

**Hanford Site River Protection Project
Tank Farm Closure**

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ABSTRACT

The U. S. Department of Energy, Office of River Protection and the CH2M HILL Hanford Group, Inc. are responsible for the operations, cleanup, and closure activities at the Hanford Tank Farms. There are 177 tanks overall in the tank farms, 149 single-shell tanks (see Figure 1), and 28 double-shell tanks (see Figure 2). The single-shell tanks were constructed 40 to 60 years ago and all have exceeded their design life. The single-shell tanks do not meet *Resource Conservation and Recovery Act of 1976* [1] requirements. Accordingly, radioactive waste is being retrieved from the single-shell tanks and transferred to double-shell tanks for storage prior to treatment through vitrification and disposal. Following retrieval of as much waste as is technically possible from the single-shell tanks, the Office of River Protection plans to close the single-shell tanks in accordance with the Hanford Federal Facility Agreement and Consent Order [2] and the *Atomic Energy Act of 1954* [3] requirements. The double-shell tanks will remain in operation through much of the cleanup mission until sufficient waste has been treated such that the Office of River Protection can commence closing the double-shell tanks. At the current time, however, the focus is on retrieving waste and closing the single-shell tanks.

The single-shell tanks are being managed and will be closed in accordance with the pertinent requirements in: *Resource Conservation and Recovery Act of 1976* and its Washington State-authorized Dangerous Waste Regulations [4], US DOE Order 435.1 Radioactive Waste Management [5], the *National Environmental Policy Act of 1969* [6], and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*. [7] The Hanford Federal Facility Agreement and Consent Order, which is commonly referred to as the Tri-Party Agreement or TPA, was originally signed by Department of Energy, the State of Washington,

and the U. S. Environmental Protection Agency in 1989. Meanwhile, the retrieval of the waste is under way and is being conducted to achieve the completion criteria established in the Hanford Federal Facility Agreement and Consent Order.

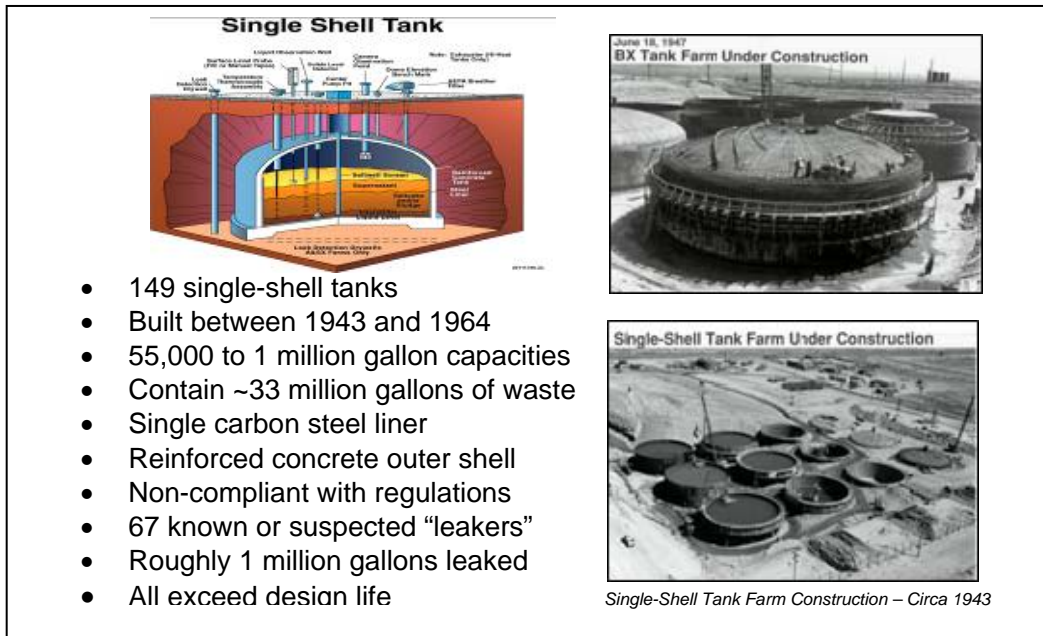


Fig. 1. Fact sheet for single-shell tanks at the Hanford Site.

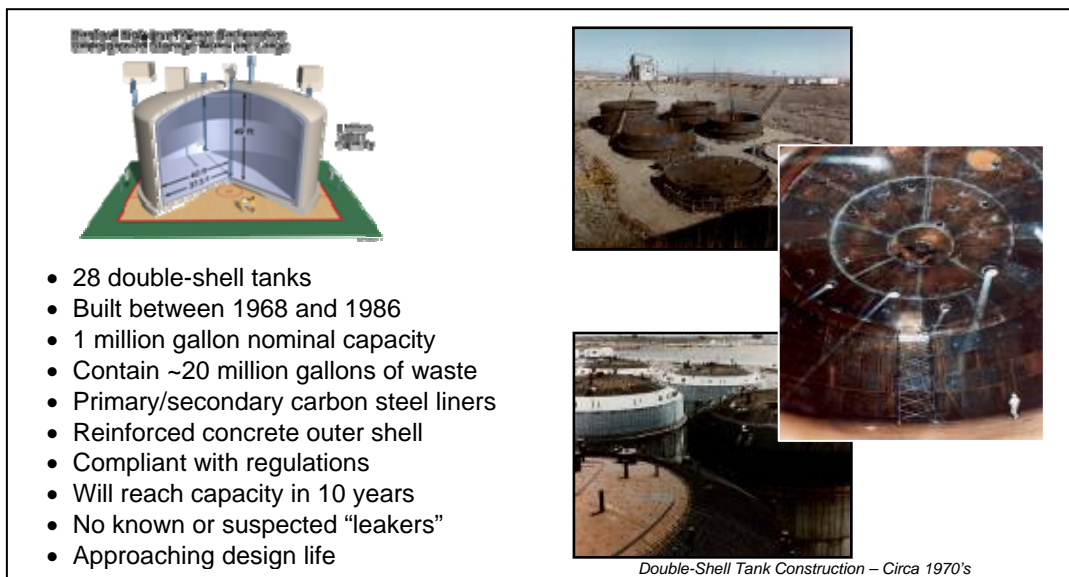


Fig 2. Fact sheet for double-shell tanks at the Hanford Site.

INTRODUCTION

The single-shell tanks (SSTs) are located in 12 individual tank farms: six farms in 200 the West Area of the Central Plateau and six farms in the 200 East Area of the Central Plateau (see Figure 3). These 12 tank farms have been grouped into seven Waste Management Areas (WMAs) under the Hanford Federal Facility Agreement and Consent Order (HFFACO) for *Resource Conservation and Recovery Act of 1976 (RCRA)* closure planning and logistical purposes (Table I). Closure of a WMA includes dispositioning of the SSTs, ancillary equipment, and contaminated soils.

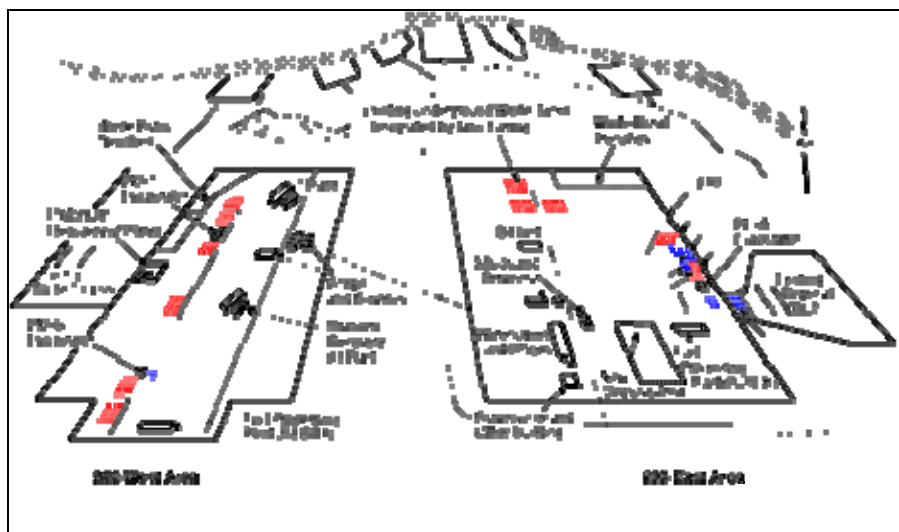


Fig. 3. Map of Hanford Central Plateau.

Table I. Waste Management Areas Distribution

Waste Management Area	Tank Farm	Number of Tanks	Tank Size (Capacity in gal)
WMA A-AX	A	6 – 100 Series	1,000,000
	AX	4 – 100 Series	1,000,000
WMA B-BX-BY	B	12 – 100 Series 4 – 200 Series	533,000 55,000
	BX	12 – 100 Series	533,000
	BY	12 – 100 Series	758,000
WMA C	C	12 – 100 Series	533,000
		4 – 200 Series	55,000
WMA S-SX	S	12 – 100 Series	758,000
	SX	15 – 100 Series	1,000,000
WMA T	T	12 – 100 Series	533,000
		4 – 200 Series	55,000
WMA TX-TY	TX	18 – 100 Series	758,000
	TY	6 – 100 Series	758,000
WMA U	U	12 – 100 Series	533,000
		4 – 200 Series	55,000

During the period when the SSTs were in active operations, as many as 67 tanks may have leaked greater than 500,000 gallons into the soil column. The tanks are in a dry vadose zone with approximately 200 feet of relatively dry soils and other materials between the tanks and the aquifer. Accordingly, characterization activities are underway that will help the Office of River Protection (ORP) determine its remediation approach for contaminated soils.

Several major nuclear fuel-processing facilities, such as the Plutonium Uranium Extraction Facility (PUREX) canyon facility and the Plutonium Finishing Plant (PFP) are located in close proximity to the tanks. Numerous cribs and ponds received liquid wastes from such facilities. Those non-tank farm facilities will be closed mainly under *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) requirements as will the groundwater beneath the tank farms. The combination of facilities on the Central Plateau, some of which will be closed under RCRA and others under CERCLA, requires close attention to possible inter-facility post-closure groundwater influences.

The HFFACO describes the steps required to achieve closure of the SST System. The WMAs are the smallest final closure units identified in the HFFACO; however, individual units (e.g., single tanks) can undergo an interim closure (stabilization) process prior to the final closure of an entire WMA. Each interim closure process effectively starts once the retrieval of the waste from a tank has been completed.

THE INTEGRATED CLOSURE PROCESS

The closure process of the SST System involves numerous considerations and requirements that must be integrated and managed in order to achieve the final closure of the WMAs. The Integrated Closure Process delineated in the HFFACO was developed with the intent of integrating most of these requirements with as little redundancy as possible.

HFFACO Requirements Associated With Completion of Retrieval Criteria

Prior to the State issuance of a RCRA Closure Permit and ORP implementation of closure activities, it must be demonstrated that the retrieval of waste from each tank has met the criteria set by the HFFACO. The criteria are: (1) reaching the technical limits of the retrieval technology, (2) leaving no more than 360 cubic feet in the large tanks and no more than 30 cubic feet in the small tanks (55,000 gallon tanks), and (3) obtaining Washington State Department of Ecology approval through the HFFACO Appendix H process if the technical limits of the retrieval technology/technologies result in residual volumes in excess of those in (2) above. This waiver request (commonly referred to as an Appendix H Request) includes elements such as a risk assessment and an evaluation of alternative retrieval technologies. At the end of retrieval of each tank, a Retrieval Data Report is submitted to the State and EPA to summarize the post-retrieval status of the tank; i.e., residual waste volume, residual waste characterization data, retrieval leak monitoring data, and a post-retrieval risk assessment.

Tank Residual Waste Determinations

The retrieval criteria established in the HFFACO are set by the State of Washington through the provisions of the HFFACO and are comprised within the criteria set by the DOE M 435.1-1[8]

and the U. S. Nuclear Regulatory Commission (NRC) for incidental waste.[9] These criteria are: 1) Process waste to remove key radionuclides to the maximum extent that is technically and economically practical, and 2) The waste will be managed to meet safety requirements comparable to the performance objectives set out in the 10CFR 61, Subpart C (Licensing Requirements for the Land Disposal of Radioactive Waste) [10], and 3) The waste must be incorporated in a solid physical form that does not exceed the concentration limits for Class C low-level waste as set out in 10 CFR 61.55.

Historically, DOE policy required all Hanford tank wastes to be managed as high-level waste regardless of the waste's concentration or origin; therefore, one of the first steps in preparation for tank closure will be for DOE to make a determination that any residual waste remaining in the tank is incidental waste suitable for on-site disposal. DOE will make such determinations using a public process and in consultation with the NRC.

Tank Closure Permitting

The closure of the SST WMAs will be achieved in three phases under RCRA and State requirements. The first phase involves retrieval and closure of an individual tank or ancillary equipment component. The second phase will close an entire WMA after all tanks and other components of the WMA have been closed and contaminated soil and groundwater have been addressed. The final phase concludes when all SST WMAs are closed. These WMA closures will be done in coordination with the final delisting of the Hanford Site Central Plateau from the National Priorities List through the final Records of Decision issued by EPA. The WMA closures are achieved through State approval of three tiers of Closure Plans in the RCRA Site-Wide Permit [11]:

1. Tier I: An SST system-wide closure plan (the SST Framework Closure Plan) will provide an overall framework for closure.
2. Tier II: Seven Waste Management Area closure plans for individual or grouped tank farms will be appendices to the SST Framework Closure Plan.
3. Tier III: Component closure plans will be developed for one or a group of components within the SST system (e.g., one or more tanks, one or more pieces of ancillary equipment).

These closure plans will also be reviewed by DOE to ensure that they fulfill the elements required for DOE Tier 1 and Tier 2 Closure Plans [12], thereby eliminating the redundancy between the RCRA and DOE documentation (See Figure 4).

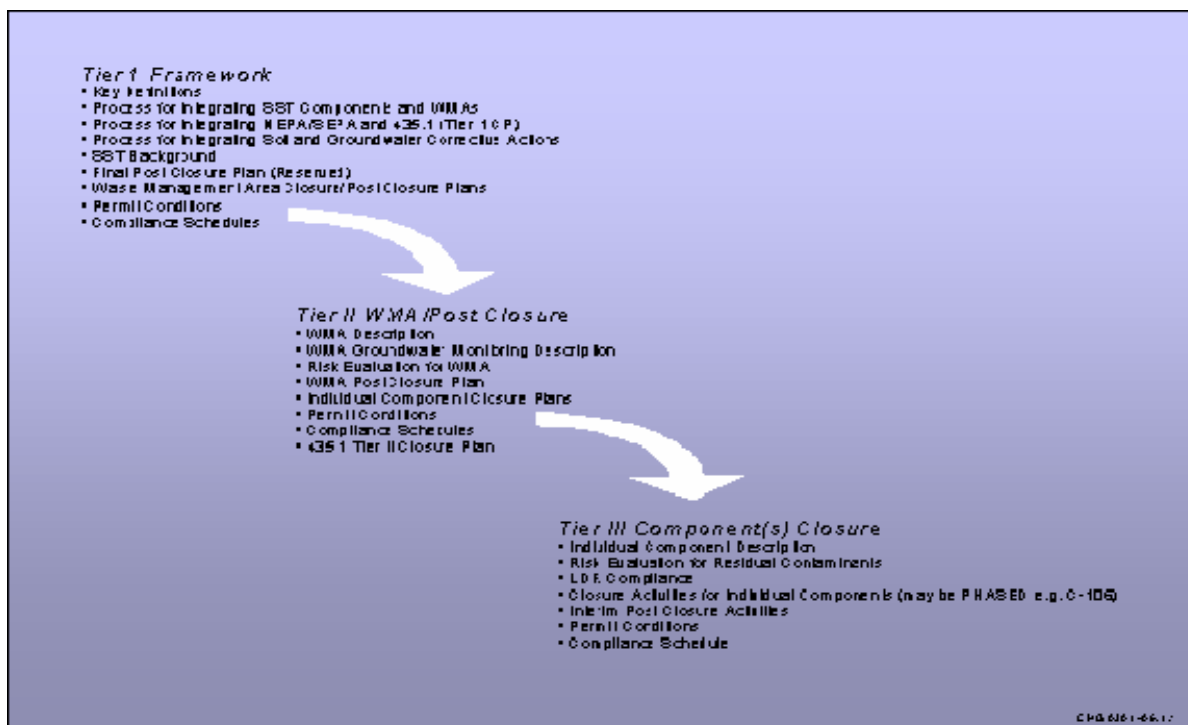


Fig. 4. Closure plans for single-shell tank system.

Tank Closure NEPA Analysis

An overarching regulatory process is the National Environmental Policy Act of 1969 (NEPA), which requires the DOE to consider environmental impacts in major decision-making. At the State level, the *Washington State Environmental Policy Act of 1971* (SEPA) [13] requires State agencies to consider environmental impacts before issuing permits and approvals, such as RCRA permits and closure plans.

ORP is currently developing the Hanford Tank Closure and Waste Management Environmental Impact Statement (EIS) in accordance with NEPA requirements. This document is being developed in cooperation with the State of Washington. In it, ORP evaluates a variety of closure alternatives that range from the mandatory “no action” alternative to total exhumation of tanks. Scoping hearings and other means were used to elicit stakeholder input into the Hanford Tank Closure and Waste Management EIS to ensure stakeholder values are integrated into the decision-making process. Among the challenges faced in developing the Hanford Tank Closure and Waste Management EIS are identifying consistent and acceptable analytical parameters for calculating impacts and integrating those parameters into appropriate contaminant fate and transport models. Extensive science and technology research has been conducted to refine hydraulic parameters, such as infiltration rates and hydraulic conductivities for soils in order to better estimate contaminant movement and velocities in the EIS analyses.

Tank Farm Corrective Action Program

The State of Washington has determined that at least four of the seven WMAs (e.g., B, BX/BY, T, TX/TY, and S/SX) have soil and groundwater contamination due to past tank and/or pipe leaks within their boundaries. This resulted in putting these WMAs in the RCRA Corrective

Action Program. Phase I characterization work scope is near completion. Hence, corrective actions for each WMA must be completed to achieve final closure. A RCRA Corrective Action Program has been collecting data on the major tank leaks and spills for the last 8 years. This program, driven by HFFACO milestones, aims at gaining sufficient knowledge about the nature and extent of the contamination in the vadose zone (VZ) under the tank farms for the purpose of identifying measures to minimize and control impacts to the groundwater (GW). More data will be gained regarding the contamination “plumes” under tank farms principally using two newly deployed technologies “High Resolution Resistivity Surface Geophysical Exploration” (SGE), and the “Hydraulic Hammer Direct Push” deep soil sampling tool. These data will be fed into a performance assessment (described below) for the SST System that supports the cleanup and closure of the tank farms.

- The SGE technology is being used to “map” the contaminant plumes in the Vadose Zone under the tank farms caused by past tank leaks. It uses high resolution resistivity to provide an outline of the plumes under the tanks. This will subsequently be used to target specific areas in the tank farms for further soil sampling and characterization
- The Direct Push technology utilizes a mobile unit mounted on a small back-hoe and:
 - Uses small diameter pipe capable of investigation of the shallow vadose zone
 - Has the ability to deploy slim hole geophysical instruments (e.g. neutron moisture gauge, spectral and gross gamma)
 - Collect soil samples from target depths
 - Reaches the targeted depth vertically or at a set angle/slant
 - Has been driven effectively to 127 feet vertically and 100 feet at a 30° slant
 - Generates minimal waste

The present strategy for the Tank Farm VZ Corrective Action program calls for collection of sufficient data in the next two years to develop a more complete knowledge of the deep contamination, to integrate with the GW decisions, and to better focus Phase 2 activities on closure of WMAs. In most of the WMAs, leaked contaminants would be classified as critical sources to the related Groundwater Operable Units under the WMAs.

Five elements to this strategy include:

- Near-term focus on field investigations to improve baseline data (Direct Push and SGE)
- Monitor and characterize leak sites
- Demonstrate temporary barriers to reduce water infiltration, and hence, reduce impact to GW,
- Evaluate and remediate, as necessary, selected high risk soil or ancillary equipment areas
- Produce Corrective Measures Studies (CMS) focused on individual WMAs.

This strategy will result in a stronger integration of the VZ contamination data collection under WMAs with the decision making process for GW remediation. Through these field

investigations that will take place in the next two years, a better understanding will be developed of the nature and extent of the WMA critical sources impacting GW.

Single-Shell Tank System Performance Assessment/Risk Assessment

The DOE Order Radioactive Waste Management (DOE O 435.1), the RCRA Closure Plans, and the NRC/DOE Incidental Waste requirements call for a performance assessment (risk assessment) to be conducted to ensure that the closed system is protective of human health and the environment. It was agreed by DOE and the State of Washington to produce one document that satisfies both organizations per their respective authorities in terms of risk or performance. An overall Single-Shell Tank Performance Assessment (SST PA) [14] has been developed and will be published for review by the State, EPA, and the NRC.

This SST PA was developed using the data and scientific research accomplished in the last eight years. The modeling parameters and scenarios were supplemented by sensitivity analyses to evaluate the impacts of variations of these parameters and scenarios on the outcome of the analysis. This SST PA will be used to establish the overall methodology of developing performance assessments for the WMAs, and to provide guidance to the Corrective Action Program to focus the areas of characterization and sampling.

Subsequent to the finalization of the SST PA, more concise WMA specific PAs will be developed to support the closure of these WMAs. These WMA specific PAs will be part of the WMA Closure Plans to be approved by the State.

INTEGRATION WITH OTHER CENTRAL PLATEAU CLEANUP ACTIVITIES

The closure activities of the Tank Farm System are also being closely integrated with the other remedial activities being conducted outside the WMAs.

- Integration of the final closure of the WMAs with the remedial work taking place immediately outside the boundaries of these WMAs,
- Coordination of the screening of viable technologies to remediate or immobilize the deep VZ contamination caused by past tank and component leaks under and around the WMAs, and
- Modeling the impacts of the contamination in the deep VZ on GW in order to make informed decisions for the remediation of GW.

STRIVING FOR PROGRESS

The complexity of the physical system to be closed (tanks, ancillary systems, contaminated soils, GW) and the nature of the waste to be managed during this mission make this a daunting task. In addition to the technical challenges, there are similar challenges in accomplishing the major regulatory requirements that guide the establishment of controls to protect human health and the environment. Innovative approaches have been identified and are being implemented to address regulatory requirements and build momentum toward closing the Hanford Site tanks, while not

diminishing the quality of closure. This is being achieved in constant communication with the site regulators and stakeholders.

Awaiting the development of the critical regulatory tools, a set of closure demonstration activities are being planned by DOE, CH2M HILL, and the State of Washington to provide field experience that supports resource planning, closure planning, and environmental impacts evaluations. The activities being evaluated for demonstration include: tank stabilization, pipe removal, pipe grouting, diversion box characterization and stabilization, soil characterization and remediation. This is aimed at obtaining new data that supports the planning, and analysis activities discussed previously.

CONCLUSIONS

At Hanford, SSTs are managed as HLW regardless of waste concentrations or origin. These SSTs are planned to be closed using an integrated closure process that assures:

- The regulatory requirements stemming from RCRA, CERCLA, Washington State Dangerous Waste Regulations and DOE Orders are addressed.
- Tanks, components and WMA closures will be coordinated with other nearby RCRA or CERCLA activities.
- Tank, component and WMA closures will be protective of public health and safety and environmentally protective.
- Closure activities will be coordinated with the State of Washington, the U.S. EPA and the U.S. NRC.

Research and analyses are underway to provide both new and confirmatory data for use in the EIS and performance assessments. Research plans include a set of demonstration activities designed to provide field experience in in-tank grout placement, tank stabilization, residual waste characterization and pipe grouting or removal. These planned activities are to be coordinated with the State of Washington and the NRC in order to provide more informed regulatory decisions.

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