2.2 High-Level Waste Overview

2.2.1 HIGH-LEVEL WASTE DESCRIPTION

According to Section 2(12) of the Nuclear Waste Policy Act (42 USC 10101), high-level radioactive waste means:

> (A) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and
>
> (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.

In July 1999, DOE issued Order 435.1 *Radioactive Waste Management*. This Order and its associated Manual and Guidance set forth the authorities, responsibilities, and requirements for the management of DOE's inventory of HLW, transuranic waste, and low-level waste. Specific to HLW, DOE uses the Nuclear Waste Policy Act definition but has jurisdictional authority consistent with existing law to determine if the waste requires permanent isolation as the appropriate disposal mechanism. This authority is based on enabling legislation in the Atomic Energy Act, sections 202(3) and 202(4) of the Energy Reorganization Act of 1974, and others. The documents associated with DOE Order 435.1 describe processes for: waste incidental to reprocessing determinations; the characterization, certification, storage, treatment and disposal of HLW; and HLW facility design, decommissioning, and closure. In this EIS, the term HLW and all management aspects related to HLW are used consistent with the DOE Order 435.1 and its associated documents (see Section 6.3.2.2).

2.2.2 HIGH-LEVEL WASTE MANAGEMENT AT INEEL

From 1952 to 1991, DOE processed spent nuclear fuel at INTEC. The process was designed to recover the highly enriched uranium in the fuel using a three-step solvent extraction process. The first solvent extraction cycle resulted in a highly radioactive liquid that was considered HLW and stored at the Tank Farm. Subsequent extraction cycles and decontamination activities generated a liquid waste that was concentrated by evaporation and stored at the Tank Farm. Because of the high sodium content from decontamination activities, this waste has been called ***mixed transuranic waste/sodium-bearing waste*** (***referred to as mixed transuranic waste/***SBW). In addition, newly generated liquid waste from processes and decontamination activities at INTEC facilities not associated with the HLW program and from other INEEL facilities has also been evaporated and ***stored at the Tank Farm***. All of this liquid waste at the Tank Farm has been managed by the HLW program. Some of this waste has been calcined with other liquids, and added to the bin sets. ***Calcine is stored at INTEC in the Calcined Solids Storage Facilities, which are referred to in this EIS as "bin sets."***

The Tank Farm consists of storage tanks, tank vaults, interconnecting waste transfer lines, valves and valve boxes, cooling equipment, and several small buildings that contain instrumentation and equipment for the waste tanks. ***The liquid wastes are stored in ten 300,000-gallon capacity tanks (an additional 300,000-gallon tank is available as a spare). Five of the tanks are of a design known as "pillar and panel." The Tank Farm also includes four smaller 30,000-gallon waste tanks that were flushed and removed from service in 1983. Disposition of all 15 tanks is within the scope of this EIS.***

Other processes at INTEC such as the Process Equipment Waste Evaporator, which concentrates low-level liquid waste, and the Liquid Effluent Treatment and Disposal Facility, which processes evaporator overheads, generate waste that is managed by the HLW Program. Figure 2-***4*** shows a simplified flow diagram of the INTEC HLW system.

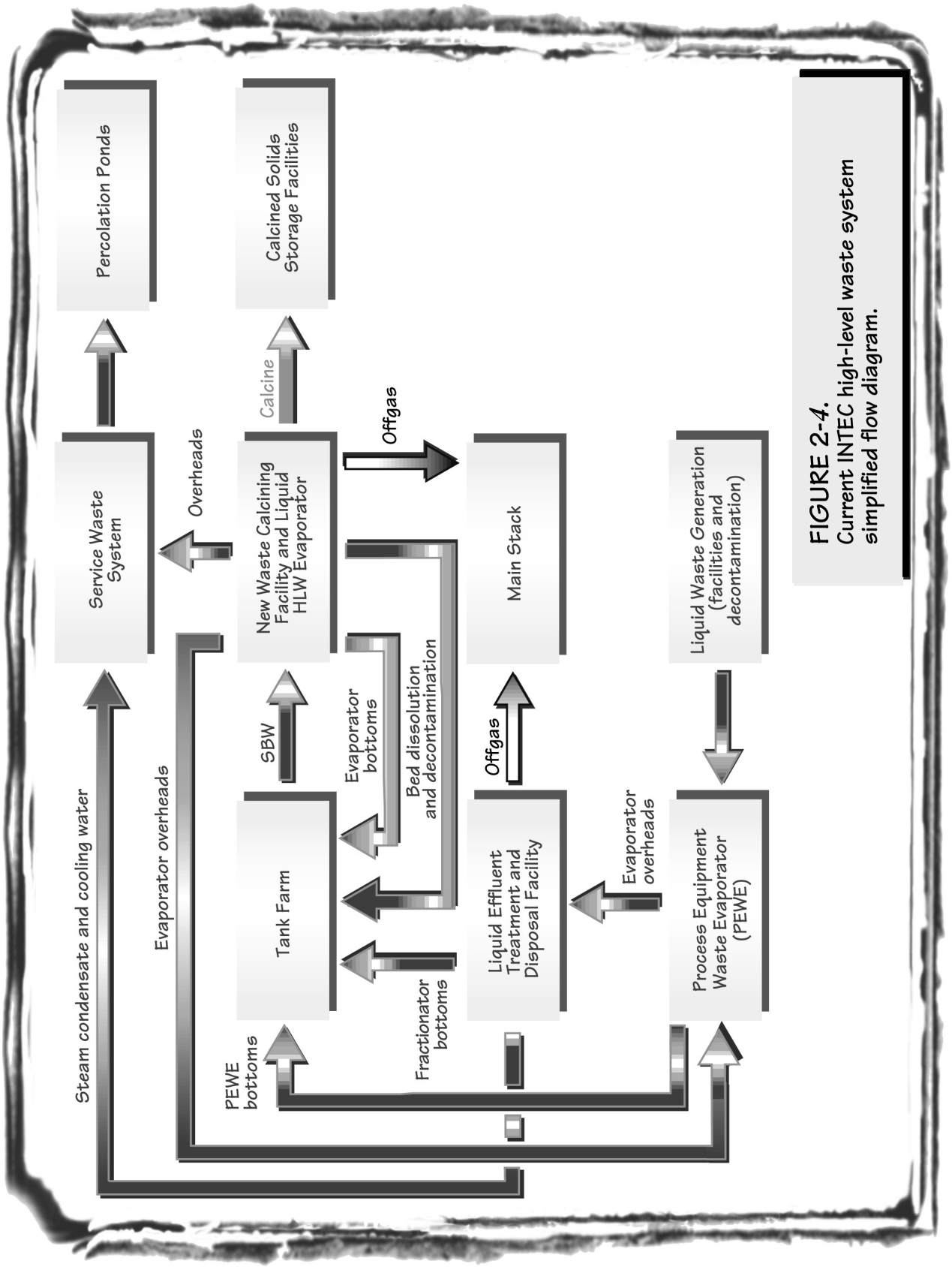


FIGURE 2-4.
Current INTEC high-level waste system simplified flow diagram.

Since 1963, liquid wastes stored at the Tank Farm have been converted to a dry, stable granular form called calcine using the waste calcining facilities at INTEC. In addition to putting the liquid into a solid form that poses less risk to the environment, calcining provides a two- to ten-fold volume reduction. As of February 1998, all of the liquid ***mixed*** HLW derived from first cycle uranium extraction was converted to calcine. Calcining of the mixed transuranic waste/SBW and newly generated liquid waste remaining in the tanks ***continued through May 2000. The New Waste Calcining Facility calciner was placed in standby in May 2000 in accordance with the Notice of Noncompliance Consent Order***. ***The inventory of liquids in the INTEC Tank Farm varies depending on operations and use of the High-Level Liquid Waste Evaporator.*** There are approximately ***1 million*** gallons of liquid in the ***Tank Farm***. ***As of May 2000,*** there are approximately ***4,400*** cubic meters of mixed HLW calcine in the bin sets. Figure 2-***5*** shows the seven bin sets at INTEC (six operational and one spare).

With DOE's decision to discontinue ***spent nuclear fuel*** processing, the mission of INTEC shifted to management of the accumulated HLW from past spent nuclear fuel processing and the wastes generated by activities and ongoing INTEC operations. Many former waste operations and fuel processing facilities at INTEC have been or will soon be shut down as their missions are completed. The Tank Farm, bin sets, New Waste Calcining Facility calciner, and associated support buildings, structures, and laboratories (as well as any HLW management facilities that would be constructed under the waste processing alternatives) would be decontaminated and decommissioned. Decisions regarding closure of these facilities under this EIS will be coordinated with the INEEL ***Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*** Program.

2.2.3 TECHNOLOGY DEVELOPMENT

Since the 1950s, DOE has engaged in numerous research and technology development activities to ensure that HLW and mixed transuranic waste/SBW at INTEC can be safely managed and ultimately prepared for disposition in a geologic repository or other appropriate disposal facility. The technology development and demonstration studies were carried out using the laboratory and pilot plant facilities at INTEC. Areas of technology development, which took place at DOE's national laboratories and major universities, include:

- Calcining mixed transuranic waste/SBW
- Separations technologies
- Immobilization technologies
- Removing or stabilizing tank heels
- Retrieving and dissolving calcine

Calcination of Mixed Transuranic Waste (SBW)

The SNF & INEL EIS and Record of Decision determined that HLW and mixed transuranic waste/SBW in the Tank Farm should continue to be calcined while other treatment options were studied. Unlike the liquid HLW, the mixed transuranic waste/SBW cannot be calcined directly due to the presence of low melting point alkali compounds formed during calcination that clog the New Waste Calcining Facility calcine bed. A large amount of nonradioactive aluminum nitrate solution must be added to the waste before it is fed into the calciner. In order to meet its commitments to complete calcination of the mixed transuranic waste/SBW by December 2012, DOE studied alternative methods for calcining this waste. Two techniques emerged as viable candidates: (1) high temperature calcination and (2) sugar-additive calcination (LMITCO 1997). Based on the results of the pilot plant studies, DOE determined high temperature calcination to be the viable technological solution. High temperature calcination ***was*** demonstrated during calciner operations through June 2000.

Separations Technologies

DOE is making every effort to manage waste in the most efficient and environmentally conscious way. As part of this effort, DOE is proposing HLW volume-reduction and treatment processes that would generate low-level wastes as a byproduct. In this regard, DOE has examined several separation techniques to reduce the

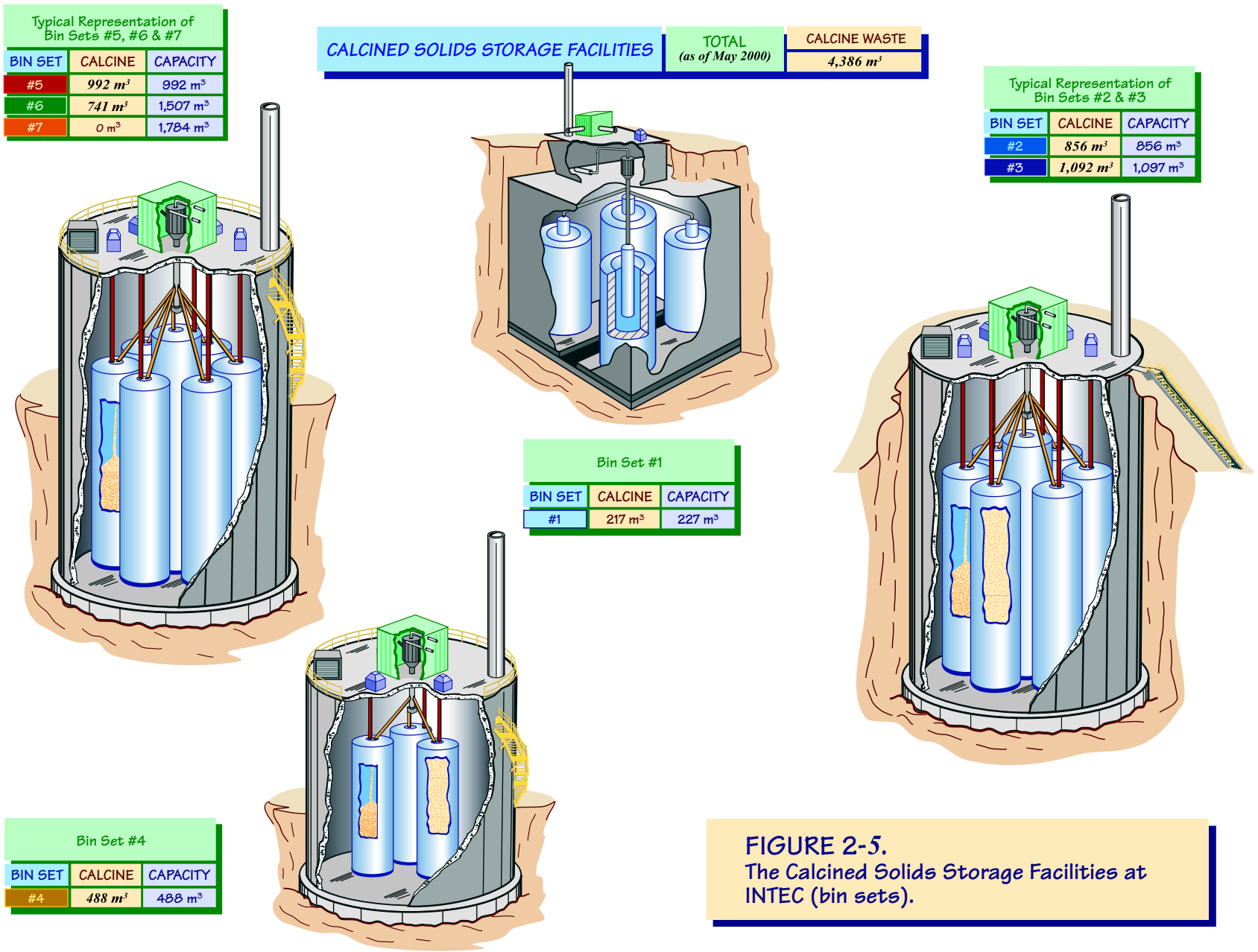


FIGURE 2-5.
The Calcined Solids Storage Facilities at INTEC (bin sets).

volume of HLW that must ultimately be disposed of in a repository. These techniques would separate the waste into a small HLW fraction containing most of the short-lived (cesium, strontium) and long-lived (transuranic) radioactive components or a small transuranic waste fraction containing most of the transuranics. These fractions would be treated for acceptance at a repository. In either case, the large volume of remaining waste would be considered a low-level waste ***or transuranic waste*** fraction and managed accordingly. Thus, in this EIS, the term fraction is used to describe chemical separation products.

Immobilization Technologies

DOE analyzed potential technologies to treat and immobilize calcine and mixed transuranic waste/SBW (LITCO 1995). This study evaluated 27 options using criteria that considered technology, cost, and other factors. DOE identified two ways to treat mixed transuranic waste/SBW and calcine: direct immobilization or radionuclide separation followed by vitrification. Subsequent studies, such as the *High-Level Waste Alternatives Evaluation* (LMITCO 1996), examined selected options in greater detail, particularly with respect to cost. This study also considered vitrification of the waste at an alternative DOE site. DOE has also looked at ways to immobilize the low-level waste or transuranic waste fractions, resulting from the separation technologies, with grout.

What is Calcination?

Calcine results from heating a substance to a high temperature that is below its melting or fusing point. At INEEL, calcination is carried out in the calciner in the New Waste Calcining Facility where liquid HLW and mixed transuranic waste/SBW are converted into the granular solid known as calcine. The liquid waste is drawn from the Tank Farm and sprayed into a vessel containing an air-fluidized bed of granular solids. The bed is heated by combustion of a mixture of kerosene and oxygen. All of the liquid evaporates, while radioactive fission products adhere to the granular bed material in the vessel. The gases from the reaction vessel (called offgases) are processed in the offgas cleanup system before they are released to the environment.

Calcination reduces the volume of the radioactive liquid waste (usually 2 to 10 times), so less storage space is needed. The final waste form is a dense powder similar in consistency to powdered detergent. These calcined solids are transferred to the Calcined Solids Storage Facilities, commonly referred to as bin sets. The bin sets are a series of concrete vaults, each containing three to seven stainless steel storage bins.

Tank Heel Removal/Stabilization

To close the eleven 300,000-gallon waste storage tanks in the INTEC Tank Farm, DOE may need to design, construct, and operate equipment to internally rinse and remove the 5,000- to 20,000-gallon heels (liquid and solids remaining after a tank has been emptied using the currently installed transfer jets). Special heel removal equipment could include mixing pumps to suspend the solids in the heel and keep them in suspension for transfer out of the tanks, and pumps to transfer the mixed heel solution from the tanks. Remote technology could be used to rinse inside the tank (DOE 1995). An ongoing program of technology development continues to explore improved retrieval methods. In June 1999, DOE completed a demonstration testing the ability of a specially formulated grout to move and raise the liquid residue from the bottom of the tank to the level of the jet inlet so that more liquid can be suctioned out of the tank and to stabilize the residue that cannot be removed (DOE 1999b). Figure 2-***6*** illustrates the ***proposed process for*** tank heel removal and stabilization.

Calcine Retrieval

To remove calcine from the bin sets, DOE would need to design, construct, and operate equipment to access the individual storage bins located

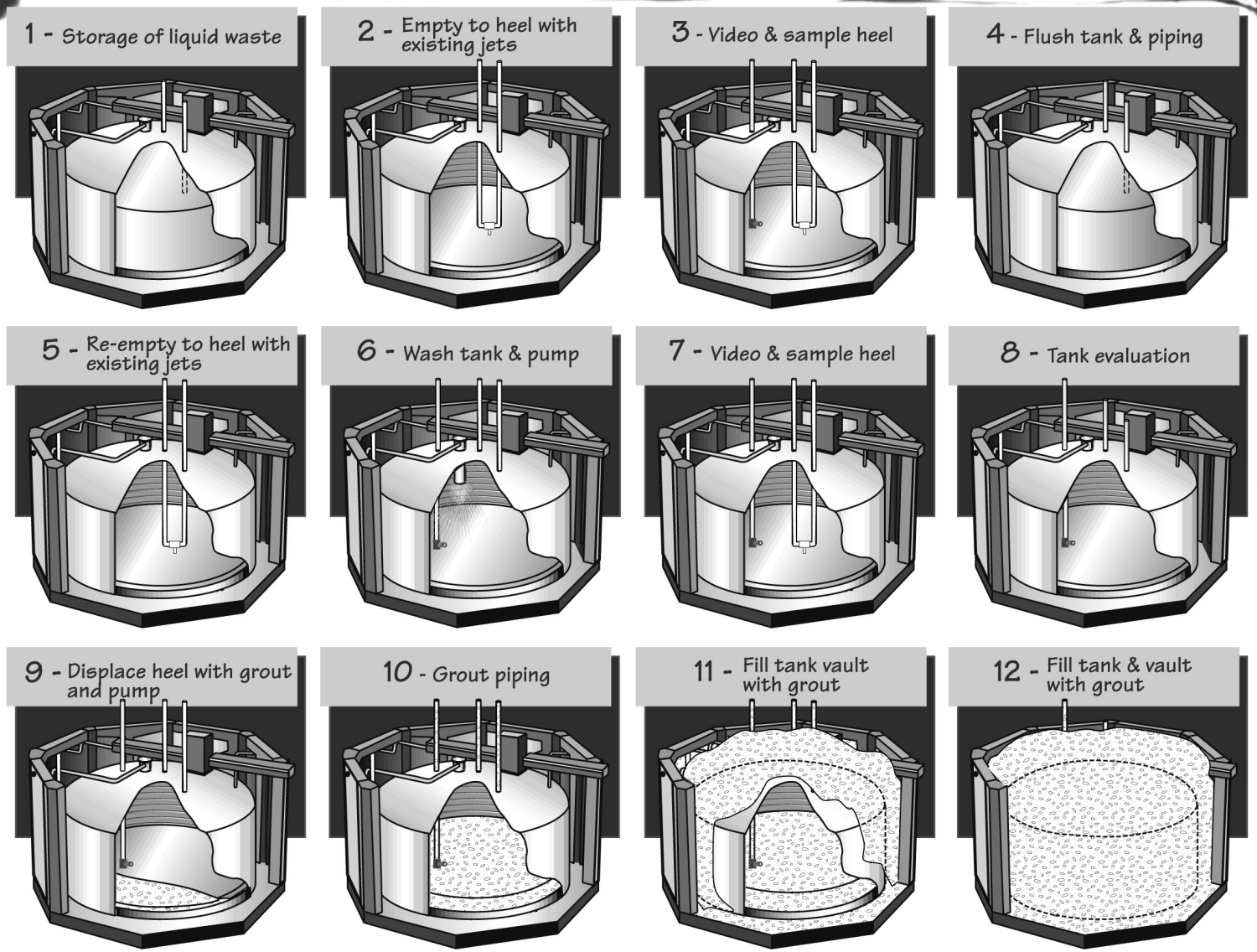


FIGURE 2-6. Tank heel removal and stabilization.

Vitrification

Vitrification is a method of immobilizing the radionuclides and hazardous constituents in the waste by incorporating them into glass. The waste is combined with frit (finely ground glass or sand) or glass-forming chemicals and the resultant mixture is melted at temperatures between 1,000 and 1,200 degrees Celsius. The molten glass mixture is then poured into stainless steel canisters to solidify.

The waste feed to the vitrification process may be in solid (e.g., calcine) or liquid form. The frit can be varied according to the type of waste in order to produce a glass with the desired characteristics. The type of glass commonly used to immobilize wastes such as those at the INEEL is known as borosilicate glass. The U.S. Environmental Protection Agency (EPA) has specified vitrification (borosilicate glass) as the best demonstrated available technology for treatment of HLW (55 FR 22520; June 1, 1990). Borosilicate glass has been used to vitrify HLW in several facilities in the United States and other countries.

within the bin set vaults, retrieve the calcine, and decontaminate the internal surfaces of the bins. Calcine retrieval is expected to use pneumatic techniques similar to the system used to transfer calcine from the New Waste Calcining Facility calciner to the bins. An air jet would agitate the calcine, and a suction nozzle would lift the agitated calcine out of the bin. This technique is expected to remove more than 99 percent of the stored calcine. If required, further cleaning could involve the use of robotics to remove additional calcine from the floor of the bins or other techniques to remove calcine from bin wall surfaces. DOE is examining cleaning techniques that are suitable for remote operation in the high radiation fields in the bins, are compatible with the bin materials, minimize secondary waste generation and environmental impacts, and enhance worker safety.

2.2.4 HIGH-LEVEL WASTE MANAGEMENT IN A NATIONAL CONTEXT

Four DOE sites now manage HLW: INEEL, the Savannah River Site in South Carolina, the Hanford Site in Washington, and the West Valley Demonstration Project in New York. DOE processed spent nuclear fuel at the first three sites. Although the West Valley Demonstration Project was a commercial spent nuclear fuel processing facility, under the West Valley Demonstration Project Act (Public Law 96-368), DOE has responsibility for the treatment of the HLW inventory and disposition of the facilities used during the demonstration.

As a result of processing spent nuclear fuel, DOE has generated approximately 100 million gallons of liquid HLW complex-wide. Approximately 90 percent of this waste remains in storage in liquid form. DOE is proceeding with plans to treat the liquid HLW, converting it to solid forms that would not be readily dispersible into air or leachable into groundwater or surface water. ***To date, treatment decisions at the Savannah River Site, West Valley Demonstration Project, and Hanford Site have generally involved solidification of HLW via vitrification.*** Vitrification would be expected to produce approximately 22,000 canisters (the canisters vary in volume of vitrified HLW from 0.6 to 1.2 cubic meters) from the current inventory of HLW at all four sites. The ***projected quantity of*** INEEL HLW ***represents*** approximately ***6*** percent of the total DOE inventory of immobilized HLW canisters. DOE plans to dispose of the ***immobilized HLW*** canisters in a geologic repository (DOE ***2002a***).

The following sections describe the current status of DOE's HLW management and facility disposition activities at the other sites. The map inside the cover of this EIS indicates the locations of these DOE sites.

Savannah River Site

The Savannah River Site currently manages approximately 34 million gallons of HLW in two Tank Farms containing a total of 51 tanks. In 1982, DOE prepared an EIS for the Defense

Waste Processing Facility, a system for treatment of HLW at the Savannah River Site that includes HLW pretreatment processes, a Vitrification Facility, ***a low-level waste grout*** and disposal facility, glass waste storage facilities, and associated support facilities (DOE 1982a). That EIS, its Record of Decision, and a subsequent *Environmental Assessment, Waste Form Selection for Savannah River Plant High-Level Waste* (DOE 1982b) provided environmental impact information that DOE used in deciding to construct and operate the Defense Waste Processing Facility to immobilize the HLW generated from processing activities in borosilicate glass. Modifications to the original design for the Defense Waste Processing Facility were implemented following publication of the 1982 EIS. In a Record of Decision for a supplemental EIS (DOE 1994), DOE decided to ***operate*** the Defense Waste Processing Facility system ***with the modifications.***

The pretreatment processes would separate HLW into HLW and low-level waste fractions. Since 1990, certain low-level wastes have been blended with cement, slag, and flyash to create a concrete-like waste form known as "saltstone." The saltstone mixture is disposed of onsite in large concrete vaults. In 1996, the vitrification facility began immobilizing the HLW sludges in borosilicate glass. As canisters of vitrified waste are produced, they are stored in shielded, underground concrete vaults pending disposal in a geologic repository.

In 1996, DOE developed the general protocol and performance objectives for operational closure of the Savannah River Site HLW tanks in consultation with the South Carolina Department of Health and Environmental Control and EPA Region IV (DOE 1996a). DOE completed the first closure of a Savannah River Site HLW storage tank in 1997. This closure configuration includes *in situ* stabilization of the residual material (the tank heel) that cannot practicably be removed using available waste removal techniques. ***A second HLW tank was also closed in 1997 using the same closure configuration. DOE has prepared an EIS (DOE 2002b) that evaluates alternatives for closure of the remaining HLW tanks at the Savannah River Site.***

Hanford Site

The Hanford Site currently manages approximately 54 million gallons of HLW in 177 underground tanks (149 single-shell tanks and 28 double-shell tanks). The waste consists of highly alkaline sludge, saltcake, slurry, and liquids. The *Tank Waste Remediation System Final EIS*, issued in August 1996, evaluated management and disposal alternatives for the Hanford tank waste. The Record of Decision calls for phased implementation of the proposal to retrieve the waste, separate it into HLW and low-activity waste fractions, vitrifying both fractions, with the low-activity waste disposed of onsite and the HLW stored onsite until it can be shipped offsite for disposal in a geologic repository (DOE 1996b). Closure of the Hanford HLW tanks will be the subject of a future National Environmental Policy Act review.

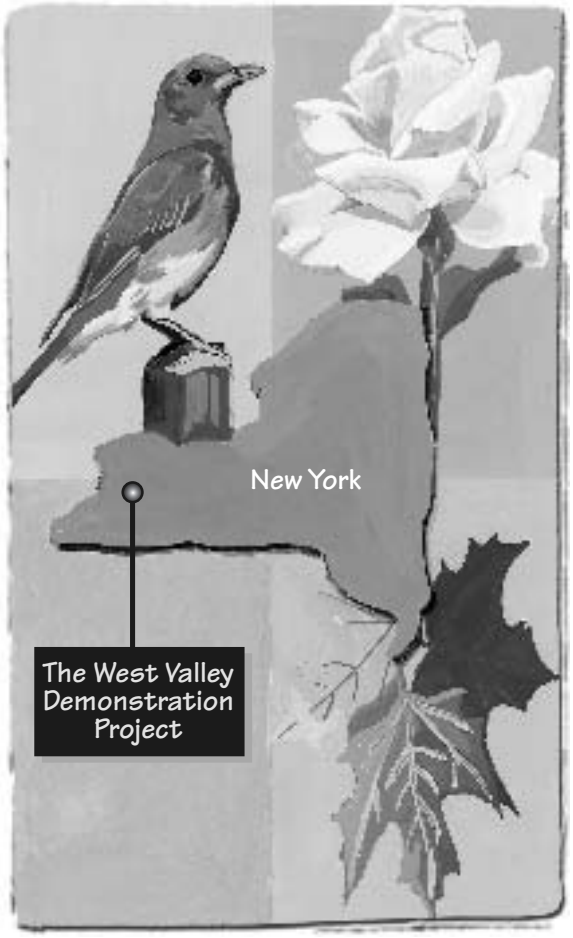
In 1992, DOE established the Tank Waste Remediation System Program to manage, retrieve, treat, immobilize, and dispose of the Hanford Site tank wastes in a safe, environmentally sound, and cost-effective manner. In FY 2001, as directed by Congress, the Tank Waste Remediation System Program was renamed the River Protection Project and is managed by the Office of River Protection. A major objective of the project is to immobilize 10 percent of the tank waste by volume and 25 percent of the tank waste by radioactivity by 2018. In May 2000, DOE terminated the privatized construction contact with British Nuclear Fuel Limted (BNFL), Inc. and awarded a competitively bid, non-privatized design and construction contract for the Waste Treatment and Immobilization Plant (WTP) to Bechtel National, Inc. (BNI) in December 2000. The facility consists of a Pretreatment Plant, a Low Level Waste (LLW) Vitrification Facility, a HLW Vitrification Facility as well as an analytical laboratory and support facilities. The facilities have been designed to support production of up to 30 metric tons of glass per day of immobilized LLW and 1.5 metric tons of glass per day of immobilized HLW. The BNI contract requires that hot commissioning of the facility begin by December 2007 and conclude by January 2011. After hot commissioning is completed, the WTP will then be turned over to an operations contractor in 2011. The Department is continuing to accelerate the project by providing contractor fee incentives to optimize life-cycle performance, cost, and schedule, including the process design, facility design, and technologies.

West Valley Demonstration Project

The Western New York Nuclear Service Center is owned and managed by the New York State Energy Research and Development Authority. The Center contains a commercial spent nuclear fuel processing facility that operated from 1966 to 1972 and generated approximately 600,000 gallons of liquid HLW. Under the West Valley Demonstration Project Act of 1980, DOE assumed possession of the portion of the facility that includes the former reprocessing facility and the HLW tanks, waste lagoons, and waste storage areas. The Act also assigned the Nuclear Regulatory Commission to provide oversight in the areas of radiation health and safety.

In 1982, DOE prepared an EIS and then issued a Record of Decision for the operation of the West Valley Demonstration Project that selected concentration and chemical treatment followed by vitrification as the immobilization technology for the Project's HLW inventory (47 FR 40705; September 15, 1982). Vitrification of the HLW began in July 1996. Approximately 300 canisters of vitrified HLW ***will be*** produced and stored, pending disposal in a geologic repository (DOE 1997b).

In 1996, DOE and the New York State Energy Research and Development Authority prepared a draft EIS that evaluated alternatives for completion of the West Valley Demonstration Project (DOE 1996c, 1997c). ***DOE and the New York State Energy Research and Development Authority have revised their strategy for completing this review (66 FR 16447, March 26, 2001). DOE now intends to prepare and issue for public comment a revised Draft EIS that***

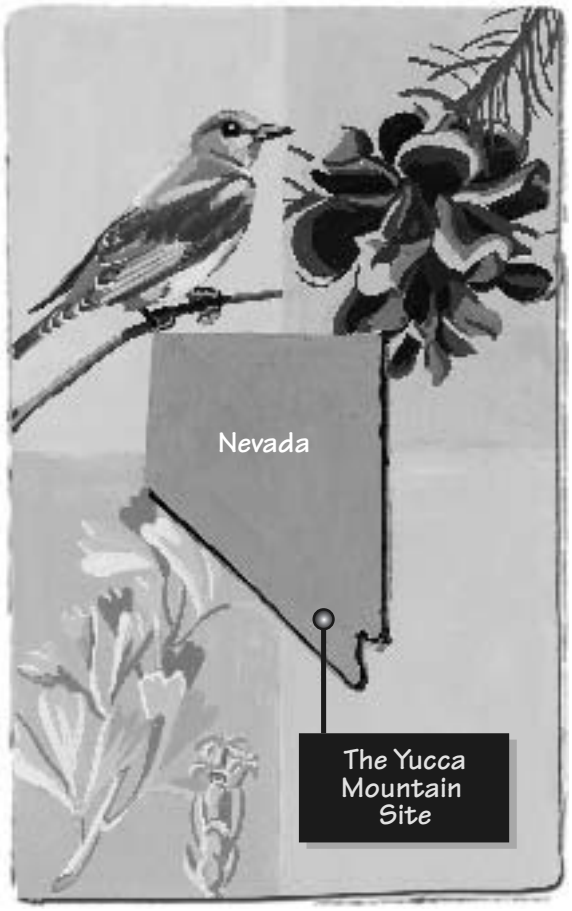


will focus on DOE's actions to decontaminate West Valley facilities and manage wastes controlled by DOE under the Project. DOE also intends to issue a second EIS with the New York State Energy Research and Development Authority as a joint lead agency, that would focus on site closure and/or long-term stewardship at West Valley.

The Nuclear Regulatory Commission ***has developed*** decommissioning criteria for the ***West Valley Demonstration Project site***. ***The Commission has issued a policy that would apply the License Termination Rule (10 CFR 20, Subpart E), which sets the decommissioning requirements for all NRC licensees, as decommissioning criteria for the West Valley Demonstration Project site. Following completion of the EIS and identification of a preferred alternative, NRC will verify that the criteria proposed by DOE are within the License Termination Rule, and will prescribe specific criteria for the site (67 FR 5003, February 1, 2002).***

Geologic Repository at Yucca Mountain

The Nuclear Waste Policy Act, as amended (42 USC 10101 et seq.), establishes a process for determining whether to recommend the site to the President for development of a repository. As part of this decisionmaking process, ***DOE*** is to undertake the physical characterization of the Yucca Mountain site. ***Upon the Secretary of Energy's recommendation for*** approval of the site and the ***President's determination that*** the site ***is*** qualified for an application for construction authorization, the Nuclear Waste Policy Act, as amended, directs the President to submit a recommendation of the site to Congress. Within 60 days of the day the President recommends the site, the Governor and Legislature of the State of Nevada can submit a notice of disapproval of the site to Congress. If the Governor and Legislature



do not submit a notice of disapproval within 60 days, the site designation becomes effective. If they submit a notice of disapproval, the site is disapproved unless Congress then passes a resolution approving the repository site during the first period of 90 calendar days of continuous session.

Section 114(d) of the Act instructs the Nuclear Regulatory Commission to limit the first repository to emplacement of a quantity of spent nuclear fuel containing 70,000 metric tons of heavy metal (MTHM) or a quantity of solidified HLW resulting from reprocessing that amount of spent nuclear fuel until a second geologic repository is in operation. Current projections of the spent nuclear fuel and HLW inventories from civilian and government sources exceed 70,000 MTHM.

In a report required by Section 8 of the Nuclear Waste Policy Act of 1982 (Public Law 97-425), the Secretary of Energy was required to recommend to the President whether defense HLW should be disposed of in a geologic repository with commercial spent nuclear fuel. Table 1-1 of that report, *An Evaluation of Commercial Repository Capacity for the Disposal of Defense High-Level Waste* (DOE 1985), provided MTHM equivalence for HLW.

The MTHM quantity for spent nuclear fuel is determined by the actual heavy metal content of the fuel. The Nuclear Waste Policy Act also specifies that the 70,000 MTHM limitation as it applies to HLW is to be determined by the "...quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent nuclear fuel...." That method of determining an MTHM "equivalence" does not recognize the differences in radiological content between spent nuclear fuel and HLW.

DOE would emplace 10,000 to 11,000 waste packages containing no more than 70,000 MTHM of spent nuclear fuel and HLW in the repository. Of that amount, 63,000 MTHM would be spent nuclear fuel assemblies that would be shipped from commercial sites to the repository. The remaining 7,000 MTHM would consist of about 2,333 MTHM of DOE spent nuclear fuel, and approximately 8,315 canisters (the equivalent of 4,667 MTHM) ***of HLW*** that DOE would ship to the repository (DOE ***2002a***). To determine the number of canisters of HLW included in the waste inventory, DOE used 0.5 MTHM per canister of defense HLW. DOE has recognized that determination of appropriate MTHM equivalence was necessary, therefore, DOE considered several equivalency techniques, including the method based on spent nuclear fuel reprocessed, a method based on total radioactivity in the material, and a method based on radiotoxicity (Knecht et al. 1999). For a brief description of these techniques see Chapter 6 ***of this EIS***. Though DOE has recognized these other equivalency techniques; DOE has used the 0.5 MTHM per canister approach since 1985 (DOE 1985).

DOE is continuing to conduct site characterization activities at Yucca Mountain to determine whether that site is suitable for geologic disposal of spent nuclear fuel and HLW. ***For status of Yucca Mountain site approval process, see Section 2.3.1: EIS for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain.*** Final technical standards for the HLW to be disposed of in the geologic repository are not yet available. Analyses in the repository EIS and other DOE National Environmental Policy Act documents and decisions based on these analyses regarding management of spent nuclear fuel and HLW are based on the best available knowledge regarding these draft technical standards. DOE evaluated alternative

Metric Tons of Heavy Metal (MTHM)

Quantities of unirradiated and spent nuclear fuel and targets are traditionally expressed in terms of metric tons of heavy metal (typically uranium), exclusive of other materials, such as cladding, alloy materials, and structural materials. A metric ton equals approximately 2,200 pounds. Section 6.3.2.4 ***of this EIS*** *more fully describes issues related to MTHM.*

treatments for the ***mixed*** HLW at INEEL based on the current waste acceptance criteria for the ***proposed geologic*** repository (DOE 1996d, 1999c; TRW 1997).

2.2.5 *LEGAL REQUIREMENTS* FOR HIGH-LEVEL WASTE MANAGEMENT

Environmental restoration and waste management activities at ***the*** INEEL are subject to ***a number of*** laws and regulations that apply to the treatment, storage, and disposal of wastes, and the determination of cleanup standards and schedules. This section discusses the specific requirements for management of ***mixed*** HLW and disposition of associated facilities at INTEC. This information is repeated in Chapter 6, Statutes, Regulations, Consultations and Other Requirements, which also provides supplemental information on environmental regulations and DOE's compliance status.

Federal and state requirements for the management of ***mixed*** HLW and disposition of associated facilities at INTEC include those established under:

- Atomic Energy Act
- Nuclear Waste Policy Act
- EPA Environmental Radiation Protection Standards
- Resource Conservation and Recovery Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- Idaho Settlement Agreement/Consent Order
- Notice of Noncompliance Consent Order.
- Site Treatment Plan (under the Federal Facility Compliance Act)

Table 2-1 identifies site-specific agreements between DOE and the State of Idaho that affect the management of mixed HLW and disposition of associated facilities at INTEC. The table also provides a summary of the specific milestones and their current status.

Atomic Energy Act

The Atomic Energy Act of 1954 (42 USC 2011, et seq.) establishes responsibility for the regulatory control of radioactive materials including radioactive wastes. Pursuant to the Atomic Energy Act, DOE established a series of Orders to protect health and minimize danger to life or property from activities at its facilities.

Potential exists for Congress to direct the Nuclear Regulatory Commission to assume regulatory authority over DOE facilities in the timeframe of the activities analyzed in this EIS. DOE has engaged in joint pilot projects with the Nuclear Regulatory Commission to assess the feasibility of Nuclear Regulatory Commission regulation at DOE facilities. Based on these pilot projects, DOE has identified a number of unresolved issues that should be evaluated further. Because DOE is not actively pursuing Nuclear Regulatory Commission regulation of DOE's facilities, the effects of Nuclear Regulatory Commission regulation of DOE-ID facilities, if any, are not discussed in this EIS (Richardson 1999a,b,c,).

Nuclear Waste Policy Act

The Nuclear Waste Policy Act of 1982, as amended (42 USC 10101 et seq.), established a national policy for disposal of HLW and spent nuclear fuel in a geologic repository.

EPA Environmental Radiation Protection Standards

In 1993, EPA issued "Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Waste," codified in 40 CFR 191.

Table 2-1. Agreements between DOE and the State of Idaho for operations at INTEC.

Agreement	Summary of milestones	Status of milestones/comments
1992 Consent Order, and Amendments, Resolving a 1990 Notice of Noncompliance under RCRA (Notice of Noncompliance Consent Order)	- DOE must cease use of the five pillar and panel tanks by March 31, 2009 - DOE must cease use of remaining tanks by June 30, 2015 - DOE must close the calciner if operation is not commenced by January 1, 1993, or operation is discontinued for three consecutive years	This Consent Order has been modified three times to reflect changes agreed upon between the State and DOE. None of these milestones is currently in effect.
1994 Modification to Notice of Noncompliance Consent Order	- DOE must calcine all ***liquid*** HLW by January 1, 1998	***The deadline for completing calcination of liquid HLW was changed to June 30, 1998 by the 1995 Settlement Agreement/Consent Order.***
	- DOE must evaluate and select ***treatment*** technologies for SBW and calcine by June 1, 1995	***DOE met this milestone with the issuance of the SNF & INEL EIS Record of Decision in May 1995.***
1995 Settlement Agreement/Consent Order, resolving the cases of Public Service Co. of Colorado v. Batt and United States v. Batt	- DOE shall complete the process of calcining all the remaining liquid HLW by June 30, 1998	***DOE completed calcination of the remaining liquid HLW in February 1998, by lowering the liquid level to the greatest extent possible by use of existing equipment, in accordance with the second modification to the Notice of Noncompliance Consent Order paragraph VIII.G.***
	- DOE shall commence calcination of SBW by June 1, 2001	***DOE met this milestone by commencing calcination of SBW in February 1998.***
	- Begin negotiation of a plan and schedule for treatment of calcined waste by December 1999	***In conjunction with this EIS, DOE and the State of Idaho commenced negotiation for treatment of calcined waste in September 1999.***
	- Complete calcination of SBW by December 31, 2012 - Treat all ***HLW currently at INEL*** so that it is ***ready to be moved out of*** Idaho ***for disposal by a target date of 2035***	DOE is currently in compliance with this Settlement Agreement/Consent Order. Ability to meet commitments for calcination may be affected by subsequent decisions regarding treatment technologies ***and disposal requirements.***

Table 2-1. Agreements between DOE and the State of Idaho for operations at INTEC (continued).

Agreement	Summary of milestones	Status of milestones/comments
1998 Modification to Notice of Noncompliance Consent Order	- DOE must cease use of the pillar and panel ***vault*** tanks by June 30, 2003 - DOE must cease use of the remaining tanks by December 31, 2012 - ***Closure plans developed for these tanks will address the remaining heel and vaults, and the use of these tanks and equipment for closure including any flushing or other cleaning of the tanks***	These milestones are in effect, except for the requirement regarding operation of the calciner (see below). ***DOE and the State of Idaho have agreed to define "cease use" as emptying the tanks to their heels (i.e., the liquid level remaining in each tank after lowering to the greatest extent possible by use of the existing transfer equipment). DOE intends to segregate newly generated liquid waste in 2005. DOE could employ RCRA-compliant storage after 2012, if necessary*** .
	- ***DOE shall submit a closure plan for at least one pillar and panel vault tank by December 31, 2000***	***DOE submitted a closure plan for two tanks in December 2000.***
	- DOE must place the calciner in a standby mode by April 30, 1999, unless and until a hazardous waste permit is received. DOE will determine on June 1, 2000 whether to operate or not and submit a schedule for closure or for permitting	***The date for operation of the calciner was extended to June 1, 2000 by the 1999 Modification to the Notice of Noncompliance Consent Order.***

Table 2-1. Agreements between DOE and the State of Idaho for operations at INTEC (continued).

Agreement	Summary of milestones	Status of milestones/comments
1999 Modification to Notice of Noncompliance Consent Order	- The date for operation of the calciner is extended to June 1, 2000	***DOE placed the calciner in standby prior to the extended deadline of June 1, 2000. Shutdown activities included flushing the system. DOE submitted a two-phased, partial closure plan on August 29, 2000, for the calciner portion of the New Waste Calcining Facility that is consistent with the Consent Order milestone and 40 CFR 265.112(a). The closure plan describes and accommodates the EIS decision-making process and schedule. If DOE decides in the Record of Decision for this EIS to upgrade and permit the calciner, DOE would modify the closure plan accordingly through the permitting process.*** The potential lack of availability of the calciner after June 1, 2000 could impact the milestone for completion of calcination by December 31, 2012.
	- Begin, ***by June 7, 1999***, submitting monthly ***calciner*** air emission reports ***until one month after the calciner is placed in standby***	***DOE began the monthly submittals to the State of Idaho by June 7, 1999 and continued until one month after the calciner was placed in standby.***
	- Complete a plan and schedule for inspection and corrosion coupon evaluation of the tanks by November 15, 1999	***DOE met this milestone by submitting the plan and schedule to the State of Idaho by November 15, 1999.***

These standards provide for isolation of the radioactive portion of the waste in order to limit releases to the environment, including releases to underground sources of drinking water, for 10,000 years after disposal. This regulation would be generally applicable to the disposal of HLW or transuranic waste into any disposal system other than the proposed geologic repository at Yucca Mountain, which is exempt from these standards because site-specific standards (40 CFR 197, "Environmental Protection Standards for Yucca Mountain, Nevada") ***have been*** developed. ***These standards*** may therefore be applicable to residual materials left in the tanks or bins at INTEC if DOE determines the residue ***will*** be ***managed*** as HLW or transuranic waste.

On ***June 13, 2001 (66 FR 32074)***, EPA ***promulgated*** "Environmental Radiation Protection Standards for Yucca Mountain, Nevada" codified in 40 CFR 197. These regulations contain the site-specific public health and safety standards governing storage or disposal of radioactive material within the proposed repository at Yucca Mountain.

Resource Conservation and Recovery Act/Idaho Hazardous Waste Management Act

The ***mixed*** HLW, mixed transuranic waste/SBW, and associated wastes managed at INTEC ***con-***

tain a combination of "characteristic" (e.g., toxic or corrosive) and "listed" hazardous wastes that are regulated under RCRA (DOE 1998a). RCRA requires regulated wastes to be treated in accordance with the applicable land disposal restrictions treatment standards before disposal. A technology for treatment of the waste that does not comply with all of the applicable treatment standards could only be used if a treatment variance or determination of equivalent treatment were obtained.

The treated waste forms (HLW and any transuranic or low-level wastes) would still be considered "mixed waste" under RCRA. Under the current waste acceptance criteria (DOE 1999c), DOE would not accept RCRA-regulated HLW at the potential geologic repository at Yucca Mountain. It would be necessary for DOE to obtain a "delisting" for the treated HLW or obtain a RCRA permit for the repository. The Waste Isolation Pilot Plant is permitted to receive certain RCRA-regulated transuranic wastes. However, it may be necessary to modify the Waste Isolation Pilot Plant's RCRA permit, or seek a delisting, in order to dispose of the transuranic waste portion of the INTEC waste. INEEL has no mixed low-level waste disposal capacity. Consequently, any mixed low-level waste fraction would need to be treated to meet land disposal restriction standards and delisted prior to onsite disposal. Further, DOE's Record of Decision for the Waste Management PEIS states that Hanford or the Nevada Test Site would serve as the regional disposal facilities for DOE's mixed low-level waste. These offsite disposal options along with available commercial facilities would be considered for any INEEL mixed low-level waste treated to meet land disposal restriction standards but not delisted.

The existing INTEC waste management facilities are regulated by the Idaho ***Department*** of Environmental Quality and EPA as "interim status" facilities under RCRA. The major existing HLW facilities addressed by this EIS that are regulated under RCRA include:

- Tank Farm
- Calcined Solids Storage Facilities (bin sets)
- New Waste Calcining Facility calciner
- Process Equipment Waste Evaporator
- Liquid Effluent Treatment & Disposal Facility

The Idaho Hazardous Waste Management Act regulates operations and closure of these facilities. New treatment facilities to implement DOE's decisions based on this EIS would also be regulated under RCRA.

Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA, as amended by the Superfund Amendments and Reauthorization Act (42 USC 9601 et seq.), provides a statutory framework for cleaning up waste sites containing hazardous substances and provides an emergency response program in the event ***or threat*** of a release of a hazardous substance to the environment. The INEEL was placed on the National Priorities List in 1989 due to confirmed releases of contaminants to the environment. The State of Idaho, EPA, and DOE signed a Federal Facility Agreement and Consent Order in 1991 that outlines a process and schedule for conducting investigation and remediation activities at the INEEL. To better manage the investigation and cleanup, the Agreement divides the INEEL into 10 Waste Area Groups.

Facility disposition decisions ***under this EIS*** must be coordinated with the INEEL Environmental Restoration Program's Record of Decision under CERCLA for Waste Area Group 3. Waste Area Group 3 is an area containing suspected release sites designated for investigation under the INEEL Federal Facility Agreement and Consent Order which encompasses the INTEC area.

Notice of Noncompliance Consent Order

In 1992, DOE and the Idaho Department of Health and Welfare signed a consent order to resolve the Notice of Noncompliance issued by

EPA Region 10 on January 29, 1990 (Monson 1992). This Notice of Noncompliance Consent Order addresses concerns regarding the RCRA secondary containment requirements for the INEEL HLW tanks by prescribing dates by which the tanks must be removed from service. In accordance with this Consent Order and an August 18, 1998 modification (Cory 1998), five of the tanks known as pillar and panel tanks must be removed from service ("cease use") on or before June 30, 2003 and the remaining tanks on or before December 31, 2012. DOE-ID and the Idaho ***Department*** of Environmental Quality have agreed to define "cease use" as emptying the tanks to their "heels" (Cory 1998). A third modification to the Consent Order on April 19, 1999 (Kelly 1999) further stipulates that DOE must place the New Waste Calcining Facility calciner in a standby mode by June 1, 2000 unless the facility receives a hazardous waste permit for continued operation. ***DOE placed the calciner in standby prior to the deadline of June 1, 2000 and submitted a two-phased, partial closure plan on August 29, 2000, for the calciner portion of the New Waste Calcining Facility that is consistent with the Consent Order milestone and 40 CFR 265.112(a). If DOE decides in the Record of Decision for this EIS to upgrade and permit the calciner, DOE would modify the closure plan accordingly through the permitting process.***

Settlement Agreement/ Consent Order

In October 1995, the State of Idaho, the Department of the Navy, and DOE settled the case of Public Service Company of Colorado v. Batt, involving the management of spent nuclear fuel at INEEL. The resulting Consent Order (USDC 1995) requires DOE, among other things, to:

- Complete calcination of all remaining non-sodium bearing liquid ***mixed*** HLW by June 1998 (completed February 1998)
- Start negotiations with the State of Idaho by December 31, 1999 regarding a plan and schedule for treatment of calcined waste ***(begun September 1999)***
- Start calcination of liquid mixed transuranic waste/SBW by June 2001 (begun February 1998)
- Complete calcination of liquid mixed transuranic waste/SBW by December 2012
- Treat all ***HLW currently*** at INEEL ***so that it is ready to be moved out*** of Idaho ***for disposal*** by a target date of 2035

The Settlement Agreement/Consent Order also addresses the potential that the National Environmental Policy Act process may result in selection of an action that conflicts with the actions in the Agreement. In that event, ***Section J.4 of the Agreement provides a process where*** DOE may request ***a modification to the Settlement Agreement requirements*** to conform to the selected actions.

Site Treatment Plan

Under the Federal Facility Compliance Act of 1992, DOE was required to enter into an agreement with the State of Idaho as to how it would attain compliance with applicable treatment requirements for mixed wastes at INEEL. The Site Treatment Plan (DOE 1998a) sets forth the terms and conditions with which DOE must comply to satisfy the land disposal restrictions applicable to the hazardous components of the mixed wastes at INTEC. The Plan proposes treatment of ***mixed*** HLW and mixed transuranic waste/SBW by calcination through the New Waste Calcining Facility and a new Remote-Handled Immobilization Facility for processing the waste into forms suitable for disposal. In accordance with provisions of the Site Treatment Plan, these waste treatment proposals are updated annually by DOE.

2.3 EIS Scope and Overview

This EIS examines potential environmental impacts associated with managing mixed HLW and mixed transuranic waste/SBW and closing the HLW management facilities at INTEC. The

In August 2000, the Tanks Focus Area also conducted a follow-up independent technical review (TFA 2001) of a proposed steam-reforming treatment process for mixed transuranic waste/SBW to determine its feasibility, applicability, and cost realism, and provided the following recommendations:

- *Maintain and pursue direct vitrification as the baseline technology for treating and immobilizing mixed transuranic waste/SBW.*
- *Do not pursue further steam reforming initiatives for treatment of mixed transuranic waste/SBW to produce waste forms for direct disposal in a HLW geologic repository or at the Waste Isolation Pilot Plant.*
- *Follow a multi-step process with appropriate go/no go decision points to properly evaluate further steam reforming of mixed transuranic waste/SBW to produce an interim solid form suitable for subsequent vitrification.*
- *Consider the application of steam reforming to the treatment of the offgas that would be generated by direct vitrification of the mixed transuranic waste/SBW.*

DOE considered the Tanks Focus Area reports and recommendations as a part of its analysis of the EIS alternatives.

DOE Management Assessment of Alternatives - In September 2001 the DOE Assistant Secretary for Environmental Management requested an assessment of the preferred alternative recommended by the DOE and State of Idaho Decision Management Team and approved in October 2000. The assessment was to be conducted under the following assumptions:

- *Sodium bearing waste may be managed as mixed transuranic waste*
- *Treated SBW may be disposed of at WIPP*
- *Calcine is an acceptable final waste form for disposal at the geologic repository*
- *Steam reforming is an acceptable treatment technology for the SBW*
- *The mixed transuranic/SBW can be grouted in place*
- *The calciner may be operated in its present interim status configuration.*

The assessment team decided to add the Steam Reforming Option to the Final EIS in response to public and agency comment and additional information received from private sector industry.

The option of containerizing the mixed HLW calcine and shipping it to the geologic repository was added to this EIS as part of the Non-Separations Alternative in the Steam Reforming Option.

The option of grouting the mixed transuranic/SBW in place was eliminated from detailed analysis in this EIS because the waste would have to be removed from the tanks and the process involved to neutralize and grout the waste would result in a substantial increase in waste volumes with no long term reduction in risk to the environment.

The option of operating the calciner in its interim status configuration is not included in the detailed analysis in the Final EIS based on programmatic considerations.