United States General Accounting Office

GAO

Report to Congressional Requesters

April 2000

LOW-LEVEL RADIOACTIVE WASTES

Department of Energy Has Opportunities to Reduce Disposal Costs

GAO

Accountability * Integrity * Reliability

GAO/RCED-00-64

Contents

Letter 3

Appendixes

Appendix I: Decisions to Establish On-Site CERCLA Disposal Facilities or Dispose of Cleanup Wastes at Existing Disposal Facilities 32

Appendix II: Waste Volumes and Disposal Preparation Activities and Costs for DOE's Major Waste-Generating Sites 44

Appendix III: DOE's Disposal Facilities for Low-Level and Mixed Wastes 47

Appendix IV: Scope and Methodology 59

Appendix V: GAO Contact and Staff Acknowledgments 61

Related GAO Products 62

Tables

Table 1: Current Estimated Cost of Disposing of Low-Level and Mixed Wastes in Planned or Operating CERCLA Facilities 38

Table 2: Summary of Fernald's Disposal Decisions for Low-Level and Mixed Wastes, Fiscal Years 1997-99 43

Table 3: Past and Future Disposal Volumes of Low-Level and Mixed Wastes for DOE's 20 Major Waste-Generating Sites 45

Table 4: Low-Level and Mixed Waste Disposal Preparation Costs at 15 Major Waste-Generating Sites, Fiscal Years 1997-99 46

Table 5: Waste Disposal Volumes and Remaining Capacity at DOE's Six Active Waste Management Disposal Facilities 48

Table 6: Waste Storage, Treatment, and Disposal Costs at DOE's Six Active Waste Management Disposal Facilities, Fiscal Years 1997-99 49

Figures

Figure 1: Estimated Volume of Low-Level and Mixed Wastes for Disposal at DOE's Facilities 7

Figure 2: DOE's Major Low-Level and Mixed Waste-Generating Sites and Disposal Facilities 9

Figure 3: Aboveground Disposal Facilities at Savannah River and Oak Ridge 10

Figure 4: Disposal in Subsidence Craters at NTS and Mixed Waste Disposal Trench at Hanford 12

Figure 5: Estimated Disposal Volumes and 3-Year Costs to Manage and Dispose of Mixed and Low-Level Wastes at Six DOE Sites With Disposal Facilities 22
Figure 6: Six DOE Disposal Sites' Costs to Store, Treat, and Dispose of Mixed and Low-Level Wastes, Fiscal Years 1997-99 23
Figure 7: Diagram of a Typical Closure Cap for a Waste Disposal Facility 26
Figure 8: CERCLA On-Site Disposal Facility at DOE's Fernald Site 40

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	Department of Energy
EPA	Environmental Protection Agency
GAO	General Accounting Office
INEEL	Idaho National Engineering and Environmental Laboratory
IWMF	Interim Waste Management Facility
NTS	Nevada Test Site
RCRA	Resource Conservation and Recovery Act
RWMC	Radioactive Waste Management Complex
TSCA	Toxic Substances Control Act

GAO
Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-284389

April 12, 2000

The Honorable Frank Murkowski
Chairman, Committee on Energy
and Natural Resources
United States Senate

The Honorable Wayne Allard
Chairman, Subcommittee on
Strategic Forces
Committee on Armed Services
United States Senate

As the Cold War drew to a close, the Department of Energy (DOE) shifted its focus from producing nuclear weapons to cleaning up the contaminated facilities where it had produced them. During the 1990s, DOE spent hundreds of millions of dollars to treat, store, and dispose of radioactive wastes generated at over 50 of its nuclear facilities around the country. Some of these wastes, including spent (used) fuel and liquid wastes from chemically processing spent fuel, are highly radioactive. By volume, however, most of DOE's radioactive wastes are classified as "low-level wastes," that is, wastes contaminated with relatively small amounts of radioactivity. Some low-level wastes also contain components such as lead that are hazardous in their own right; these wastes are called "mixed wastes." DOE generates these low-level and mixed wastes as by-products of its research and nuclear weapons missions. Cleanup activities at contaminated facilities also produce low-level wastes in the form of contaminated soils, debris from dismantled buildings, and other materials. Many of these wastes can be disposed of on-site in designated facilities. However, over the next several decades, DOE expects to permanently dispose of about 2.1 million cubic meters of low-level and mixed wastes at six locations where it operates disposal facilities. This volume of waste would fill an area the size of a football field stacked to nearly one and a half times the height of the Empire State Building.

Concerned that DOE may not be managing and disposing of its low-level and mixed wastes as cost-effectively as possible, you asked us to review (1) the factors that influence DOE's decisions about the treatment, storage, and disposal of low-level and mixed wastes and (2) DOE's costs to treat,

store, and dispose of these wastes and the cost-effectiveness of DOE's disposal decisions.

Results in Brief

The limited availability of disposal alternatives is the principal factor influencing DOE's decisions about the treatment, storage, and disposal of its low-level and mixed wastes. Four of DOE's six disposal sites—the Idaho National Engineering and Environmental Laboratory; Los Alamos National Laboratory, New Mexico; Oak Ridge Reservation, Tennessee; and Savannah River Site, South Carolina—are restricted to disposing almost exclusively of their own wastes because of limits on their remaining disposal capacity and/or unfavorable site conditions, such as proximity to groundwater or relatively wet climates. The other two disposal sites—the Hanford Site in Washington State and the Nevada Test Site—have relatively dry climates and enough capacity to dispose of nearly all the low-level and mixed wastes generated at DOE's nuclear facilities nationwide. Access to the disposal facilities at these two sites has, however, been limited in three ways. First, DOE formerly directed most of its waste-generating sites to use one, but not both, of the two facilities. Second, some of DOE's waste-generating sites did not have access to either disposal facility because DOE stopped granting new access to the two facilities in 1990 pending the completion of an environmental review of its waste programs, which was recently completed. Third, neither the Hanford nor the Nevada facility currently disposes of mixed wastes generated at DOE sites in other states. Some waste-generating sites have been able to use a commercial disposal facility, but the only facility that is readily available can accept only wastes that are very lightly contaminated with radioactivity. With such limited access to disposal facilities, DOE's waste managers have had few opportunities to consider costs when making disposal decisions. On February 25, 2000, DOE adopted a new policy that will make the disposal facilities at the Nevada Test Site and the Hanford Site available to all of its waste-generating sites, for both low-level and mixed wastes. However, there are roadblocks to fully implementing this policy: The states that host the disposal facilities may oppose increases in waste disposal at the sites, and DOE may need to obtain environmental permits from these states to dispose of out-of-state mixed wastes.

From fiscal year 1997 through fiscal year 1999, DOE spent over $700 million to prepare, treat, store, and dispose of its low-level and mixed wastes. Treatment and storage costs increased during this 3-year period while waste generators waited for DOE to issue its new policy making the Hanford and Nevada disposal facilities available to them. When DOE fully

implements this new policy, waste managers will have at least two disposal options and may be able to lower their waste disposal costs. However, these managers currently lack complete information and guidance from the Department for making cost-effective disposal decisions. The fees charged to waste generators by some DOE disposal facilities are not based on all of the facilities' costs to dispose of wastes. Moreover, the disposal facilities do not use uniform cost accounts in developing their respective fees. Finally, DOE has not developed full life-cycle costs for its six waste disposal facilities or established guidance to ensure that its waste managers base their disposal decisions on considerations of cost-effectiveness for DOE's entire program rather than on each site's annual budgetary interests. Therefore, GAO is recommending that DOE (1) develop the ability to compare the complete costs of disposing of wastes at its own and at commercial disposal facilities and (2) provide waste managers with guidance for considering these costs in their waste management and disposal decisions.

Background

DOE defines low-level waste as all radioactive waste that does not fall within other classifications, such as high-level waste and spent (used) nuclear fuel. Mixed waste is low-level radioactive waste with hazardous components, such as lead and mercury. Low-level wastes can range from barely contaminated soil and debris to waste with enough radioactivity to require remote handling. The wastes can include items such as contaminated equipment, protective clothing, rags, and packing material.

DOE's low-level and mixed wastes are regulated under several statutes and authorities, depending on their content and where they are disposed of. The Atomic Energy Act of 1954, as amended, gives DOE authority to regulate the treatment, storage, and disposal of low-level wastes. The hazardous components of mixed wastes are regulated by the Environmental Protection Agency (EPA) or by a state authorized by EPA to establish its own program, in place of EPA's, under the Resource Conservation and Recovery Act of 1976, as amended (RCRA). For a facility that disposes of wastes containing hazardous components, a RCRA permit issued by EPA or an authorized state sets out, among other things, the detailed conditions under which the facility may operate. The act provides that a facility that was in existence in November 1980 may continue to operate under "interim status" as long as it applies for a RCRA permit and complies with general-facility and unit-specific standards until EPA or the host state issues or denies the RCRA permit. EPA also oversees the on-site treatment, storage, and disposal of both low-level and mixed wastes

resulting from DOE's cleanup of contaminated sites under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA).

Finally, the National Environmental Policy Act of 1969, as amended, requires a federal agency to prepare a detailed environmental impact statement for every major federal action that may significantly affect the quality of the human environment. Such a statement includes a discussion of alternatives to the action and of measures to avoid or minimize any adverse effects of the action. In May 1997, DOE issued a final environmental impact statement addressing its programs for managing and disposing of various types of wastes, including low-level and mixed wastes, at all of its facilities. DOE completed this environmental impact statement process on February 25, 2000, for low-level and mixed wastes, by issuing its Record of Decision on key policies for managing and disposing of these wastes.

DOE manages its low-level and mixed wastes through two separate organizational programs within its Office of Environmental Management: The Environmental Restoration program manages wastes from cleanup activities under CERCLA, while the Waste Management program generally manages wastes produced from previous operations and wastes from current mission activities. The Environmental Restoration program's cleanup activities can generate large volumes of wastes. Many of these wastes can be disposed of on-site in disposal facilities developed for a CERCLA cleanup action. (App. I discusses DOE's process for establishing on-site CERCLA disposal facilities, including the estimated costs of constructing, operating, and closing them.) If CERCLA cleanup wastes cannot be disposed of on-site in a CERCLA facility, they are generally transferred to the Waste Management program or to a commercial facility for disposal.

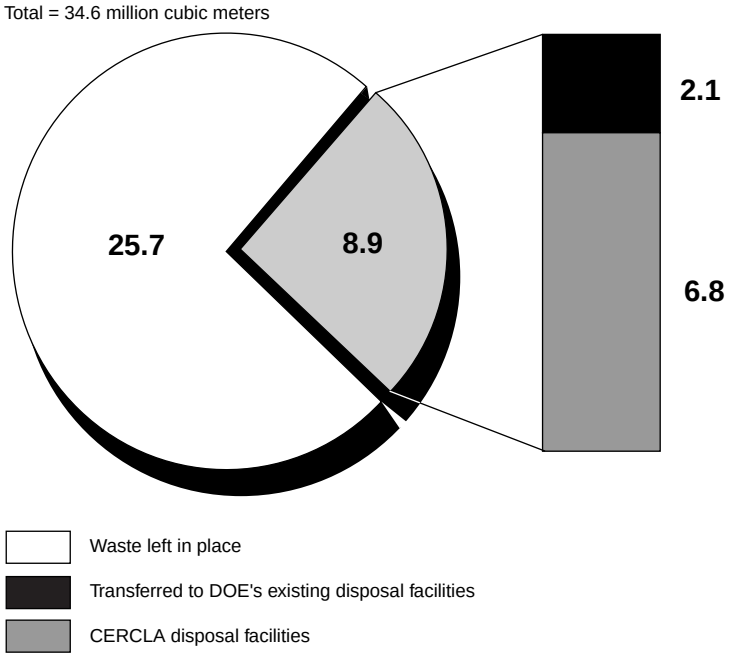
DOE estimates that it has or, over the next several decades, will have over 34 million cubic meters[1] of low-level and mixed wastes at its sites throughout the country; however, it expects to leave almost three-quarters of these wastes, largely contaminated soils, in place.[2] The remaining wastes

[1]A cubic meter equals about 35.3 cubic feet.

[2]Many of these wastes will be remediated in place. For example, some will be covered with a clay cap.

will be retrieved and disposed of in one of two ways. First, most wastes that will be generated from cleanup activities are expected to be disposed of in designated on-site CERCLA disposal facilities. Second, wastes from operations and cleanup wastes that cannot be disposed of in on-site CERCLA disposal facilities (about 2.1 million cubic meters) must be disposed of at the six DOE sites with existing disposal facilities for low-level and/or mixed wastes, or at a commercial disposal facility. See figure 1. This second category of wastes is the focus of this report.

Figure 1: Estimated Volume of Low-Level and Mixed Wastes for Disposal at DOE's Facilities



Cubic meters in millions

Note: The volume estimated for disposal in CERCLA and existing DOE disposal facilities includes some wastes that may be disposed of commercially.

Source: GAO's presentation of data provided by DOE.

Policy and Other Constraints, Not Costs, Have Primarily Dictated Waste Treatment, Storage, and Disposal Options

For 20 years, DOE's disposal policies, together with constraints on the disposal facilities themselves, have limited the availability of disposal options for DOE's waste-generating sites. Moreover, the one commercial disposal site that is readily available to DOE can accept only low-level and mixed wastes that contain very low concentrations of radioactivity. As a result, with few options available, most of DOE's waste managers had little opportunity to consider costs when making their waste disposal decisions. On February 25, 2000, DOE issued a new waste disposal policy, making the low-level and mixed waste disposal facilities at two of its sites—the Nevada Test Site (NTS) and the Hanford Site—available to all of its waste-generating sites. But before DOE can fully implement this new policy, it will need to secure the cooperation of Nevada and Washington State.

Opportunities for Disposal at DOE's Facilities Have Been Limited

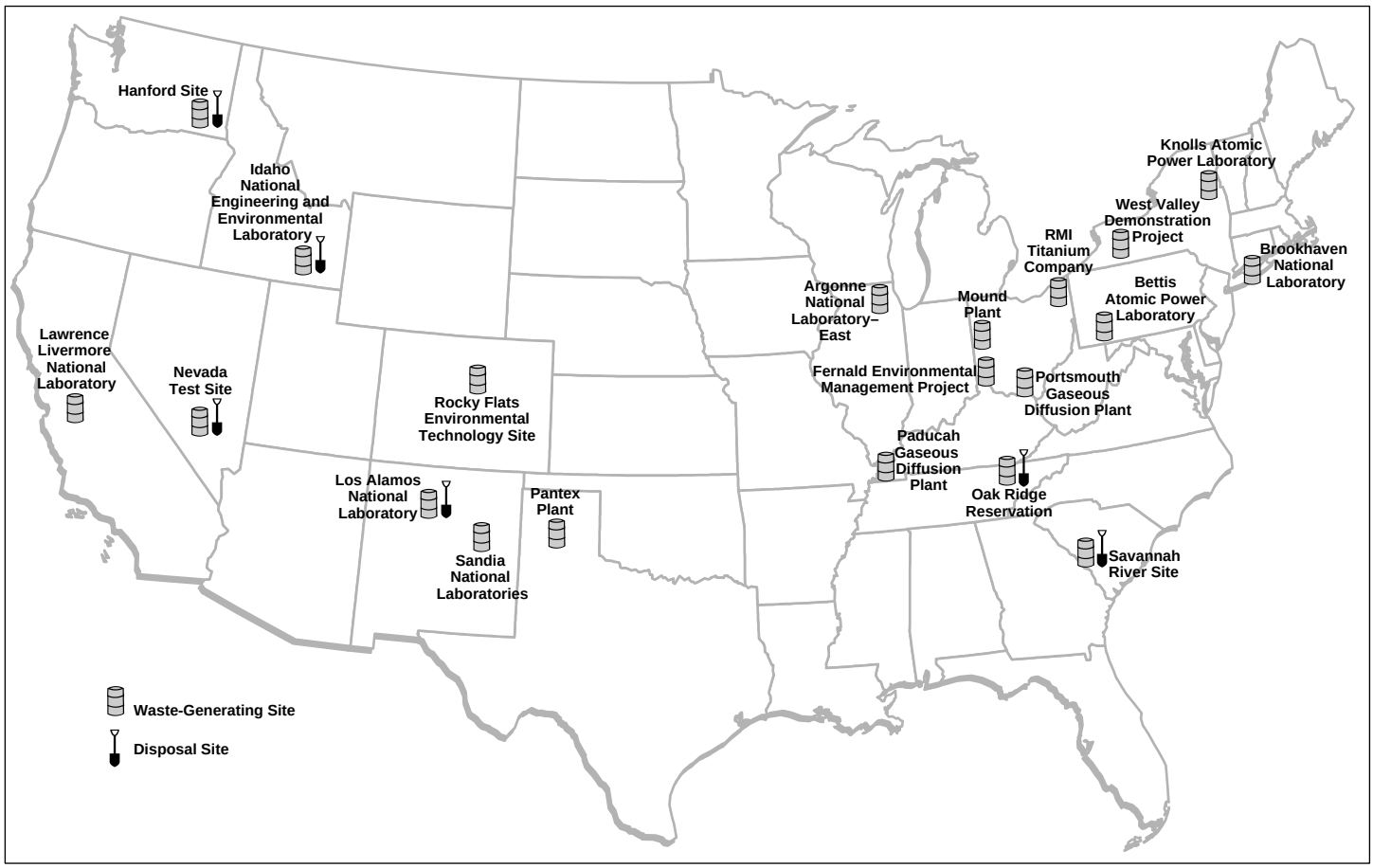
Over 50 DOE sites generate low-level and/or mixed wastes, but 20 of these sites are expected to generate almost all of DOE's low-level and mixed wastes.[3] DOE requires its waste-generating sites to dispose of their low-level and mixed wastes on the site where they are generated or at another DOE site, unless it is not practicable or cost-effective to do so. In some instances, DOE grants exemptions from these requirements for disposal at a commercial facility.

Six of DOE's 20 major waste generators have on-site disposal facilities. Of the six, only Hanford and NTS can dispose of all the low-level and mixed wastes that they themselves generate, as well as low-level wastes from other sites. The other four sites–the Idaho National Engineering and Environmental Laboratory, Idaho; the Los Alamos National Laboratory, New Mexico; the Oak Ridge Reservation, Tennessee; and the Savannah River Site, South Carolina—cannot dispose of any mixed wastes and can only dispose of some or all of their own low-level wastes.[4] Figure 2 shows the location of DOE's 20 major waste-generating sites, including the 6 sites with disposal facilities. (See app. II for the volumes of wastes estimated for these 20 sites.)

[3]This projection is based on existing waste inventories and the waste generation anticipated for a 20-year period. See DOE's *Final Waste Management Programmatic Environmental Impact Statement* (May 1997).

[4]The Savannah River and Idaho sites also dispose of low-level wastes from the Naval Nuclear Propulsion Program.

Figure 2: DOE's Major Low-Level and Mixed Waste-Generating Sites and Disposal Facilities



Source: GAO's presentation of data provided by DOE.

Variation in the size and physical characteristics of the six disposal sites, as well as in the type and design of their disposal facilities, limits the quantities and types of wastes the facilities can dispose of. For example, Oak Ridge and Savannah River are located in humid, rainy climates, where contaminants can readily leach into groundwater, which is located near the surface. Therefore, most of the active facilities for disposing of low-level wastes at these sites are aboveground, are expensive to construct, and have limited capacity (see fig. 3). Savannah River recently spent $1.6 million on a supercompactor to reduce waste volumes and extend the life of one of its aboveground disposal vaults. Oak Ridge has only one aboveground facility (expected to close in 2003), which it has reserved for its high-radioactivity,

short-lived low-level wastes. The site does not have disposal facilities for its remaining low-level wastes.

Figure 3: Aboveground Disposal Facilities at Savannah River and Oak Ridge

Source: DOE.

Waste acceptance criteria established by DOE for each of the six disposal sites—dictated in part by the physical characteristics of the disposal facilities—also limit the disposal options available to DOE's waste-managers. These criteria identify the requirements, terms, and conditions

under which the facilities will accept wastes for disposal. The criteria specify, among other things, the allowable types and quantities of radioactive materials; the types of containers required; and any restrictions on specific wastes, materials, or containers. At Savannah River, for example, an open trench can be used to dispose of only mildly radioactive wastes, such as lightly contaminated rubble and soil.

Of the six disposal sites, Hanford and NTS afford the greatest flexibility. They have the greatest current and potential disposal capacity and are both large enough and remote enough to isolate their disposal facilities. Located in arid regions where evaporation exceeds precipitation, they are positioned high above groundwater, allowing for the use of low-cost, open trenches. Compared with Oak Ridge and Savannah River, Hanford and NTS pose few concerns about contaminants leaching into groundwater. NTS disposes of low-level wastes in trenches and in subsidence craters created by previous underground weapons testing.[5] In addition, both NTS and Hanford have facilities for disposing of mixed wastes generated on-site or in state. Neither site currently disposes of mixed wastes from sites outside its respective state. Figure 4 shows subsidence craters used for disposal at NTS and one of Hanford's two mixed waste disposal trenches. Further information about DOE's disposal facilities appears in appendix III.

[5]A "subsidence crater" results when the earth settles into a cavity caused by an underground explosion.

Figure 4: Disposal in Subsidence Craters at NTS and Mixed Waste Disposal Trench at Hanford

Source: DOE.

While Hanford and NTS have the characteristics and capacity needed to dispose of nearly all the low-level and mixed wastes that DOE generates nationwide, DOE's policies have limited the waste-generating sites' access to the two sites' disposal facilities. For example, in 1979, when the Department essentially stopped using commercial disposal facilities because of uncertainties over their continued operation, DOE directed most of its waste-generating sites to use either Hanford or NTS, but not

both, for off-site disposal. Specifically, it directed its sites with wastes from defense-related activities to use NTS and those with wastes from non-defense-related activities (e.g., energy research) to use Hanford.

Before DOE's waste-generating sites could ship their low-level wastes to NTS or Hanford for disposal in accordance with DOE's 1979 policy decision, they had to obtain approval from NTS or Hanford. NTS and Hanford based their approval on reviews of the waste-generating sites' waste management programs—reviews assessing the adequacy of the sites' quality assurance and waste characterization activities and the compatibility of the sites' wastes with NTS' or Hanford's waste acceptance criteria. By October 1990, NTS had approved the disposal of wastes from 15 waste-generating sites, and Hanford had approved the disposal of wastes from 26 other sites. Several sites, including the Idaho, Oak Ridge, and Savannah River sites, had not obtained approval from either NTS or Hanford. In October 1990, DOE stopped NTS and Hanford from approving additional sites to avoid prejudicing the outcome of the environmental impact statement on its waste management programs that it had agreed to conduct as part of a legal settlement.[6] The environmental impact statement, which was issued in May 1997, was designed to demonstrate, on a national basis, the environmental effects of alternative approaches to managing and disposing of DOE's wastes, including low-level and mixed wastes. As a result, since October 1990, the sites that had not obtained approval to dispose of their wastes at NTS or Hanford before that date–including the Idaho, Oak Ridge, and Savannah River sites—have had to store any low-level wastes that they could not dispose of on-site. Also, a December 1996 decision on an NTS-related environmental impact statement limited access for the disposal of low-level wastes at NTS to already approved waste generators until DOE completed the low-level and mixed waste part of its waste management environmental impact statement.

[6]Some exceptions have been made through DOE headquarters decisions, primarily for unique wastes and wastes from work done previously by others for DOE (i.e., laboratory work).

Opportunities for Disposal at Commercial Facilities Have Also Been Limited

While DOE sometimes authorizes disposal at a commercial facility, few commercial facilities are in operation, and only one is a viable option for most of DOE's waste-generating sites.[7] To grant an exemption for disposal at a commercial facility, DOE must determine that the use of commercial disposal is cost-effective and in the "best interest" of DOE, after taking into account, among other factors, life-cycle disposal costs, potential liability to DOE, and the protection of public health and the environment. Since 1988, DOE orders have authorized exemptions for the use of commercial disposal facilities that meet specific criteria. According to DOE, its field managers evaluate the cost-effectiveness of available disposal options. If commercial disposal is more advantageous, the managers can approve exemptions and ensure that proper permits are in place and notifications completed.

[7]For information on commercial low-level waste disposal facilities, see *Low-Level Radioactive Wastes: States Are Not Developing Disposal Facilities* (GAO/RCED-99-238, Sept. 17, 1999).

Three commercial disposal facilities are in operation. One of them, operated by US Ecology, is located at DOE's Hanford Site on land leased by DOE to the state of Washington, which subleases it to the facility operator. Washington and seven other western states, which formed a compact to manage commercial low-level wastes within that compact's region, control access to this disposal facility.[8] DOE (or any waste generator not located within the region) would have to obtain the approval of Washington, and of the compact, before it could dispose of its low-level wastes at this commercial facility. Another facility, Barnwell Waste Management near Savannah River, accepts a wide range of low-level wastes, excluding mixed wastes, but is very expensive. Over the last 3 years, only 1 of the 20 sites we contacted reported shipping wastes to Barnwell–a small quantity of wastes too radioactive for other commercial facilities to accept. Envirocare of Utah, Inc. is licensed to treat and dispose of some of DOE's wastes–but only low-level and mixed wastes that are only lightly contaminated with specific radionuclides.[9] The facility's license also restricts the chemical properties of the wastes.

DOE has issued contracts for low-level and mixed waste disposal at Envirocare that are available to all of its waste generators, and these waste generators have been sending low-level and/or mixed wastes to Envirocare since 1992. Over the last 3 years, for example, 9 of the 20 major waste-generating sites sent low-level wastes to Envirocare, and 15 sent mixed wastes. According to DOE's Office of Environmental Management,[10] from 1992 through September 1998, DOE sites shipped 31,430 cubic meters of mixed wastes to Envirocare for disposal—an amount equal to about 10 percent of the nearly 300,000 cubic meters of mixed wastes DOE estimates its Waste Management program will have to dispose of between 1998 and 2070.

[8]The Low-Level Radioactive Waste Policy Act of 1980, as amended in 1985, authorized states to form compacts for the purpose of regulating the management and disposal of commercially generated low-level radioactive wastes. Compact agreements must be approved by the Congress before they take effect.

[9]Envirocare is licensed for "Class A" wastes under the Nuclear Regulatory Commission's division of commercially generated nuclear wastes. In November 1999, Envirocare asked Utah for an amendment to its license that would allow for the disposal of wastes with higher radioactivity levels. Envirocare also has to submit a siting application. To dispose of higher-level wastes, Envirocare would have to build a more complex disposal facility.

[10]*Commercial Disposal Policy Analysis for Low-Level and Mixed Low-Level Wastes* (DOE/EM, Mar. 1999).

Limited Disposal Choices Have Afforded Few Opportunities to Consider Disposal Costs

The limited disposal options available to DOE's waste generators have given them few opportunities to consider cost-effectiveness in their waste management and disposal decisions. Generally, the waste managers we contacted at DOE's 20 major waste-generating sites said that the policies and other constraints described above play significant roles in their disposal decisions. For their different waste streams, these waste managers reported considering the availability of disposal facilities, the facilities' waste acceptance criteria, and the costs of disposal. They also said they consider other factors, such as transportation risks, stakeholders' willingness to accept the wastes, and regulatory agreements and milestones. Finally, they said, cost comparisons of the disposal alternatives were relevant only when more than one disposal option existed.

Occasionally, when the costs of disposal seemed too high, a site's waste manager decided against off-site disposal. For example, Lawrence Livermore National Laboratory in California decided to continue storing radioactively contaminated solvents when it learned that incineration would cost $1 million. Similarly, the Idaho National Engineering and Environmental Laboratory decided not to ship some remote-handled low-level wastes off-site when it determined that the packaging and transportation costs would be too high.

The factors cited by DOE's waste managers were similar to those cited in a September 1998 DOE Inspector General's report, which stated that DOE generally did not dispose of low-level and mixed wastes as cost-effectively as possible because factors other than cost played an integral role in disposal decisions.[11] These factors included environmental impact, transportation routes, state equity, litigation involving disposal sites, interaction with the public and regulators, and funding limitations. The Inspector General estimated that, had cost been the only criterion in sites' disposal decisions, DOE could have reduced its low-level waste disposal costs by $5.3 million at three sites from fiscal year 1993 through fiscal year 1996. According to the report, officials from DOE's Office of Environmental Management were of the view that political and environmental sensitivities sometimes outweigh simple cost comparisons in making the most effective decisions for their programs.

[11] *Disposal of Low-Level and Low-Level Mixed Waste* (DOE/IG-0426, Sept. 1998).

Access to Designated Disposal Facilities May Continue to Be Limited

Although DOE's February 25, 2000, Record of Decision designated Hanford and NTS as the primary locations for off-site disposal of the Department's low-level and mixed wastes, DOE may not be able to fully implement its decision until it has met all relevant regulatory requirements, such as those for obtaining RCRA permits from Washington and Nevada for its mixed waste disposal facilities. In addition, the Los Alamos and Oak Ridge sites will continue to dispose of their own low-level wastes to the degree practicable, and the Idaho and Savannah River sites will continue to dispose of their own low-level wastes and those from the Naval Nuclear Propulsion Program. The nearly 3-year delay between the May 1997 issuance of the final environmental impact statement on waste management and the February 2000 issuance of the Record of Decision naming specific sites for low-level and mixed waste disposal occurred, according to DOE's Assistant Secretary for Environmental Management, to fulfill DOE's commitment to have further discussions with states, stakeholders, and tribal entities before making the decision. DOE officials from the Environmental Management program said these discussions were designed to help prevent political and legal problems after the decision was issued.

Even after issuing the Record of Decision, DOE may not be able to implement its new disposal policy immediately, and its sites may not have access to disposal facilities for all of their low-level and mixed wastes. DOE may still have to meet regulatory requirements that will allow the designated disposal facilities to function as intended under the decision. For example, before the designated mixed waste disposal facilities can dispose of mixed wastes from other sites, they must meet the requirements of, and obtain the permits needed under, RCRA. Hanford must obtain a RCRA permit from Washington, NTS from Nevada. Currently, neither site has obtained the required RCRA permit for its mixed waste disposal facility. Instead, both facilities are operating under RCRA's interim status provisions and standards. Interim status has enabled the two sites' facilities to dispose of on-site mixed wastes while the sites seek to obtain RCRA permits.

DOE does not expect to begin disposing of off-site mixed wastes at Hanford until April 2001, at the earliest, when it expects to complete an environmental review of the management of solid wastes at the site. DOE officials have stated that Hanford's interim status does not preclude the disposal of mixed wastes from other DOE sites, because there is no restriction on the source of the wastes. However, the Governor of Washington has publicly vowed to fight DOE's plan to increase shipments

of low-level and mixed wastes to Hanford if DOE does not agree to set and meet deadlines for cleaning up the site. For example, although Hanford's mixed waste disposal facilities are designed to comply with RCRA's requirements—the facilities are lined and have leachate collection systems—the state could limit the site's disposal capacity for future trenches when it issues the RCRA permit. Hanford officials expect the state to issue the RCRA permit sometime after June 2002, the date the state has asked DOE to submit its application for a permit.

NTS uses an unlined pit for disposing of mixed wastes generated on-site and currently does not dispose of mixed wastes from sites outside the state.[12] The site is limited to disposing of mixed wastes generated on-site or elsewhere within the state of Nevada, for which DOE's Nevada Operations Office has responsibility. NTS' mixed waste disposal facility operates under interim RCRA status. To receive a RCRA permit from the state, the facility must either be modified to meet certain general requirements—for example, incorporation of liners, a leachate collection system, and a leak detection program–or demonstrate alternative methods of meeting the RCRA permitting requirements. The site first applied to the state for a RCRA permit in 1992 and has revised its application several times, most recently in November 1999. DOE does not expect the state to issue a RCRA permit for the facility for another 1 to 2 years.

Nevada is taking the position that it has already done more than any other state in support of the nation's nuclear weapons development and testing and nuclear waste disposal. In addition, the state vigorously opposes DOE's efforts to determine if Yucca Mountain, located adjacent to NTS, is suitable for use as a geologic repository for the permanent disposal of highly radioactive wastes. In early February 2000, for example, Nevada's state engineer denied DOE's application for a permit to use water to build and operate a nuclear waste repository at Yucca Mountain. Thus, we believe the state may oppose NTS' designation as a primary disposal site for DOE's low-level and mixed wastes, especially if DOE continues to move forward on the Yucca Mountain project despite the state's objections.

[12]Before May 1990, NTS disposed of mixed wastes from other sites–primarily from the Rocky Flats Plant.

DOE's experiences with the state of Tennessee illustrate the types of problems the Department could face in implementing its new disposal policy. Tennessee has blocked DOE from incinerating some mixed wastes containing hazardous and toxic components at DOE's Oak Ridge incinerator–the only DOE incinerator with a permit for treating radioactive wastes with certain hazardous or toxic materials, such as PCBs.[13] The incinerator destroys essentially all of the PCBs and hazardous constituents, allowing most of the ash to be disposed of at a commercial disposal facility. Since 1997, Tennessee, by rejecting DOE's plans for burning wastes in the incinerator, has effectively imposed a moratorium on the receipt of most out-of-state DOE wastes–except for some wastes from sites formerly under Oak Ridge's operations. The state has rejected DOE's plans because DOE (1) has not incinerated Oak Ridge's wastes as planned, (2) has not provided Oak Ridge with access to NTS for the disposal of existing and future low-level waste inventories, and (3) has repeatedly reduced funding levels for Oak Ridge's cleanup activities. With the issuance of the recent Record of Decision on low-level waste disposal, DOE expects that Tennessee will lift its restrictions on out-of-state wastes in the near future.

[13]The treatment, storage, and disposal of PCBs fall under the Toxic Substances Control Act of 1976 (TSCA). The Oak Ridge incinerator operates under a TSCA authorization issued by EPA Region IV and a RCRA permit issued by the state of Tennessee.

The lack of an available option for disposing of DOE's mixed wastes (including those with PCBs that could be incinerated at Oak Ridge), the almost 3-year delay in issuing the Record of Decision, and the additional time that DOE may need to develop a mixed waste disposal facility could significantly affect at least one of the DOE waste-generating sites–Rocky Flats—that expects to finish its cleanup activities by the end of 2006. The site continues to store a number of waste streams, known as "orphan wastes," which do not yet have identified treatment or disposal options because of technical and/or regulatory concerns. Site officials said that while none of these waste streams is particularly large on a relative scale, all must be addressed before the site can be closed.[14] When we asked the officials about their management and disposal of low-level and mixed wastes, they said they do not anticipate that mixed waste disposal facilities at NTS or Hanford will be available in time for Rocky Flats to meet its 2006 closure schedule.[15]

[14]For information on issues that could affect Rocky Flats' closure, see *Department of Energy: Accelerated Closure of Rocky Flats: Status and Obstacles* (GAO/RCED-99-100, Apr. 30, 1999).

[15]Rocky Flats officials believe that either NTS' or Hanford's mixed waste disposal facility must be available by 2003 if Rocky Flats is to meet its closure schedule. Of particular concern are mixed wastes with activity levels too high for disposal at Envirocare. Rocky Flats could be ready to ship these wastes to the selected DOE mixed waste disposal facility or facilities as early as 9 to 12 months after DOE issued its Record of Decision.

DOE Is Spending Millions on Waste Management, but Managers Lack Information and Guidance for Making Cost-Effective Disposal Decisions

DOE spent over $700 million over the last 3 fiscal years to manage and dispose of its low-level and mixed wastes.[16] These costs, particularly for waste storage, may have been higher than they would have been without DOE's restrictions on disposal options–all but two waste-generating sites have had to store their mixed wastes while awaiting DOE's policy decision on the management and disposal of low-level and mixed wastes. Although this decision would, if fully implemented, give all of DOE's waste managers at least two disposal options, these managers do not have all of the information on costs and guidance from DOE that they will need to make cost-effective disposal decisions. DOE's waste managers track the annual costs of treating, storing, and disposing of their sites' low-level and mixed wastes. However, DOE has not developed estimates of the life-cycle costs of its waste disposal facilities, including the costs to close and monitor them.[17] Therefore, these costs cannot be factored into disposal decisions. In addition, DOE's waste managers typically base their waste management and disposal decisions on their sites' annual budgetary interests, without taking into account the complete costs of disposal or determining whether decisions are cost-effective for DOE as a whole.

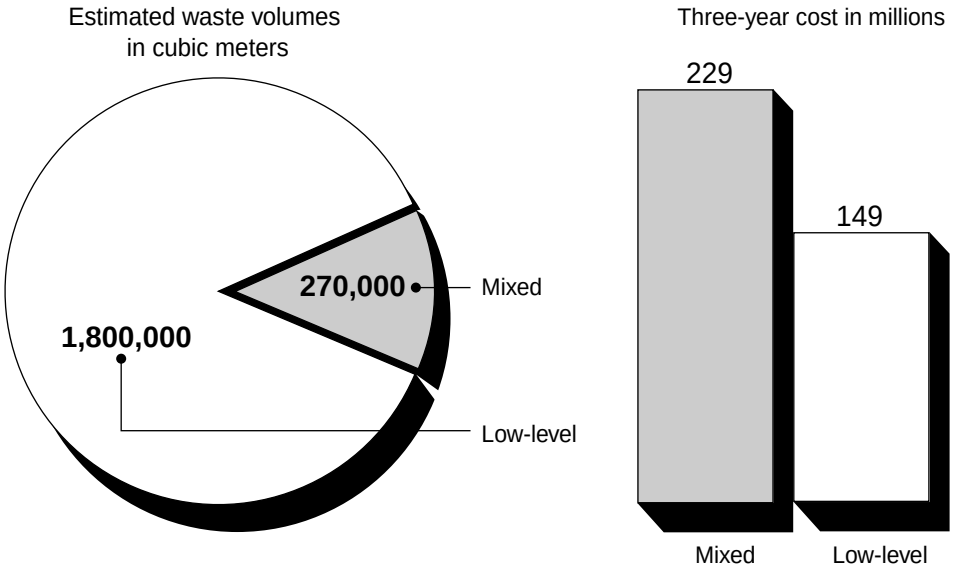
Treatment, Storage, and Disposal Costs Are Substantial

For fiscal years 1997 through 1999, DOE's waste-generating and disposal sites reported spending about $705 million to manage and dispose of their low-level and mixed wastes. This amount included about $525 million to treat, store, or otherwise prepare these wastes for disposal and about $180 million to dispose of the wastes. At least one-fourth of the disposal costs were spent on disposal at a commercial facility. Mixed wastes, by volume, represent a small fraction of DOE's projected low-level wastes. Yet, of the $378 million spent by DOE's six sites with disposal facilities, most of the expenditures were on mixed, rather than low-level, wastes. (See fig. 5.)

[16]These include DOE's costs to manage wastes from past operations, wastes from ongoing missions, and cleanup wastes transferred from DOE's Environmental Restoration program.

[17]A 1997 cost report on DOE's disposal facilities provided annual—but not life-cycle—facility and waste generator cost estimates. A primary conclusion of the report was that generators' costs make up two-thirds of the total costs to dispose of low-level wastes.

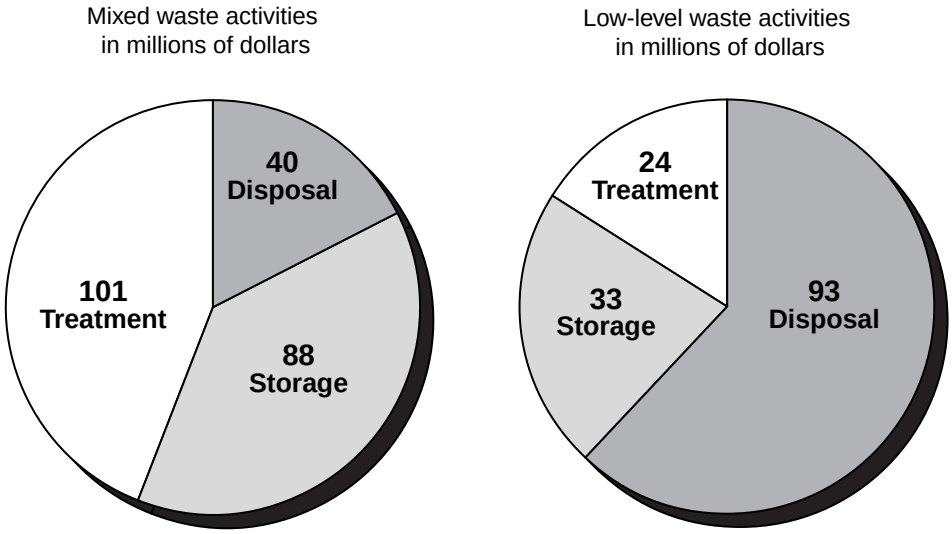
Figure 5: Estimated Disposal Volumes and 3-Year Costs to Manage and Dispose of Mixed and Low-Level Wastes at Six DOE Sites With Disposal Facilities



Source: GAO's presentation of data provided by DOE.

Moreover, as shown in figure 6, DOE spent more at its six sites with disposal facilities over the 3-year period to treat and store its relatively small volume of mixed wastes than it did to treat, store, and dispose of its much larger volume of low-level wastes. Storage and treatment costs were high for mixed wastes because four of the six sites had no disposal options for many of these wastes. For example, Oak Ridge, which has about one-half of DOE's mixed waste inventory, spent $53 million over 3 years to store these wastes. In contrast, DOE spent $33 million to store low-level wastes at all six of its disposal sites. Thus, while the majority of the costs for mixed wastes were for treatment and storage, the majority of the costs for low-level wastes were for disposal. (See app. III for the waste management and disposal costs at DOE's six disposal sites.)

Figure 6: Six DOE Disposal Sites' Costs to Store, Treat, and Dispose of Mixed and Low-Level Wastes, Fiscal Years 1997-99



Source: GAO's presentation of data provided by DOE.

In addition to the 3-year costs incurred at the 6 disposal sites, 15 of DOE's 20 major waste-generating sites reported spending $280 million to prepare, store, and ship their low-level and mixed wastes over the same period.[18] In fiscal year 1999, for example, DOE's Fernald site in Ohio spent $23 million on waste characterization, repackaging, treatment, and storage and $15 million on shipping, including large-volume rail shipments. The waste-generating sites also reported spending a total of $47 million to dispose of some of their wastes at commercial facilities (primarily Envirocare). (App. II presents information on the disposal preparation activities and costs reported by the waste-generating sites.)

[18]While not all of these sites routinely track and report their costs for waste preparation prior to disposal, 15 of the 20 largest waste-generating sites reported these costs to us.

DOE's Waste Managers Do Not Have Complete Cost Information

With the additional disposal options that may be created by DOE's recent Record of Decision, the costs of disposal options will become more important to disposal decision-making. However, DOE does not have complete and comparable information for considering these costs. For example, some of DOE's disposal sites charge fees to the waste-generating sites. These fees are not consistent among the disposal sites and do not include all of each site's annual disposal costs. Moreover, DOE does not have a policy on whether its disposal facilities should charge fees for disposal services.[19] And finally, because DOE does not have adequate estimates of the total costs to develop, operate, close, and monitor its disposal facilities—called life-cycle costs—not all of these costs are being considered in disposal decisions.

Four of DOE's six disposal sites currently charge disposal fees to their on- and/or off-site waste generators. The fees, which are generally expressed in the cost per unit of waste, are based on a portion of the costs of regulatory compliance and operations that are funded out of the current year's operating budget, together with estimates of waste volumes. The fees charged by the four sites do not, however, capture complete costs, nor are the bases for the fees charged comparable across the four sites. As a result, waste generators do not have comparable cost information for evaluating their waste disposal options.

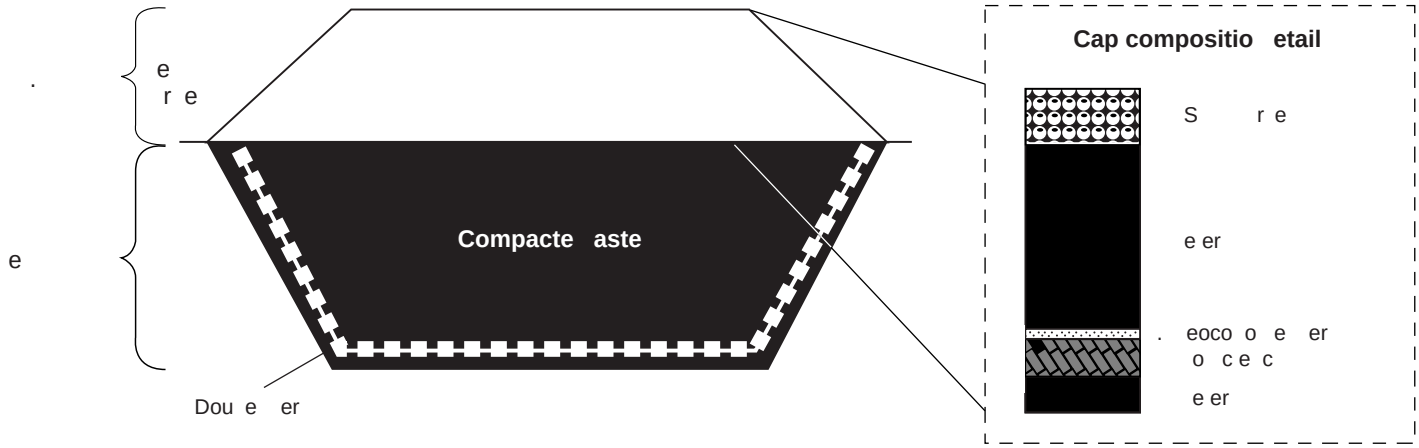
The fees charged by DOE's disposal facilities are not complete because they do not reflect all of the fixed or long-term costs that are a part of the disposal facilities' total life-cycle costs. According to officials at some of the disposal facilities, the fees should not include all fixed costs, such as the costs to maintain existing disposal trenches, because DOE will continue to incur these costs regardless of the rate of future disposal activity. Furthermore, the DOE officials pointed out, the federal government's annual budget process does not provide a mechanism for DOE to set aside funds from each year's budget to cover future costs at its disposal facilities. Therefore, according to the officials, the fees should cover only current costs. However, commercial facilities can and do set aside funds to cover fixed and other long-term costs, and their fees reflect these costs. The fees that Envirocare charges, for example, are designed to cover all of the costs of developing, operating, and closing its disposal facility. Until DOE includes these same cost categories, it cannot compare

[19]DOE developed draft guidance in an effort to standardize the costs that would be covered by disposal fees. However, this guidance was never finalized.

the costs of disposal at its own facilities with the costs at commercial facilities.

To develop cost estimates that reflect the life-cycle costs of its disposal facilities (as commercial facilities must do to charge disposal fees to recover their past, present, and future costs), DOE needs to accurately estimate the future costs of closing its existing disposal facilities and of monitoring them over the long term. Closure requires the construction of caps over the disposal facilities and of other barriers to prevent deterioration or intrusion at the sites. The design of a disposal facility's closure cap may be affected by, among other things, the final size of the disposal facility, decisions on neighboring cleanup areas, and timing. Officials at NTS, for example, said their closure estimates do not account for disposal volumes beyond those predicted for the sites currently disposing of their wastes at NTS. Hanford officials said the cost of a closure cap over Hanford's disposal facilities would depend on whether existing roads will have to be moved or can stay in place until the entire site is closed and the roads are no longer needed. Figure 7 illustrates a typical closure cap for a waste disposal facility, based on the design of the cap for the CERCLA disposal facility at Hanford.

Figure 7: Diagram of a Typical Closure Cap for a Waste Disposal Facility



Source: DOE.

In July 1999, DOE required the operators of its six disposal sites to develop preliminary closure plans.[20] Among other things, these plans are intended to address how the disposal facilities will be closed to achieve long-term stability and minimize the need for active maintenance, as well as estimate the waste volumes to be disposed of at each facility over its expected operational life. However, estimates of the costs of closure activities are not required.

In addition to the costs of constructing closure caps, DOE will incur what it refers to as long-term stewardship costs after it closes its disposal sites. DOE has not estimated these costs. Long-term stewardship covers activities required to protect human health and the environment from hazards remaining after cleanup is complete. Such activities include maintaining records of contamination, maintaining and repairing closure caps, monitoring and treating environmental contamination and precipitation run-off, erecting and maintaining barriers, and enforcing land-use restrictions. DOE recently reported that, for sites where cleanups do not reduce contamination to a level suitable for unrestricted use, the costs of stewardship activities are unknown.[21] In October 1999, DOE announced

[20]See the implementation manual for DOE's 1999 Order 435.1, *Radioactive Waste Management*.

[21]*From Cleanup to Stewardship: A Companion Report to Accelerating Cleanup: Paths to Closure* (DOE/EM-0466, Oct. 1999).

a study on long-term stewardship, which it anticipates will be issued in late fall 2000.

The Congress has expressed interest in understanding the future costs of DOE's disposal facilities. The Senate Committee on Armed Services' report accompanying the National Defense Authorization Act for Fiscal Year 2000 directs the Secretary of Energy to

> "submit a report to the defense committees of Congress not later than March 1, 2000, on the life-cycle cost comparisons of on-site versus off-site disposal of low-level radioactive wastes. The report shall assess the potential costs to the federal government for long-term monitoring and maintenance at DOE-owned disposal sites."[22]

DOE issued its report in March 2000. Relying on data from studies previously prepared for other purposes, DOE estimated that the life-cycle cost to dispose of its low-level and mixed wastes either primarily or exclusively at its disposal facilities would slightly exceed $4 billion (in fiscal year 1998 dollars). In contrast, DOE estimated that using only commercial disposal facilities would cost over $7 billion. The report does not provide the projected life-cycle costs for individual disposal facilities. Thus, the report does not provide managers at DOE's waste-generating sites or other program officials with the kind of disposal cost data that would be useful in making disposal decisions. DOE recognized this limitation in the report by pointing out that, without additional and more detailed analysis, efforts to estimate and compare the life-cycle costs of DOE and commercial facilities remain uncertain.

Lack of Focus Across DOE May Increase Overall Costs

DOE's decentralized management approach encourages site-level decision-making on waste treatment, storage, and disposal. Waste managers need consider only the effects of their decisions on their site's annual budget and may not consider the immediate or future costs of the decisions to the Department. Furthermore, because the costs for storage, treatment, and disposal are interdependent, managers may–without DOE guidance–make decisions in their site's interests that could result in higher costs for other sites or for DOE as a whole. For example, the fees that one of DOE's waste disposal facilities would charge a waste-generating site would add to that site's waste management costs. Higher waste management costs could, in turn, encourage the site to assign higher priority in its budget to other

[22]S. Rep. No. 106-50, at 452 (1999).

cleanup or operational activities. By contrast, the absence of disposal fees could encourage the same waste-generating site to assign higher priority to waste disposal activities.

The lack of a DOE-wide policy on charging fees for disposal services has given the Department's existing disposal sites wide latitude in deciding whether to charge fees and, if so, what components of their disposal costs should be included in the fee structure. The disposal sites' fee decisions are intertwined, however, with the disposal decisions of other DOE sites. The fees set by some of DOE's disposal facilities are sensitive to increases or decreases in disposal volumes. Therefore, a decision by one waste-generating site to dispose of its wastes elsewhere could raise the unit cost and, in turn, the fees charged to other waste-generating sites. A site's decision to use the Envirocare disposal facility, for example, would decrease the amount of waste disposed of at a DOE disposal facility. In such a case, that facility might raise the fees it charges to DOE's other waste-generating sites. In addition, according to officials at one DOE disposal facility, a waste-generating site's use of a commercial facility means that DOE "pays twice" for disposal services—once to maintain its disposal facilities in support of its waste-generating sites and again to dispose of wastes at a commercial facility. However, DOE has not assessed the effects of the use of commerical disposal facilities on its overall waste management and disposal costs.

According to some site officials, charging disposal fees to waste-generating sites may, in some instances, reduce efficiencies. For example, officials at NTS stated that their disposal fees encourage an end-of-year shipping rush by waste-generating sites anxious to use funds by the end of the fiscal year. The result may be higher costs both for continuing to store the wastes at the waste-generating sites during the year and for operating inefficiencies at the disposal facilities caused by workflow fluctuations. Overestimating waste volumes could also result in fees that were too low to cover a disposal facility's operating costs. During a pilot program in fiscal year 1998, for example, Savannah River incurred a $4 million shortfall by relying on waste generators' estimates of waste volumes that were twice as high as the actual volumes. Conversely, underestimating waste volumes could result in fees that were too high, producing excess collections that might need to be returned to the generators.

Disposal decisions made at DOE headquarters and at individual DOE waste-generating and disposal sites can affect the entire complex of nuclear facilities. As discussed, storage costs were high, especially for

mixed wastes, during the years that DOE was preparing to designate NTS and Hanford as its primary disposal sites. In addition, satisfying a particular facility's waste acceptance criteria can be burdensome and costly. The Idaho site, for example, did not have the authority to dispose of any of its wastes at an off-site DOE disposal facility. To meet its restrictive criteria for on-site disposal and to conserve disposal space, from August 1994 through December 1997, the site's operator shipped 5,200 cubic meters of one type of low-level waste to a commercial facility for incineration and ash compaction.[23] The waste volume was reduced by a ratio of 400 to 1, and the compacted ash was returned to the Idaho site for disposal. Waste treatment, storage, and disposal decisions can also affect other on-site activities. Without an off-site DOE disposal option, the Oak Ridge site has not been able to remove a large pile of contaminated scrap metal that occupies an area the state of Tennessee wants cleaned up.

Conclusions

Until DOE meets remaining regulatory requirements for its mixed waste disposal facilities at NTS and Hanford, it cannot fully implement its new policy for managing and disposing of its low-level and mixed wastes. Once these two disposal facilities are made available, waste managers will have new opportunities to factor the costs of alternative disposal options into their disposal decisions, which may reduce DOE's waste disposal costs. At present, however, DOE does not have complete, comparable, and consistent information on the life-cycle costs of each of its six sites' disposal facilities so that accurate cost comparisons can be made. Similarly, DOE has not determined if it is in the Department's best interests for the disposal sites to charge fees to waste-generating sites for disposal services. Finally, DOE has not assessed the effects of using commercial disposal facilities on the costs of operating its own disposal facilities. Until DOE addresses these issues, it will not have the information it needs to make cost-effective agencywide decisions about treating, storing, and disposing of its low-level and mixed wastes.

Recommendations

To improve the effectiveness, efficiency, and economy of DOE's management and disposal of low-level and mixed wastes, we recommend that the Secretary of Energy develop criteria and guidance for DOE's waste managers to use in making decisions on the best available options within

[23]The on-site volume reduction facility was not available at that time.

DOE and at commercial facilities for treating, storing, and disposing of their wastes. Specifically, the Secretary should

- develop reasonable and consistent estimates of the life-cycle costs of each of DOE's disposal facilities, including the costs to close, monitor, and maintain each facility;
- decide if the operators of DOE's disposal facilities should charge waste-generating sites fees for disposal services;
- if charging disposal fees is the preferred policy, provide the operators of disposal facilities with guidance on how to develop and use fees and what those fees should include;
- if charging fees is not the preferred policy, provide DOE's waste-generating sites with guidance on how to compare the costs of disposing of their wastes at each available DOE and commercial disposal facility, including consideration of the estimated life-cycle costs of those facilities; and
- assess the effects of using commercial waste disposal facilities on the costs of operating DOE's disposal facilities and develop guidance on how to compare and consider the total costs of using both types of disposal facilities in disposal decision-making.

Agency Comments

We provided DOE with a draft of this report for its review and comment. DOE stated that our report, in general, is factual and reflects several of the disposal issues that it identified in its recent report to the Congress on its disposal costs. DOE also provided technical clarifications that we incorporated as appropriate.

Scope and Methodology

We performed our review at the Department of Energy's headquarters in Washington, D.C., and offices in Germantown, Maryland, as well as at the following seven DOE sites: Hanford Site, Washington State; Idaho National Engineering and Environmental Laboratory, Idaho; Los Alamos National Laboratory, New Mexico; Nevada Test Site, Nevada; Oak Ridge Reservation, Tennessee; Rocky Flats Environmental Technology Site, Colorado; and Savannah River Site, South Carolina. We also contacted 13 other DOE waste-generating sites to gather additional data. We conducted our review from May 1999 through April 2000 in accordance with generally accepted government auditing standards. (See app. IV for details of our scope and methodology, including the identification of the 20 waste-generating sites that provided information.)

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Honorable Bill Richardson, the Secretary of Energy, and other interested parties. We will also make copies available upon request. If you or your staff have any questions about this report, please call me at (202) 512-3841. Key contributors to this report are listed in appendix V.

(Ms.) Gary L. Jones
Associate Director, Energy,
Resources, and Science Issues

Decisions to Establish On-Site CERCLA Disposal Facilities or Dispose of Cleanup Wastes at Existing Disposal Facilities

Of the 8.9 million cubic meters of low-level and mixed wastes that the Department of Energy (DOE) expects to retrieve and dispose of, about 2.1 million cubic meters will be disposed of in existing disposal facilities operated by DOE's Waste Management program at six sites, according to DOE's estimates. The remaining 6.8 million cubic meters of wastes—the subject of this appendix—will be generated from cleanup activities, such as digging up contaminated soils and dismantling buildings and other structures, conducted under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA). DOE expects to dispose of the majority of these cleanup wastes at the sites where they are generated in disposal facilities dedicated to on-site cleanup wastes—known as CERCLA disposal facilities.

Under CERCLA, which is administered by the Environmental Protection Agency (EPA), a site's cleanup wastes can be disposed of at a dedicated on-site disposal facility if on-site disposal meets public health and environmental protection criteria tailored to the site by EPA and DOE. DOE has already constructed a CERCLA disposal facility at Hanford and has decided to construct CERCLA disposal facilities at the Idaho National Engineering and Environmental Laboratory (INEEL) and Oak Ridge. Furthermore, DOE considered developing a CERCLA disposal facility at Savannah River but decided not to do so. These four sites also have low-level waste disposal facilities operated by DOE's Waste Management program. In addition, DOE has constructed a CERCLA disposal facility at the Fernald Environmental Management Project in Ohio, the only site that does not have a Waste Management disposal facility for low-level or mixed wastes.[1] At all five of these sites, DOE considered the comparative costs of on-site and off-site disposal when deciding whether to build a CERCLA disposal facility.

[1]In addition to the CERCLA facilities discussed in this report, DOE constructed such facilities at its Weldon Spring Site and Monticello Mill Site (largely for uranium mill tailings) and is considering constructing a CERCLA facility for the Paducah Gaseous Diffusion Plant. Sandia National Laboratory has a small CERCLA Corrective Action Management Unit limited to the disposal of cleanup waste, such as soil and debris, with very low tritium contamination.

CERCLA Allows the Disposal of Cleanup Wastes at Some DOE Sites

The Congress enacted CERCLA to clean up the nation's most severely contaminated hazardous waste sites. The act directs, among other things, that cleanup remedies be permanent, to the maximum extent practicable, and cost-effective. CERCLA does not require the complete elimination of risks or of all known or anticipated effects. With respect to DOE's contaminated sites, the Department and EPA, which is responsible for administering the act, assess the current and potential risks to health and the environment posed by each site's contamination to determine what remediation steps are necessary to adequately protect against such risks. The two agencies, in conjunction with the appropriate state regulatory agencies, then select remedies intended to reduce the threats from radioactive, hazardous, and/or toxic contaminants at a particular site. EPA's policy states that risks greater than 1 in 10,000 for carcinogens and greater than 1 for noncarcinogens are considered serious enough to require cleanup action. CERCLA states that cleanups must meet "legally applicable" or "relevant and appropriate" requirements, including applicable or relevant federal and state environmental regulations.

CERCLA disposal facilities are generally designed to take large quantities of soil and debris. The facilities are built with liners, water collection systems, and leak detection systems. These facilities do not require a permit under the Resource Conservation and Recovery Act (RCRA). Because RCRA permits are not required for CERCLA disposal facilities, a CERCLA disposal facility can accept only CERCLA cleanup wastes (low-level and mixed wastes) from the site where the facility is located. It cannot accept either cleanup wastes from another site or any wastes that are not cleanup wastes. A CERCLA disposal facility can be used only for the disposal of wastes that are within the waste acceptance criteria set out in the Record of Decision for the facility. If one or more types of cleanup waste do not meet these criteria, those wastes must be disposed of at one of DOE's Waste Management disposal facilities or at a commercial disposal facility, such as Envirocare.

DOE Considered Developing CERCLA Disposal Facilities at Four Sites With Low-Level Waste Disposal Facilities

DOE considered developing CERCLA disposal facilities at four sites that have low-level waste disposal facilities operated by the Department's Waste Management program. For each of these sites—Hanford, INEEL, Oak Ridge, and Savannah River—DOE's decision-making included an analysis of the estimated costs for on-site and off-site disposal of the site's cleanup wastes. According to DOE, it also considered factors such as the quantity of cleanup wastes requiring disposal and site-specific features, such as proximity to the public.

The Hanford Site's CERCLA disposal facility has been in operation since July 1996 and, as of May 1999, had disposed of almost 700,000 cubic meters of cleanup wastes. The facility is being used primarily to dispose of contaminated soils and debris removed from cleanup areas near the Columbia River. The facility is located relatively high above groundwater and is in the same general area as DOE's low-level and mixed waste disposal facilities and the US Ecology facility, which disposes of commercially generated low-level wastes. DOE estimated that the life-cycle cost—for the construction, operation, and eventual closure—of Hanford's CERCLA disposal facility would be about $275 million.[2] This estimate includes about $45 million to close the facility and $7.5 million—$250,000 per year for 30 years—to monitor and maintain the closed facility. The estimate does not include about $160 million projected as needed to transport wastes from around the Hanford Site itself to the disposal facility.

According to DOE, the unit cost to dispose of cleanup wastes at the Hanford CERCLA facility, excluding on-site transportation costs, is about $63 per cubic meter. In contrast, DOE estimated that Envirocare's fees for disposing of mixed wastes would range from about $416 to $660 per cubic meter (depending on the condition of the wastes). To dispose of low-level wastes, some of DOE's waste generators paid Envirocare fees of about $207 per cubic meter of waste in 1999. (These commercial disposal fees do not include the costs of shipping the low-level and mixed wastes to Envirocare's Utah facility.) Also in fiscal year 1999, DOE's low-level waste disposal facility at Hanford charged the DOE waste-generating sites authorized to use that facility $496 per cubic meter or more, depending on the types of wastes, to dispose of their wastes.

[2]Unless otherwise noted, all dollar amounts in this appendix are expressed in 1999 dollars.

While DOE has decided to develop a CERCLA disposal facility at INEEL, it has not begun constructing the facility. The design of the planned facility, according to DOE, will (1) meet RCRA's substantive standards for the treatment and disposal of mixed wastes, (2) provide the "best available technology" for protecting the sole-source Snake River Plain Aquifer beneath the site, and (3) accommodate the types of wastes that will be generated throughout INEEL by CERCLA remediation activities. These wastes include low-level and mixed wastes, as well as limited quantities of wastes with toxic and other substances regulated under the Toxic Substances Control Act of 1976 (TSCA). In September 1998, the Department estimated that the planned low-level and mixed waste treatment and disposal facility, which would have a total capacity of about 390,000 cubic meters of wastes, would cost about $239 million to construct, operate, close, and then monitor. This estimate, equal to about $613 per cubic meter of waste, does not include the cost of transporting the wastes to the treatment facility but does include the cost of transportation from the treatment facility to the disposal facility. DOE also estimated that treating and disposing of these wastes at the Envirocare facility would cost about $1,854 per cubic meter. The scope of DOE's cost estimate study did not include estimates of the cost to dispose of these wastes at the existing disposal facilities for low-level and mixed wastes at Hanford and the Nevada Test Site (NTS).

At Oak Ridge, as at INEEL, DOE plans to develop a CERCLA disposal facility for the site's mixed and low-level cleanup wastes but has not yet constructed the facility. DOE estimated that a facility designed to dispose of 273,000 cubic meters of wastes would cost about $101 million ($370 per cubic meter),[3] while a facility designed to dispose of 1.3 million cubic meters of wastes would cost about $170 million ($131 per cubic meter). Each estimate includes the costs of constructing, operating, and closing a proposed facility and then providing surveillance and maintenance of the facility for 100 years. Neither estimate includes the costs of retrieving and transporting wastes to the proposed facility. The estimated closure costs, depending on the volume of wastes disposed, range from $12 million to $59 million. The planned facility would be constructed above groundwater and would have leachate detection and collection systems. Alternatively, DOE considered the costs of disposing of the majority of these wastes at the Envirocare facility and of storing wastes that could not be disposed of at

[3]DOE derived these costs from a life-cycle cost analysis model developed by the National Institute of Standards & Technology in 1995.

Envirocare at Oak Ridge until another disposal option became available. DOE estimated that this alternative would cost about $135 million for disposing of 216,000 cubic meters of wastes ($625 per cubic meter) at Envirocare and about $456 million for disposing of 1 million cubic meters of wastes ($456 per cubic meter) at Envirocare. Transportation costs accounted for about 32 percent of each of these cost estimates for disposal at Envirocare.

Finally, DOE considered developing a CERCLA disposal facility at the Savannah River Site for low-level—but not mixed—cleanup wastes in the form of radioactive soils and debris. DOE rejected that option as too expensive for disposing of the limited quantity of qualifying wastes. In a May 1997 report addressing the potential for developing an on-site CERCLA disposal facility or shipping wastes off site, DOE and its operating contractor at the site identified 20 separate areas on the site with low-level cleanup soils and debris.[4] DOE determined which of these 20 areas' soils and debris were candidates for cleanup and consolidation in an on-site CERCLA disposal facility. The criteria used to determine whether the wastes should be cleaned up and consolidated were the location and future use of each area and the extent to which cleanup and consolidation would (1) reduce the area of the site that must remain restricted because of radioactivity, (2) reduce the site's risks, and (3) contribute to increased groundwater contamination. DOE concluded that the wastes in 16 of the 20 areas should not be retrieved, primarily because of their proximity to nuclear fuel production reactors, nuclear materials separation facilities, or underground tanks containing high-level radioactive wastes.

[4] *Alternative Screening Report, Radioactive Soil/Debris Consolidation Facility/Off Unit Disposal*, Westinghouse Savannah River Company (RP-96-893, May 1997).

DOE also determined that wastes in the remaining four areas at Savannah River, estimated to contain about 62,400 cubic meters of soil and debris, were candidates for retrieval and disposal in existing on-site or off-site disposal facilities. On the basis of its contractor's modeling of groundwater, DOE concluded that a large volume of the wastes would require treatment prior to disposal in an on-site CERCLA facility. DOE also concluded that the wastes in these four areas do not warrant the construction of a new on-site disposal facility for contaminated soil and debris. Therefore, DOE considered disposing of at least some of the low-level wastes from the four areas in the site's existing trenches or vaults, which were developed for the disposal of low-level wastes, and disposing of other wastes at NTS and/or Envirocare. According to the operating contractor's May 1997 report, excavating and then disposing of these wastes on-site in existing trenches or vaults would cost about $348 ($357 in 1999 dollars) or $1,435 ($1,473 in 1999 dollars), respectively, per cubic meter.[5] In contrast, excavating, packaging, transporting, and disposing of the wastes at NTS or Envirocare would cost about $1,365 or $467, respectively, per cubic meter. Savannah River now plans to ship approximately 4,250 cubic meters of low-level soil and debris from CERCLA cleanup actions to Envirocare for disposal. This plan is designed to segregate CERCLA wastes from other types of low-level wastes and maintain clear regulatory lines of authority. The shipment is scheduled to begin in the summer of calendar year 2000 if sufficient funding is available. Also, according to DOE, the costs to treat these wastes, combined with the on-site disposal costs, made off-site disposal cost-effective.

In February 2000, DOE's Office of Environmental Restoration issued a report assessing the expected life-cycle costs of the Hanford, INEEL, and Oak Ridge CERCLA disposal facilities, the Fernald facility (discussed below), and the two CERCLA facilities where DOE disposes of uranium mill tailings. Table 1 presents the estimated disposal volumes and unit costs for the four disposal facilities.

[5]In fiscal year 1999, according to DOE, the cost per cubic meter to dispose of low-level waste on-site in trenches and vaults was $86 and $497, respectively.

Table 1: Current Estimated Cost of Disposing of Low-Level and Mixed Wastes in Planned or Operating CERCLA Facilities

Volume in cubic meters

CERCLA facility	Estimated waste volume	Estimated total cost	Estimated cost per cubic meter
Hanford Site	4,370,000	$275 million	$63
INEEL (planned)	356,020	$148 million	$377
Oak Ridge Reservation (planned)	840,000	$216 million	$183
Fernald Environmental Management Project	1,900,000	$259 million	$136

Source: GAO's presentation of data from DOE's *Cost Engineering Report on Environmental Restoration Waste Disposal Facilities* (Feb. 2000).

Key Decisions Affecting the Disposal of Cleanup Wastes at DOE's Fernald Site

Unlike the other sites discussed in this appendix, DOE's Fernald Environmental Management Project (Fernald) did not already have a facility for disposing of low-level and/or mixed wastes from nuclear operations when the Department developed an on-site CERCLA disposal facility. DOE is cleaning up the Fernald site and has established a goal of completing the cleanup by 2006. The cleanup has generated both low-level and mixed wastes, some of which will be disposed of in the on-site CERCLA facility and others of which must be disposed of off-site. After considering several alternatives for treating and disposing of the site's low-level and mixed cleanup wastes, including estimates of the costs of each alternative, DOE decided, in February 1996, to develop a CERCLA disposal facility on-site. Low-level wastes that do not meet the criteria for disposal in this facility are disposed of at NTS or Envirocare. Mixed wastes that do not meet criteria for disposal at Fernald or Envirocare are stored until DOE can dispose of these wastes at NTS.[6]

Fernald's project, under CERCLA, is to clean up DOE's former Feed Materials Production Center, a uranium metal production facility that operated on-site from the early 1950s until 1989. The 1,050-acre Fernald site is located about 18 miles northwest of Cincinnati, Ohio. The land adjacent to Fernald is primarily devoted to agriculture and recreation. Residential

[6]Because Fernald is considered a defense facility, it received approval to ship its wastes to NTS, but not to Hanford. Under DOE's recent Record of Decision, though, Hanford could become an option.

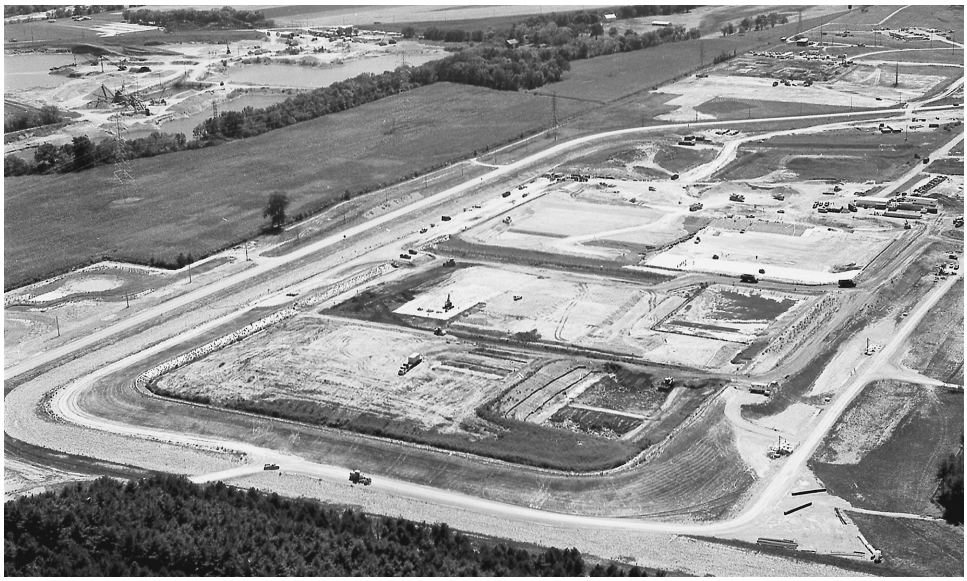
areas are concentrated northeast of Fernald, and an estimated 23,000 residents live within a 5-mile radius of the site.

In 1986, DOE and EPA entered into a Federal Facility Compliance Agreement, in which DOE agreed to comply with various federal and state laws, including RCRA and CERCLA. In 1991, DOE and EPA signed a final consent agreement establishing revised milestones for completing required studies and activities for managing hazardous wastes. Subsequently, in 1996, DOE, its operating contractor, and Ohio's Environmental Protection Agency signed an agreement that, among other things, integrated and streamlined the remediation and closure requirements under CERCLA and RCRA. The agreement recognized that under CERCLA, EPA oversees the cleanup of the site's radioactive wastes while under RCRA, the state of Ohio regulates the treatment, storage, and disposal of the site's hazardous wastes. The agreement required DOE and its contractor to prepare one remediation plan to comply with the requirements of both acts. Under CERCLA, the Fernald site has been divided into five "operable units" for cleanup. The on-site CERCLA disposal facility is designed for cleanup wastes generated from operable units 2, 3, and 5. The formal decision to develop the on-site disposal facility was made as part of the plan for remediating operable unit 5, which also encompasses the treatment of contaminated water contained in the Great Miami Aquifer under the Fernald site.

The Fernald on-site disposal facility, which began receiving wastes in late 1997, has the capacity to dispose of about 1.9 million cubic meters of contaminated soil and debris generated through environmental restoration and facility decontamination and decommissioning activities. (See fig. 8 for a picture of the Fernald disposal facility.) Soil and soil-like material will make up about 85 percent of the wastes disposed of in the facility, while the remainder will consist of debris from the demolition of the site's buildings. The disposal facility covers about 140 acres and includes the disposal area, which consists of a series of disposal cells, and a buffer zone around the disposal area. When all of the planned disposal cells have been constructed, the facility will be about 800 feet wide, 3,700 feet long, and 65 feet high. The facility will be reserved for the disposal of wastes generated during the cleanup at Fernald and will remain under federal control after the cleanup has been completed and the disposal facility closed. The primary engineering features of the facility include a 5-foot-thick multilayered liner system under the waste materials, a leak detection system beneath the primary liner, and an 8.75-foot-thick multilayered cap system, to be constructed over the waste materials upon closure. The

facility is located adjacent to the site's former production area, which has the best geology on the Fernald site for protecting the sole-source Great Miami Aquifer. Wells for monitoring water in this aquifer, which serves over 600,000 people in southwestern Ohio, are also part of the facility.

Figure 8: CERCLA On-Site Disposal Facility at DOE's Fernald Site



Source: DOE.

Comparison of On-Site and Off-Site Disposal Alternatives

In one of five CERCLA Records of Decision documenting the selection of various remedial actions for the Fernald Site, DOE elected to excavate contaminated soil at the site, place the soil in an on-site disposal facility, and restore the Great Miami Aquifer to its full beneficial use. In reaching this decision, DOE compared the estimated costs of eight on-site and off-site disposal options (including one "no action" option). DOE also compared the eight options to assess their overall protection of human health and the environment; attainment of "applicable or relevant and appropriate" environmental requirements; long-term effectiveness and performance; reduction of toxicity, mobility, or volume through treatment; and feasibility of implementation.

DOE expressed the estimated cost of each alternative in terms of the "present worth" of the cost to achieve a range of risks embodied in EPA's

goal for reducing the threat from carcinogenic contaminants. For example, DOE estimated that the preferred alternative of constructing the on-site CERCLA disposal facility and related actions to clean up the underlying aquifer would cost from $606 million, to achieve EPA's least protective standard for acceptable risk to individuals, to $658 million, to achieve EPA's most protective standard. All other on-site and off-site alternatives affording similar levels of protection were estimated to cost at least $731 million. For example, the estimated cost of excavating and disposing of all soils and sediments at one or more off-site facilities, in terms of present worth, was over $1 billion and $4 billion, respectively, to achieve EPA's least protective and most protective levels of acceptable risk to individuals. DOE estimates that the cost to develop, operate, close, and provide long-term stewardship of the on-site disposal facility will total about $267 million.

The Fernald CERCLA Disposal Facility's Waste Acceptance Criteria

The criteria in the Record of Decision for determining which wastes may be disposed of in Fernald's on-site disposal facility and which wastes must be disposed of off-site are based on achieving compliance with health and environmental standards established in federal and state environmental laws. Under CERCLA, on-site cleanup facilities are not required to obtain any federal, state, or local permits. Although permits are not required, EPA's National Contingency Plan[7] requires that CERCLA activities meet the technical requirements of RCRA and other federal and state environmental requirements that are "applicable" or "relevant and appropriate." Accordingly, the consent agreement between EPA and DOE exempts the Department from permit requirements established in statutes such as RCRA. At the same time, the agreement specifies that DOE must satisfy all federal and state standards, requirements, criteria, or limitations that would have been included in any permit otherwise required. The Fernald CERCLA disposal facility was designed to meet the requirements of RCRA for hazardous waste, of Ohio's regulations for solid waste, and of the Uranium Mill Tailings Remedial Action Program for radioactive waste.

The Fernald CERCLA disposal facility's waste acceptance criteria include limits on concentrations of specific radioactive elements and chemicals, limits on the size of contaminated materials, and a list of prohibited items. These criteria are stringent because they were developed to provide long-

[7]The National Contingency Plan is the federal government's blueprint for responding to oil spills and hazardous substance releases.

term protection for the Great Miami Aquifer, which is the sole source of local drinking water. Furthermore, according to DOE's Record of Decision—agreed to by EPA and the state of Ohio—the design of the CERCLA disposal facility and the waste acceptance criteria protect human health to risk levels that are within the range specified by the National Contingency Plan.

Fernald's Waste Disposal Decision-Making Process

DOE has disposed of over 260,000 cubic meters of cleanup wastes at the Fernald Site's CERCLA disposal facility since its opening in late 1997. In addition, DOE has shipped over 56,000 cubic meters of low-level and mixed cleanup wastes that did not meet the criteria for on-site disposal to disposal facilities at NTS and Envirocare. Mixed wastes that do not meet the criteria for on-site disposal are either treated and disposed of at Envirocare or stored on-site until they can be disposed of at NTS or Hanford.

We included Fernald in our survey of DOE's 20 largest generators of low-level and mixed wastes, and DOE's Ohio Field Office–which is responsible for overseeing the site–provided information on the volumes of low-level and mixed wastes requiring disposal and the costs of their disposal. Waste managers at the site also provided information on their disposal options and disposal decision-making process.

According to DOE's Ohio Field Office, decisions about disposal are based on a combination of technical factors, cost, and input from stakeholders (regulators and the local community). Wastes from the site's cleanup that meet the criteria for on-site disposal are disposed of in the CERCLA facility. Wastes that exceed these criteria are sent off-site for disposal at either NTS or Envirocare, if possible. Which of these two facilities is chosen depends on their waste acceptance criteria, disposal costs, utilization rates and disposal capacities, and regulators' and citizens' concerns. On the basis of these factors, according to DOE's Ohio Field Office, for fiscal years 1997 through 1999, the Fernald site disposed of its low-level wastes and some of its mixed wastes as shown in table 2.

Table 2: Summary of Fernald's Disposal Decisions for Low-Level and Mixed Wastes, Fiscal Years 1997-99

Volume in cubic meters and price in dollars per cubic meter

Type of waste	Disposal facility	Reason location selected	Volume	Disposal price
Low-level	Fernald	On-site disposal least expensive	261,330	$131
Low-level	Envirocare	Accepted bulk wastes that did not meet criteria for on-site disposal; economical rail transport available	35,091	207
Low-level	NTS	Preferred choice for bulk waste containers (in 1997 before on-site disposal facility began operating)	17,342	265
Low-level	NTS	Accepted wastes in bulk containers that did not meet criteria for on-site disposal	3,365	265
Mixed	Envirocare	Only choice for disposal of mixed wastes that do not meet criteria for on-site disposal	459	777

Source: GAO's presentation of data provided by DOE.

As the table indicates, the estimated cost per cubic meter for the on-site disposal of low-level wastes in the CERCLA facility at Fernald was about half as much as Fernald paid to dispose of low-level wastes at NTS or Envirocare. Moreover, most of the wastes disposed of by the Fernald site over the 3-year period were disposed of on-site. Furthermore, the availability of rail transportation for shipments of bulk low-level wastes to Envirocare resulted in the lowest off-site disposal costs for Fernald's low-level wastes. DOE does not have direct rail access to NTS. Finally, the cost of off-site commercial disposal for mixed wastes was approximately three times as great as the cost of either commercial or DOE off-site disposal of low-level wastes.

Waste Volumes and Disposal Preparation Activities and Costs for DOE's Major Waste-Generating Sites

According to DOE's May 1997 *Final Waste Management Programmatic Environmental Impact Statement*, 20 of the Department's waste-generating sites are expected to generate about 99.6 percent of its low-level and mixed wastes, taking into account its existing inventories and anticipated generation for a 20 year period. These 20 sites will generate most of the 2.1 million cubic meters of wastes that DOE estimated, in a 1998 report, may be disposed of at its six sites that operate disposal facilities for low-level and/or mixed wastes.[1]

We obtained more current estimates of waste volumes from DOE's 20 major waste-generating sites. (See table 3.) These estimates may differ from DOE's 1998 estimates if the generators made different assumptions or included volumes of wastes that will be disposed of commercially. According to these 20 waste-generating sites, they have already disposed of over 1.9 million cubic meters of low-level wastes and over 46,000 cubic meters of mixed wastes. Although cleanup wastes are being generated and disposed of in the existing on-site CERCLA disposal facilities at Hanford and Fernald (and are expected to be disposed of at INEEL and Oak Ridge), these wastes, except for those from Fernald, are not included in the table.

[1] *Current and Planned Low-Level Waste Disposal Capacity Report, Revision 1* (Sept. 18, 1998).

Table 3: Past and Future Disposal Volumes of Low-Level and Mixed Wastes for DOE's 20 Major Waste-Generating Sites

Volume in cubic meters

	Low-level waste			Mixed waste			
DOE site	**Disposal completed**	**Disposal planned**	**Total**	**Disposal completed[a]**	**Disposal planned**	**Total**	**Total**
Argonne National Laboratory East, IL	886	623	**1,509**	25	62	87	**1,596**
Bettis Atomic Power Laboratory, PA	12,254	3,642	**15,896**	Less than 1	27	27	**15,923**
Brookhaven National Laboratory, NY	1,403	[b]	**1,403**	20	[b]	20	**1,423**
Fernald Environmental Management Project, OH	439,017	2,173,271	**2,612,288**	5,011	14,855	19,866	**2,632,154**
Hanford Site, WA[c]	495,049	128,707	**623,756**	182	72,589	72,771	**696,527**
INEEL, ID	98,500	26,000	**124,500**	82	1,440	1,522	**126,022**
Knolls Atomic Power Laboratory, NY	5,763	6,267	**12,030**	Less than 1	81	81	**12,111**
Lawrence Livermore National Laboratory, CA	5,641	6,350	**11,991**	1,959	1,217	3,176	**15,167**
Los Alamos National Laboratory, NM	223,400	273,000	**496,400**	[b]	[b]	[b]	**496,400**
Mound Plant, OH	54,798	103,321	**158,119**	Less than 1	19	19	**158,138**
NTS, NV[d]	243,000	119,983	**362,983**	270	Less than 1	270	**363,253**
Oak Ridge Reservation, TN	4,253	579,191	**583,444**	20,526	114,471	134,997	**718,441**
Paducah Gaseous Diffusion Plant, KY	[b]	11,000	**11,000**	[b]	5,600	5,600	**16,600**
Pantex Plant, TX	3,070	[b]	**3,070**	213	[b]	213	**3,283**
Portsmouth Gaseous Diffusion Plant, OH	978	14,387	**15,365**	2,033	8,717	10,750	**26,115**
RMI Titanium Company, OH	44	10,477	**10,521**	Less than 1	735	735	**11,256**
Rocky Flats Environmental Technology Site, CO	9,424	157,436	**166,860**	16,499	45,146	61,645	**228,505**
Sandia National Laboratories, NM	2,047	4,220	**6,267**	29	660	689	**6,956**
Savannah River Site, SC	353,911	407,000	**760,911**	0	6,216	6,216	**767,127**
West Valley Demonstration Project, NY	11,988	56,634	**68,622**	4	283	287	**68,909**
Total	**1,965,426**	**4,081,509**	**6,046,935**	**46,853**	**272,118**	**318,971**	**6,365,906**

Note: The volumes of wastes in this table were provided by the 20 sites in 1999.

[a]Since Hanford and NTS have the only disposal facilities for on-site mixed wastes and currently cannot dispose of mixed wastes from other sites, any other sites that disposed of mixed wastes did so at a commercial facility.

[b]Information was not readily available from this site.

[c]The quantities for Hanford include only DOE wastes; they exclude Department of Defense wastes disposed of at the site.

[d]The amounts disposed of at NTS are approximate. In addition, the total volume of low-level and mixed wastes that could be disposed of at NTS depends on future decisions on regulatory, technical, or management issues (e.g., final negotiated soil cleanup levels, funding gaps in site baseline budgets, etc.).

Source: GAO's presentation of data provided by DOE.

Waste Disposal Preparation Activities and Costs for Fiscal Years 1997-99

Fifteen of DOE's 20 major waste-generating sites reported incurring total costs of about $280 million to prepare low-level and mixed wastes for disposal. For the most part, the costs of waste preparation at the six sites with low-level and/or mixed waste disposal facilities were either reported as part of the disposal facilities' costs (see app. III) or were not readily available. INEEL officials identified approximately $4 million in waste preparation costs that were in addition to the costs reported for the site's waste disposal facility. These costs for INEEL are included in the total costs of the 15 major waste-generating sites' activities presented in table 4.

Table 4: Low-Level and Mixed Waste Disposal Preparation Costs at 15 Major Waste-Generating Sites, Fiscal Years 1997-99

Dollars in thousands

Disposal preparation activity	Costs for low-level wastes	Costs for mixed wastes	Total costs
Storage	$30,446	$42,408	**$72,854**
Treatment	23,171	44,897	**68,068**
Shipping	43,566	7,480	**51,046**
Assay/characterization	20,626	18,435	**39,061**
Repackaging	5,928	2,650	**8,578**
Other	28,266	12,245	**40,511**
Total	**$152,003**	**$128,115**	**$280,118**

Source: GAO's presentation of data provided by DOE.

DOE's Disposal Facilities for Low-Level and Mixed Wastes

DOE has six sites with active disposal facilities for low-level and/or mixed wastes generated from past and current mission operations and cleanup wastes that cannot be disposed of in on-site CERCLA disposal facilities. DOE projects that up to 2.1 million cubic meters of low-level and mixed wastes will be disposed at these six locations. All six sites are located where DOE and its predecessor agencies generated low-level and mixed wastes through a variety of activities, from producing nuclear weapons, to operating nuclear reactors, to conducting nuclear research. The sites historically disposed of their low-level wastes in burial grounds, many of which are currently undergoing environmental cleanup and remediation. Over time, and with advances in technology and environmental concerns, the sites' disposal activities have evolved into the current disposal facilities. These active facilities manage the sites' wastes with the intent to contain the contaminated materials and protect human health and the environment. Table 5 lists the six active disposal facilities, the volumes of wastes disposed of at each facility, and each facility's current capacity for additional waste disposal.[1]

[1]This report addresses the facilities' volume capacity rather than their radiological capacity. However, DOE's *Current and Planned Low-level Waste Disposal Capacity Report* indicates that the Department has sufficient complexwide radiological capacity through 2070 for low-level and mixed wastes, according to a radiological analysis performed for the active disposal facilities included in table 5.

Table 5: Waste Disposal Volumes and Remaining Capacity at DOE's Six Active Waste Management Disposal Facilities

Volume in cubic meters

		Disposed waste volume		
Disposal facility	**DOE site**	**Low-level waste**	**Mixed waste**	**Remaining disposal capacity**
Hanford 200 Area Low-Level Burial Grounds[a]	Hanford Site	380,500	182	934,000
Radioactive Waste Management Complex	INEEL	98,500	[b]	64,300
Area G of Technical Area-54 Material Disposal Area	Los Alamos National Laboratory	223,400	[b]	273,000
Radioactive Waste Management Sites Areas 3 and 5	NTS	551,000	8,300	2,400,000
Interim Waste Management Facility	Oak Ridge Reservation	3,640	[b]	1,760
E-Area Low-Level Waste and Saltstone Disposal Facilities	Savannah River Site	29,911	[b]	133,300
Total		**1,286,951**	**8,482**	**3,806,360**

Note: Volumes and disposal capacities were provided by the sites in 1999.

[a]The quantities for Hanford include only DOE wastes; they exclude Department of Defense wastes disposed of at the site.

[b]Not applicable.

Source: GAO's presentation of data provided by DOE.

Table 6 shows the storage, treatment, and disposal costs at the six sites with active Waste Management disposal facilities from fiscal year 1997 through fiscal year 1999.

Table 6: Waste Storage, Treatment, and Disposal Costs at DOE's Six Active Waste Management Disposal Facilities, Fiscal Years 1997-99

Dollars in thousands

Waste type and activity	Hanford	INEEL[a]	Los Alamos	NTS	Oak Ridge	Savannah River	Total
Low-level waste							
Disposal	23,034	5,430	7,723	38,124[b]	9,692	8,506	**92,509**
Treatment	0	3,608	2,515	0	3,047	14,584	**23,754**
Storage	0	114	1,525	274	23,813	7,212	**32,938**
Total	**23,034**	**9,152**	**11,763**	**38,398**	**36,552**	**30,302**	**149,201**
Mixed waste							
Disposal	7,634	3,399	12,523	[b]	16,567	89	**40,212**
Treatment	9,209	25,324	4,698	2,124	45,902	13,811	**101,068**
Storage	23,111	4,026	2,776	36	52,995	4,715	**87,659**
Total	**39,954**	**32,749**	**19,997**	**2,160**	**115,464**	**18,615**	**228,939**
Grand total	**62,988**	**41,901**	**31,760**	**40,558**	**152,016**	**48,917**	**378,140**

Note: Columns may not total because of rounding.

[a]INEEL provided data only for fiscal years 1998 and 1999.

[b]NTS combines its costs for disposing of a small amount of mixed waste with its costs for low-level waste disposal.

Source: GAO's presentation of data provided by DOE contractors managing the disposal facilities.

The six sites with active Waste Management disposal facilities differ in ways that affect the types and amounts of waste they can accept, as well as their disposal costs. The following brief descriptions of the sites and their facilities highlight any significant issues or features.

Hanford Site's Active Low-Level Burial Grounds

Located in southeastern Washington State, DOE's Hanford Site occupies 560 square miles of semi-arid land bounded on one side by the Columbia River. This nuclear weapons production site, established in 1942, fabricated nuclear fuel and operated nine reactors and five chemical separation facilities over a period of almost 50 years. The legacy of these activities–over 2,300 waste sites and contaminated facilities, including 177 underground storage tanks containing high-level nuclear waste–is now the focus of a massive DOE cleanup effort. Under DOE's current plans, cleanup activities are expected to continue at Hanford through 2046.

Hanford's Active Low-Level Burial Grounds covers about 1 square mile in the middle of the Hanford Site. It includes eight active low-level burial grounds that are dispersed among other cleanup sites on a plateau approximately 200 feet above the water table. The site's average annual rainfall (about 6 inches) is less than the amount of evaporation, thus limiting the downward migration of contaminants. However, the Columbia River is about 10 miles away, and the city of Richland, Washington, lies downstream about 25 miles from the burial grounds. Stakeholders in the community take an interest in Hanford's operations largely because of the Columbia River's importance to agriculture and the life cycle of salmon.

Each burial ground comprises a number of trenches, which will be filled with wastes contained, for the most part, in wooden boxes or drums. Most of the trenches are used to dispose of DOE's wastes, but one is reserved for contaminated reactors from naval vessels operated by the Department of Defense. These reactors will be buried 15 to 20 feet below the surface. Two RCRA-compliant trenches are designed for mixed waste disposal and have liners and rainwater collection systems. Until recently, the site used these trenches to store mixed wastes, but in September 1999, it began to operate one of the trenches as a mixed waste disposal facility, collecting leachate in accordance with RCRA. However the state of Washington has not issued a final RCRA permit for the site's mixed waste disposal facility. According to site officials, the permit, when issued, could limit the site's capacity for mixed waste disposal in future trenches. The site has developed performance assessments that demonstrate its disposal operations are protective of human health and the environment.

The Hanford Low-Level Burial Grounds can accept virtually all types of low-level wastes, including remote-handled wastes that are transported and buried in containers with extra radioactive shielding. The burial grounds also have approximately 38,000 containers of transuranic wastes,[2] which site officials plan to recharacterize. They expect that after the recharacterization, about half of these wastes will be reclassified as low-level and mixed wastes, suitable for on-site disposal. In 1998, DOE estimated that Hanford had the capacity to dispose of all low-level wastes projected for disposal at the facility for at least the next 70 years. However, this projection predated the February 2000 Record of Decision designating Hanford as a primary disposal facility for DOE's low-level and mixed

[2]Transuranic waste contains more than 100 nanocuries of radioactive elements whose atomic numbers are higher than uranium's.

wastes. The site's ability to dispose of projected volumes of mixed wastes depends on the terms of the final RCRA permit issued by the state.

INEEL's Radioactive Waste Management Complex

INEEL occupies about 890 square miles of dry, cool desert in southeastern Idaho. Originally established as the National Reactor Testing Station, the site once had as many as 52 active nuclear reactors. It also reprocessed spent nuclear fuel for decades. In addition to the wastes generated from these activities, large volumes of transuranic and low-level wastes from the Rocky Flats Plant were buried or stored at INEEL. Currently, the site's primary missions include storing spent nuclear fuel and treating and eventually disposing of transuranic wastes off-site.

The site's Radioactive Waste Management Complex (RWMC) covers roughly 144 acres and is used for the interim storage of transuranic wastes and the disposal of low-level wastes. The four active low-level waste disposal pits are conjoined and cover about 6 acres adjacent to the transuranic waste storage areas. The pits are also adjacent to previously filled waste burial grounds managed by the Environmental Restoration program. As a result, the disposal facility's closure plans must be coordinated with these other activities. The site is fairly remote and dry (the average annual rainfall is 9 inches), with the groundwater about 700 feet below the surface. However, the site is located above a sole-source aquifer that empties into the Snake River. Downstream populations depend on the river and the aquifer for agriculture and drinking water, making waste management activities at the complex a political issue.

RWMC disposes primarily of low-level wastes in containers such as large (primarily 4- x 4- x 8-foot) wood and metal boxes, which are stacked 20 feet high in the unlined pits. To conserve disposal capacity and to increase the long-term stability of the disposal facility, low-level wastes are sized and compacted at the site's Waste Experimental Reduction Facility prior to disposal. Smaller quantities of remote-handled low-level wastes are disposed of in special concrete vaults in one area within the disposal pits. Additional vaults may be constructed, but, according to site officials, the pits will not require expansion.

RWMC does not dispose of any mixed wastes, but on- and off-site mixed wastes can be treated at the Waste Experimental Reduction Facility's incinerator. Any remaining ash that contains hazardous components is shipped back to the waste-generating site or to an off-site disposal facility. Because of newly imposed air quality requirements, the incinerator is being

evaluated to determine its future use in mixed waste treatment. All low-level wastes disposed of at RWMC are from INEEL. In fiscal year 1999, the facility disposed of about 6,000 cubic meters of waste, almost eliminating the site's backlog of stored low-level wastes. DOE's current plans assume the disposal facility will accept contact-handled low-level waste through 2006 and remote-handled waste through 2008.

Los Alamos National Laboratory's Area G of Technical Area-54 Material Disposal Area

The Los Alamos National Laboratory, located with the town of Los Alamos approximately 35 miles northwest of Santa Fe, occupies 43 square miles in northern New Mexico. Developed as part of the Manhattan Project to create atomic weapons, the laboratory also produced nuclear weapons components. Today the laboratory's central mission is enhancing global security by ensuring the safety and reliability of the U.S. nuclear weapons stockpile; reducing threats to U.S. security; cleaning up the legacy of the Cold War; and providing technical solutions to energy, environment, infrastructure, and health security problems. As a result, research and development activities at Los Alamos are expected to generate over 273,000 cubic meters of various radioactive wastes through 2070.

Before 1957, the laboratory used numerous small waste disposal areas scattered throughout the site. Most of these areas are now being stabilized and/or cleaned up under the Environmental Restoration program. The current low-level waste disposal facility, Area G, located in Technical Area-54 (TA-54), began routinely accepting wastes in about 1959. This area occupies approximately 64 acres on top of a mesa adjacent to the highway between the laboratory and the nearby community of White Rock. The relatively dry climate (with an average annual rainfall of 14 inches in Area G) and volcanic bedrock combine to limit the potential migration of contaminants from the disposal facility. The water table lies 800 feet below the top of the mesa. The edges of the mesa ultimately limit the disposal facility's potential for expansion, but additional acreage could be developed beyond the area currently used. Area G operates under a DOE-approved performance assessment, which demonstrates the long-term safety of the facility to the public.

The facility disposes of low-level wastes using shallow land disposal in either pits or shafts. Approximately 40 disposal pits have been used in Area G, four of which are currently active. The unlined pits, which are no more than 65 feet deep, are filled with, on average, 10 to 12 tiers of tightly stacked wastes. The layers of waste are covered with backfill to build the tiers. During waste emplacement, pipes are installed for environmental

sampling during operations and after closure. The area also has over 180 shafts ranging from 1 foot to 16 feet in diameter and up to 65 feet in depth. The shafts are used for higher-activity and special waste forms that require additional confinement. To optimize its disposal capacity, the facility uses a compactor to reduce the volumes of some low-level wastes by as much as 8 to 1. The facility accepts low-level wastes but cannot dispose of those that are most radioactive. Specific limitations are detailed in the facility's performance assessment and waste acceptance criteria.

The Los Alamos site does not have a mixed waste disposal facility. Some of its mixed wastes are shipped off-site for treatment and/or disposal, and the remainder are stored pending a disposal option. Until the site began shipping mixed wastes to off-site facilities in 1995, some mixed wastes were stored outside because TA-54 did not have sufficient storage capacity. Currently, containers of mixed wastes are stored in storage domes in TA-54, as are some transuranic wastes. TA-54 also provides storage for some nonradioactive hazardous wastes.

Most of the site's low-level wastes and mixed wastes come to TA-54 from over 2,000 on-site generators, although a limited amount of off-site waste is accepted on a case-by-case basis–mostly from Los Alamos scientists working at other locations. Because Los Alamos expects to continue its current missions in the foreseeable future, it is attempting to conserve the site's limited disposal capacity for on-site wastes anticipated in future years.

NTS' Area 3 and Area 5 Radioactive Waste Management Sites

NTS covers approximately 1,375 square miles of federally owned land in southeastern Nevada, approximately 65 miles northwest of Las Vegas. The populated area closest to the site's disposal facilities is the small town of Indian Springs, Nevada, 34 miles to the southeast. Public exclusion areas owned and used by the U.S. Air Force surround the site on the east, west, and north. Established in 1950, NTS was used to conduct atmospheric and underground tests of nuclear explosives in connection with weapons research and development. From 1951 through 1992, DOE and its predecessor agencies conducted 928 nuclear tests at the site, 100 atmospheric and 828 underground. Because of the widely dispersed plutonium and other radionuclides resulting from the explosions, many of the testing areas will require long-term institutional controls to prevent inadvertent exposure to residual contamination. Although it is technically feasible to remediate identified hot spots of surface contamination, the

cost of remediating the hundreds of contaminated acres across the site would be prohibitive.

NTS' disposal facilities are located in two areas—Area 5 and Area 3—which are well within the boundaries of the site. Both disposal areas are arid, receiving 4 to 6 inches of rain per year. There is no surface water near either disposal area, and the water table is approximately 800 feet below the Area 5 site and 1,600 feet below the Area 3 site. NTS has developed performance assessments that demonstrate its disposal operations are protective of human health and the environment. The Area 5 disposal site, located near the site of the first atmospheric test in the 1950s, comprises 732 acres, 92 of which are currently used for shallow-land disposal. The wastes are accepted in boxes, drums, or soft packages and are stacked in a stair-step manner within 22 engineered and excavated disposal trenches. As the trenches fill, the wastes are covered with clean soil until the facility can be permanently closed. The Area 5 disposal site also has 13 boreholes intended for the disposal of wastes requiring greater confinement, as well as one trench reserved for mixed wastes. Although the site's mixed waste disposal trench satisfies RCRA's interim status requirements, it requires modifications (such as a liner, leachate collection system, and leak detection system) to meet the standards for a RCRA permit. The facility currently does not dispose of mixed wastes from DOE sites in other states.

The Area 3 disposal site covers about 120 acres and currently disposes of low-level wastes in seven subsidence craters[3] that resulted from underground nuclear tests. The subsidence craters require little excavation before being used for disposal, in contrast to the engineered trenches at Area 5 and other DOE sites. Low-level bulk wastes destined for disposal in Area 3 arrive in large cargo containers or in soft containers, some of which can be rolled off hydraulic truck beds, reducing necessary handling.

Although NTS has been disposing of low-level wastes from other sites since the 1960s, the site did not begin accepting significant quantities of off-site low-level wastes for disposal until the mid-1970s. Off-site wastes represented approximately 57 percent of the total volume of low-level wastes disposed at NTS from 1974 through 1997. During the last 5 years of this period, off-site wastes accounted for approximately 95 percent of the total volume of low-level wastes disposed of at the site. In fact, NTS

[3]The seven craters make up five disposal units. In two cases, the area between craters was excavated to make two craters into a single disposal unit.

accepted more than 41 percent of all low-level wastes disposed in DOE's shallow-land disposal facilities from 1987 through 1996. DOE studies reported that waste capacity is not a limitation at NTS' disposal areas and that there are no limits on the volumes of wastes, only on the concentrations of contaminants.

Oak Ridge Reservation's Interim Waste Management Facility

Oak Ridge Reservation occupies approximately 55 square miles in eastern Tennessee, near Knoxville. In 1942, the federal government selected the Oak Ridge site for uranium enrichment facilities, displacing four small communities. The town of Oak Ridge was established nearby to house the workers who built and operated the facilities. Today, the residential section of the city of Oak Ridge forms the northern boundary of the Oak Ridge Reservation. Three major facilities operated at the reservation beginning in the early 1940s: (1) the K-25 site supplied enriched uranium for nuclear weapons production; (2) the Y-12 Plant, originally established to separate uranium isotopes, later enriched lithium and fabricated and stored nuclear weapons components; and (3) the Oak Ridge National Laboratory produced the first gram quantities of plutonium and developed the prototype production reactor later built at the Hanford Site. All of these activities resulted in large quantities of wastes being disposed of or stored at Oak Ridge. Although cleaning up wastes and contaminated facilities is a central mission at the Oak Ridge Reservation today, the site has other ongoing missions. The laboratory supports radioisotope production and research and continues to generate a variety of radioactive wastes. The Y-12 Plant continues to support defense programs by managing special nuclear materials.

Although the Oak Ridge site was selected, in part, because there was nearby water transportation for production materials, the same hydrogeologic conditions make the site unsuitable for the shallow-land disposal of radioactive wastes. The climate at Oak Ridge is humid, with an average rainfall of 55 inches. Depth to groundwater is shallow (less than 20 feet in some areas and averaging 20 to 50 feet) and groundwater is discharged to the surface in some areas, to on-site streams and springs. The Clinch River and six tributaries run through the reservation, and a major aquifer lies under the site.

Because of this wet environment, Oak Ridge's only low-level waste disposal facility, the Interim Waste Management Facility (IWMF), is an aboveground, high-cost engineered facility. Modular concrete vaults are filled with low-level wastes encapsulated in concrete. The vaults are placed on concrete

pads, and grout is used to fill void spaces within the vaults. A concrete lid with a seal is placed on each vault following the grouting operation. IWMF has a total of six 18-meter-by-27-meter concrete pads, a leachate collection system, and a monitoring capability. The facility is expensive, and its use for long-term disposal has been questioned.

No significant amount of waste was disposed of in IWMF during fiscal year 1999 for two reasons. First, the high disposal costs at the facility mandate optimizing the use of its capacity, and operations were suspended pending a full evaluation of candidate waste streams against the facility's waste acceptance criteria and the projected costs of off-site disposal. Second, the facility's performance assessment and waste acceptance criteria are being reevaluated. The site will eventually load vaults onto the pads that are already constructed. These vaults will be filled primarily with wastes containing high-activity, short-lived isotopes like cesium and strontium. The facility cannot accept much of the low-level waste generated at the site, and its disposal capacity is limited to 5,400 cubic meters. Mixed waste cannot be disposed of in IWMF. The Oak Ridge Reservation's incinerator treats some mixed and hazardous wastes; however, the residual ash is generally shipped to Envirocare for disposal.

Savannah River Site's Low-Level Waste Disposal Facilities

The Savannah River Site encompasses approximately 325 square miles bordering the Savannah River in the humid climate of western South Carolina, near Aiken, South Carolina, and Augusta, Georgia. The site was constructed in the early 1950s to produce, separate, purify, and process plutonium, tritium, and other radioisotopes for nuclear weapons programs and other purposes. The site fabricated fuel, operated five reactors and two chemical separation plants, and conducted research and development. While much of DOE's focus has shifted to cleaning up the site and managing the wastes from previous production work, Savannah River has ongoing missions, including those stemming from a recent DOE decision to build and operate several facilities for disposition of the nation's surplus weapons plutonium.

The Savannah River Site's active disposal facilities are located primarily at the E-Area in the center of the site. The E-Area covers about 200 acres, and the active disposal facilities occupy about 100 acres. The groundwater at Savannah River is only 50 to 60 feet below the surface and is therefore of great concern in waste disposal, as well as in environmental remediation decisions. In addition, the site's climate is humid, with average annual rainfall of 48 inches, increasing concerns about the migration of

contaminants. The site's concrete aboveground E-Area disposal vaults were built to comply with a 1987 departmental directive that new disposal facilities in humid climates be physically separated from the groundwater table. Expanding these facilities would be costly, given the requirement for expensive engineered aboveground disposal dictated by the site's hydrology.

The site disposes of wastes in two vault facilities and a trench area located near the old waste burial grounds. (Many of the old burial grounds are being remediated under CERCLA.) The Low-Activity Waste Vault is a concrete, aboveground vault with 12 cells for containerized lower-activity, low-level wastes. This vault also contains a waste-sorting area and a supercompactor to reduce waste volumes to maximize the use of the vault's limited capacity. The Intermediate-Level Vault consists of concrete, partly underground vaults, for higher-activity low-level wastes, including some wastes that contain tritium and are placed in special silos. In the trench area, unlined slit trenches are used for slightly contaminated containerized and bulk wastes, such as soil, rubble, wood, and concrete. In addition, the site places large naval reactor components on open gravel pads until they can be mounded over with dirt.

The Savannah River Site also has two large vaults used to dispose of contaminated wastes converted to grout at the site's Saltstone facility, which processes liquid low-level wastes from other programs at the site that manage tank wastes and other liquids. The Saltstone facility turns the liquid wastes into a grout that can be pumped into the concrete vaults, which will eventually be capped. Although plans for the site include up to 17 more of these vaults, according to site officials, Saltstone is currently inactive while decisions are being made about the tank waste programs.[4] Savannah River does not have any disposal facilities for its mixed wastes, which remain in storage until a disposal pathway becomes available.

The disposal facilities at Savannah River are used primarily to dispose of low-level wastes from various on-site processing facilities. The facilities also dispose of low-level wastes from a few sites in the Naval Nuclear Propulsion Program. Under the site's current plans–which assume the use of waste-reduction treatments–the existing Low-Activity and Intermediate

[4]For information on problems with Savannah River's In-Tank Precipitation Program, see *Nuclear Waste: Process to Remove Radioactive Waste From Savannah River Tanks Fails to Work* (GAO/RCED-99-69, Apr. 30, 1999).

Level Vaults will be filled by 2010 and 2029, respectively. The trenches may be filled in 2 years; however, additional trenches may be constructed. Finally, the site operates the Consolidated Incinerator Facility, which, together with the supercompactor, reduces low-level waste volumes but is primarily designed to destroy the hazardous components of mixed wastes.

Scope and Methodology

The Chairman of the Senate Committee on Energy and Natural Resources and the Chairman of the Subcommittee on Strategic Forces, Senate Committee on Armed Services, asked us to review (1) the factors that influence DOE's decisions about the treatment, storage, and disposal of low-level and mixed wastes and (2) DOE's costs to treat, store, and dispose of these wastes and the cost-effectiveness of DOE's disposal decisions. We performed our audit work through interviews and document reviews at DOE headquarters in Washington, D.C., and offices in Germantown, Maryland, as well as at DOE field offices and sites operating waste management disposal facilities. Our review covered seven sites: the Hanford Site in Washington, Idaho National Engineering and Environmental Laboratory in Idaho, Los Alamos National Laboratory in New Mexico, Nevada Test Site in Nevada, Oak Ridge Reservation in Tennessee, and Savannah River Site in South Carolina, as well as the Rocky Flats Field Office at the Rocky Flats Environmental Technology Site in Colorado.

In addition to the officials we interviewed at these seven sites, we contacted DOE officials at 13 other sites by telephone, fax, and/or electronic mail: Argonne National Laboratory-East in Illinois, Bettis Atomic Power Laboratory in Pennsylvania, Brookhaven National Laboratory in New York, Fernald Environmental Management Project in Ohio, Knolls Atomic Power Laboratory in New York, Lawrence Livermore National Laboratory in California, Mound Plant in Ohio, Paducah Gaseous Diffusion Plant in Kentucky, Pantex Plant in Texas, Portsmouth Gaseous Diffusion Plant in Ohio, RMI Titanium Company in Ohio, Sandia National Laboratory in New Mexico, and West Valley Demonstration Project in New York. These 13 sites, in addition to the 7 sites visited, accounted for almost all of DOE's projected low-level and mixed wastes, according to DOE's existing inventories and anticipated generation for a 20-year period.

To determine the factors that influence DOE's decisions about the treatment, storage, and disposal of low-level and mixed wastes, we obtained and analyzed the regulations and DOE policies pertaining to the disposal of low-level and mixed wastes. We reviewed DOE's *Final Waste Management Programmatic Environmental Impact Statement* and gathered testimonial evidence on the then pending Record of Decision on low-level and mixed wastes, on delays in its issuance, and on its potential impact through interviews with DOE and contractor officials at DOE headquarters in Washington, D.C., and offices in Germantown, Maryland, as well as DOE field offices and sites operating waste management disposal facilities. We obtained the waste acceptance criteria

and other information on the available DOE and commercial disposal facilities. We asked officials at the waste-generating sites to describe how they make low-level and mixed waste disposal decisions and what factors influence these decisions.

To review DOE's costs to treat, store, and dispose of these wastes and the cost-effectiveness of DOE's disposal decisions, we interviewed DOE and contractor officials, and we requested, obtained, and analyzed cost data for the treatment, storage, and disposal of low-level and mixed wastes from each site with disposal facilities. Because disposal options are often limited, we decided that excluding storage costs would grossly underreport the costs of managing the sites' wastes. Also, because the nature of many wastes or the characteristics of many disposal facilities necessitate treatment, we decided to include treatment costs. Therefore, the costs reported here are for the storage, treatment, and disposal of the sites' solid low-level and mixed wastes. We obtained the data on the disposal facilities from the contractors operating the facilities because they were able to sort the data by the type of activity and could separate the costs of managing and disposing of low-level and mixed wastes from the costs of managing other types of wastes at the sites. In most cases, the contractors provided cost-accounting reports that detailed storage, treatment, and disposal costs by waste type. For accounts that accumulated costs for multiple activities, the contractors distributed the costs to the appropriate waste types and activities. All contractors included their overhead charges. Although we did not independently verify the disposal facilities' cost data, the cost reports were generated from financial systems approved and audited under DOE's authority. We also requested and analyzed data on disposal costs and additional waste preparation costs from DOE site officials with oversight of the 20 major waste-generating sites. In general, we relied on the information these officials provided and did not independently verify its accuracy. Our requests for cost data from the disposal sites and the waste-generating sites covered fiscal years 1997 through 1999. We conducted our review from May 1999 through April 2000 in accordance with generally accepted government auditing standards.

GAO Contact and Staff Acknowledgments

GAO Contact

Dwayne E. Weigel (202) 512-3841

Acknowledgments

In addition, Pamela J. Timmerman, Patricia J. Rennie, John E. Cass, Krislin M. Nalwalk, Elizabeth R. Eisenstadt, Doreen S. Feldman, Susan W. Irwin, and Richard P. Johnson made key contributions to this report.

Related GAO Products

Low-Level Radioactive Wastes: States Are Not Developing Disposal Facilities (GAO/RCED-99-238, Sept. 17, 1999).

Nuclear Waste Cleanup: Progress Made but DOE Management Attention Needed to Increase Use of Innovative Technologies (GAO/T-RCED-99-190, May 26, 1999).

Department of Energy: Cost Estimates for the Hanford Tank Waste Remediation Project (GAO/RCED-99-188R, May 19, 1999).

Nuclear Regulation: Better Oversight Needed to Ensure Accumulation of Funds to Decommission Nuclear Power Plants (GAO/RCED-99-75, May 3, 1999).

Department of Energy: Accelerated Closure of Rocky Flats: Status and Obstacles (GAO/RCED-99-100, Apr. 30, 1999).

Nuclear Waste: DOE's Accelerated Cleanup Strategy Has Benefits but Faces Uncertainties (GAO/RCED-99-129, Apr. 30, 1999).

Nuclear Waste: Process to Remove Radioactive Waste From Savannah River Tanks Fails to Work (GAO/RCED-99-69, Apr. 30, 1999).

Nuclear Waste: Corps of Engineers' Progress in Cleaning Up 22 Nuclear Sites (GAO/RCED-99-48, Feb. 26, 1999).

Nuclear Waste: Department of Energy's Hanford Tank Waste Project—Schedule, Cost, and Management Issues (GAO/RCED-99-13, Oct. 8, 1998).

Department of Energy: Alternative Financing and Contracting Strategies for Cleanup Projects (GAO/RCED–98-169, May 29, 1998).

Nuclear Waste: Understanding of Waste Migration at Hanford Is Inadequate for Key Decisions (GAO/RCED-98-80, Mar. 13, 1998).

Nuclear Waste: Department of Energy's Project to Clean Up Pit 9 at Idaho Falls Is Experiencing Problems (GAO/RCED-97-180, July 28, 1997).

Radioactive Waste: Interior's Continuing Review of the Proposed Transfer of the Ward Valley Waste Site (GAO/RCED-97-184, July 15, 1997).

Department of Energy: Management and Oversight of Cleanup Activities at Fernald (GAO/RCED-97-63, Mar. 14, 1997).

Nuclear Waste: Uncertainties About Opening Waste Isolation Pilot Plant (GAO/RCED-96-146, July 16, 1996).

Radioactive Waste: Status of Commercial Low-Level Waste Facilities (GAO/RCED-95-67, May 5, 1995).

Ordering Information

The first copy of each GAO report is free. Additional copies of reports are $2 each. A check or money order should be made out to the Superintendent of Documents. VISA and MasterCard credit cards are accepted, also.

Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:
U.S. General Accounting Office
P.O. Box 37050
Washington, DC 20013

Orders by visiting:
Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders by phone:
(202) 512-6000
fax: (202) 512-6061
TDD (202) 512-2537

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

Orders by Internet:
For information on how to access GAO reports on the Internet, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web home page at:

http://www.gao.gov

To Report Fraud, Waste, or Abuse in Federal Programs

Contact one:

- **Web site: http://www.gao.gov/fraudnet/fraudnet.htm**
- **e-mail: fraudnet@gao.gov**
- **1-800-424-5454 (automated answering system)**

PRINTED ON RECYCLED PAPER

United States
General Accounting Office
Washington, D.C. 20548-0001

Official Business
Penalty for Private Use $300

Address Correction Requested

Bulk Rate
Postage & Fees Paid
GAO
Permit No. GI00