | | | | | |
| Rocky Flats | | | | | 20,200 | | | | |
| RMI | | | | | | | | | |
| Sandia | | | | | 1,400 | | | | |
| SPRU | | | | | | | | | |
| SRS | | | | | | | 78,600 | | 900 |
| West Valley | | | | | | | | 11,300 | |
| TOTAL | 0 | 159,930 | 24,300 | 129,700 | 34,900 | 0 | 78,600 | 95,100 | 3,900 |

[2]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

***Table A-2.** Projected 20-Year LLW Disposal Volumes ($m^3$) Subject to CERCLA/RCRA Decisions (from Environmental Restoration Activities, for Potential Transfer to WM Facilities)*[3]

| Generator Sites | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[4] |
| Ames | | | | | | | | | |
| Argonne East | | 800 | | | | | | | |
| Battelle Columbus | | 1,400 | | | | | | 7,800 | 101,000 |
| Brookhaven | | 9,000 | | | | | | 9,400 | 15,100 |
| ETEC | | 600 | | | 2,800 | | | | |
| Fernald | | | | | 83,600 | | | | |
| General Atomics | | 300 | | | | | | | |
| GE Vallecitos | | | | | | | | 20 | |
| Grand Junction | | | | | | | | 60 | |
| Hanford | | | | | | | | | |
| INEEL | | | 100 | | | | | | |
| ITRI | | | | | | | | | |
| LANL | | | | 37,400 | | | | | 600 |
| Lawrence Berkeley | | | | | | | | | 10 |
| Lawrence Livermore | | | | | | | | | |
| Mound | | | | | 64,200 | | | | |
| NTS | | | | | 215,100 | | | | |
| Oak Ridge | | | | | | | | 20,300 | |
| Paducah | | | | | | | | | 600 |
| Pantex | | | | | | | | | |
| Portsmouth | | | | | | | | | |
| Princeton | | | | | | | | | |
| Rocky Flats | | | | | 44,800 | | | | |
| RMI | | | | | | | | | |
| Sandia | | | | | 1,400 | | | | |
| SPRU | | | | | | | | 8,200 | |
| SRS | | | | | | | 45,800 | | |
| West Valley | | | | | | | | | |
| TOTAL | 0 | 12,100 | 100 | 37,400 | 411,900 | 0 | 45,800 | 45,780 | 117,310 |

[3]Represents current planning estimate; volume may change as individual CERCLA/RCRA decisions are made.

[4]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

***Table A-3.*** *Projected 20-Year LLW Disposal Volumes ($m^3$) Subject to CERCLA/RCRA Decisions (from Environmental Restoration Activities, Expected to be Disposed On-Site)*[5]

| Generator Sites | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[6] |
| Ames | | | | | | | | | |
| Argonne East | | | | | | | | | |
| Battelle Columbus | | | | | | | | | 1,300 |
| Brookhaven | | | | | | | | | |
| ETEC | | | | | | | | | |
| Fernald | 1,600,000 | | | | | | | | 360,000 |
| General Atomics | | | | | | | | | |
| GE Vallecitos | | | | | | | | | |
| Grand Junction | | | | | | | | | |
| Hanford | | 3,400,000 | | | | | | | |
| INEEL | | | 250,000 | | | | | | |
| ITRI | | | | | | | | | |
| LANL | | | | | | | | | |
| Lawrence Berkeley | | | | | | | | | |
| Lawrence Livermore | | | | | | | | | |
| Mound | | | | | | | | | |
| NTS | | | | | | | | | |
| Oak Ridge | | | | | | 60,000 | | | |
| Paducah | | | | | | | | | 5,700 |
| Pantex | | | | | | | | | |
| Portsmouth | | | | | | | | | |
| Princeton | | | | | | | | | |
| Rocky Flats | | | | | | | | | |
| RMI | | | | | | | | | 14,800 |
| Sandia | | | | | | | | | |
| SPRU | | | | | | | | | |
| SRS | | | | | | | | | |
| West Valley | | | | | | | | | |
| TOTAL | 1,600,000 | 3,400,000 | 250,000 | 0 | 0 | 60,000 | 0 | 0 | 381,800 |

[5]Represents current planning estimate; volume may change as individual CERCLA/RCRA decisions are made.

[6]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

*Table A-4. Summary of Projected 20-Year LLW Disposal Volumes ($m^3$) Subject to WM PEIS Decisions (WM Operations ONLY) and CERCLA/RCRA Decisions (from ER Activities, Expected to be Transferred to WM or to be Disposed On-Site)*[7]

| Generator Activities | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[8] |
| WM Operations | 0 | 159,930 | 24,300 | 129,700 | 34,900 | 0 | 78,600 | 95,100 | 3,900 |
| On-Site | 0 | 148,500 | 24,300 | 129,700 | 400 | 0 | 78,600 | 0 | |
| Off-Site | 0 | 11,430 | 0 | 0 | 34,500 | 0 | 0 | 95,100 | |
| ER-WM Transfer | 0 | 12,100 | 100 | 37,400 | 411,900 | 0 | 45,800 | 45,800 | 117,300 |
| On-Site | 0 | 0 | 100 | 37,400 | 215,100 | 0 | 45,800 | 0 | |
| Off-Site | 0 | 12,100 | 0 | 0 | 196,800 | 0 | 0 | 45,800 | |
| ER On-Site | 1,600,000 | 3,400,000 | 250,000 | 0 | 0 | 60,000 | 0 | 0 | 381,800 |
| TOTAL | 1,600,000 | 3,572,030 | 274,400 | 167,100 | 446,800 | 60,000 | 140,900 | 140,900 | 503,010 |

[7]Represents current planning estimate; volume may change as individual CERCLA/RCRA decisions are made.

[8]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

***Table A-5.*** *Projected 20-Year MLLW Disposal Volumes ($m^3$) Subject to WM PEIS Decision (from Waste Management Operations)*

| Generator Sites | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[9] |
| Ames | | | | | | | | | 1 |
| Argonne East | | | | | | | | | 50 |
| Battelle Columbus | | | | | | | | | |
| Brookhaven | | | | | | | | | 30 |
| ETEC | | | | | | | | | |
| Fernald | | | | | | | | | |
| General Atomics | | | | | | | | | |
| GE Vallecitos | | | | | | | | | 1 |
| Grand Junction | | | | | | | | | |
| Hanford | | 69,100 | | | | | | 100 | |
| INEEL | | | | | | | | | 3,100 |
| ITRI | | | | | | | | | 20 |
| LANL | | | | | | | | | 2,100 |
| Lawrence Berkeley | | | | | | | | | 30 |
| Lawrence Livermore | | | | | | | | | 500 |
| Mound | | | | | | | | | |
| NTS | | | | | | | | | |
| Oak Ridge | | | | | | | | 25,500 | 2,500 |
| Paducah | | | | | | | | 2,700 | 100 |
| Pantex | | | | | | | | | 200 |
| Portsmouth | | | | | | | | 2,800 | 2,200 |
| Princeton | | | | | | | | | |
| Rocky Flats | | | | | | | | 7,400 | 10,900 |
| RMI | | | | | | | | | |
| Sandia | | | | | | | | 160 | 400 |
| SPRU | | | | | | | | | |
| SRS | | | | | | | | 4,100 | |
| West Valley | | | | | | | | 30 | |
| TOTAL | | 69,100 | 0 | 0 | 0 | 0 | 0 | 42,800 | 22,100 |

[9]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

***Table A-6.*** *Projected 20-Year MLLW Disposal Volumes ($m^3$) Subject to CERCLA/RCRA Decisions (from Environmental Restoration Activities, for Potential Transfer to WM Facilities)*[10]

| Generator Sites | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[11] |
| Ames | | | | | | | | | |
| Argonne East | | | | | | | | | |
| Battelle Columbus | | | | | | | | | |
| Brookhaven | | | | | | | | | |
| ETEC | | | | | | | | 1,400 | 40 |
| Fernald | | | | | | | | | |
| General Atomics | | | | | | | | | |
| GE Vallecitos | | | | | | | | | |
| Grand Junction | | | | | | | | | |
| Hanford | | | | | | | | | |
| INEEL | | | | | | | | 20 | |
| ITRI | | | | | | | | | |
| LANL | | | | | | | | 3,400 | |
| Lawrence Berkeley | | | | | | | | | |
| Lawrence Livermore | | | | | | | | | |
| Mound | | | | | | | | | |
| NTS | | | | | | | | | |
| Oak Ridge | | | | | | | | | 30,100 |
| Paducah | | | | | | | | 10 | |
| Pantex | | | | | | | | | |
| Portsmouth | | | | | | | | 40 | |
| Princeton | | | | | | | | | |
| Rocky Flats | | | | | | | | 60,800 | |
| RMI | | | | | | | | | |
| Sandia | | | | | | | | | |
| SPRU | | | | | | | | | |
| SRS | | | | | | | | | |
| West Valley | | | | | | | | | |
| TOTAL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65,700 | 30,100 |

[10]Represents current planning estimate; volume may change as individual CERCLA/RCRA decisions are made.

[11]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

*Table A-7. Projected 20-Year MLLW Disposal Volumes ($m^3$) Subject to CERCLA/RCRA Decisions (from Environmental Restoration Activities, Expected to be Disposed On-Site)*[12]

| Generator Sites | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[13] |
| Ames | | | | | | | | | |
| Argonne East | | | | | | | | 700 | |
| Battelle Columbus | | | | | | | | | 30 |
| Brookhaven | | | | | | | | | 2,100 |
| ETEC | | | | | | | | | |
| Fernald | | | | | | | | | 4,500 |
| General Atomics | | | | | | | | | |
| GE Vallecitos | | | | | | | | | |
| Grand Junction | | | | | | | | | |
| Hanford | | 400 | | | | | | | 600 |
| INEEL | | | 325,600 | | | | | 400 | |
| ITRI | | | | | | | | | |
| LANL | | | | | | | | | |
| Lawrence Berkeley | | | | | | | | | 10 |
| Lawrence Livermore | | | | | | | | | |
| Mound | | | | | | | | | |
| NTS | | | | | | | | | 800 |
| Oak Ridge | | | | | | 26,300 | | | 13,900 |
| Paducah | | | | | | | | | 100 |
| Pantex | | | | | | | | | 10 |
| Portsmouth | | | | | | | | | 700 |
| Princeton | | | | | | | | | |
| Rocky Flats | | | | | | | | | |
| RMI | | | | | | | | | |
| Sandia | | | | | | | | | 200 |
| SPRU | | | | | | | | | |
| SRS | | | | | | | | | |
| West Valley | | | | | | | | | |
| TOTAL | 0 | 400 | 325,600 | 0 | 0 | 26,300 | 0 | 1,000 | 23,000 |

[12]Represents current planning estimate; volume may change as individual CERCLA/RCRA decisions are made.

[13]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

*Table A-8. Summary of Projected 20-Year MLLW Disposal Volumes ($m^3$) Subject to WM PEIS Decisions (WM Operations ONLY) and CERCLA/RCRA Decisions (from ER Activities, Expected to be Transferred to WM or to be Disposed On-Site)*[14]

| Generator Activities | Disposal Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fernald | Hanford | INEEL | LANL | NTS | ORR | SRS | TBD | Commercial[15] |
| WM Operations | 0 | 69,100 | 0 | 0 | 0 | 0 | 0 | 42,700 | 22,200 |
| On-Site | 0 | 69,100 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Off-Site | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42,700 | |
| ER-WM Transfer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65,600 | 30,100 |
| On-Site | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Off-Site | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65,600 | |
| ER On-Site | 0 | 400 | 325,600 | 0 | 0 | 26,300 | 0 | 0 | 22,800 |
| TOTAL | 0 | 69,500 | 325,600 | 0 | 0 | 26,300 | 0 | 108,300 | 75,100 |

[14]Represents current planning estimate; volume may change as individual CERCLA/RCRA decisions are made.

[15]Represents waste currently projected to be disposed in a commercial disposal facility; as additional waste stream information becomes available, more waste may become eligible for commercial disposal.

**Figure A.1** Total Volume of Waste and Contaminated Media From Waste Management Operations and Environmental Restoration Activities Over the Next 20 Years

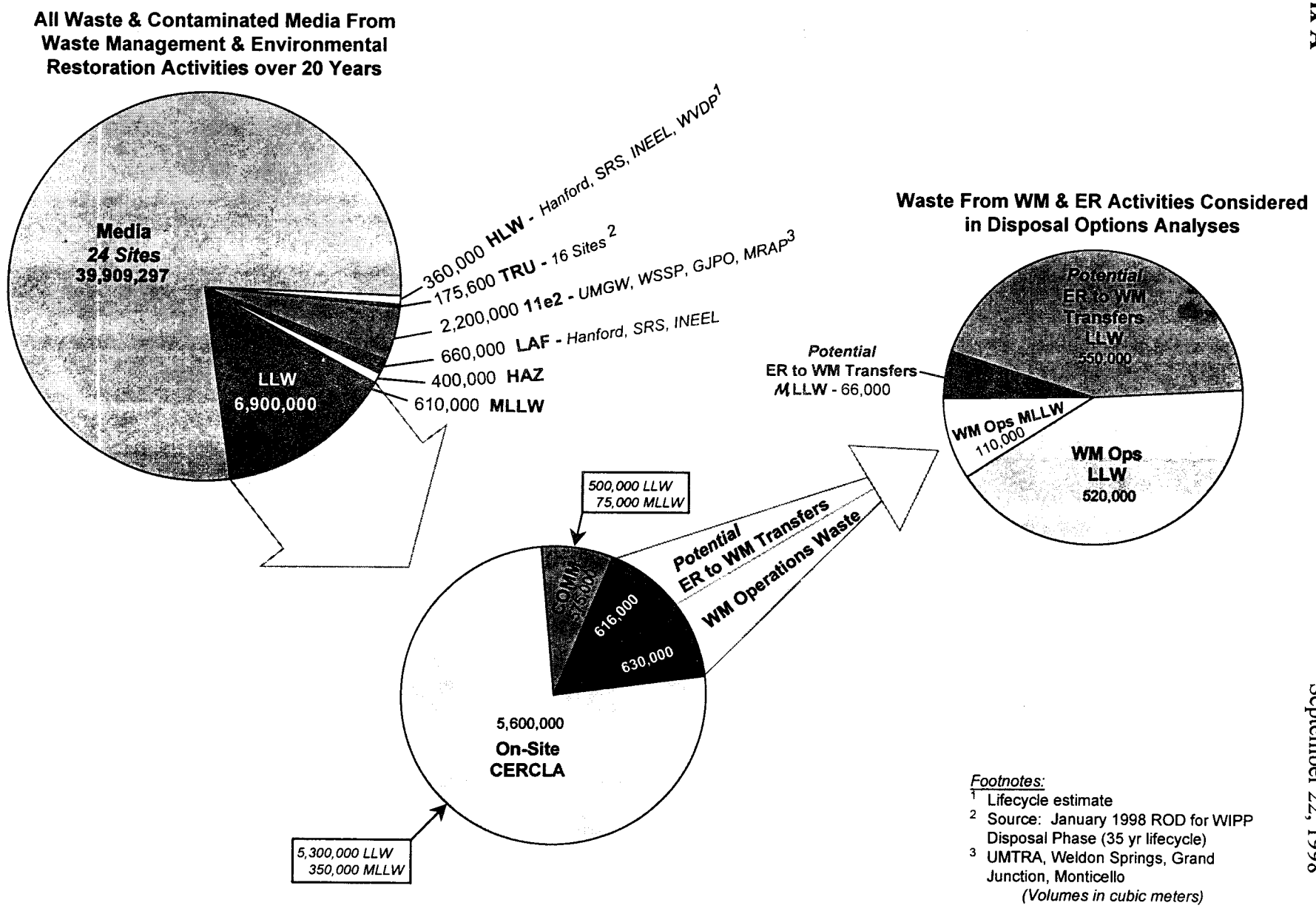
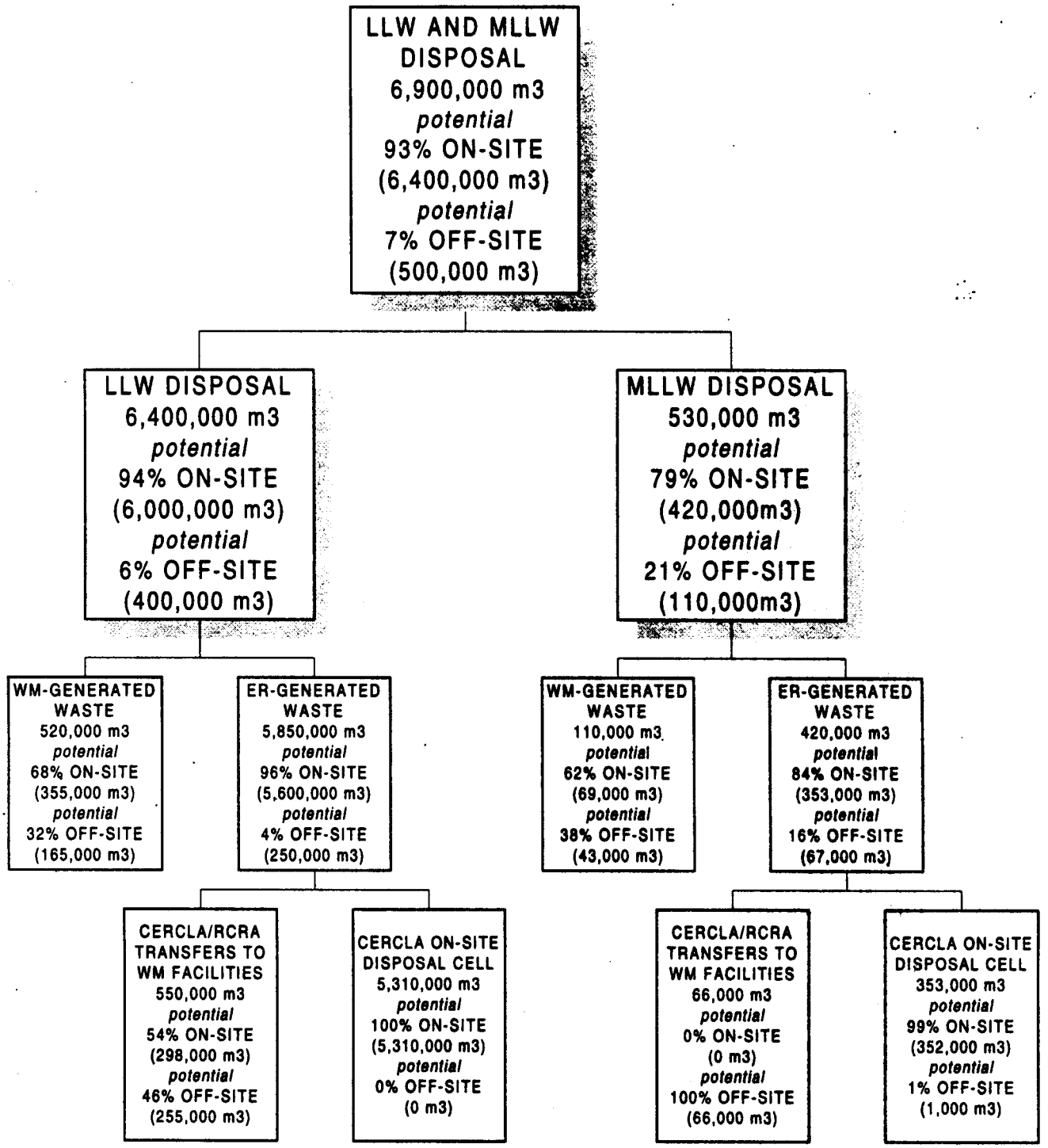


**Figure A.2** Estimated Volumes and Potential Disposal Pathways for LLW and MLLW from Waste Management Operations & Environmental Restoration Activities



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September 22, 1998

# APPENDIX B

# ENVIRONMENT, SAFETY AND HEALTH AND TRANSPORTATION

# IMPACTS SCALING ANALYSIS

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# WM PEIS Scaling Factor Analysis

This appendix is broken into four sections. Section 1 overviews the methodology the *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS) used to analyze potential impacts associated with various waste management alternatives. Section 2 presents the results of the scaling factor analysis: potential impacts associated with updated volumes of LLW and MLLW, for each configuration option the Department is now considering. Results are given first for those wastes generated by the waste management program that are subject to the WM PEIS decisions. Results are also presented for waste management-generated wastes *plus* those wastes generated by the environmental restoration program which could potentially be transferred to waste management disposal facilities through site-specific CERCLA or RCRA records of decision. Section 3 lists the assumptions used in the analysis, and Section 4 details the scaling factor analysis methodology.

## 1.0 BACKGROUND

In May 1997, the Department issued the final WM PEIS. For waste management activities, the WM PEIS evaluated two general types of potential impacts associated with waste treatment, storage, and disposal: (1) facility-related impacts; and (2) transportation-related impacts. For each general type of potential impact, both routine operation (i.e., incident-free) and accident conditions were evaluated. WM PEIS Volume I, Chapter 5 (Figures 5.1-1 and 5.1-2) describes in detail the eleven types of ***facility-related impacts*** evaluated: health risks; air quality; water resources; ecological resources; socioeconomic impacts; population impacts; environmental justice; land use; infrastructure; cultural resources; and cost. WM PEIS Volume IV, Appendix E details the two types of ***transportation-related impacts*** evaluated: latent cancer fatalities from radiological exposure and diesel exhaust exposure; and physical trauma fatalities from accidents. Summaries of potential transportation impacts also are in each of the waste-type chapters in Volume I.

Of the WM PEIS's eleven facility-related impacts, only three varied enough among the alternatives evaluated to be useful in discriminating among them. These three facility-related impacts are: health risks; air quality; and water resources. Consequently, the WM PEIS used these three facility-related impacts, together with truck transportation impacts (which bound rail transportation impacts), to characterize the potential impacts of the WM PEIS Preferred Alternatives (e.g., Tables 6.16-3 and 7.16-3 of Volume I). Even within these impact categories, however, certain impact parameters proved to be generally bounding of other impact parameters. Therefore, WM PEIS Volume I highlights only the subset of impact parameters shown in **Figure B-1** in its comparison of alternatives (Tables 6.16-1, 6.16-2, 7.16-1 and 7.16-2 of Volume I) or its discussion of Preferred Alternatives.

This scaling factor analysis uses the same subset of impact parameters shown in **Figure B-1** to evaluate potential facility-related and transportation-related impacts associated with the LLW and MLLW treatment and disposal options currently under consideration by the Department. The analysis is based on recent waste volume data developed for the *Paths to Closure: Accelerating Cleanup* report. (Note: The Department separately evaluated and presented its update of the "cost" facility-related impact in the June 1998 draft *Low-Level Waste/Mixed Low-Level Waste Disposal Cost Analysis in Support of the Waste Management Disposal Records of Decision.*) Ultimately, this analysis will be used to support the Department's issuance of WM PEIS Records of Decision for LLW and MLLW treatment and disposal.

***Figure B-1**. Impact Categories and Parameters Which Distinguish Among WM PEIS Alternatives*

| IMPACT CATEGORIES | IMPACT PARAMETERS |
|---|---|
| FACILITY-RELATED IMPACTS | |
| Health Risks | Worker Physical Hazard Fatalities |
| | Worker Radiation Exposure Fatalities |
| | Off-site Population Radiation Exposure Fatalities |
| Air Quality | Sites with Air Pollutants That Exceed Standards |
| Water Resources | Sites with Radionuclide Concentrations That Exceed Drinking Water Standards |
| TRANSPORTATION-RELATED IMPACTS | |
| Radiological | Truck/Rail Radiation Fatalities |
| Nonradiological | Truck/Rail Nonradiation Fatalities |

## 2.0 DATA ANALYSIS

The results of the Department's analysis of potential impacts are presented in **Figures B-2** through **B-5**. The figures are organized by waste type (first LLW and then MLLW) and include the analysis results for waste management operations waste only (Figures B-2 and B-4) and for waste management *plus* potential environmental restoration transfers (Tables B-3 and B-5).

LLW Disposal

**Figure B-2** presents the impact estimates for each LLW Option in comparison to the WM PEIS Preferred Alternatives and to WM PEIS impact ceiling estimates. Overall, for LLW disposal, the potential Option impacts are lower than those of the WM PEIS Preferred Alternative for WM-only volumes. When ER-transfer waste is added (**Figure B-3**), the impacts remain lower than the WM PEIS Preferred Alternative impact estimates. Consequently, the addition of the ER-transfer waste would not change any conclusions drawn from this analysis.

As can be seen in **Figures B-2** and **B-3**, the potential impacts, especially for transportation, are significantly lower than those estimated in the WM PEIS preferred alternative. The reason for this is that the upper end of the WM PEIS preferred alternative assumes all LLW travels for centralized disposal. Among the options the Department is currently considering, not only is the total volume two-thirds lower now than was analyzed in the WM PEIS (520,000 $m^3$ versus 1,500,000 $m^3$), but of this current amount, only one-third (170,000 $m^3$) is transported. Consequently, the Department is now analyzing the potential impacts of transporting only approximately one-tenth the amount of LLW that was analyzed in the WM PEIS.

MLLW Disposal

**Figure B-4** presents the impact estimates for each MLLW Option in comparison to the WM PEIS Preferred Alternatives and to WM PEIS impact ceiling estimates. For MLLW disposal, the potential Option impacts for WM-only volumes sometimes exceed those of the preferred alternative, but always remain within the WM PEIS ceiling impacts. This remains true when ER-transfer waste is added (**Figure B-5**). Consequently, the addition of the ER-transfer waste would not change any conclusions drawn from this analysis.

As with LLW, the potential transportation impacts are lower for both WM-only and WM plus ER-transfer waste volumes (**Figures B-4** and **B-5**). This may seem unexpected, given that the Department is currently analyzing the disposal of more MLLW than was analyzed in the WM PEIS (112,000 $m^3$ versus 71,000 $m^3$). Again, however, as described for LLW, the upper end of the WM PEIS preferred alternative assumes all MLLW travels for centralized disposal. Although the current total WM-only volume is approximately 1.5 times what was analyzed in the WM PEIS, current MLLW disposal options transport a maximum of only 60 percent (or 43,000 $m^3$) of the WM PEIS volume.

***Figure B-2.*** *Summary of Potential Impacts for DOE LLW Disposal Options*

| Configuration | Worker | | Air | Water | Transportation | | | | Ratio of Low-to-High Population Sites[1] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Truck | | Rail | | |
| | Physical Fatalities | Radiation Fatalities | Sites Exceeding Standards | Sites Exceeding Standards | Radiation Fatalities | Non-rad Fatalities | Radiation Fatalities | Non-rad Fatalities | |
| WM PEIS | | | | | | | | | |
| Max Impacts | 6 | 3 | 1 | 3 | 16 | 38 | 2 | 3 | |
| Preferred | 0.6-4.8 | 2.2-2.8 | 0-1 | 0-2 | 2-16 | 3-38 | NA | NA | 4/2 |
| Option 1 | 1 | 1.3 | 0 | 2 | 0.46 | 1.08 | 0.04 | 0.06 | 4/1 |
| Option 2 | 1 | 1.3 | 0 | 2 | 0.51 | 1.2 | 0.04 | 0.05 | 4/1 |
| Option 3 | 1.3 | 0.9 | 0 | 2 | 0.18 | 0.41 | 0.02 | 0.02 | 4/1 |
| Option 4 | 1.1 | 1.1 | 0 | 2 | 0.11 | 0.26 | 0.01 | 0.02 | 4/2 |
| Option 5 | 1.3 | 1.1 | 0 | 2 | 0.16 | 0.37 | 0.02 | 0.02 | 4/2 |
| Option 6 | 1 | 1.3 | 0 | 2 | 0.46 | 1.08 | 0.04 | 0.05 | 4/1 |

***Figure B-3.*** *Summary of Potential Impacts for DOE LLW Disposal Options* ***with ER-Transfers***

| Configuration | Worker | | Air | Water | Transportation | | | | Ratio of Low-to-High Population Sites[2] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Truck | | Rail | | |
| | Physical Fatalities | Radiation Fatalities | Sites Exceeding Standards | Sites Exceeding Standards | Radiation Fatalities | Non-rad Fatalities | Radiation Fatalities | Non-rad Fatalities | |
| WM PEIS | | | | | | | | | |
| Max Impacts | 6 | 3 | 1 | 3 | 16 | 38 | 2 | 3 | |
| Preferred | 0.6-4.8 | 2.2-2.8 | 0-1 | 0-2 | 2-16 | 3-38 | NA | NA | 4/2 |
| Option 1 | 1.5 | 2.2 | 0 | 2 | 1.26 | 2.95 | 0.1 | 0.14 | 4/1 |
| Option 2 | 1.6 | 2.3 | 0 | 2 | 1.33 | 3.1 | 0.11 | 0.14 | 4/1 |
| Option 3 | 2.1 | 2 | 0 | 2 | 0.83 | 1.94 | 0.07 | 0.1 | 4/1 |
| Option 4 | 1.8 | 2.1 | 0 | 2 | 0.77 | 1.8 | 0.07 | 0.09 | 4/2 |
| Option 5 | 2 | 2 | 0 | 2 | 0.82 | 1.91 | 0.07 | 0.09 | 4/2 |
| Option 6 | 1.4 | 2.2 | 0 | 2 | 1.28 | 2.99 | 0.11 | 0.14 | 4/1 |

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[1] *Final Waste Management Programmatic Environmental Impact Statement,* Volume I, Section 5.4.1 describes the analysis to assess potential collective risk to off-site populations from waste disposal. Section 7.4.1.8 provides information for LLW; Section 6.4.1.8 for MLLW.

[2] Ibid.

***Figure B-4.*** *Summary of Potential Impacts for DOE MLLW Disposal Options*

| Configuration | Worker | | Air | Water | Transportation | | | | Ratio of Low-to-High Population Sites[3] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Truck | | Rail | | |
| | Physical Fatalities | Radiation Fatalities | Sites Exceeding Standards | Sites Exceeding Standards | Radiation Fatalities | Non-rad Fatalities | Radiation Fatalities | Non-rad Fatalities | |
| WM PEIS | | | | | | | | | |
| Max Impacts | <1 | 1 | 1 | 4 | <1 | 1 | <1 | <1 | |
| Preferred | 0.08-0.4 | 0.4-0.5 | 0 | 0-3 | <0.5 | <1 | N/A | N/A | 4/2 |
| Option A | 0.2 | 0.6 | 1 | 1 | 0.19 | 0.37 | 0.02 | 0.02 | 2/0 |
| Option B | 0.2 | 0.6 | 1 | 1 | 0.18 | 0.35 | 0.02 | 0.02 | 2/0 |
| Option C | 0.8 | 0.6 | 1 | 2 | 0.04 | 0.08 | 0.004 | 0.004 | 1/1 |
| Option D | 0.2 | 0.6 | 1 | 1 | 0.19 | 0.37 | 0.02 | 0.02 | 1/0 |
| Option E | 0.2 | 0.6 | 1 | 1 | 0.18 | 0.35 | 0.02 | 0.02 | 2/0 |

***Figure B-5.*** *Summary of Potential Impacts for DOE MLLW Disposal Options* ***with ER-Transfers***

| Configuration | Worker | | Air | Water | Transportation | | | | Ratio of Low-to-High Population Sites[4] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Truck | | Rail | | |
| | Physical Fatalities | Radiation Fatalities | Sites Exceeding Standards | Sites Exceeding Standards | Radiation Fatalities | Non-rad Fatalities | Radiation Fatalities | Non-rad Fatalities | |
| WM PEIS | | | | | | | | | |
| Max Impacts | <1 | 1 | 1 | 4 | <1 | 1 | <1 | <1 | |
| Preferred | 0.08-0.4 | 0.4-0.5 | 0 | 0-3 | <0.5 | <1 | N/A | N/A | 4/2 |
| Option A | 0.4 | 0.9 | 1 | 1 | 0.33 | 0.66 | 0.03 | 0.03 | 2/0 |
| Option B | 0.3 | 0.9 | 1 | 1 | 0.28 | 0.57 | 0.03 | 0.03 | 2/0 |
| Option C | 0.9 | 1 | 1 | 2 | 0.19 | 0.38 | 0.017 | 0.018 | 1/1 |
| Option D | 0.4 | 0.9 | 1 | 1 | 0.33 | 0.66 | 0.03 | 0.03 | 1/0 |
| Option E | 0.3 | 0.9 | 1 | 1 | 0.26 | 0.52 | 0.03 | 0.03 | 2/0 |

[3]Ibid.

[4]Ibid.

## 3.0 ASSUMPTIONS

The following assumptions were used in this analysis:

- The *Paths to Closure* database of March 1998 is the source of the updated LLW and MLLW 20-year inventory and generation projections for treatment and disposal volumes. These volume projections include all waste currently designated for disposal at the six waste management disposal sites or for disposal at a "to be determined" (TBD) site.

- Since facility-related impacts are a function of waste throughput, potential impacts calculated in the WM PEIS are linearly related to changes in waste volumes. This analysis uses this same assumption. Transportation-related impacts are also assumed to be linearly related to changes in waste volumes.

- All source terms (i.e., waste stream-specific radiological and chemical profiles) are assumed to be the same as those evaluated in the WM PEIS.

- The radiological source term for wastes transferred to waste management facilities from the environmental restoration (ER) program, is assumed to have the same radiological source term as for WM-generated wastes; this assumption is expected to be conservative.

- Transportation-related impacts are attributed only to waste disposal, even though, in the case of MLLW treatment, some intersite transfers are expected to occur for treatment, in accordance with Site Treatment Plans.

## 4.0 METHODOLOGY

This analysis uses 20-year inventory and generation volumes from the *Paths to Closure* report for treatment and disposal of LLW and MLLW, to develop scaled estimates of the discriminating impact parameters presented in the WM PEIS. Impact estimates are developed based on *Paths to Closure* data for waste volumes managed by DOE's Office of Waste Management (WM). Analysis has also been done to estimate potential impacts associated with waste volumes which could be transferred to WM facilities through CERCLA site-specific cleanup decisions or RCRA corrective action decisions. The WM PEIS decisions will not determine how much contaminated media will be removed for cleanup purposes.

The following example provides a walk-through of the approach used to estimate impacts for the updated LLW/MLLW configuration options, based on the results presented in the WM PEIS. This example shows how the scaling factor analysis yields impact estimates for LLW Disposal Option 1. Section 2 of this analysis displays the results of the following methodology and readers may wish to refer to those results tables, as well.

*Facility-Related Impacts*

1. Site-Specific Scaling Factor. Under Option 1, the total amount of WM-generated LLW (on-site plus off-site shipments) expected to be disposed at Hanford over the next 20 years is 148,530 $m^3$. From WM PEIS Volume I, Table 7.4-10, Regionalized Alternative 6 (R6) is the first alternative that shows more than 148,530 $m^3$ being disposed at Hanford. R6 disposes 460,000 $m^3$ at Hanford (versus 148,530 $m^3$ for Option 1).

   Using R6 as a baseline for Hanford impacts, a scaling factor is calculated for Hanford by dividing the Hanford's Option 1 volume by Hanford's volume under WM PEIS R6:

   *Hanford Scaling Factor (SF)* = *Hanford Option 1 Volume ÷ Hanford WM PEIS R6 Volume*
   = 148,530 $m^3$ ÷ 460,000 $m^3$
   = 0.32

2. Site-Specific "Health Risk" Impacts. To scale "health risk" impacts, the site-specific and waste type-specific impacts estimates presented in Volume II of the WM PEIS are used. For example, potential Hanford LLW impacts are presented in Tables II-5.2-1 through II-5.2-13 of Volume II. To estimate Hanford's facility-related impacts for Option 1, the Hanford facility-related impacts for R6 presented in these tables are multiplied by the above scaling factor.

   *Hanford Impact* = *Hanford SF X Hanford WM PEIS R6 Impact*

   Hanford "Worker Physical Hazard Fatalities" = 0.32 X 6.0E-01 fatalities (from Table II-5.2-1 for R6 disposal)
   = 0.2 fatalities

   Hanford "Worker Radiation Exposure Fatalities" = 0.32 X 1.1E+00 fatalities (from Table II-5.2-1 for R6 disposal)
   = 0.4 fatalities

   [Note: The WM PEIS calculates the third discriminating Health Risk impact parameter -- "Offsite Population Radiation Exposure Fatalities" -- only for treatment activities, so this disposal example does not show a value for this parameter.]

3. Site-Specific "Air Quality" Impacts. For the parameter "Number of Sites with Air Pollutants that Exceed Standards," the WM PEIS lists specific pollutants that are estimated to exceed the standards (Table II-5.2-7 displays criteria air pollutants for Hanford). In this example, Hanford has no pollutants expected to exceed standards (exceedences are shown as tabulated values 100% or higher). However, to understand the methodology for a site that might have an exceedence, the discussion for Step 4 below applies.

4. Site-Specific "Water Resources" Impacts. For the "Number of Sites with Radionuclide Concentrations that Exceed Drinking Water Standards," the WM PEIS lists specific radionuclides estimated to exceed standards (for Hanford, this is displayed in Table II-5.2-10). This scaling analysis conservatively assumes that exceedences estimated in the WM PEIS are still likely to exist at certain sites for certain radionuclides, even if disposal volumes decrease. Therefore, for Hanford, an entry for "U-238" is placed in the Option 1 disposal impacts summary table, indicating that U-238 may still be a radionuclide of concern at Hanford (WM PEIS Table II-5.2-10 shows this is the only radionuclide of concern at Hanford for R6). Performance Assessments being conducted at DOE disposal sites will better address the potential for groundwater contamination than the screening level analyses conducted for the WM PEIS.

5. Option-Level Impacts. Steps 1 through 4 are repeated for each of the other LLW disposal sites identified in Option 1 (i.e., INEEL, LANL, NTS, and SRS). Site-specific scaling factors are calculated based on the volumes to be disposed at each site in Option 1. Estimates of option-level "Worker Physical Hazard Fatalities" and "Worker Cancer Fatalities" are calculated by summing the scaled values for each site. For the parameter "Radionuclides Exceeding Drinking Water Standards," an option-level value is calculated by adding the number of individual sites with potential exceedences. For Option 1, this value is 2 because of potential exceedences at Hanford and Savannah River. Similarly, the option-level value for "Highest Air Pollutant (percent of standard)" is not a sum of individual site impacts but rather the highest reported value among all sites. This value is not a concern until it exceeds 100%. Therefore, for Option 1, since this value is only 37% -- based on the scaled estimate for the Nevada Test Site -- Option 1 shows no sites with potential exceedences.

*Transportation-Related Impacts*

6. Option-Level Scaling Factors. Transportation-related fatality impacts are scaled at the option-level versus site-level, since it is the distances traveled between sites that drive these potential impacts. However, unlike for facility-related impacts which are scaled solely based on volumes, transportation-related impacts are scaled based on both volumes shipped and distances traveled. For Option 1, scaling factors are developed by first multiplying each generator site's number of LLW shipments in Option 1, by the mileage between the generator site and its Option 1 disposal site. This calculation varies for truck versus rail transport, because the difference in truck capacity versus rail car capacity determines the number of shipments. For example, truck transport assumes an average volume capacity of approximately 17 $m^3$ at an average waste density of 1200 $kg/m^3$, whereas a railcar has an average volume capacity of approximately 63 $m^3$ at the same density. Once shipment-miles by truck and rail are calculated for each generator site, the values are summed to develop Option 1 shipment-mileage totals. To obtain scaling factors, these Option 1 truck and rail values are divided by a similar shipment-mileage totals for WM PEIS Centralized 1 Alternative (C1), as

a baseline for maximum transportation. WM PEIS Tables 7.4-14 and 7.4-15 display truck and rail shipment miles, respectively, for each LLW alternative.

*Option 1 Truck SF* = *Option 1 Truck Shipment-Miles ÷ PEIS C1 Truck Shipment-Miles*
= 16,500,000 shipment-miles ÷ 530,000,000 shipment-miles (from WM PEIS Table 7.4-14 for C1 truck disposal)
= 0.029

*Option 1 Rail SF* = *Option 1 Rail Shipment-Miles ÷ PEIS C1 Rail Shipment-Miles*
= 5,600,000 shipment-miles ÷ 224,000,000 shipment-miles (from WM PEIS Table 7.4-15 for C1 rail disposal)
= 0.025

7. Option-Level Impacts. The above scaling factors are applied to the radiation and nonradiation fatality estimates for C1 to obtain transportation-related impact estimates for Option 1. Two types of transportation population impacts are estimated for both truck and rail transport: (1) radiation latent cancer fatalities; and (2) nonradiation fatalities (i.e., physical trauma from accidents, and latent cancer fatalities from diesel exhaust emissions). The WM PEIS reports potential truck and rail impacts in two locations: WM PEIS Volume I, Tables 7.4-14 and 7.4-15 which show rounded estimates, and WM PEIS Volume IV, Tables E-15 and E-16 which show more detailed estimates. For simplicity in describing the analysis methodology, this example refers to values in Tables 7.4-14 and 7.4-15. The actual analysis was performed on the more detailed data in Tables E-15 and E-16. The radiation fatality estimates in Tables 7.4-14 and 7.4-15 are the sum of the crew and public latent cancer fatality estimates presented in Tables E-15 and E-16. The nonradiation fatality estimates presented in Tables 7.4-14 and 7.4-15 are the sum of the emissions and accident fatality estimates listed under vehicle-related fatalities in Tables E-15 and E-16.

*Option 1 Transportation Impact* = *Option 1 SF X WM PEIS C1 Transportation Impact*

Option 1 "Truck Radiation Fatalities" = 0.029 X 16 fatalities (from Table 7.4-14 for C1 disposal, summing values for public and crew normal operations plus exposure from traffic accidents )
= 0.46 fatalities

Option 1 "Truck Nonradiation Fatalities"= 0.029 X 37 fatalities (from Table 7.4-14 for C1 disposal, summing values for fuel emissions and injuries from traffic accidents)
= 1.1 fatalities

Option 1 "Rail Radiation Fatalities" = 0.025 X 2 fatalities (from Table 7.4-15 for C1 disposal, summing values for public and crew normal operations plus exposure from traffic accidents )
= 0.05 fatalities

Option 1 "Rail Nonradiation Fatalities" = 0.025 X 3 fatalities (from Table 7.4-15 for C1 disposal, summing values for fuel emissions and injuries from traffic accidents)
= 0.08 fatalities

September 22, 1998

# APPENDIX C

# COST ANALYSIS

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**Appendix C** September 22, 1998

## Cost Analysis of LLW and MLLW Disposal Options

This appendix estimates the costs DOE would incur to implement each of the LLW and MLLW Options the Department is now considering. Section 1 provides background and an overview of the cost analyses. Section 2 presents the analysis results, in the form of tabulated cost estimates for each LLW and MLLW option. The costs are presented first for only the waste management-generated wastes subject to the WM PEIS disposal decisions. Cost estimates are also shown for disposing both waste management-generated wastes *plus* environmental restoration-generated wastes which could be transferred to waste management disposal facilities through CERCLA or RCRA corrective action decisions. Section 3 describes briefly each element of cost that was evaluated and the methodology DOE used to estimate the costs. Section 4 presents the assumptions used in the analysis.

## 1.0 BACKGROUND [1]

In 1979, DOE adopted the policy of disposing its LLW primarily at DOE sites to ensure capacity would exist as to not disrupt its defense production mission and to limit liability. Prior to this time, DOE and its predecessor agencies disposed its waste at both government-owned and commercial facilities. Since 1979, DOE ensured continued development of LLW disposal facilities at six DOE sites: Hanford, Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Nevada Test Site (NTS), Oak Ridge Reservation (ORR), and Savannah River Site (SRS). In the 1980's, DOE developed plans to also locate MLLW disposal facilities at these sites. To date, however, only two MLLW disposal facilities have been developed, at Hanford and NTS, and neither is currently operating for disposal of MLLW from other sites within the complex.

DOE is now considering options for disposing its LLW and MLLW as analyzed in its May 1997 Final Waste Management Programmatic Environmental Impact Statement (WM PEIS). In preparation for making these disposal RODs DOE has updated and expanded its analysis of disposal costs beyond that which was analyzed in the WM PEIS. During consideration of potential configuration decisions, DOE has studied the drivers behind disposal costs to better understand how configuration decisions may affect overall costs.

The *Low-Level Waste Disposal Cost Comparison Report* (DOE, 1997, hereinafter referred to as the 1997 Cost Analysis), as updated, provided a method to estimate and compare the costs to DOE sites of LLW disposal, including the costs of operating disposal facilities and costs borne by generators to prepare waste for disposal. The analysis was expanded to reflect life-cycle costs

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[1]Extracted from "Creating a Lean, Mean, LLW Disposal Configuration -- Reaping the Efficiencies of a Right-Sized Disposal Complex with a Mix of Commercial and Federal Services" presented at the Waste Management '98 conference by Martin J. Letourneau of the Department of Energy

and disposal locations which match the LLW and MLLW WM-PEIS options. The analysis concluded that generator costs for preparing and certifying waste for disposal at DOE facilities is often higher than the unit cost charged by the disposal facility for disposal. A large portion of the total cost of disposal, possibly as much as 60 percent, is associated with generator packaging, certification, and acceptance costs. Of the costs associated with the disposal facilities alone, fixed costs represent approximately 71 percent of the total DOE disposal program costs projected for FY 1998, with the remaining 29 percent representing variable operations and maintenance costs.

In general, the unit cost per volume disposed was lowest at facilities with the largest volumes of LLW disposed, demonstrating the economies of scale. The type of disposal facility (trench vs. engineered vault) was also a driver of unit cost, which is closely linked with site geology, climate, and other site-specific factors. Special waste characteristics (activity/shielding, remote handling) also affected unit cost. The unit costs at environmental restoration disposal facilities are generally lower than operations waste facilities because: (1) higher disposal volumes at which result in lower unit costs; and (2) larger percentages of bulk wastes, reducing packaging and handling costs.

Follow-on studies from the cost comparison report have continued to look at the functionality of costs. Results from these are further described in the methodology section. The results are also being used to analyze configuration decisions for MLLW disposal due to operational similarities.

## 2.0 DATA ANALYSIS

The following tables summarize the cost estimates performed for LLW and MLLW disposal. **Figure C-1** is the LLW summary for WM waste only, **Figure C-2** is the MLLW summary for WM waste only, **Figure C-3** is the LLW summary for WM plus ER waste, and **Figure C-4** is the MLLW summary for WM plus Environmental Restoration (ER) waste. As described in Section 3.6, the cost of storing the TBD waste for 20 years has been estimated for the LLW and MLLW baseline configurations. Therefore, these tables have included an entry for 20-year storage costs for the baseline configurations and a 20-year total cost for the baseline configurations if the TBD waste is stored in lieu of disposal.

For presentation purposes, all costs are summarized by WM disposal facility. The costs for generators to prepare waste for disposal and transport it to the disposal facility are included in the Generator and Transportation categories, respectively.

***Figure C-1.*** *20-Year LLW Cost Summary (WM waste only)* (Dollars in millions except as noted)

| | | Baseline | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 |
|---|---|---|---|---|---|---|---|---|
| Hanford | Fixed Cost | $ 43.2 | $ 43.2 | $ 43.2 | $ 43.2 | $ 43.2 | $ 43.2 | $ 43.2 |
| | Volume (m3) | 159,927 | 164,535 | 248,241 | 148,530 | 148,530 | 148,530 | 148,530 |
| | Disposal | $ 50.3 | $ 51.8 | $ 67.0 | $ 46.7 | $ 46.7 | $ 46.7 | $ 46.7 |
| | Generator | $ 63.3 | $ 65.1 | $ 84.2 | $ 58.7 | $ 58.7 | $ 58.7 | $ 58.7 |
| | Transportation | $ 8.0 | $ 10.8 | $ 67.3 | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ 164.7 | $ 170.8 | $ 261.7 | $ 148.6 | $ 148.6 | $ 148.6 | $ 148.6 |
| | *Unit Cost ($/m3)* | $ 1,030 | $ 1,038 | $ 1,054 | $ 1,001 | $ 1,001 | $ 1,001 | $ 1,001 |
| INEEL | Fixed Cost | $ 37.4 | $ 37.4 | $ 37.4 | $ 37.4 | $ 37.4 | $ 37.4 | $ 37.4 |
| | Volume (m3) | 24,251 | 24,251 | 24,251 | 24,251 | 24,251 | 24,251 | 24,251 |
| | Disposal | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 |
| | Generator | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 |
| | Transportation | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ 43.4 | $ 43.4 | $ 43.4 | $ 43.4 | $ 43.4 | $ 43.4 | $ 43.4 |
| | *Unit Cost ($/m3)* | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 |
| LANL | Fixed Cost | $ 57.7 | $ 57.7 | $ 57.7 | $ 57.7 | $ 57.7 | $ 57.7 | $ 57.7 |
| | Volume (m3) | 129,708 | 104,474 | 104,474 | 104,474 | 104,474 | 104,474 | 104,474 |
| | Disposal | $ 2.0 | $ 0.3 | $ 0.3 | $ 0.3 | $ 0.3 | $ 0.3 | $ 0.3 |
| | Generator | $ 41.8 | $ 33.7 | $ 33.7 | $ 33.7 | $ 33.7 | $ 33.7 | $ 33.7 |
| | Transportation | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ 101.5 | $ 91.7 | $ 91.7 | $ 91.7 | $ 91.7 | $ 91.7 | $ 91.7 |
| | *Unit Cost ($/m3)* | $ 783 | $ 877 | $ 877 | $ 877 | $ 877 | $ 877 | $ 877 |
| NTS | Fixed Cost | $ 15.1 | $ 15.1 | $ 15.1 | $ 15.1 | $ 15.1 | $ 15.1 | $ 15.1 |
| | Volume (m3) | 34,794 | 150,144 | 66,439 | 66,297 | 66,297 | 66,297 | 166,150 |
| | Disposal | $ 8.5 | $ 36.6 | $ 16.2 | $ 16.2 | $ 16.2 | $ 16.2 | $ 40.5 |
| | Generator | $ 12.0 | $ 51.8 | $ 22.9 | $ 22.9 | $ 22.9 | $ 22.9 | $ 57.3 |
| | Transportation | $ 7.9 | $ 68.8 | $ 8.7 | $ 16.4 | $ 16.4 | $ 16.4 | $ 78.5 |
| | *TOTAL* | $ 43.5 | $ 172.4 | $ 72.9 | $ 70.5 | $ 70.5 | $ 70.5 | $ 191.5 |
| | *Unit Cost ($/m3)* | $ 1,251 | $ 1,148 | $ 1,098 | $ 1,064 | $ 1,064 | $ 1,064 | $ 1,153 |
| ORR | Fixed Cost | $ - | $ - | $ - | $ - | $ 30.9 | $ 30.9 | $ - |
| | Volume (m3) | - | - | - | - | 73,023 | 24,940 | - |
| | Disposal | $ - | $ - | $ - | $ - | $ 196.3 | $ 67.0 | $ - |
| | Generator | $ - | $ - | $ - | $ - | $ 96.2 | $ 32.9 | $ - |
| | Transportation | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ - | $ - | $ - | $ - | $ 323.4 | $ 130.8 | $ - |
| | *Unit Cost ($/m3)* | $ - | $ - | $ - | $ - | $ 4,428 | $ 5,243 | $ - |
| SRS | Fixed Cost | $ 45.4 | $ 45.4 | $ 45.4 | $ 45.4 | $ 45.4 | $ 45.4 | $ 45.4 |
| | Volume (m3) | 75,443 | 75,444 | 75,444 | 175,297 | 102,274 | 150,357 | 75,444 |
| | Disposal | $ 18.0 | $ 18.0 | $ 18.0 | $ 41.7 | $ 24.3 | $ 35.8 | $ 18.0 |
| | Capital | $ 38.0 | $ 38.0 | $ 38.0 | $ 76.0 | $ 57.0 | $ 76.0 | $ 38.0 |
| | Generator | $ 19.6 | $ 19.6 | $ 19.6 | $ 45.5 | $ 26.6 | $ 39.1 | $ 19.6 |
| | Transportation | $ - | $ - | $ - | $ 14.5 | $ 6.6 | $ 11.8 | $ - |
| | *TOTAL* | $ 120.9 | $ 120.9 | $ 120.9 | $ 223.2 | $ 159.9 | $ 208.0 | $ 120.9 |
| | *Unit Cost ($/m3)* | $ 1,603 | $ 1,603 | $ 1,603 | $ 1,273 | $ 1,564 | $ 1,384 | $ 1,603 |
| TOTALS | Fixed Cost | $ 198.8 | $ 198.8 | $ 198.8 | $ 198.8 | $ 229.6 | $ 229.6 | $ 198.8 |
| | Volume (m3) | 424,123 | 518,848 | 518,849 | 518,849 | 518,849 | 518,849 | 518,849 |
| | Storage (20-yr) | $ 805.8 | NA | NA | NA | NA | NA | NA |
| | Disposal | $ 81.2 | $ 109.1 | $ 103.9 | $ 107.4 | $ 286.3 | $ 168.5 | $ 108.0 |
| | Capital | $ 38.0 | $ 38.0 | $ 38.0 | $ 76.0 | $ 57.0 | $ 76.0 | $ 38.0 |
| | Generator | $ 140.1 | $ 173.6 | $ 163.9 | $ 164.3 | $ 241.6 | $ 190.7 | $ 172.8 |
| | Transportation | $ 15.9 | $ 79.6 | $ 86.0 | $ 30.9 | $ 23.0 | $ 28.2 | $ 78.5 |
| | *TOTAL* | $ 1,279.9 | $ 599.1 | $ 590.6 | $ 577.4 | $ 837.5 | $ 693.0 | $ 596.1 |
| | *Unit Cost ($/m3)** | $ 1,118 | $ 1,155 | $ 1,138 | $ 1,113 | $ 1,614 | $ 1,336 | $ 1,149 |

* Unit Cost in the Baseline is for disposal only; storage costs are not factored in.

***Figure C-2.*** *20-Year MLLW Cost Summary (WM waste only)* (Dollars in millions except as noted)

| | | Baseline | Option A | Option B | Option C | Option D | Option E |
|---|---|---|---|---|---|---|---|
| Hanford | Fixed Cost | $ 28.0 | $ 28.0 | $ 28.0 | $ 28.0 | $ 28.0 | $ 28.0 |
| | Volume ($m^3$) | 69,124 | 111,635 | 96,401 | 76,745 | 111,819 | 69,225 |
| | Disposal | $ 23.9 | $ 28.0 | $ 25.9 | $ 25.6 | $ 28.1 | $ 23.9 |
| | Generator | $ 37.6 | $ 44.1 | $ 40.7 | $ 40.2 | $ 44.1 | $ 37.6 |
| | Transportation | $ - | $ 27.1 | $ 19.0 | $ 2.5 | $ 27.2 | $ - |
| | ***TOTAL*** | $ 89.4 | $ 127.2 | $ 113.7 | $ 96.2 | $ 127.4 | $ 89.5 |
| | ***Unit Cost ($/m³)*** | $ 1,294 | $ 1,140 | $ 1,179 | $ 1,254 | $ 1,139 | $ 1,293 |
| | | | | | | | |
| NTS | Fixed Cost | $ - | $ 10.0 | $ 10.0 | $ - | $ - | $ 10.0 |
| | Volume ($m^3$) | - | 184 | 15,418 | - | - | 42,594 |
| | Disposal | $ - | $ 0.0 | $ 1.6 | $ - | $ - | $ 2.9 |
| | Generator | $ - | $ 0.1 | $ 2.9 | $ - | $ - | $ 5.2 |
| | Transportation | $ - | $ 0.1 | $ 6.9 | $ - | $ - | $ 23.5 |
| | ***TOTAL*** | $ - | $ 10.2 | $ 21.4 | $ - | $ - | $ 41.6 |
| | ***Unit Cost ($/m³)*** | NA | $ 55,290 | $ 1,391 | NA | NA | $ 976 |
| | | | | | | | |
| SRS | Fixed Cost | $ - | $ - | $ - | $ 22.2 | $ - | $ - |
| | Volume ($m^3$) | - | - | - | 35,074 | - | - |
| | Disposal | $ - | $ - | $ - | $ 7.7 | $ - | $ - |
| | Capital | $ - | $ - | $ - | $ 42.0 | $ - | $ - |
| | Generator | $ - | $ - | $ - | $ 10.5 | $ - | $ - |
| | Transportation | $ - | $ - | $ - | $ 3.6 | $ - | $ - |
| | ***TOTAL*** | $ - | $ - | $ - | $ 86.0 | $ - | $ - |
| | ***Unit Cost ($/m³)*** | NA | NA | NA | $ 2,451 | NA | NA |
| | | | | | | | |
| TOTALS | Fixed Cost | $ 28.0 | $ 38.0 | $ 38.0 | $ 50.2 | $ 28.0 | $ 38.0 |
| | Volume ($m^3$) | 69,124 | 111,819 | 111,819 | 111,819 | 111,819 | 111,819 |
| | Storage (20-yr) | $ 329.2 | NA | NA | NA | NA | NA |
| | Disposal | $ 23.9 | $ 28.1 | $ 27.6 | $ 33.2 | $ 28.1 | $ 26.9 |
| | Capital | $ - | $ - | $ - | $ 42.0 | $ - | $ - |
| | Generator | $ 37.6 | $ 44.1 | $ 43.7 | $ 50.6 | $ 44.1 | $ 42.8 |
| | Transportation | $ - | $ 27.2 | $ 25.9 | $ 6.1 | $ 27.2 | $ 23.5 |
| | ***TOTAL*** | $ 418.6 | $ 137.4 | $ 135.1 | $ 182.2 | $ 127.4 | $ 131.1 |
| | ***Unit Cost ($/m³)**** | $ 1,294 | $ 1,229 | $ 1,208 | $ 1,629 | $ 1,139 | $ 1,172 |

* Unit Cost in the Baseline is for disposal only; storage costs are not factored in.

***Figure C-3.*** *20-Year LLW Cost Summary (WM plus ER waste)* (Dollars in millions except as noted)

| | | Baseline | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 |
|---|---|---|---|---|---|---|---|---|
| Hanford | Fixed Cost | $ 46.9 | $ 46.9 | $ 46.9 | $ 46.9 | $ 46.9 | $ 46.9 | $ 46.9 |
| | Volume (m3) | 173,697 | 180,770 | 286,861 | 148,530 | 148,530 | 148,530 | 148,530 |
| | Disposal | $ 54.6 | $ 56.9 | $ 77.4 | $ 46.7 | $ 46.7 | $ 46.7 | $ 46.7 |
| | Generator | $ 68.7 | $ 71.5 | $ 97.3 | $ 58.7 | $ 58.7 | $ 58.7 | $ 58.7 |
| | Transportation | $ 17.4 | $ 22.2 | $ 94.3 | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ 187.6 | $ 197.4 | $ 315.9 | $ 152.3 | $ 152.3 | $ 152.3 | $ 152.3 |
| | *Unit Cost ($/m3)* | $ 1,080 | $ 1,092 | $ 1,101 | $ 1,026 | $ 1,026 | $ 1,026 | $ 1,026 |
| INEEL | Fixed Cost | $ 37.6 | $ 37.6 | $ 37.6 | $ 37.6 | $ 37.6 | $ 37.6 | $ 37.6 |
| | Volume (m3) | 24,393 | 24,393 | 24,393 | 24,393 | 24,393 | 24,393 | 24,393 |
| | Disposal | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 | $ 2.5 |
| | Generator | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 | $ 3.5 |
| | Transportation | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ 43.6 | $ 43.6 | $ 43.6 | $ 43.6 | $ 43.6 | $ 43.6 | $ 43.6 |
| | *Unit Cost ($/m3)* | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 | $ 1,789 |
| LANL | Fixed Cost | $ 74.3 | $ 74.3 | $ 74.3 | $ 74.3 | $ 74.3 | $ 74.3 | $ 74.3 |
| | Volume (m3) | 167,130 | 141,896 | 141,896 | 141,896 | 141,896 | 141,896 | 141,896 |
| | Disposal | $ 4.6 | $ 2.8 | $ 2.8 | $ 2.8 | $ 2.8 | $ 2.8 | $ 2.8 |
| | Generator | $ 53.9 | $ 45.7 | $ 45.7 | $ 45.7 | $ 45.7 | $ 45.7 | $ 45.7 |
| | Transportation | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ 132.8 | $ 122.9 | $ 122.9 | $ 122.9 | $ 122.9 | $ 122.9 | $ 122.9 |
| | *Unit Cost ($/m3)* | $ 794 | $ 866 | $ 866 | $ 866 | $ 866 | $ 866 | $ 866 |
| NTS | Fixed Cost | $ 161.2 | $ 161.2 | $ 161.2 | $ 161.2 | $ 161.2 | $ 161.2 | $ 161.2 |
| | Volume (m3) | 435,652 | 573,388 | 467,297 | 470,261 | 470,261 | 470,261 | 605,628 |
| | Disposal | $ 106.3 | $ 139.9 | $ 114.0 | $ 114.7 | $ 114.7 | $ 114.7 | $ 147.8 |
| | Generator | $ 150.3 | $ 197.8 | $ 161.2 | $ 162.2 | $ 162.2 | $ 162.2 | $ 209.0 |
| | Transportation | $ 105.1 | $ 180.1 | $ 115.9 | $ 114.2 | $ 114.2 | $ 114.2 | $ 200.4 |
| | *TOTAL* | $ 522.9 | $ 679.1 | $ 552.4 | $ 552.4 | $ 552.4 | $ 552.4 | $ 718.3 |
| | *Unit Cost ($/m3)* | $ 1,200 | $ 1,184 | $ 1,182 | $ 1,175 | $ 1,175 | $ 1,175 | $ 1,186 |
| ORR | Fixed Cost | $ - | $ - | $ - | $ - | $ 30.9 | $ 30.9 | $ - |
| | Volume (m3) | - | - | - | - | 78,882 | 30,799 | - |
| | Disposal | $ - | $ - | $ - | $ - | $ 212.0 | $ 82.8 | $ - |
| | Generator | $ - | $ - | $ - | $ - | $ 103.9 | $ 40.6 | $ - |
| | Transportation | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| | *TOTAL* | $ - | $ - | $ - | $ - | $ 346.8 | $ 154.2 | $ - |
| | *Unit Cost ($/m3)* | $ - | $ - | $ - | $ - | $ 4,397 | $ 5,008 | $ - |
| SRS | Fixed Cost | $ 48.9 | $ 48.9 | $ 48.9 | $ 48.9 | $ 48.9 | $ 48.9 | $ 48.9 |
| | Volume (m3) | 121,256 | 121,256 | 121, 256 | 256,623 | 177,741 | 225,824 | 121,256 |
| | Disposal | $ 28.9 | $ 28.9 | $ 28.9 | $ 61.1 | $ 42.3 | $ 53.7 | $ 28.9 |
| | Capital | $ 38.0 | $ 38.0 | $ 38.0 | $ 76.0 | $ 57.0 | $ 76.0 | $ 38.0 |
| | Generator | $ 31.5 | $ 31.5 | $ 31.5 | $ 66.7 | $ 46.2 | $ 58.7 | $ 31.5 |
| | Transportation | $ - | $ - | $ - | $ 22.1 | $ 1366 | $ 18.8 | $ - |
| | *TOTAL* | $ 147.3 | $ 147.3 | $ 147.3 | $ 274.8 | $ 208.0 | $ 256.1 | $ 147.3 |
| | *Unit Cost ($/m3)* | $ 1,215 | $ 1,215 | $ 1,215 | $ 1,071 | $ 1,170 | $ 1,134 | $ 1,215 |
| TOTALS | Fixed Cost | $ 369.0 | $ 369.0 | $ 369.0 | $ 369.0 | $ 399.8 | $ 399.8 | $ 369.0 |
| | Volume (m3) | 922,128 | 1,041,703 | 1,041,703 | 1,041,703 | 1,041,703 | 1,041,703 | 1,041,703 |
| | Storage (20-yr) | $ 805.8 | NA | NA | NA | NA | NA | NA |
| | Disposal | $ 196.8 | $ 231.0 | $ 225.6 | $ 227.9 | $ 421.1 | $ 303.3 | $ 228.7 |
| | Capital | $ 38.0 | $ 38.0 | $ 38.0 | $ 76.0 | $ 57.0 | $ 76.0 | $ 38.0 |
| | Generator | $ 307.9 | $ 350.1 | $ 339.3 | $ 336.9 | $ 420.3 | $ 369.5 | $ 348.4 |
| | Transportation | $ 122.5 | $ 202.3 | $ 210.2 | $ 136.3 | $ 127.8 | $ 133.0 | $ 200.4 |
| | *TOTAL* | $ 1,840.1 | $ 1,190.3 | $ 1,182.1 | $ 1,146.1 | $ 1,426.1 | $ 1,281.7 | $ 1,184.5 |
| | *Unit Cost ($/m3)** | $ 1,122 | $ 1,143 | $ 1,135 | $ 1,100 | $ 1,369 | $ 1,230 | $ 1,137 |

* Unit Cost in the Baseline is for disposal only; storage costs are not factored in.

***Figure C-4.*** *20-Year MLLW Cost Summary (WM plus ER waste)* (Dollars in millions except as noted)

| | | Baseline | Option A | Option B | Option C | Option D | Option E |
|---|---|---|---|---|---|---|---|
| Hanford | Fixed Cost | $ 28.0 | $ 28.0 | $ 28.0 | $ 28.0 | $ 28.0 | $ 28.0 |
| | Volume ($m^3$) | 69,124 | 173,826 | 96,409 | 149,901 | 174,010 | 69,225 |
| | Disposal | $ 23.9 | $ 60.1 | $ 33.3 | $ 51.8 | $ 60.1 | $ 23.9 |
| | Generator | $ 37.6 | $ 94.4 | $ 52.4 | $ 81.4 | $ 94.5 | $ 37.6 |
| | Transportation | $ - | $ 47.1 | $ 19.0 | $ 22.5 | $ 47.2 | $ - |
| | *TOTAL* | $ 89.4 | $ 229.6 | $ 132.7 | $ 183.7 | $ 229.8 | $ 89.5 |
| | *Unit Cost ($/m³)* | $ 1,294 | $ 1,321 | $ 1,376 | $ 1,225 | $ 1,321 | $ 1,293 |
| | | | | | | | |
| NTS | Fixed Cost | $ 57.7 | $ 57.7 | $ 57.7 | $ - | $ 57.7 | $ 57.7 |
| | Volume ($m^3$) | 11,009 | 11,193 | 88,610 | - | 11,009 | 115,794 |
| | Disposal | $ 2.9 | $ 3.0 | $ 23.7 | $ - | $ 2.9 | $ 31.0 |
| | Generator | $ 5.2 | $ 5.2 | $ 41.9 | $ - | $ 5.2 | $ 54.7 |
| | Transportation | $ - | $ 0.1 | $ 21.7 | $ - | $ - | $ 38.3 |
| | *TOTAL* | $ 65.8 | $ 66.0 | $ 145.0 | $ - | $ 65.8 | $ 181.7 |
| | *Unit Cost ($/m³)* | $ 5,977 | $ 5,893 | $ 1,636 | NA | $ 5,977 | $ 1,569 |
| | | | | | | | |
| SRS | Fixed Cost | $ - | $ - | $ - | $ 22.2 | $ - | $ - |
| | Volume ($m^3$) | - | - | - | 35,118 | - | - |
| | Disposal | $ - | $ - | $ - | $ 8.7 | $ - | $ - |
| | Capital | $ - | $ - | $ - | $ 42.0 | $ - | $ - |
| | Generator | $ - | $ - | $ - | $ 13.1 | $ - | $ - |
| | Transportation | $ - | $ - | $ - | $ 3.6 | $ - | $ - |
| | *TOTAL* | $ - | $ - | $ - | $ 89.6 | $ - | $ - |
| | *Unit Cost ($/m³)* | NA | NA | NA | $ 2,552 | NA | NA |
| | | | | | | | |
| TOTALS | Fixed Cost | $ 85.7 | $ 85.7 | $ 85.7 | $ 50.2 | $ 85.7 | $ 85.7 |
| | Volume ($m^3$) | 80,133 | 185,019 | 185,019 | 185,019 | 185,019 | 185,019 |
| | Storage (20-yr) | $ 329.2 | NA | NA | NA | NA | NA |
| | Disposal | $ 26.8 | $ 63.1 | $ 57.0 | $ 60.5 | $ 63.1 | $ 54.9 |
| | Capital | $ - | $ - | $ - | $ 42.0 | $ - | $ - |
| | Generator | $ 42.7 | $ 99.6 | $ 94.3 | $ 94.5 | $ 99.6 | $ 92.3 |
| | Transportation | $ - | $ 47.2 | $ 40.7 | $ 26.1 | $ 47.2 | $ 38.3 |
| | *TOTAL* | $ 484.4 | $ 295.6 | $ 277.7 | $ 273.3 | $ 295.6 | $ 271.2 |
| | *Unit Cost ($/m³)* * | $ 1,937 | $ 1,598 | $ 1,501 | $ 1,477 | $ 1,598 | $ 1,466 |

* Unit Cost in the Baseline is for disposal only; storage costs are not factored in.

## 3.0 METHODOLOGY

The total cost of LLW and MLLW disposal at DOE facilities is the sum of the following five categories of cost:

- **Fixed** Disposal Facility Costs
- Variable or Incremental **Disposal** Facility Costs
- Waste **Generator** Costs
- Disposal Facility **Capital** Costs
- Waste **Transportation** Costs

In addition, for the baseline only, waste **Storage** costs are calculated. Sections 3.1 through 3.6 describe briefly each type of cost and how the costs were estimated, first for LLW then for MLLW. Section 3.7 describes how cleanup wastes generated by the environmental restoration (ER) program are addressed in these analyses.

### *Low-Level Waste*

The estimates of the cost of LLW disposal presented here are derived from cost estimate data developed for the 1997 Cost Analysis, except as noted. The 1997 Cost Analysis reviewed and validated the cost of disposal at the six waste management LLW disposal facilities. The 1997 Cost Analysis also developed estimates of the cost to prepare the waste for disposal and, if necessary, ship the waste from the site of generation to a disposal site.

### *Mixed Low-Level Waste*

The 1997 Cost Analysis addressed LLW only. Cost data for the two existing DOE MLLW disposal facilities at Hanford and NTS were not collected or analyzed. Therefore, actual annual fixed costs and incremental cost of disposal for MLLW were not directly available for this cost analysis. The following sections describe how the MLLW disposal costs were estimated for each option.

### *Disposal Volumes*

Updated disposition volumes reported in the database underlying the February 1998 *Draft Accelerating Cleanup: Paths to Closure* report (hereinafter referred to as the PtC database) were used to determine the baseline volumes of waste disposed over the 20-year timeframe of the ROD. Two sets of disposition volumes were evaluated: 1) waste generated from Waste Management (WM) operations targeted for disposal at DOE waste management disposal facilities; and 2) waste generated from both Waste Management operations <u>and</u> Environmental Restoration (ER) activities targeted for disposal at DOE waste management disposal facilities. Section 3.7 details how ER wastes were addressed in these analyses.

## 3.1 Fixed Cost

### *Low-Level Waste*

The methodology used in estimating the fixed and variable cost of disposal for the LLW disposal options is identical to the methodology used in the 1997 Cost Analysis. The 1997 Cost Analysis developed annual fixed and variable costs for fiscal years (FYs) 1996 through 1998 for each WM disposal facility. A simple linear regression computing the y-intercept (annual fixed cost) and slope (incremental cost per cubic meter) was determined for each facility. The best-fit lines were drawn using the equation:

$$y = mx + b$$

where:

y = total annual cost
m = slope/incremental cost per cubic meter
x = annual volume disposed
b = y-intercept/annual fixed cost

The methodology for estimating LANL's LLW disposal facility's cost of operation is slightly different from the linear equation above. LANL's cost of operation is expected to be constant, or fixed, for annual disposal volumes of 0 to 5,000 cubic meters. The incremental cost per cubic meter applies only to annual disposal volumes above 5,000 cubic meters. Therefore, LANL's cost equation is:

$$y = b \quad (\text{for } x \leq 5{,}000/\text{year})$$

and

$$y = m(x-5{,}000) + b \quad (\text{for } x > 5{,}000/\text{year})$$

The fixed costs of operating WM disposal facilities for the 20-year period were calculated by multiplying the disposal facility's annual fixed cost ("***b***") by the number of years of operation. Hanford, LANL, NTS, and SRS were assumed to operate for the entire 20-year period in the baseline and all options, INEEL was assumed to operate for 10 of the 20 years in the baseline and all options, and ORR was assumed to operate for 0 years in the baseline and cases 1, 2, 3 and 6, and for 20 years in cases 4 and 5.

The annual fixed costs determined during the 1997 Cost Analysis were based on the total annual volume of waste disposed at each facility, irrespective of the program generating the wastes. However, the WM PEIS and the subsequent ROD address WM waste only. Therefore, the fixed cost estimates developed for the WM-only analyses used prorated annual fixed costs based on the ratio of WM to ER waste volumes received for disposal. This is necessary because at sites such as NTS, WM wastes account for less than 10% of the total waste disposed in NTS's disposal facilities, while at other sites, WM wastes comprise more than 90% of the total volume disposed. Estimating the total cost of disposal and the unit cost of disposal using the total annual fixed cost

would have been inappropriate and likely would have lead to the wrong conclusion about the cost of the disposal options. The inclusion of ER waste volumes in the analysis is discussed in more detail in Section 3.7.

***Mixed Low-Level Waste***

Previous MLLW disposal cost estimates indicate that MLLW costs are approximately 25 to 50% higher than LLW costs. LLW annual fixed costs were increased by 50% to arrive at the estimated MLLW annual fixed cost.

## 3.2 Disposal Cost

***Low-Level Waste***

The disposal cost reflects the incremental (or variable) cost of disposing each cubic meter of waste. Disposal cost is calculated by multiplying the incremental cost per cubic meter (determined in the 1997 Cost Analysis) by the total volume disposed in the 20-year period using the following equation:

$$DispCost = (DispVol \times IC)$$

where:

DispCost = incremental cost of disposal
DispVol = volume disposed (20 years) at WM facility (cubic meters)
IC = disposal facility's incremental cost per cubic meter ("m" from the linear regression equation)

Since LANL's annual cost of operation is constant (fixed) for disposal volumes up to 5,000 cubic meters per year, LANL's cost of disposal was calculated using the following equation:

$$DispCost_{LANL} = ((DispVol - (20\ years \times 5{,}000\ m^3/year)) \times IC)$$

***Mixed Low-Level Waste***

Previous MLLW disposal cost estimates indicate that MLLW costs are approximately 25 to 50% higher than LLW costs. LLW incremental disposal costs were increased by 25% to estimate the incremental disposal cost for MLLW. The volume of MLLW disposed was substituted for the LLW volume in the equation and the MLLW incremental cost of disposal was used to determine the disposal cost.

## 3.3 Generator Cost

### *Low-Level Waste*

The generator cost reflects the cost to the generator to prepare one cubic meter of waste for disposal. The 1997 Cost Analysis determined that each disposal facility had slightly different waste acceptance requirements and the cost to generators to meet the waste acceptance criteria varied also. As an update to the 1997 Cost Analysis, each participating site estimated the cost to their generators.

For this analysis, the generator cost per cubic meter of LLW disposed was determined by calculating the ratio of generator costs to disposal costs in the 1997 Cost Analysis and applying that ratio to the incremental cost of disposal. Generator cost is then calculated by multiplying the calculated generator cost per cubic meter by the total volume disposed in the 20-year period using the following equation:

$$GenCost = (DispVol \times GC)$$

where:

GenCost = generator cost of disposal
DispVol = volume disposed (20 years) at WM facility (cubic meters)
GC = disposal facility's generator cost per cubic meter

### *Mixed Low-Level Waste*

Previous MLLW disposal cost estimates indicate that MLLW costs are approximately 25 to 50% higher than LLW costs. LLW generator costs used above were increased by 25% to estimate the generator cost for MLLW. The volume of MLLW disposed was substituted for the LLW volume in the equation and the MLLW generator cost was used to determine the generator cost.

## 3.4 Capital Cost

### *Low-Level Waste*

The incremental cost of disposal at Hanford, INEEL, LANL, and NTS includes the cost of constructing new disposal trenches, therefore, no additional capital costs were estimated. Additionally, no capital costs were included for ORR as the annual fixed and variable costs include the cost for tumulus expansion. Consequently, SRS is the only site for which additional capital costs were estimated.

DOE's SRS site waste management program representative provided cost estimates for a new Low Activity Waste (LAW) vault ($23 million) and a new Intermediate Level Waste (ILW) vault

($15 million). DOE's SRS also estimated when and how many new LAW and ILW vaults are needed for the base case and would be needed for each of the options. This estimate assumed the ratio of types of waste (e.g., intermediate vs. low activity, compactible vs. non-compactible, etc.) are identical to the historical ratio.

***Mixed Low-Level Waste***

The cost of constructing a new MLLW disposal vault at SRS was included as capital costs in this analysis. The *Title I Design Summary for Hazardous Waste/Mixed Waste Disposal Facility, Line Item 89-D-175, Project S-2944, Westinghouse Savannah River Company for the US DOE, Savannah River Site* (September 1989) estimated the capital cost of a new MLLW disposal vault to be $32.6 million in 1989 dollars, $42 million when escalated to FY 1997 dollars. This analysis assumed only one vault was needed for the 20-year MLLW disposal volumes in MLLW Option C.

The incremental cost of disposal at Hanford and NTS was assumed to include the cost of constructing new disposal trenches, therefore, no additional capital costs were estimated.

## 3.5 Transportation Cost

***Low-Level Waste***

As part of the 1997 Cost Analysis, standard transportation costs were developed and used for the cost estimates. The standard transportation costs assumed for the cost estimates were $2 per mile, per truck, for contact-handled (CH) waste, and $5 per mile, per truck, for remote-handled (RH) waste. For purposes of this analysis, the CH cost per mile ($2) was used. Distances between sites for truck transportation and an average volume of 7 cubic meters transported per truckload were obtained from the WM PEIS. Therefore, the cost of transportation was estimated by this equation:

$$TransCost = (DispVol \div 7) \times miles \times \$2.00$$

where:

TransCost = transportation cost
DispVol = volume disposed (20 years) at WM facility (cubic meters)
miles = truck transportation mileage between generator site and disposal site

***Mixed Low-Level Waste***

The methodology for estimating the transportation costs for MLLW disposal is identical to the LLW methodology described above.

## 3.6 20-Year Storage Costs for Baseline

The LLW and MLLW Baseline configurations assume a generating site's waste will continue to be disposed at facilities approved to accept that waste. However, some LLW and MLLW have no approved disposal pathway and will have to remain or be placed in storage until a disposal facility is approved. The disposal location for these wastes is "to be decided" and these wastes are referred to as "TBD" wastes.

The following sections describe the methodology used to estimate the cost of storing "TBD" wastes for the 20-year timeframe evaluated for the ROD. The storage costs apply only to the Baseline configurations because the "TBD" wastes are assumed to have disposal pathways in the options evaluated.

***Low-Level Waste***

The *Paths to Closure* (PtC) database was queried to determine the following data elements for all sites:

- Cost of LLW Storage in FY 1998
- LLW Inventory at end of FY 1997
- LLW Inventory at end of FY 1998

The average 1998 LLW Inventory for each site was calculated by summing the end of FY 1997 and end of FY 1998 LLW inventories and dividing by 2. The FY 1998 cost per cubic meter stored for each site was then calculated by dividing the FY 1998 storage cost by the average 1998 inventory. Each site's storage cost per cubic meter was then multiplied by one-half of the LLW "TBD" quantity to calculate the average annual cost of LLW storage for wastes with no disposition pathway. Using one-half of a site's "TBD" volume gives a conservatively low estimate of the average amount of TBD waste in storage and may understate the cost of storage.

**Figure C-5** summarizes the data and calculations used to estimate the cost of storing TBD LLW for 20 years in the Baseline configuration.

***Figure C-5.*** *Cost of Storage of "TBD" LLW for 20 Years in Baseline Configuration*

| Site | FY 98 Storage Cost ($M) | Inventory ($m^3$) [1] | | | $/$m^3$ Stored per Year | TBD Quantity ($m^3$) | Storage Cost of TBD Waste ($M/yr) |
|---|---|---|---|---|---|---|---|
| | | End FY97 | End FY98 | Avg FY98 | | | |
| INEEL | $ 610 | 10,250 | 12,700 | 11,500 | $ 50 | 6,000 | $ 0.2 |
| ORR | $ 36,300 | 31,100 | 37,600 | 34,400 | $ 1,100 | 73,000 | $ 38.6 |
| Paducah | No Data | | | | $ 200[2] | 4,400 | $ 0.4 |
| West Valley | No Data | | | | $ 200[2] | 11,300 | $ 1.1 |
| **TOTAL** | | | | | | **94,700** | **$ 40.3** |

[1] Total reported LLW in inventory. Amount of waste in inventory is not necessarily the amount of waste to be disposed.

[2] No LLW storage cost data provided by these sites in PtC database. $ 200/$m^3$ of LLW stored/year is the average cost for all sites reporting FY 1998 LLW storage costs and LLW storage inventories in PtC database.

### *Mixed Low-Level Waste*

The methodology for estimating the cost of storing MLLW in lieu of disposal for 20 years in the baseline is identical to the LLW methodology described above. **Figure C-6** summarizes the data and calculations used to estimate the cost of storing TBD MLLW for 20 years in the Baseline configuration.

***Figure C-6.*** *Cost of Storage of "TBD" MLLW for 20 Years in Baseline Configuration*

| Site | FY 98 Storage Cost ($M) | Inventory ($m^3$) [3] | | | $/$m^3$ Stored per Year | TBD Quantity ($m^3$) | Storage Cost of TBD Waste ($M/yr) |
|---|---|---|---|---|---|---|---|
| | | End FY97 | End FY98 | Avg FY98 | | | |
| Hanford | No Data | | | | $ 840 [4] | 100 | $ 0.04 |
| ORR | $ 20,400 | 27,500 | 17,500 | 22,500 | $ 900 | 25,500 | $ 11.5 |
| Paducah | No Data | | | | $ 840 [4] | 2,700 | $ 1.1 |
| Portsmouth | No Data | | | | $ 840 [4] | 2,800 | $ 1.2 |
| RFETS | $ 600 | 17,200 | 13,200 | 15,200 | $ 40 | 7,400 | $ 0.1 |
| Sandia | $ 1,600 | 200 | 200 | 200 | $ 8,700 | 200 | $ 0.7 |
| SRS | $ 2,300 | 3,700 | 1,700 | 2,700 | $ 830 | 4,100 | $ 1.7 |
| West Valley | No Data | | | | $ 840 [4] | 30 | $ 0.01 |
| **TOTAL** | | | | | | **42,700** | **$16.4** |

[3] Total reported MLLW in inventory. Amount of waste in inventory is not necessarily the amount of waste to be disposed.

[4] No MLLW storage cost data provided by these sites in PtC database. $ 840/$m^3$ of MLLW stored/year is the average cost for all sites reporting FY 1998 MLLW storage costs and MLLW storage inventories in PtC database.

### 3.7 Inclusion of Environmental Restoration Waste

The WM PEIS addresses LLW and MLLW generated or managed by Waste Management operations. The WM PEIS decisions will not determine how much contaminated media will be removed for cleanup purposes. However, site-specific CERCLA or RCRA decisions could be made to dispose the media at a waste management facility. Therefore, DOE has analyzed the potential impacts associated with disposing these cleanup-generated wastes at WM facilities.

For the analysis which includes ER waste, 100 percent of the fixed costs was applied. As described in Section 3.1, the fixed costs were prorated for the WM-only analysis based on the ratio of WM to ER wastes received for disposal.

## 4.0 ASSUMPTIONS

The following assumptions were used in the analysis.

- The PtC database as of March 1998 forms the basis of LLW and MLLW disposal volume projections. The volume projections include all LLW and MLLW currently designated for disposal at the six WM disposal facilities or to a "To Be Decided" site.
- For Hanford, the analysis used as-generated volumes in lieu of disposal volumes due to the volume increase resulting from stabilizing Cat 3 LLW in high integrity containers (HICs).
- LLW targeted for disposal in commercial facilities in the February 1998 *Paths to Closure* Report is not included. Commercial disposal facility costs are also not included.
- Special Case Waste (SCW), Greater-than-Class-C (GTCC) waste, and LLW addressed in other environmental impact statements (such as saltstone at SRS) are not included. Costs for managing these wastes while disposal options are being developed are also not included.
- Remote Handled (RH) and Contact Handled (CH) low-level waste are included. All alpha LLW (10-100 nanocuries/gram of transuranic alpha emitters) is also included (except for alpha mixed LLW at INEEL managed under the TRU program).
- Each site determined if LLW would be directly disposed or treated prior to disposal, whichever is more cost effective. The cost to treat LLW sludges and liquids is not included.
- The total costs of disposal, including direct costs, indirect costs, support costs, etc., are included.
- The definitions of fixed and variable costs are identical to those definitions developed in the 1997 Cost Analysis.
- Closure costs are not included. Consistent with the previous (1997) cost analysis, disposal facility closure costs were not included in the Baseline or any of the options. For purposes of this analysis, closure costs for each disposal facility are assumed to be essentially the same for all options.

September 22, 1998

# APPENDIX D

# CUMULATIVE IMPACTS

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**Appendix D** September 22, 1998

## 1. Cumulative Impacts

WM PEIS Volume I, Chapter 11 presents cumulative impacts for each of the six candidate disposal sites. Cumulative impacts are calculated by first determining the incremental impacts of a proposed action (in the case of the WM PEIS, the proposed actions are alternatives for managing five waste types); then adding these impacts to potential impacts from other past, present, and reasonably foreseeable future actions. Both the Council on Environmental Quality and DOE regulations for implementing NEPA require the assessment of cumulative impacts because significant impacts could result from several smaller actions that, by themselves, might not have significant impacts.

1.1 *Scope of WM PEIS versus Cumulative Impacts Analysis*. WM PEIS analyses cover five major types of radioactive and hazardous waste: LLW, MLLW, HLW, TRU, and hazardous. While the WM PEIS scope does not evaluate alternatives for managing other materials (e.g., spent nuclear fuel and other special nuclear materials), the WM PEIS does include the cumulative impacts of managing these materials in its analysis of cumulative impacts.[1]

1.2 *Methodology*. The WM PEIS uses generally accepted methods to estimate cumulative impacts. First, DOE examined the combined impacts of alternatives for all five types of wastes analyzed in the WM PEIS at each of the major 17 sites. To these combined impacts, DOE added the impacts of other past, present, and reasonably foreseeable future actions external to the WM PEIS analysis. Impacts of current site activities were incorporated into the cumulative impacts analysis, since they contribute to the baseline (existing) conditions at each site. To the extent possible, where data on environmental restoration activities was available, impacts from remediation were included in the future actions.[2]

1.3 *Conservative Estimates*. The WM PEIS cumulative impact estimates are very conservative, generic estimates of impacts from general program alternatives. The Department believes it is unlikely that actual cumulative impacts at any site would exceed the sum of the individual impacts of the actions considered in the cumulative impacts section because:

- individual impact estimates are generally conservative;
- most impacts would occur at different locations;
- most impacts would not overlap or would only partially overlap in time; and
- most impacts would affect different endpoints (e.g., might affect a different population based on the location of the activity on the site).[3]

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[1] WM PEIS, Volume V, p. 5-261.

[2] Ibid.

[3] Ibid. 3, Volume V, p. 5-255.

**Figure D-1** presents cumulative impacts for each candidate disposal site, including impacts associated with each waste type's WM PEIS preferred alternative. Since impacts associated with current LLW and MLLW disposal options fall within those analyzed in the WM PEIS preferred alternative, the totals shown in the figure are considered conservative. (For each category, **bolding** denotes the relative "most desirable" site; shading notes the relative "least desirable.")

***Figure D-1.*** *Candidate Disposal Sites' Cumulative Impacts from Existing Operations, WM PEIS Preferred Alternatives, and Reasonably Foreseeable Future Actions*

| IMPACT CATEGORY | CANDIDATE DISPOSAL SITE | | | | | |
|---|---|---|---|---|---|---|
| | Hanford | INEEL | LANL | NTS | ORR | SRS |
| Offsite Population | | | | | | |
| Collective dose, 10 years (person-rem) | 2.8E+02 | 1.1E+02 | 2.1E+01 | **2.9E-01** | 4.5E+02 | 3.0E+03 |
| Number of cancer fatalities from collective dose | 1.4E-01 | **~0** | **~0** | **~0** | 2.3E-01 | 1.5E+00 |
| Off-site Maximum Exposed Individual | | | | | | |
| Annual dose, atmospheric releases (mrem) | 1.9E+00 | 1.6E+00 | 7.9E+00 | **1.2E-02** | 1.9E+00 | 3.9E+00 |
| Worker Population | | | | | | |
| Collective dose, 10 years (person-rem) | **2.8E+01** | 5.1E+03 | 5.3E+03 | 7.2E+03 | 3.9E+03 | 2.0E+04 |
| Number of Cancer fatalities from collective dose | 1.1E+01 | 2.0E+00 | 2.1E+00 | 2.9E+00 | **1.6E+00** | 8.0E+00 |
| Transportation Effects on Off-Site Maximum Exposed Individual | | | | | | |
| Annual dose (mrem) from truck transport | 1.7E+00 | 1.1E+00 | **1.9E-01** | 3.7E+00 | 4.4E+00 | 5.9E-01 |
| Annual dose (mrem) from rail transport | 4.0E-01 | 3.7E-01 | **3.7E-02** | 1.7E-01 | 1.0E-01 | 1.1E-01 |
| Resources and Infrastructure | | | | | | |
| Land requirement (% of suitable area) | 12% | **2%** | 41% | 28% | 69% | 10% |
| Water Use (% of total capacity) | **13%** | 18% | 42% | 352% | 46% | 139% |
| Wastewater production (% of treatment capacity) | 123% | 30% | **2%** | 110% | 87% | 123% |
| Power demand (% current load) | 52% | 129% | 73% | 129% | **39%** | 293% |
| Employment | | | | | | |
| Number of site workers | 28,532 | 15,787 | **8,122** | 17,182 | 26,009 | 25,106 |
| Air Quality Exceedences | 6[4] | 1[5] | **None** | 2[6] | **None** | **None** |
| Groundwater Quality Exceedences | 18 | **1** | 13 | 11 | 22 | 43 |

[4]Hanford's six potential air exceedences are from $PM_{10}$, $NO_2$, $SO_2$, U-238, Pu-239, and Pu-240.

[5]INEEL's single potential air exceedences is from $PM_{10}$.

[6]NTS's two potential air exceedences are from $PM_{10}$ and CO.

1.4 *Programmatic versus Site-Specific Analyses*. The WM PEIS analysis of cumulative impacts provides an adequate basis for relative comparison of overall site impacts. However, the WM PEIS analysis is conducted at the programmatic level and is based on very general information. Therefore, these broad analyses might not provide enough information for local government and planning agencies at the regional and State levels to ascertain specific impacts or implement mitigation measures. Site-wide and project-level NEPA reviews will examine site-specific cumulative impacts, in greater detail.[7]

[7]Ibid. 3, p. 5-252.

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