

CHAPTER 4

High-Level Waste

4.1 Introduction

This chapter provides data on the current and projected quantities and locations of high-level waste (HLW) and HLW-vitrified¹ managed by the Department of Energy (DOE). In this chapter, the term “HLW” refers to both HLW and HLW-vitrified. However, data specific to HLW-vitrified are labeled as such.

The HLW data cover the following reported volumes: inventory (storage), new generation², treatment, and disposal. Sites reported identical HLW-vitrified disposal and receipts because they currently only plan to ship HLW to a single geologic repository for disposal. Therefore, this chapter does not contain a receipts section. Finally, Section 4.6 provides summary information on the radioactivity of HLW.

In the section that covers HLW in inventory, the chapter provides additional information about the physical forms that comprise HLW.

The chapter provides the volume of HLW and HLW-vitrified managed during both the 1998 and 1999 fiscal years (FY) and provides the most current DOE projections for HLW and HLW-vitrified reported inventories and management activities through FY 2070.

Tables 4-1 and 4-2 provide FY 1998 and FY 1999 summary data for HLW and HLW-vitrified. See Section 4.1.3 for a projection summary of HLW and HLW-vitrified volumes by inventory and management activity.

This chapter includes:

The volumes, locations, and radioactivity of HLW (including HLW-vitrified) at the site, state, and DOE-wide levels.

Table 4-1
Summary of Total HLW Volumes by Inventory and Management Activity as Reported by Sites: FY 1998 and FY 1999 Actuals

In cubic meters

	FY 1998 Total	FY 1999 Total
Inventory (Storage)	342,281	339,419
New Generation	14,278	16,053
Treatment	2,516	5,095

Table 4-2
Summary of Total HLW-Vitrified Quantity in Inventory as Reported by Sites: FY 1998 and FY 1999 Actuals

In no. of canisters

	FY 1998 Total	FY 1999 Total
Inventory (Storage)	712	960
Disposal ^a	-	-

Notes:

- Hyphens indicate quantities of zero.

^a DOE does not anticipate the disposal of HLW-vitrified until FY 2010.

¹ HLW-vitrified refers to HLW that has gone through a process called “vitrification” which stabilizes nuclear waste by mixing it with molten glass. HLW-vitrified data is reported separately in the Central Internet Database (CID) in “Number of HLW canisters.”

² HLW-New Generation data is covered only in Table 4-1.

This chapter does not include:

Waste incidental to reprocessing (WIR). WIR volumes are associated with the reprocessing of HLW. These volumes are accounted for as Low Activity Waste (LAW) in the low-level waste (LLW) chapter (Chapter 7). In addition, there is no waste water associated with HLW and therefore, no waste water data are provided in this chapter.

4.1.1 HLW Definition and Explanation³

HLW is defined as:

The highly radioactive waste material resulting from the reprocessing of spent nuclear fuel (SNF), including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation (U.S. DOE Order 435.1, issued July 1999).

Unless demonstrated to the contrary, the DOE considers HLW to be a mixed waste – waste containing both radioactive and hazardous waste. The Resource Conservation and Recovery Act (RCRA) defines the hazardous components of waste, whereas the radioactive components of HLW are subject to the Atomic Energy Act (AEA). The hazardous waste components can be either a *listed* hazardous waste in Subpart D of 40 CFR 261 (i.e., it contains substances managed as hazardous under RCRA) or it can be a *characteristic* mixed waste (i.e., as stored, it exhibits the characteristic of corrosivity because of its acidity, alkalinity, or toxicity and the presence of heavy metals) (Subpart C of 40 CFR Part 261). Much of the DOE's HLW, therefore, is subject to regulation under Subtitle C of RCRA as well as the AEA.

DOE's Office of Environmental Management (EM) manages all of DOE's HLW at four sites: the Hanford Site (Hanford), the Idaho National Engineering and Environmental Laboratory (INEEL), the Savannah River Site, and the West Valley Demonstration Project (West Valley). Although the Hanford Site manages the largest volume of HLW, the HLW at the Savannah River Site is more radioactive (see Section 4.6).

The radioactivity in HLW is derived from "fission products" – fission fragments and their "daughter" products resulting chiefly from the splitting of uranium-235 in production reactor fuel. Although radiation levels and health risks caused by short-lived fission products decrease dramatically within a few hundred years, the risks attributable to long-lived isotopes in HLW will not change over thousands of years. During the initial decay period, most of the radioactivity is caused by cesium-137, strontium-90, and their short-lived daughter products. After the radioactivity from fission products decays to lower levels, radioactivity from long-lived isotopes, including plutonium, americium, uranium, daughter products from these elements, technetium-99, and carbon-14, become the dominant component and will pose the largest long-term potential risk.

When first generated, HLW is a highly radioactive, acidic liquid. This liquid generates heat and must be handled remotely behind heavy shielding in corrosion-resistant vessels. Most of the DOE's liquid HLW is stored in either a highly acidic or a highly caustic solution, or as a saltcake or sludge.

Since the DOE ended reprocessing of spent nuclear fuel and other materials in the early 1990s, the generation of new HLW has decreased dramatically. Small amounts of HLW continue to be generated as a result of the stabilization and processing of nuclear materials and other activities. However, the focus of HLW activities will be continued safe storage, pretreatment, immobilization, and interim storage pending shipment to a national repository. Thus, the inventory of liquid HLW in storage generally will decrease,

³ Most of the information in this section is taken from U.S. Department of Energy *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*, DOE-EM-0319 (January 1997) and U.S. Department of Energy, *Integrated Data Base Report—1996: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics*, DOE/RW-0006, Rev. 13 (December 1997).

and the inventory of solidified HLW (i.e. HLW-vitrified) in interim storage, pending shipment to a national repository, will increase (HLW-vitrified cannot be “generated” because it is a stabilized form of HLW and will likely not undergo further treatment).

About the Data in This Chapter

- The FY 2000 DOE Environmental Management (EM) Corporate Database provided the data for this chapter. The data in the EM Corporate Database are available through the Central Internet Database (CID), located at <http://cid.em.doe.gov>. (Please see Chapter 1 for more information on both the EM Corporate Database and the CID.)
- The data in this report are in a summary format (i.e., by site rather than by waste stream). The CID offers additional details (e.g., stream level data, or comprehensive data about a specific site or activity).
- The HLW quantity data in this report are rounded to the nearest cubic meter.
- The HLW quantity data in this report are presented according to various categories, i.e., by the amount in inventory, treated, or disposed. When considered across these categories, the data are not necessarily mutually exclusive. In other words, a particular amount of HLW may be scheduled for both treatment and disposal during the same time period. For these reasons, this report does not provide data summaries across the different data categories that would misleadingly suggest data exclusivity.
- Section 4.6 of this chapter provides summary data on the radioactivity (in curies) of the HLW (HLW and HLW-vitrified) in inventory at the end of FY 1999. The information sources for these radioactivity data are:
 - FY 2000 DOE EM Corporate Database;
 - U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250D (July 1999);
 - U.S. Department of Energy, Office of Environmental Management, *Integrated Data Base Report—1996: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics*, DOE/RW-0006, Rev. 13 (December 1997); and
 - Expert consultations, as necessary.

At Hanford, HLW was neutralized with caustic soda (sodium hydroxide), and sodium nitrite was then added for corrosion control so that the HLW could be stored in carbon-steel tanks. This practice continued at Hanford, Savannah River Site, and West Valley because of cost considerations related to using stainless steel. Neutralization with caustic soda forms sodium nitrate (which remains in solution) and hydrated oxides of certain radionuclides and nonradioactive chemicals (which precipitate and collect as a sludge on the floor of the tank). In addition, the cesium-137 remains largely in solution. At INEEL, however, the waste has always been stored at the Idaho Chemical Processing Plant (ICPP) as an acidic liquid in stainless steel tanks and then converted into a granular solid (calcine) by thermal processing, which drives off water and decomposes nitrate and fluoride salts to stable oxides and calcium fluoride. The calcine is stored in stainless steel bins enclosed in concrete vaults.

Most of the liquids, sludges, and other forms of HLW also contain toxic heavy metals, and some of the HLW also contains organic solvents (e.g., hexone, tributyl phosphate) and cyanide compounds.

When HLW is prepared for disposal, it goes through a process called “vitrification.” Vitrification stabilizes the HLW by mixing it with molten glass. The glass mixture is poured into cylindrical metal canisters, where it hardens.

Under federal law, DOE HLW will eventually be disposed of when a geologic repository facility becomes available and after it has been treated to produce solid waste forms acceptable for disposal. The DOE Office of Civilian Radioactive Waste Management is currently responsible for characterizing the proposed repository, constructing the repository, and disposing of DOE HLW, DOE SNF, and commercial SNF in accordance with the Nuclear Waste Policy Act of 1982.

According to the Federal Facility Compliance Act of 1992, the DOE is required to prepare a Site Treatment Plan (STP) for each site that generates, stores, or treats mixed waste. The STPs constitute a legally enforceable agreement between the DOE and the host state that obligates the DOE to comply with certain requirements for mixed waste management. All sites managing HLW are following timetables required by the STPs.

The following site summaries explain the type of HLW managed by each site.

Hanford Site (Hanford) (State: Washington)

At Hanford, HLW alkaline liquid, salt cake, and sludge are stored in single- and double-shell underground tanks. Hanford also manufactured highly radioactive capsules containing concentrated cesium and strontium salts. Some of these HLW capsules had been leased for use off-site, and are being returned to Hanford. Some of the capsules have already been dismantled, while the remainders are being stored, pending selection of an appropriate stabilization method prior to disposal.

Savannah River Site (State: South Carolina)

HLW at the Savannah River Site is composed of alkaline liquid, salt cake, sludge, and precipitate, and is stored in double-shell underground tanks. The volume of high-level tank waste at the Savannah River Site is only about half as large as Hanford tank waste, but it contains about one and one-half times the amount of radioactivity. Hanford tank waste is less radioactive than the tank waste at the Savannah River Site because much of the radioactive cesium and strontium have been removed and concentrated in the capsules, the waste is older and has had more time to decay, and the waste has been mixed with other waste.

Idaho National Engineering and Environmental Laboratory (INEEL) (State: Idaho)

HLW at INEEL is composed of acidic liquid and calcined solids. The acidic liquids are stored in underground tanks and include actual HLW as well as sodium-bearing waste that is managed as HLW. The calcine is stored in bins. Approximately 90 percent of the radioactivity in INEEL HLW is present in the calcine.

West Valley Demonstration Project (West Valley) (State: New York)

Unlike HLW managed at Hanford, INEEL, and the Savannah River Site, the DOE did not generate the HLW at West Valley. West Valley, which operated from 1966 to 1972, was the site of the only commercial nuclear fuel reprocessing plant operated in the United States. In accordance with the 1980 West Valley Demonstration Project Act, the DOE is responsible for demonstrating HLW solidification at the facility. The State of New York currently owns both the site and the waste. The HLW at West Valley is stored in tanks and consists of alkaline liquid, sludge, and ion-exchange resin. In terms of volume, the amount of HLW at West Valley is much less than that at Hanford, the Savannah River Site, or INEEL.

4.1.2 Organization of HLW Data

This chapter summarizes the HLW volume data by site for the reported volumes of HLW inventories, treatment, and disposal. A separate receipts section is not provided because receipts and disposal data are identical – projected shipments will only be sent for disposal. Separate data are provided for HLW-vitrified in the inventory and disposal sections.

Table 4-3
Summary of Total Projected HLW Treatment Volumes as Reported by Sites: FY 2000 - FY 2070

In cubic meters

Treatment	797,574
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The chapter provides actual data for FY 1998 and FY 1999 and projection data for FY 2000 - FY 2070. In the inventory section, the chapter provides more detailed information on physical forms of HLW. Unlike other waste types detailed in this report, there is no waste water associated with HLW. Given this, the information on physical forms of HLW does not include data on waste water.

Finally, Section 4.6 provides summary information on the radioactivity (in number of curies) of HLW.

4.1.3 Summary of Total Projected HLW Inventory and Treatment Volumes: FY 2000 - FY 2070

The following tables and figure provide DOE-wide summary data on HLW projections. Table 4-3 summarizes the cumulative projected volume of HLW treatment for FY 2000 - FY 2070. Table 4-4 provides a more detailed breakdown of the treatment projection data and includes data on the projected HLW inventories. Figure 4-1 presents the total projected volumes of HLW inventories and treatment.

Table 4-4
Summary of Total Projected HLW Volumes by Inventory and Treatment as Reported by Sites: FY 2000 - FY 2070

In cubic meters

	FY 2000 ^a	FY 2001 ^a	FY 2002 ^a	FY 2003 ^a	FY 2004 ^a	FY 2005 ^a	FY 2006 ^a	FY 2007 ^a
Inventory (Storage)	354,729	354,099	354,686	351,986	351,124	350,241	340,981	341,407
Treatment	5,011	10,945	4,472	11,769	1,239	9,981	5,103	5,503
	FY 2008 ^a	FY 2009 ^a	FY 2010 ^a	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035
Inventory (Storage)	333,132	328,442	317,634	254,535	87,421	3,727	2,274	822
Treatment	6,910	9,543	10,841	173,846	187,553	192,291	128,224	34,342
	FY 2036-2040	FY 2041-2045	FY 2046-2050	FY 2051-2055	FY 2056-2060	FY 2061-2065	FY 2066-2070	Non-Annualized ^b
Inventory (Storage)	822	822	822	822	822	822	822	822
Treatment	-	-	-	-	-	-	-	-

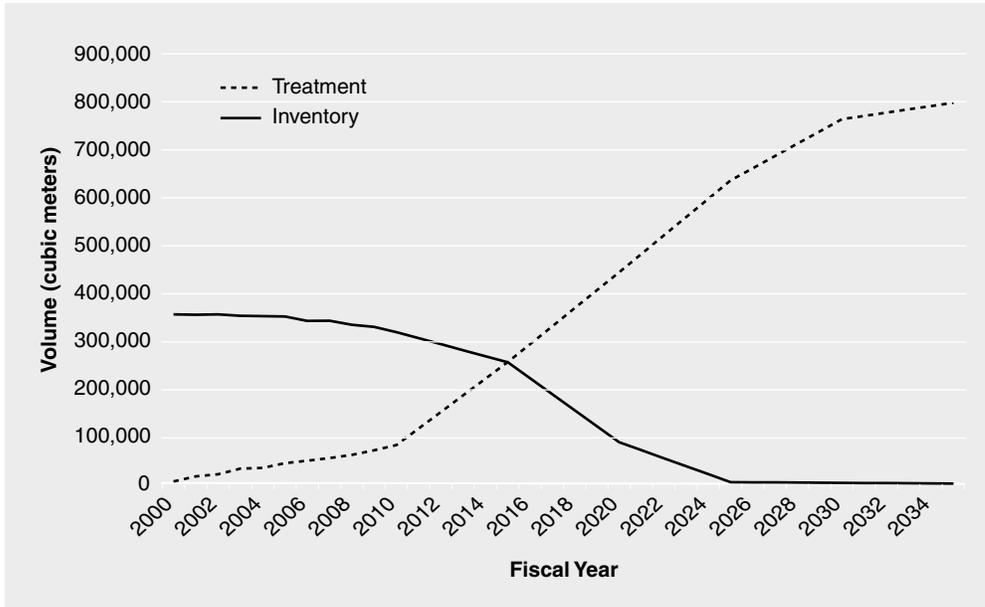
Notes:

• Hyphens indicate volumes of zero.

^a These data reflect the annual volume projected by sites for FY 2000 - FY 2010. All data (other than inventory data) reported for the post-2010 time periods reflect the total volume projected for the specific five-year time periods. The post-FY 2010 inventory data reflect the total volume projected for the end of each five-year time period.

^b Non-annualized volumes refer to those volumes of HLW for which the DOE could not specify when the inventory or management activity would occur.

**Figure 4-1
Summary of Total Projected HLW Inventory and Treatment Volumes
as Reported by Sites: FY 2000 - FY 2070^a**



Notes:

- Annual volumes are shown through FY 2010. Volumes shown for subsequent years were calculated based on the data reported by sites for each five-year time period through FY 2070 (see Table 4-4 for further information).
- Treatment data are shown as cumulative volume over time.

^a Sites did not report any HLW treatment beyond FY 2035.

4.1.4 Summary of Total Projected HLW-Vitrified Inventory and Disposal Quantities: FY 2000 - FY 2070

The following tables and figure provide DOE-wide summary data on HLW-vitrified projections. Table 4-5 summarizes the cumulative projected number of HLW-vitrified canisters that are scheduled to be disposed of in a geologic repository. Table 4-6 provides these projections in more detail and also includes data on the projected HLW-vitrified inventories. Figure 4-2 shows how sites project the disposal of HLW-vitrified starting in FY 2010.

Table 4-5	
Summary of Total Projected HLW-Vitrified Disposal as Reported by Sites: FY 2000 - FY 2070	
In No. of canisters	
Disposal	19,193

**Table 4-6
Summary of Total Projected HLW-Vitrified Quantity by Inventory and Disposal
as Reported by Sites: FY 2000 - FY 2070**

In No. of canisters

	FY 2000 ^a	FY 2001 ^a	FY 2002 ^a	FY 2003 ^a	FY 2004 ^a	FY 2005 ^a	FY 2006 ^a	FY 2007 ^a
Inventory (Storage)	1,215	1,470	1,720	1,970	2,220	2,470	2,720	3,020
Disposal	-	-	-	-	-	-	-	-

	FY 2008 ^a	FY 2009 ^a	FY 2010 ^a	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035
Inventory (Storage)	3,320	3,620	3,815	7,030	10,702	13,526	14,772	13,963
Disposal	-	-	105	1,025	1,025	1,025	1,025	1,025

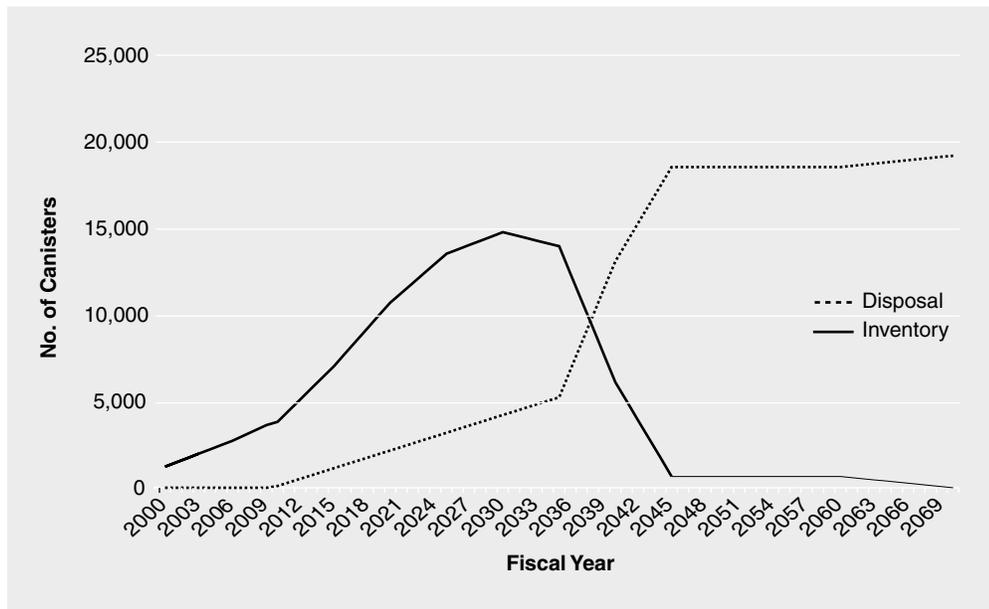
	FY 2036-2040	FY 2041-2045	FY 2046-2050	FY 2051-2055	FY 2056-2060	FY 2061-2065	FY 2066-2070
Inventory (Storage)	6,095	653	653	653	653	326	-
Disposal	7,868	5,442	-	-	-	327	326

Notes:

- Hyphens indicate quantities of zero.

^a These data reflect the annual quantities projected by sites for FY 2000 - FY 2010. All post-FY 2010 data (other than inventory data) reflect the total volume projected for the specific five-year time periods. The post-FY 2010 inventory data reflect the total quantity projected for the end of each five-year time period.

Figure 4-2. Summary of Total Projected HLW-Vitrified Quantity by Inventory and Disposal as Reported by Sites: FY 2010 - FY 2070



Notes:

- Annual quantities are shown through FY 2010. Quantities shown for subsequent years were calculated based on the data reported by sites for each five-year time period through FY 2070 (see Table 4-6 for further information).
- Disposal is shown as cumulative quantity over time.

4.2 HLW Inventory as Reported by Sites

Inventory is defined as the material that is in storage at a facility or site at a given time. This section provides data on sites' end-of-year inventories of HLW and HLW-vitrified.

4.2.1 HLW Inventory Data by Site and State

The following tables and figures detail the FY 1998 and FY 1999 end-of-year volumes of HLW and HLW-vitrified in inventory as reported by DOE sites. Table 4-7 provides HLW inventory volumes at each site; Figure 4-3 shows the geographic distribution of HLW across the U.S.; and Figure 4-4 shows sites' relative contributions to the total volume of HLW in inventory. The quantities of HLW-vitrified in inventory for each site are provided in Table 4-8, and Figures 4-5 and 4-6 show sites' relative contributions to the total quantity of HLW-vitrified in inventory.

Table 4-7
Total Volume of HLW in Inventory as Reported by Sites:
FY 1998 and FY 1999 Actuals

In cubic meters

State	Site	Site Code	FY 1998	% 1998 Total	FY 1999	% 1999 Total
ID	Idaho National Engineering and Environmental Laboratory	INEEL	10,711	3.1	9,357	2.8
NY	West Valley Demonstration Project	WVDP	182	<1	109	<1
SC	Savannah River Site	SARS	128,193	37.5	130,051	38.3
WA	Hanford Site	HASI	203,195	59.4	199,902	58.9
Total			342,281	100	339,419	100

Notes:

- Hyphens indicate volumes of zero.
- Due to data rounding, the totals in this table may not equal the exact sum of the site-specific data.

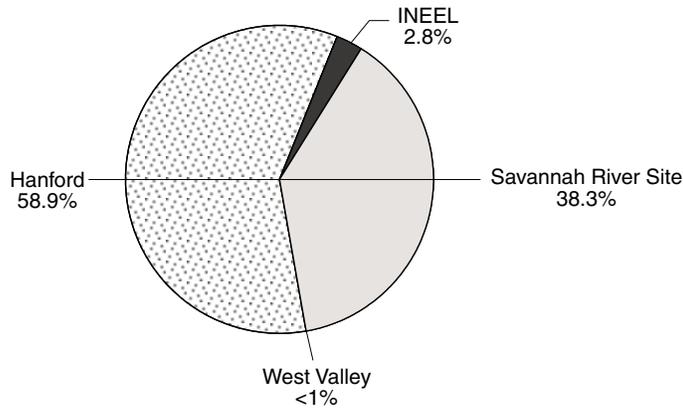
Figure 4-3
Total Volume of HLW in Inventory as Reported by Sites: FY 1999 Actuals



Notes:

- While the actual site volumes are labeled numerically on the map, the volume *icons* are based on a logarithmic scale to differentiate more easily between the sites' relative inventories.
- See Table 4-7 for more information.

Figure 4-4
Sites' Relative Contributions to the Volume of HLW in Inventory
as Reported by Sites: FY 1999 Actuals



Notes:

- At the end of FY 1999, the total reported volume of HLW in inventory was approximately 339,419 cubic meters. See Table 4-7 for further details.
- Sites' relative contributions in FY 1998 were similar to those in FY 1999. See Table 4-7 for further details.
- Percentages may not add to exactly 100% due to rounding.

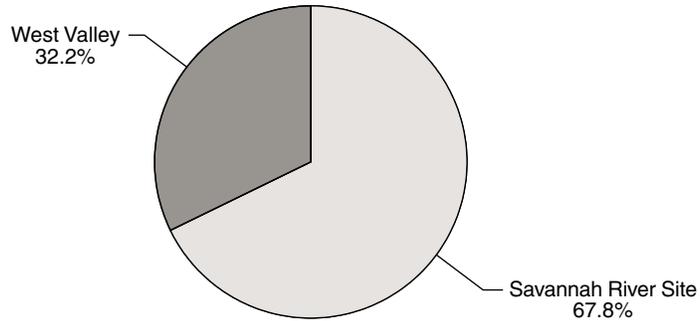
Because they were the first DOE sites to start producing vitrified HLW (in 1996), the Savannah River Site and the West Valley Demonstration Project were the only sites with inventories of HLW-vitrified in FY 1998 and FY 1999. Hanford and INEEL are currently planning their vitrification processes.

Table 4-8
Total Quantity of HLW-Vitrified in Inventory as Reported by Sites:
FY 1998 and FY 1999 Actuals

In No. of Canisters

State	Site	Site Code	FY 1998	% 1998 Total	FY 1999	% 1999 Total
SC	Savannah River Site	SARS	483	67.8	719	74.9
NY	West Valley Demonstration Project	WVDP	229	32.2	241	25.1
Total			712	100	960	100

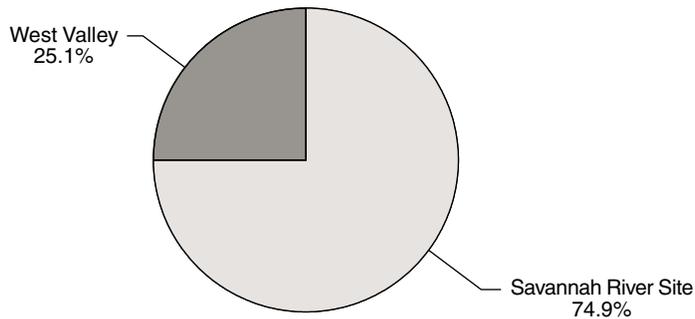
Figure 4-5
Sites' Relative Contributions to the Quantity of HLW-Vitrified in Inventory
as Reported by Sites: FY 1998 Actuals



Note:

- At the end of FY 1998, the total reported volume of HLW-vitrified in inventory was 712 canisters. See Table 4-8 for further details.

Figure 4-6
Sites' Relative Contributions to the Quantity of HLW-Vitrified in Inventory
as Reported by Sites: FY 1999 Actuals



Note:

- At the end of FY 1999, the total reported volume of HLW-vitrified in inventory was 960 canisters. See Table 4-8 for further details.

HLW Inventory Site Projection Data:

The following tables and figures provide data on the HLW inventory volumes projected for FY 2000 - FY 2070. Table 4-9 provides site-specific projections; Figure 4-7 shows projections for HLW inventory at all sites from FY 2000 - FY 2010; and Figure 4-8 shows the DOE-wide inventory projections from FY 2011 - FY 2070. Data on the corresponding projected volumes of HLW-vitrified follow in Table 4-10 and Figures 4-9 and 4-10.

**Table 4-9
Total Projected Volume of HLW Inventories as Reported by Sites:
FY 2000 - FY 2070**

In cubic meters

State	Site	Site Code	FY 2000 ^a	FY 2001 ^a	FY 2002 ^a	FY 2003 ^a	FY 2004 ^a	FY 2005 ^a	FY 2006 ^a	FY 2007 ^a
ID	Idaho National Engineering and Environmental Laboratory	INEEL	9,478	7,689	7,757	7,965	8,169	7,812	7,815	7,833
NY	West Valley Demonstration Project	WVDP	69	-	-	-	-	-	-	-
SC	Savannah River Site	SARS	136,880	135,108	133,927	135,419	129,776	127,985	121,864	119,341
WA	Hanford Site	HASI	208,302	211,302	213,002	208,602	213,179	214,445	211,302	214,233
Total			354,729	354,099	354,686	351,986	351,124	350,241	340,981	341,407

State	Site	Site Code	FY 2008 ^a	FY 2009 ^a	FY 2010 ^a	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035
ID	Idaho National Engineering and Environmental Laboratory	INEEL	7,856	6,911	5,814	4,818	4,361	2,906	1,453	-
NY	West Valley Demonstration Project	WVDP	-	-	-	-	-	-	-	-
SC	Savannah River Site	SARS	116,878	116,300	107,785	58,756	9,580	-	-	-
WA	Hanford Site	HASI	208,398	205,231	204,035	190,961	73,480	822	822	822
Total			333,132	328,442	317,634	254,535	87,421	3,727	2,274	822

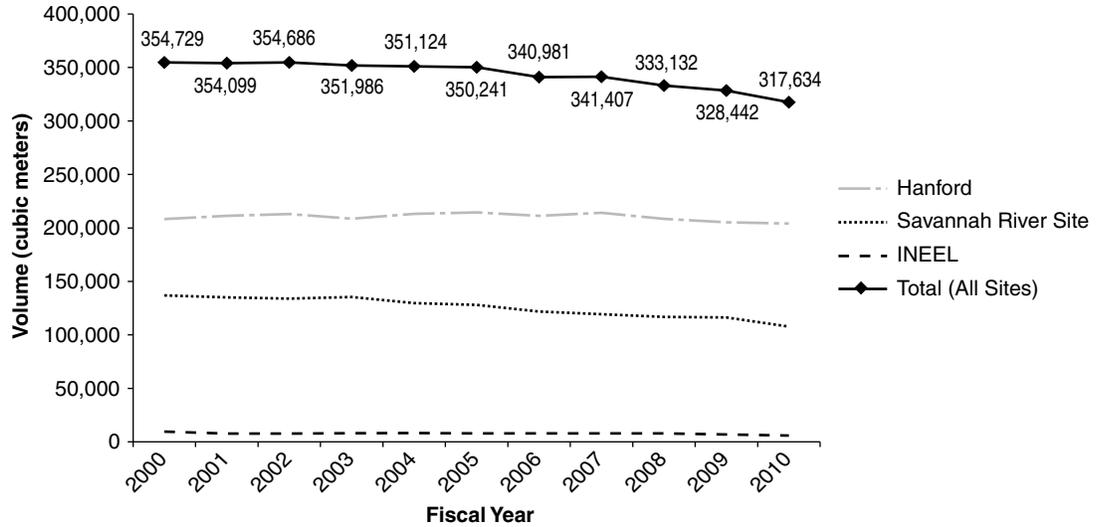
State	Site	Site Code	FY 2036-2040	FY 2041-2045	FY 2046-2050	FY 2051-2055	FY 2056-2060	FY 2061-2065	FY 2066-2070	Non-Annualized ^b
ID	Idaho National Engineering and Environmental Laboratory	INEEL	-	-	-	-	-	-	-	-
NY	West Valley Demonstration Project	WVDP	-	-	-	-	-	-	-	-
SC	Savannah River Site	SARS	-	-	-	-	-	-	-	-
WA	Hanford Site	HASI	822	822	822	822	822	822	822	822
Total			822							

Notes:

• Hyphens indicate volumes of zero.

^a These annual data reflect the projected inventory for FY 2000 - FY 2010. Post-FY 2010 data reflect the projected inventory for the last year in each five-year time period.^b Non-annualized refers to those volumes of HLW for which DOE reporting sites could not specify the year in which inventory would occur.

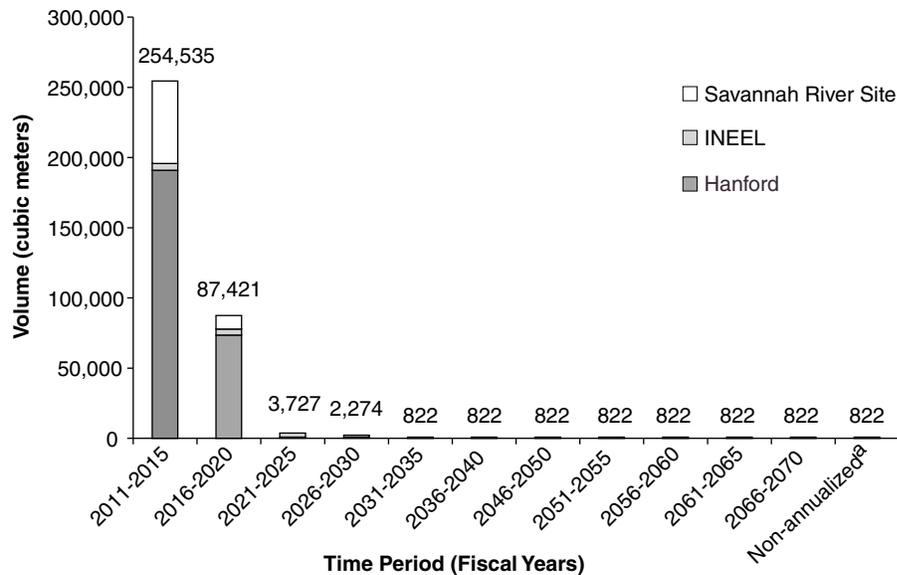
Figure 4-7
Total Projected Volume of HLW Inventories as Reported by Sites:
FY 2000 - FY 2010



Note:

- West Valley did not report inventory volumes past FY 2000. West Valley projected an inventory volume of approximately 69 cubic meters for FY 2000.

Figure 4-8
Total Projected Volume of HLW Inventories as Reported by Sites:
FY 2011 - FY 2070^a



Notes:

- The data in this figure reflect the projected inventory for the last year in each five-year time period.

^a Non-annualized refers to those volumes of HLW for which DOE reporting sites could not specify the year in which inventory would occur.

Table 4-10
Total Projected HLW-Vitrified Inventories as Reported by Sites:
FY 2000 - FY 2070

In No. of canisters

State	Site	Site Code	FY 2000 ^a	FY 2001 ^a	FY 2002 ^a	FY 2003 ^a	FY 2004 ^a	FY 2005 ^a	FY 2006 ^a	FY 2007 ^a
ID	Idaho National Engineering and Environmental Laboratory	INEEL	-	-	-	-	-	-	-	-
NY	West Valley Demonstration Project	WVDP	246	251	251	251	251	251	251	251
SC	Savannah River Site	SARS	969	1,219	1,469	1,719	1,969	2,219	2,469	2,719
WA	Hanford Site	HASI	-	-	-	-	-	-	-	50
Total			1,215	1,470	1,720	1,970	2,220	2,470	2,720	3,020

State	Site	Site Code	FY 2008 ^a	FY 2009 ^a	FY 2010 ^a	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035
ID	Idaho National Engineering and Environmental Laboratory	INEEL	-	-	-	-	5	221	437	653
NY	West Valley Demonstration Project	WVDP	251	251	251	251	251	251	251	251
SC	Savannah River Site	SARS	2,969	3,219	3,364	3,589	3,681	2,864	1,839	814
WA	Hanford Site	HASI	100	150	200	3,190	6,765	10,190	12,245	12,245
Total			3,320	3,620	3,815	7,030	10,702	13,526	14,772	13,963

State	Site	Site Code	FY 2036-2040	FY 2041-2045	FY 2046-2050	FY 2051-2055	FY 2056-2060	FY 2061-2065	FY 2066-2070
ID	Idaho National Engineering and Environmental Laboratory	INEEL	653	653	653	653	653	326	-
NY	West Valley Demonstration Project	WVDP	-	-	-	-	-	-	-
SC	Savannah River Site	SARS	-	-	-	-	-	-	-
WA	Hanford Site	HASI	5,442	-	-	-	-	-	-
Total			6,095	653	653	653	653	326	-

Notes:

- Hyphens indicate quantities of zero.
- Due to data rounding, the totals in this table may not equal the exact sum of the site-specific data.

^a These annual data reflect the projected inventory for FY 2000 - FY 2010. Post-FY 2010 data reflect the projected inventory for the last year in each five-year time period.

Figure 4-9
Total Projected Quantity of HLW-Vitrified Inventory as Reported by Sites:
FY 2000 - FY 2010

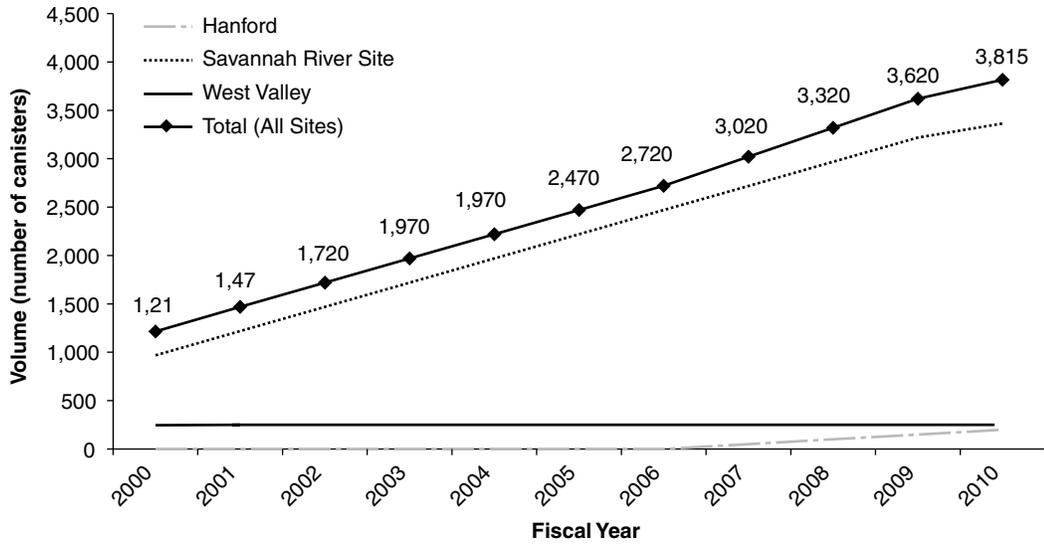
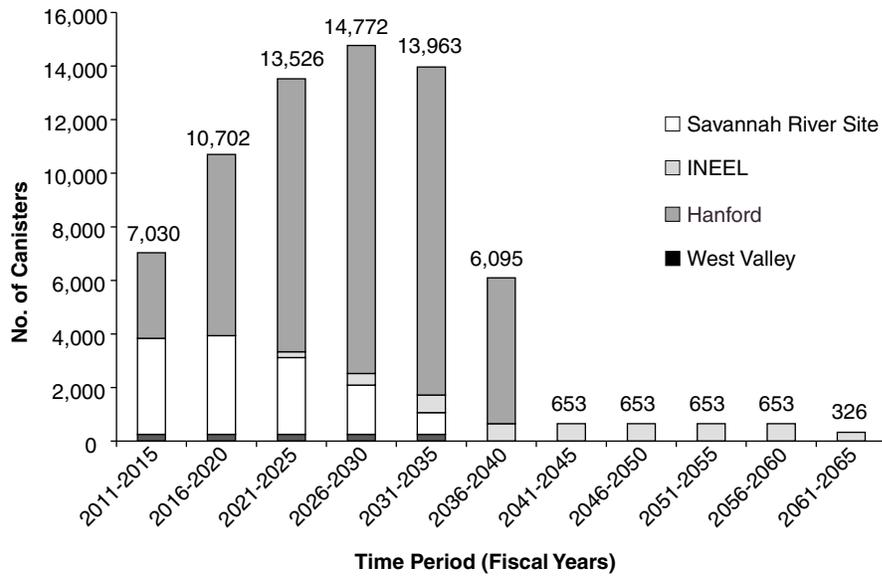


Figure 4-10
Total Projected Quantity of HLW-Vitrified Inventory as Reported by Sites:
FY 2011 - FY 2070^a



Notes:

• Data in this figure reflect the projected inventory for the last year in each five-year time period.

^a Sites did not report HLW-vitrified data past FY 2065.

4.2.2 HLW Inventory Data by Physical Form

Table 4-11 details the physical form of the HLW volumes in inventory at the end of FY 1998 and FY 1999. Figures 4-1 shows sites' relative contributions to the total volume of HLW in inventory by physical form at the end-of FY 1999.

**Table 4-11
Total Volume of HLW in Inventory by Physical Form as Reported by Sites:
FY 1998 and FY 1999 Actuals**

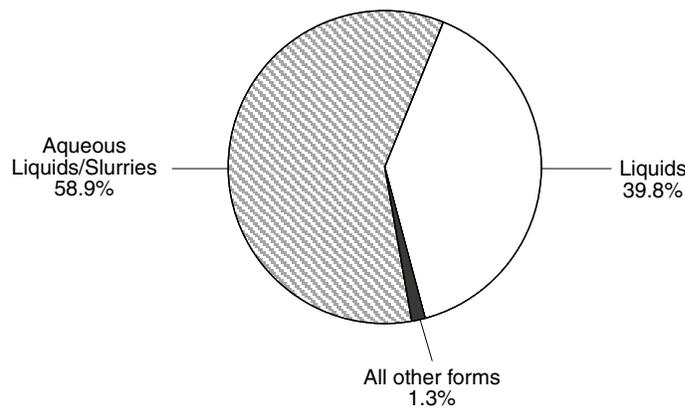
In cubic meters

Physical Form	Form Code	FY 1998	% 1998 Total	FY 1999	% 1999 Total
Aqueous Liquids/Slurries	L1000	203,193	59.4	199,900	58.9
Inorganic Sludges	S3120	182	<1	109	<1
Liquids	L0000	134,768	39.4	135,123	39.8
Salt Waste	S3140	2	<1	2	<1
Solidified Inorganic Solids	S3151	4,136	1.2	4,286	1.3
Total		342,281	100	339,419	100

Note:

- Due to data rounding, the totals in this table may not equal the exact sum of the site-specific data.

**Figure 4-11
Sites' Relative Contributions to the Volume of HLW in Inventory by Physical Form
as Reported by Sites: FY 1999 Actuals**



Notes:

- At the end of FY 1998 and FY 1999, the total reported volumes of HLW in inventory were approximately 342,281 cubic meters and 339,419 cubic meters, respectively. See Table 4-11 for further details.
- Percentages may not add to exactly 100% due to rounding.
- A separate figure for FY 1998 is not provided because FY 1998 data are nearly identical to the FY 1999 data. See table 4-11 for further details.

4.3 HLW Treatment as Reported by Sites

Treatment is defined as any method, technique, or process designed to change the physical or chemical character of waste to: render the waste less hazardous; make the waste safer to transport, store or dispose; or reduce the waste's volume.

The DOE projects that treatment of HLW will occur on-site and includes both pretreatment and immobilization processes. When HLW is immobilized, it goes through a process called "vitrification." Vitrification stabilizes nuclear waste by mixing it with molten glass.

4.3.1 HLW Treatment Data by Site and State

Table 4-12 details the total volumes of HLW treated in FY 1998 and FY 1999 by site⁴ and state. Figures 4-12 and 4-13 show the sites' relative contributions to the total volumes of HLW treated during these fiscal years.

Table 4-12
Total Volume of HLW Treated^a as Reported by Sites: FY 1998 and FY 1999 Actuals

In cubic meters

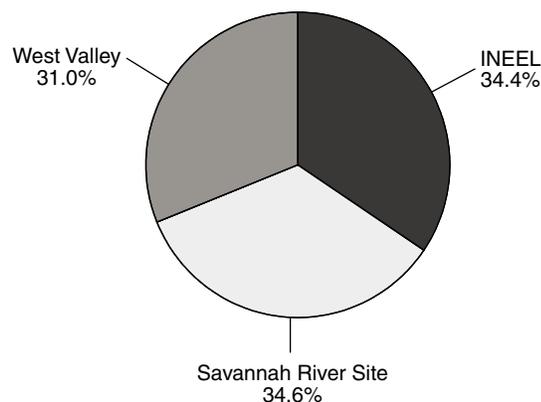
State	Site	Site Code	FY 1998	% 1998 Total	FY 1999	% 1999 Total
ID	Idaho Engineering and Environmental Laboratory	INEEL	865	34.4	509	10.0
NY	West Valley Demonstration Project	WVDP	780	31.0	73	1.4
SC	Savannah River Site	SARS	871	34.6	683	13.4
WA	Hanford Site	HASI	-	-	3,830	75.2
Total			2,516	100	5,095	100

Notes:

- Hyphens indicate volumes of zero.

^a These volumes reflect vitrification processes for all sites except Idaho, which calcines liquid HLW.

Figure 4-12
Sites' Relative Contributions to the Volume of HLW Treated as Reported by Sites: FY 1998 Actuals

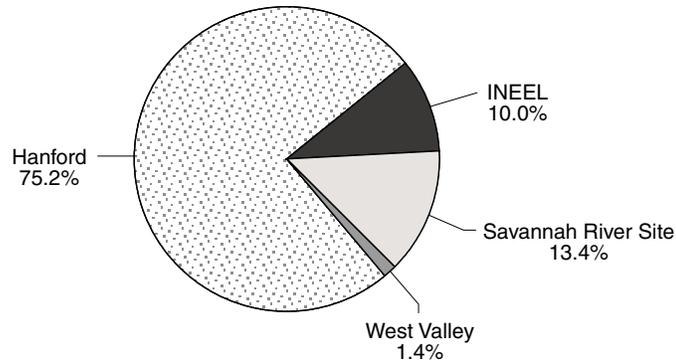


Note:

- The total reported volume of HLW treated in FY 1998 was approximately 2,516 cubic meters. See Table 4-12 for further details.

⁴ Sites did not report any off-site treatment for HLW.

Figure 4-13
Sites' Relative Contributions to the Volume of HLW Treated
as Reported by Sites: FY 1999 Actuals



Note:

- The total reported volume of HLW treated in FY 1999 was approximately 5,095 cubic meters. See Table 4-12 for further details.

HLW Treatment Site Projection Data:

Table 4-13 and Figure 4-14 provide data on projected HLW treatment.

Table 4-13
Total Projected Volume of HLW Treatment as Reported by Sites: FY 2000 - FY 2070^a

In cubic meters

State	Site	Site Code	FY 2000 ^b	FY 2001 ^b	FY 2002 ^b	FY 2003 ^b	FY 2004 ^b	FY 2005 ^b
ID	Idaho National Engineering and Environmental Laboratory	INEEL	645	3,477	17	42	26	820
NY	West Valley Demonstration Project	WVDP	40	69	-	-	-	-
SC	Savannah River Site	SARS	726	779	855	927	1,213	1,213
WA	Hanford Site	HASI	3,600	6,620	3,600	10,800	-	7,949
Total			5,011	10,945	4,472	11,769	1,239	9,981

State	Site	Site Code	FY 2006 ^b	FY 2007 ^b	FY 2008 ^b	FY 2009 ^b	FY 2010 ^b	FY 2011-2015
ID	Idaho National Engineering and Environmental Laboratory	INEEL	61	47	42	2,294	2,283	3,736
NY	West Valley Demonstration Project	WVDP	-	-	-	-	-	-
SC	Savannah River Site	SARS	1,252	1,256	1,256	1,257	2,186	14,592
WA	Hanford Site	HASI	3,790	4,200	5,612	5,992	6,372	155,517
Total			5,103	5,503	6,910	9,543	10,841	173,846

(continued...)

Table 4-13 (cont'd)
Total Projected Volume of HLW Treatment as Reported by Sites: FY 2000 - FY 2070^a

In cubic meters

State	Site	Site Code	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035	Site Total	% Total
ID	Idaho National Engineering and Environmental Laboratory	INEEL	987	34,345	34,342	34,342	117,507	14.7
NY	West Valley Demonstration Project	WVDP	-	-	-	-	109	<1
SC	Savannah River Site	SARS	12,118	1,476	-	-	41,106	5.2
WA	Hanford Site	HASI	174,448	156,470	93,882	-	638,852	80.1
Total			187,553	192,291	128,224	34,342	797,574	100

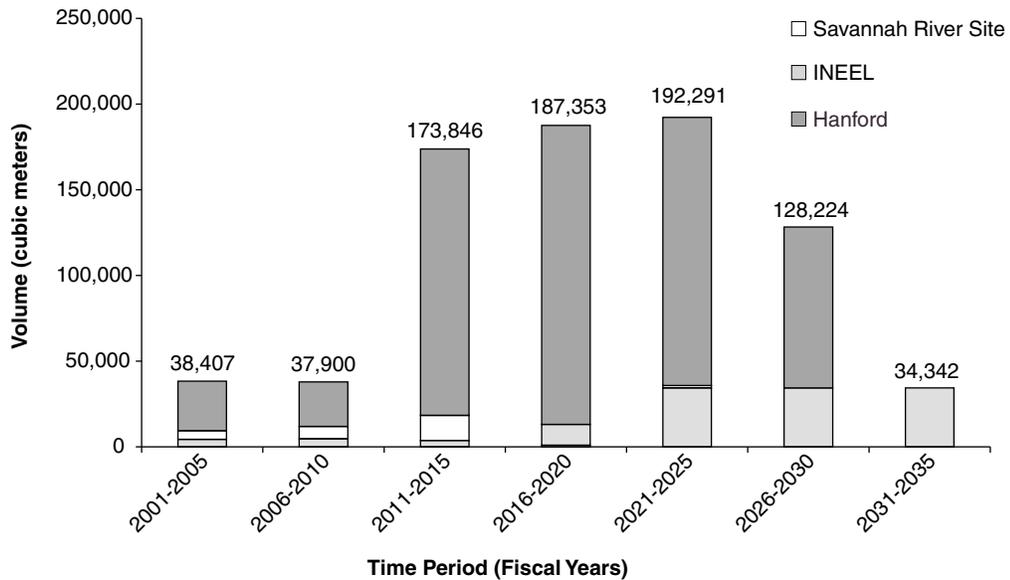
Notes:

- Hyphens indicate volumes of zero.

^a Sites did not report HLW data past FY 2035.

^b These annual data reflect the total volume projected by sites for FY 2000 - FY 2010. All post-FY 2010 data reflect the total volume projected for the specified five-year time periods.

Figure 4-14
Total Projected Volume of HLW Treatment as Reported by Sites: FY 2000 - FY 2070^a



Notes:

- West Valley did not report treatment volumes past FY 2001. West Valley projected a treatment volume of approximately 69 cubic meters for FY 2001.

^a Sites did not report HLW treatment past FY 2035.

4.4 HLW Receipts as Reported by Sites

Sites reported identical HLW-vitrified disposal and receipts because they currently only project to ship HLW-vitrified to a single geologic repository for disposal. Therefore, this chapter does not contain a receipts section.

4.5 HLW Disposal as Reported by Sites

Disposal is defined as a management activity where the waste is emplaced in a manner that ensures protection of human health and the environment within prescribed limits for the foreseeable future. HLW must be stabilized before it can be disposed. The currently accepted HLW stabilization process is vitrification. Therefore, the only HLW quantities to be disposed are HLW-vitrified quantities. To date, there has been no disposal of HLW-vitrified because a geologic repository for HLW disposal has not been opened. The DOE Office of Civilian Radioactive Waste Management is currently responsible for characterizing a geologic repository site, constructing a repository, and disposing of DOE HLW, DOE SNF, and commercial SNF in accordance with the Nuclear Waste Policy Act of 1982.

HLW-Vitrified Disposal Site Projection Data:

Table 4-14 provides summary data on the projected quantities of HLW-vitrified scheduled to be disposed of at a geologic repository. Table 4-15 and Figure 4-15 show the quantities of HLW-vitrified that each site plans to ship to the repository for disposal starting in FY 2010.

Table 4-14
Total Projected Quantity of HLW-Vitrified Disposal as Reported by Sites:
FY 2010 - FY 2070

No. of Canisters

Site	Site Code	FY 2010 ^a	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035	FY 2036-2040
Geologic Repository Disposal	GRD	105	1,025	1,025	1,025	1,025	1,025	7,868

Site	Site Code	FY 2041-2045	FY 2046-2050	FY 2051-2055	FY 2056-2060	FY 2061-2065	FY 2066-2070	Site Total
Geologic Repository Disposal	GRD	5,442	-	-	-	327	326	19,193

Notes:

- Hyphens indicate quantities of zero.

^a These annual data reflect the total volume projected by sites for FY 2010. Post-FY 2010 data reflect the total summary volume projected for each five-year time period.

Table 4-15
Total Projected Quantity of HLW-Vitrified Shipments for Disposal at a Geologic
Repository as Reported by Sites:
FY 2000 - FY 2070

In No. of canisters

State	Site	Site Code	FY 2010 ^a	FY 2011-2015	FY 2016-2020	FY 2021-2025	FY 2026-2030	FY 2031-2035	FY 2036-2040	FY 2041-2045
ID	Idaho National Engineering and Environmental Laboratory	INEEL	-	-	-	-	-	-	-	-
NY	West Valley Demonstration Project	WVDP	-	-	-	-	-	-	251	-
SC	Savannah River Site	SARS	105	1,025	1,025	1,025	1,025	1,025	814	-
WA	Hanford Site	HASI	-	-	-	-	-	-	6,803	5,442
Total			105	1,025	1,025	1,025	1,025	1,025	7,868	5,442

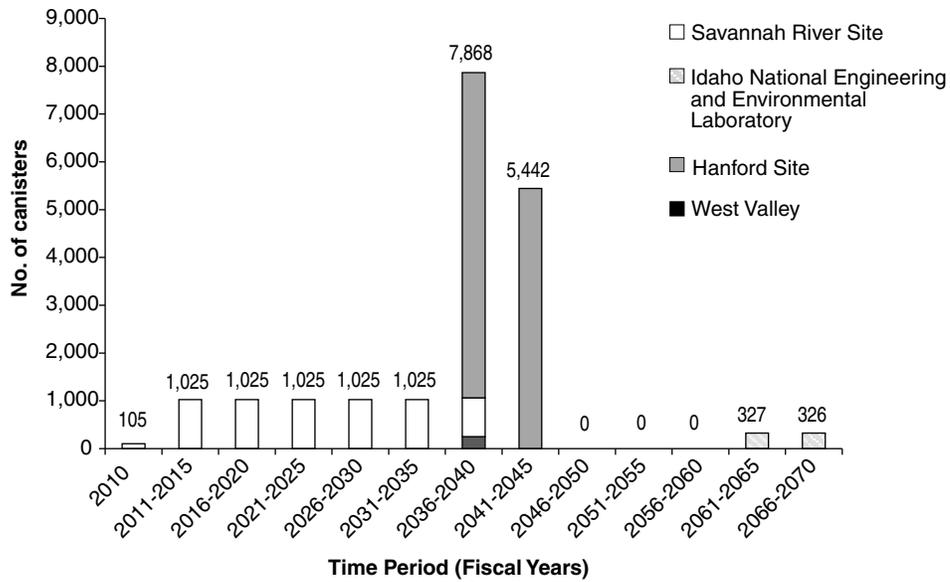
State	Site	Site Code	FY 2046-2050	FY 2051-2055	FY 2056-2060	FY 2061-2065	FY 2066-2070	Site Total	% Total
ID	Idaho National Engineering and Environmental Laboratory	INEEL	-	-	-	327	326	653	3.4
NY	West Valley Demonstration Project	WVDP	-	-	-	-	-	251	1.3
SC	Savannah River Site	SARS	-	-	-	-	-	6,044	31.5
WA	Hanford Site	HASI	-	-	-	-	-	12,245	63.8
Total			0	0	0	327	326	19,193	100

Notes:

- Hyphens indicate quantities of zero.

^a These data represent quantity projections for the end-of-FY 2010. All post-FY 2010 data reflect the total quantity projected for the specified five-year time periods.

Figure 4-15
Total Projected Quantity of HLW-Vitrified Disposal
as Reported by Sites: FY 2010 - FY 2070^a



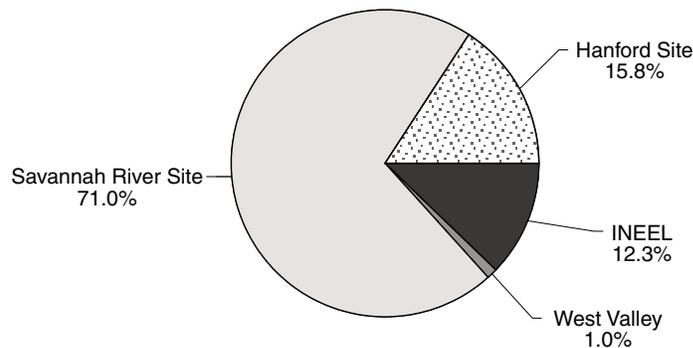
Note:

^a Sites did not report HLW-vitrified disposal data before FY 2010.

4.6 HLW Radioactivity

Figure 4-16 and Table 4-16 provide data about the radioactivity (in number of curies) of HLW in inventory at the end of FY 1999. The curie data have been decayed to the end of FY 1999 and cover the inventory of both HLW and HLW-vitrified. Because no HLW has been permanently disposed of, these curie data provide a sound approximation of the total radioactivity of the HLW managed by the DOE.

Figure 4-16
Sites' Relative Contributions to the Radioactivity of HLW in Inventory
at the End of FY 1999



Note:

- At the end of FY 1999, the total reported amount of HLW in inventory was approximately 339,419 cubic meters and 960 canisters. The total radioactivity associated with this amount was approximately 2,133,934,875 curies. See Table 4-16 for further details.

Table 4-16
Total Radioactivity of HLW and HLW-Vitrified in Inventory as of the End of FY 1999

State	Site	Site Code	HLW FY 1999 (cubic meters)	%1999 Total Volume	HLW- Vitrified FY 1999 (No. of canisters)	%1999 Total (No. of canisters)	Total Radioactivity ^a (curies)	% Total Radioactivity
ID	Idaho National Engineering and Environmental Laboratory	INEEL	9,357	2.8	-	-	300,123,817	12.3
NY	West Valley Demonstration Project	WVDP	109	<1	241	25.1	23,300,000	1.0
SC	Savannah River Site	SARS	130,051	38.3	719	74.9	1,727,162,799	71.0
WA	Hanford Site	HASI	199,902	58.9	-	-	383,472,076	15.8
Total			339,419	100	960	100	2,434,058,692	100

Notes:

- Hyphens indicate quantities of zero.
- Due to data rounding, the totals in this table may not equal the exact sum of the site-specific data.

^a Total radioactivity is based on both the volume (HLW) and number of canisters (HLW-vitrified) in inventory at the end of FY 1999 and is decayed to 1999.

Sources: 1) FY 2000 DOE EM Corporate Database; 2) U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250D (July 1999); 3) U.S. Department of Energy, Office of Environmental Management, *Integrated Data Base Report—1996: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics*, DOE/RW-0006, Rev. 13 (December 1997); and 4) Expert consultations, as necessary.