RPP-RPT-59390

Tier 3 Resource Conservation and Recovery Act (RCRA) Component Closure Activity Plan for 241-C-200 Series Tanks

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Abstract: This WMA C Component Closure Activity Plan is a part of a third tier of the three-tiered hierarchy of closure plans for the Single-Shell Tank System as defined by the Hanford Federal Facility Agreement and Consent Order Action Plan, Appendix I. This Tier 3 Component Closure Activity Plan provides the background and details of closure activities for the 241-C-200 tanks. It includes information about closure actions and requirements that apply to Waste Management Area C as a whole, and general information about closure of individual tank farm components.

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EXECUTIVE SUMMARY

This *Tier 3 Resource Conservation and Recovery Act (RCRA) Component Closure Activity Plan for 241-C-200 Series Tanks* (RCRA Tier 3 Plan) describes closure activities for the 241-C-200 series (C-200) single-shell tanks located in the Hanford Site Waste Management Area C. This RCRA Tier 3 Plan is one of multiple Tier 3 component closure activity plans that will support closure of Waste Management Area C, as described in RPP-RPT-59389, *Tier 2 Resource Conservation and Recovery Act (RCRA) Closure Action Plan for Waste Management Area C*. A compliance matrix is provided in Appendix A that indicates which document within the three-tiered single-shell tank closure plan document structure addresses individual closure performance standards.

Waste Management Area C contains four C-200 single-shell tanks, constructed in place from 1944 to 1945 to receive Hanford operations waste. These tanks received operations waste from 1947 until they were removed from service between 1970 and 1980. This Component Closure Activity Plan describes closure requirements specific to the C-200 single-shell tanks. Additionally, an overview is provided of C-200 single-shell tank closure activities including tank preparation, two stages of grout fill, and demobilization. Further details regarding these closure activities will be presented in later documents, including detailed design drawings and work plans.

The 200-series single-shell tanks will be closed to support Waste Management Area C closure, which is based on a landfill closure approach, as discussed in accordance with 78 FR 75913, "Record of Decision: Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington," pursuant to the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), Appendix I, and the applicable provisions of the *Resource Conservation and Recovery Act of 1976* (RCRA) and the *Hazardous Waste Management Act* (*Revised Code of Washington* 70.105, "Hazardous Waste Management"). This Component Closure Activity Plan does not discuss waste classification determinations and radioactive waste-specific closure actions that the U.S. Department of Energy may take under the *Atomic Energy Act of 1954*. Where this RCRA Tier 3 Plan provides data or discussions about materials regulated under the *Atomic Energy Act of 1954*, that information is provided for informational purposes only.

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CONTENTS

APPENDICES

FIGURES

TABLES

TERMS

AEA	*Atomic Energy Act of 1954*
AMS	articulating mast system
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DWMU	dangerous waste management unit
Ecology	Washington State Department of Ecology
FR	*Federal Register*
EIS	environmental impact statement
HEPA	high-efficiency particulate air
HFFACO	*Hanford Federal Facility Agreement and Consent Order*
HWMA	*Hazardous Waste Management Act*
NEPA	*National Environmental Policy Act of 1969*
PUREX	Plutonium Uranium Extraction (Plant)
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
RFI	RCRA facility investigation
ROD	record of decision
RDR	retrieval data reports
SEPA	*State Environmental Policy Act*
SST	single-shell tank
TC&WM EIS	Tank Closure and Waste Management Environmental Impact Statement
TSD	treatment, storage, and disposal
UCL	upper confidence limit
UPR	unplanned release
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System
WMA	waste management area

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1.0 INTRODUCTION

Closure activities described in this document, the *Tier 3 Resource Conservation and Recovery Act (RCRA) Component Closure Activity Plan for 241-C-200 Series Tanks* (RCRA Tier 3 Plan), are specific to 241-C-200 (C-200) series single-shell tanks (SSTs).

The U.S. Department of Energy (DOE) will conduct closure activities for single components or groups of components within Waste Management Area (WMA) C in accordance with the framework provided in the *Hanford Federal Facility Agreement and Consent Order* (HFFACO), also known as the Tri-Party Agreement (Ecology et al. 1989). The HFFACO Action Plan, Appendix I (Section 2.2) establishes a process for closing individual components and the WMAs as contributory actions in closing the SST system. The process involves a three-tiered structure of documentation to integrate the various closure actions within a WMA into WA7 89000 8967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, as revised (Hanford Site-Wide Permit). The documents in the three-tiered structure include those listed below:

- Tier 1 – Framework (SST system-wide) closure plan
- Tier 2 – WMA closure action plans
- Tier 3 – Component closure activity plans.

RPP-RPT-58858, *Tier 1 Closure Plan Single-Shell Tank System* (RCRA Tier 1 Plan) was submitted to the Washington State Department of Ecology (Ecology) in September 2015 (Letter 15-ECD-0042, "Submittal of the Tier 1 Closure Plan for the Single-Shell Tank System"), pursuant to HFFACO Milestone M-045-82. The RCRA Tier 1 Plan addresses closure actions and issues pertaining to the entire Hanford Site SST system. RPP-RPT-59389, *Tier 2 Resource Conservation and Recovery Act (RCRA) Closure Action Plan for Waste Management Area C* (RCRA Tier 2 Plan) describes actions that will be taken at the WMA C level.

This RCRA Tier 3 Component Closure Activity Plan is one of multiple Tier 3 component closure activity plans that will be developed for different components or groups of components within WMA C.

Together, the RCRA Tier 1 Plan, the RCRA Tier 2 Plan, and the various RCRA Tier 3 component closure activity plans will describe actions that will be required for closure of WMA C in accordance with RCRA and the State of Washington (State) *Hazardous Waste Management Act* (HWMA), *Revised Code of Washington* (RCW) 70.105, "Hazardous Waste Management." Separate tiered WMA C closure plans are also being developed pursuant to DOE Order 435.1, *Radioactive Waste Management* (DOE O 435.1).

Consistent with the HFFACO, Part One, Article IV, Paragraph 19, this RCRA Tier 3 Plan addresses residual waste in the tanks, including radioactive material subject to regulation under the *Atomic Energy Act of 1954* (AEA). However, the inclusion of information about such material here does not confer authority to Ecology over otherwise exempt spent, byproduct, and special nuclear material regulated under the AEA.

1.1 BACKGROUND INFORMATION

The Hanford Site SST system is grouped into seven geographically-based areas called "waste management areas" (WMAs). This RCRA Tier 3 Plan describes component closure actions that will be taken at WMA C, which is a geographic area that encompasses the Hanford Site 241-C Tank Farm (C Farm). In general, WMA C is coincident with the C Farm fence line; however, some components extend beyond the fence line or are located outside the fence line. This RCRA Tier 3 Plan describes how the C-200 SSTs will be closed to meet applicable RCRA/HWMA closure requirements. Soil contaminated by releases from WMA C will be addressed in accordance with the RCRA Corrective Action process underway at WMA C and integrated with tank closure activities. Groundwater impacted by releases from WMA C will be addressed through the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) Record of Decision (ROD) for the 200-BP-5/200-PO-1 operable unit, as available. Other WMA C components include numerous tanks, pits, transfer pipelines, diversion boxes, and vaults. In addition, soil and groundwater contamination caused by C Farm operations has been identified.

This Section discusses the location and features of the C-200 SSTs at WMA C and describes the component closure approach for these tanks. Section 1.3 provides a physical description of the tanks. Section 1.4 provides a history of tank operations (Sections 1.4.1); discusses waste volume decreases due to leaks, evaporation, and unplanned releases (UPRs) (Section 1.4.2); and discusses retrieval activities (Section 1.4.3). Section 1.5 provides details about waste constituents relevant to the C-200 SSTs.

1.1.1 Location and Extent of 241-C-200 Single-Shell Tanks

WMA C includes four 200-series SSTs, all of which are located on the north side of WMA C, inside the C Farm fence line (Figure 1-1). Each of the WMA C 200-series SSTs is considered a separate dangerous waste management unit (DWMU). The four tanks are identified as 241-C-201 (C-201), 241-C-202 (C-202), 241-C-203 (C-203), and 241-C-204 (C-204), and together, for the purposes of this RCRA Tier 3 Plan, are referred to as the C-200 SSTs (Figure 1-2). The construction details and history of operations for the four 200-series SSTs are further described in Sections 1.3 and 1.4 of this RCRA Tier 3 Plan.

1.1.2 Closure Approach

This RCRA Tier 3 Plan addresses the following specific C-200 SST DWMUs: C-201, C-202, C-203, and C-204. Each of these DWMUs is inactive and will be landfill closed, as discussed in this section.

Figure 1-1. Waste Management Area C Location, Features, and Surrounding Area.

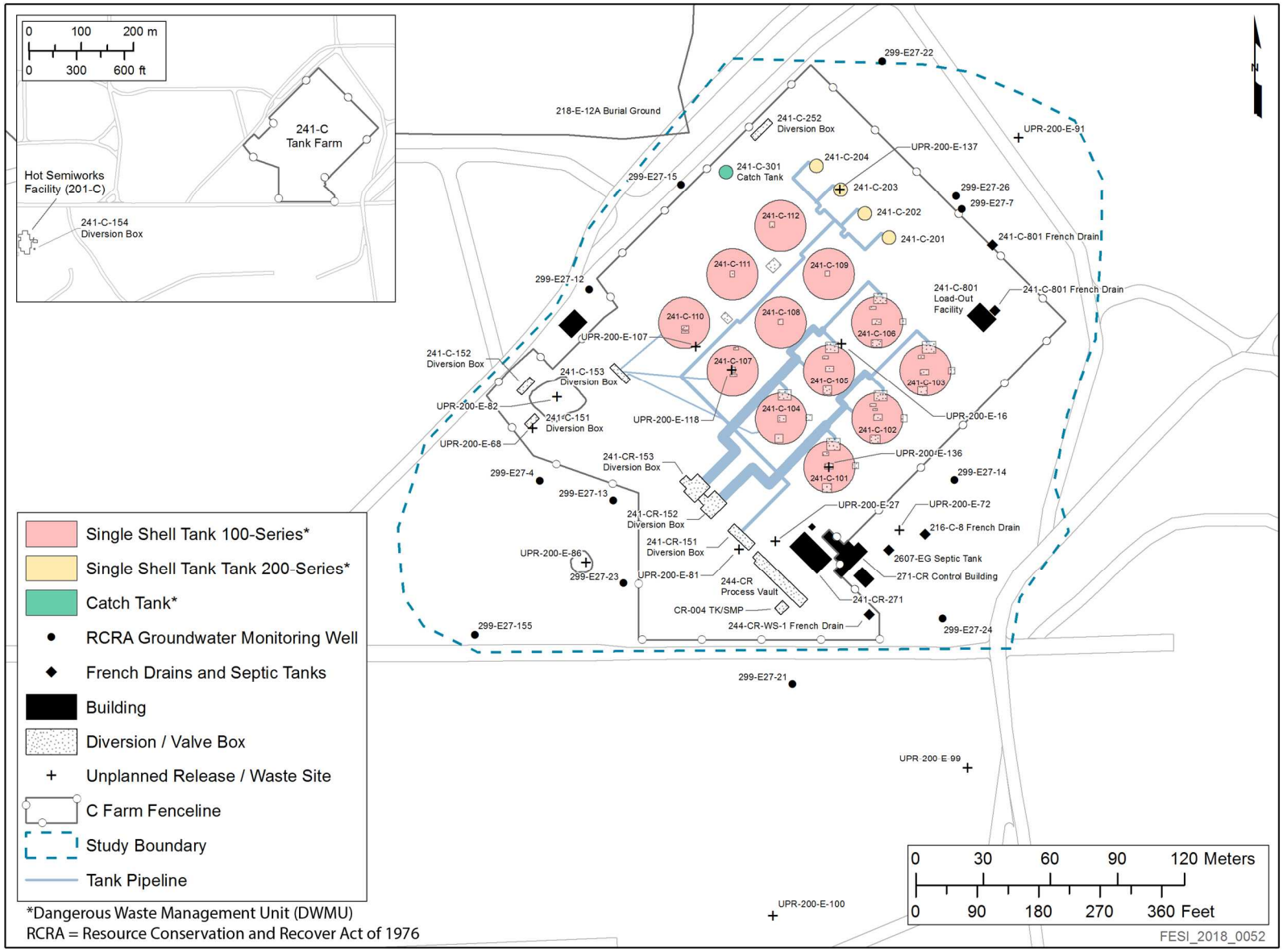
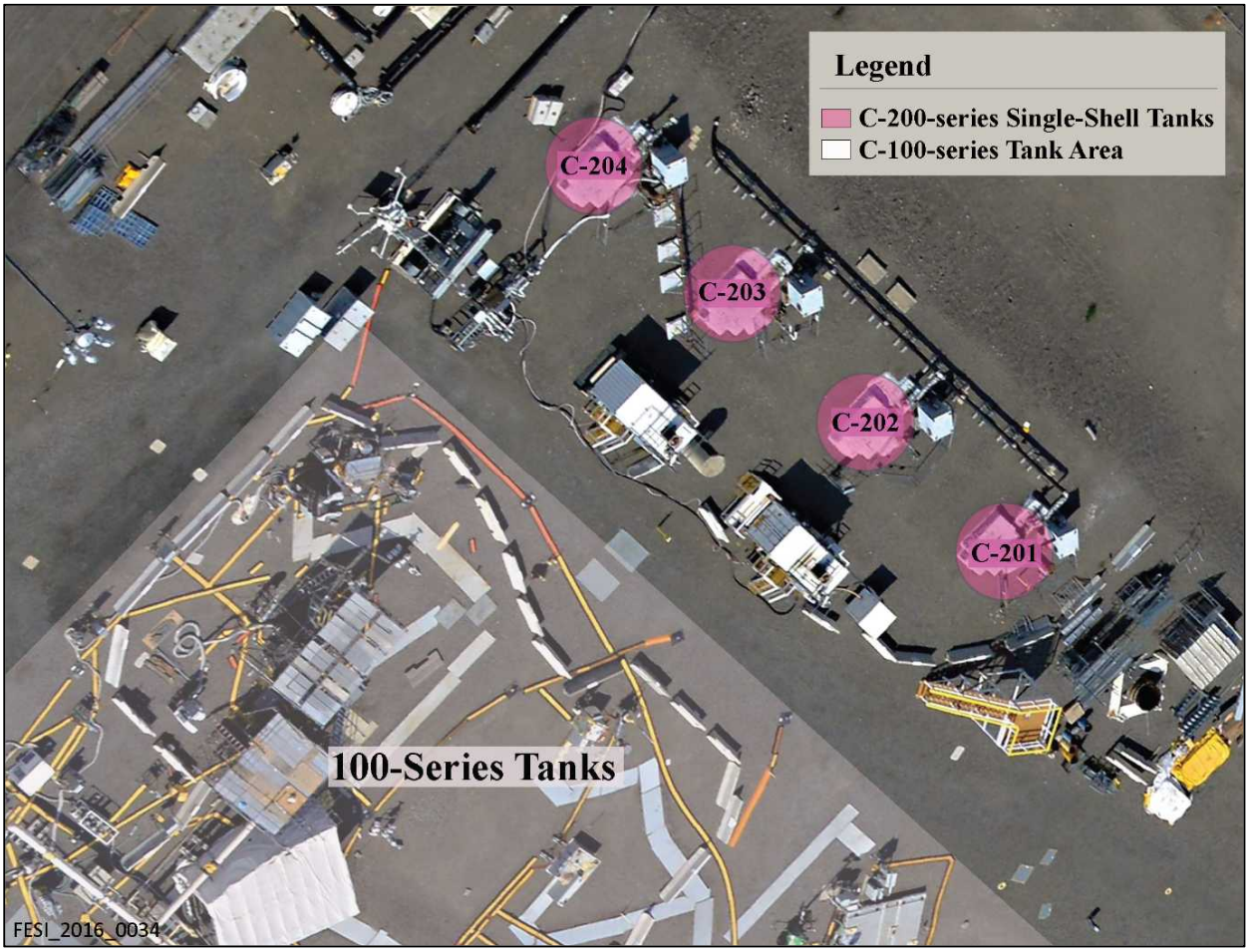


Figure 1-2. Aerial Photo of 241-C-200 Single-Shell Tanks in Waste Management Area C.



In accordance with *Washington Administrative Code* (WAC) 173-303-640, "Tank Systems," subsection (8) "Closure and post-closure care," item (b) and the Tank Closure and Waste Management (TC&WM) Environmental Impact Statement (EIS) ROD (78 FR 75913, "Record of Decision: Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington"), DOE demonstrated that removal or decontamination of the tank system and soils associated with WMA C is not practicable. The Clean Closure Practicability Demonstration for the Single-Shell Tanks (DOE/ORP-2014-02, *Clean Closure Practicability Demonstration for Single-Shell Tanks*; and DOE/ORP-2014-02-SUPP1, *Supplemental Information to the Clean Closure Practicability Demonstration for the Single Shell Tanks*) was performed in accordance with WAC 173-340-360, "Selection of Cleanup Actions," subsection (3) "Determining whether a cleanup action uses permanent solutions to the maximum extent practicable," items (e) "Disproportionate cost analysis" and (f) "Evaluation criteria." Ecology has agreed that clean closure of WMA C is not practicable.

This RCRA Tier 3 Plan is based on a landfill closure approach for the WMA C tank system in accordance with WAC 173-303-665, "Landfills," subsection (6) "Closure and post-closure care," item (a), as discussed in the RCRA Tier 1 Plan, consistent with the DOE *National Environmental Policy Act of 1969* (NEPA) EIS for the closure of Hanford Site tanks (DOE/EIS-0391, *Final*

Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington) and subsequent TC&WM EIS ROD.

The general closure approach for the C-200 SSTs includes the following planned actions:

- Remove above-grade equipment at each tank as needed to facilitate access
- Stabilize tanks to the extent necessary to prevent long-term subsidence.

Closure activities will be performed in accordance with the following Addenda: Security (Addendum E), Preparedness and Prevention (Addendum F), Personnel Training (Addendum G), Inspection (Addendum I), and Contingency Plan (Addendum J).

In the event of a release, this closure plan will be modified in accordance with WAC 173-303-610, "Closure and Post-Closure" subsection (3) "Closure plan; amendment of plan." Previous spills and subsequent cleanup will be identified and documented in the SST System portion of the facility operating record and addressed at the time of closure. A permit modification is required within 60 days when a release occurs that requires modification of the closure plan. If an unexpected event occurs prior to closure that affects the closure plan, a permit modification request to amend the closure plan will be submitted to Ecology within 60 days of the unexpected event.

Closure work at WMA C will be performed in a manner that will minimize or eliminate worker exposure to dangerous waste in accordance with the provisions of the DOE- and Hanford Site-specific health and safety plans applicable to each (closure) work activity.

Closure work completed by DOE-contracted companies for Tank Farm Operations Contract work is performed through an integrated safety management system, which incorporates safety, health, environmental and radiological controls into work planning and execution. The core functions of this DOE-approved integrated safety management system include:

- defining the work scope
- identifying known and potential hazards
- controlling hazards
- performing work
- providing continuous feedback and improvement to the work planning process.

All closure activities identified in the Tier 3 Closure Plan will be evaluated through this systemic approach to eliminate or minimize workplace hazards. The specifics of how hazards are addressed will be explained at the work package level.

Qualified personnel will perform any necessary closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment. Qualified personnel will be trained in applicable safety and environmental procedures and have appropriate training and experience in sampling activities. Field operations will be performed in accordance with DOE- and Hanford Site-specific approved health and

safety requirements identified in appropriate procedures and plans. Pre-job briefings will be performed to evaluate activities and associated hazards by considering the following factors:

- objective of the activities;
- individual tasks to be performed;
- hazards associated with the planned tasks;
- environment in which the job will be performed;
- equipment and material required;
- safety protocols applicable to the job;
- training requirements for individuals assigned to perform the work;
- level of management control;
- and emergency contacts.

Safety documentation will include, as appropriate, evaluations and controls of the hazards posed by the work to be performed. The relevant Federal standards, located at Title 10, *Code of Federal Regulations* (CFR), Part 835, "Occupational Radiation Protection" (10 CFR 835), Title 10, CFR, Part 851, "Worker Safety and Health Program" (10 CFR 851) and Title 29, CFR, Part 1910, "Occupational Safety and Health Standards" (29 CFR 1910), particularly Title 29, CFR, Part 1910, §1910.120, Hazardous waste operations and emergency response (29 CFR 1910.120), will be met, as applicable. Health and Safety Plans will be included with work packages for closure activities and with any sampling and analysis plans prepared for sampling of wastes generated during closure activities.

Sampling and analysis of residual waste following retrievals was performed in accordance with the regulatory requirements identified in RPP-PLAN-23827, *Sampling and Analysis Plan for Single-Shell Tanks Component Closure* for tanks C-202, C-203 and C-204. Sampling and analysis of tank C-201 was performed in accordance with the regulatory requirements identified in RPP-17137, *Sampling and Analysis Plan for the C-200 Series Tank Component Closure Action*. Post-retrieval sampling was not possible for SST C-201 because there was insufficient residual waste directly under a riser; therefore, as provided in RPP-16616, *Component Closure Action Data Quality Objectives for the C-200 Series Tanks*, results of the pre-retrieval samples were used to support the post-retrieval inventory calculation.

This RCRA Tier 3 Plan is subject to public comment as part of the closure permitting process.

1.2 REGULATORY FRAMEWORK – DRIVERS AND INTEGRATION

Closure actions at WMA C are consistent with the requirements of the HFFACO, which describes how requirements of the AEA, as amended; RCRA/HWMA; WAC 173-303, "Dangerous Waste Regulations"; and CERCLA is integrated for application to Hanford Site closure activities. The overall framework for the integration of WMA C closure requirements is described in HFFACO Action Plan, Appendix I, Section 3.1.

The component closure activities described in this RCRA Tier 3 Plan will be conducted in accordance with all applicable and relevant regulations and requirements, including those below:

- NEPA/Washington *State Environmental Policy Act* (SEPA) (RCW 43.21C, "State Environmental Policy")
- CERCLA
- RCRA/HWMA
- AEA and DOE O 435.1
- *Toxic Substances Control Act of 1976*
- State and Federal Air Monitoring regulations
- HFFACO.

The applicable regulations are discussed in Section 1.2 of the RCRA Tier 2 Plan. The RCRA Tier 2 Plan includes closure actions that will be taken at the WMA C level. The RCRA Tier 2 Plan also describes other components and environmental media whose cleanup is integral to final closure actions for the WMA. The various WMA C RCRA Tier 3 component closure activity plans will contain requirements pertaining to the closure of individual WMA components or groups of components. This RCRA Tier 3 Plan describes how the C-200 SSTs will be closed to meet applicable RCRA/HWMA closure requirements.

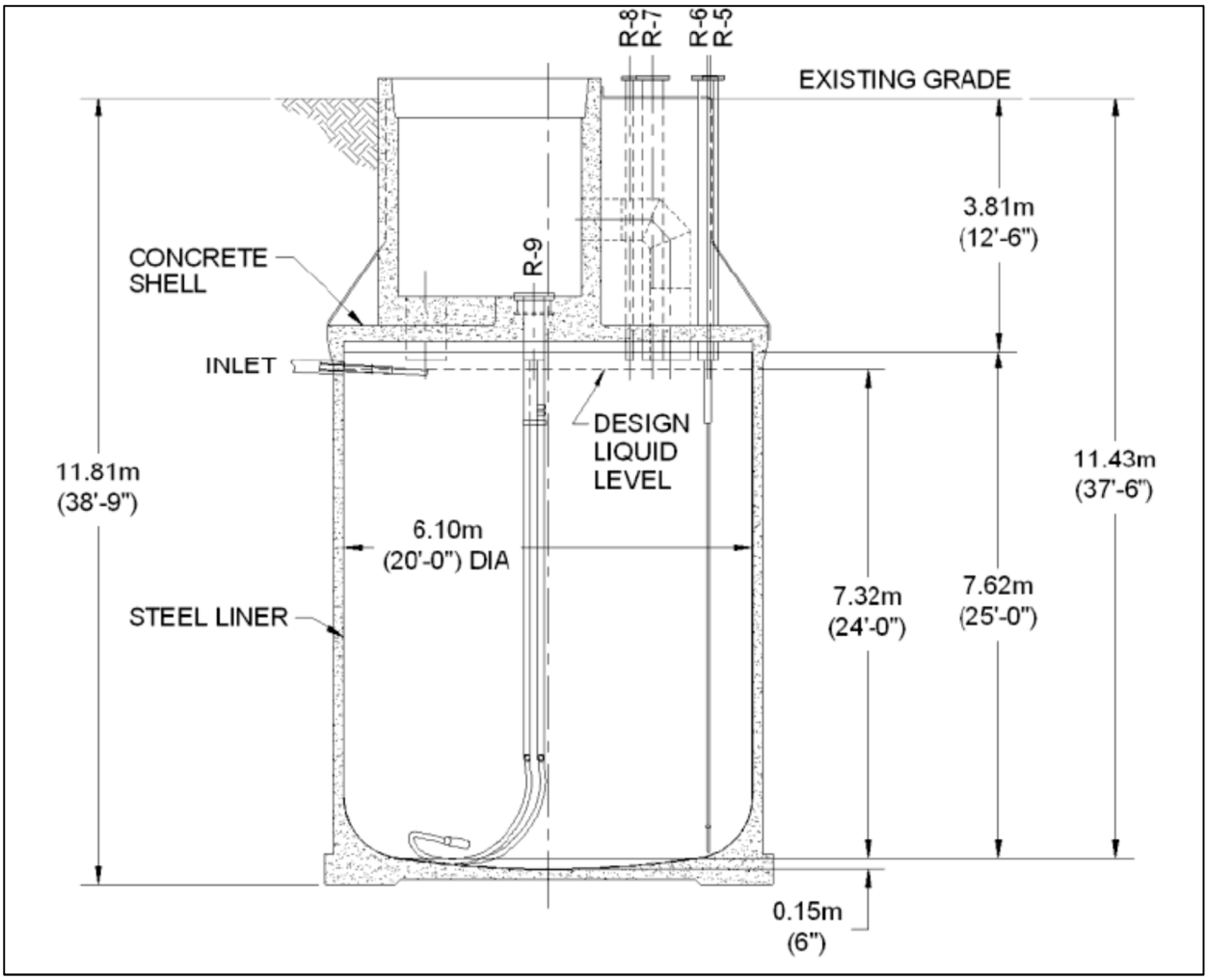
1.3 DESCRIPTION OF 241-C-200 SINGLE-SHELL TANKS

The four C-200 SSTs were constructed in place with a carbon-steel liner in a reinforced-concrete shell. The C-200 SSTs were each designed with a nominal operating capacity of 208,000 L (55,000 gal), and are 6.10 m (20 ft) in diameter with a 7.62-m (25-ft)-tall steel liner. Each C-200 SST has a dished bottom (the center of each C-200 SST is lower than the perimeter) with a curving intersection of the sides and bottom. A single stiffener ring is located at the top of the steel liner at 7.8 m (25.5 ft) above the bottom of each tank. The C-200 SSTs are below grade with approximately 3.7 m (12 ft) of soil cover from the top of each tank to ground surface to provide radiation shielding for operating personnel.

Each C-200 SST has six risers (identified as risers R-5 through R-10) that provide access into the tanks, and a riser (riser R-11) that is attached to the coverplate on the vent hatchway. These risers extend from the interior of each C-200 SST to slightly above ground surface. Two of the six risers are located in a pump pit and extend from the bottom of the pit into the tank. The pump pit has a removable pit cover that was used to provide shielding during historical waste transfer operations; the two risers in the pump pit are not accessible unless the cover block is removed. Additionally, each C-200 SST has a ventilation hatchway constructed with a vertical offset to allow tank ventilation while preventing direct line-of-sight into the tank to eliminate radiation shine. Figure 1-3 provides a generalized profile view of a typical C-200

SST configuration (tank risers R-10 and R-11 are not visible from the perspective shown in this cross-section).

Figure 1-3. 241-C-200 Single-Shell Tank Typical Configuration.



1.4 HISTORY OF OPERATIONS

During their operating life, the C-200 SSTs received metal waste primarily from the 221-B Bismuth Phosphate Separations Plant and cold uranium waste from the 202-A Plutonium Uranium Extraction Plant. To a lesser extent, the C-200 SSTs received wastes originating from research and development activities at the 201-C Hot Semiworks facility in the 200 East Area of the Hanford Site. The operating history of the C-200 SSTs is described in RPP-15408, *Origin of Wastes in C-200 Series Single-Shell Tanks*, and briefly summarized in Section 1.4.1. Waste losses and UPRs associated with the C-200 SSTs are discussed in Section 1.4.2.

Between 1970 and 1980, all of the C-200 SSTs were removed from service. Waste from all of the C-200 SSTs has been retrieved. Retrieval activities and waste residuals are summarized in Section 1.4.3.

1.4.1 241-C-200 Single-Shell Tank Historical Operations

The C-200 SSTs (C-201 through C-204) were constructed in place at C Farm from 1944 to 1945. The C-200 SSTs were inactive until November 1947, when they were activated to begin receiving waste.

Upon activation, the C-200 SSTs began receiving metal waste (high-level waste) from the 221-B Bismuth Phosphate Separations Plant process operations. The tanks were filled with metal waste by January 1948.

Between 1951 and 1952, jet pump pits and concrete-encased transfer pipelines to the 241-CR-151 master diversion box were installed on the C-200 SSTs in preparation for retrieval of metal waste from the tanks. From 1952 to 1955, metal waste received from the bismuth phosphate process was removed from the C-200 SSTs using a hydraulic mining technique known as sluicing. After these sluicing activities were completed, each of the C-200 SSTs were declared empty. However, given the inspection method used (periscope optics), residual metal waste could have been left in each tank.

From May 1955 to November 1956, C-200 SSTs received highly radioactive waste from the Hot Semiworks facility. Beginning in November 1955, tanks C-203 and C-204 also received waste from cold uranium runs conducted as part of startup operations at the Plutonium Uranium Extraction Plant (PUREX). The C-200 SSTs were not used to receive waste after being filled with waste from the Hot Semiworks facility. The C-200 SSTs within C Farm were removed from service from 1970 to 1980.

Waste remaining in the C-200 SSTs had the potential to settle over time, leaving a liquid layer, or supernate, on the surface, and a precipitated sludge on the bottom of the tank. In 1970, supernate removal from the C-200 SSTs began. The volume of supernate removed from tanks C-201, C-202, C-203, and C-204 was 54,000, 55,000, 31,000, and 14,000 gal, respectively. Three tanks contained only a heel, or residual, of supernate and sludge following these removal activities, with the exception of tank C-204, which was reported to contain a remaining 41,000 gal of supernate in June 1970. In 1970, the liquid in tanks C-201, C-202, and C-204 was transferred to SST 241-C-104, and the liquid in tank C-203 was transferred to SSTs 241-C-104 and 241-C-109. In October 1980, supernate was again pumped from all of the C-200 SSTs using a submersible pump. Residual liquids were subsequently transferred from these tanks into tank 241-C-106 in 1980.

In 1981, the C-200 SSTs were interim isolated according to SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*. All four tanks were designated “Not Intended for Reuse” and were characterized as stabilized in 1984 (SD-WM-TI-356). The tanks were then prohibited from receiving additional dangerous waste according to WAC 173-303-640 and the Hanford Site-Wide Permit.

The tanks were placed under a surveillance and monitoring program in accordance with SD-WM-TI-356, conducted as described in RPP-9645, *Single-Shell Tank System Surveillance and Monitoring Program*, and in accordance with the latest version of RPP-9937, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document*. Documentation of monitoring activities is updated annually according to RPP-9937. Controls employed to prevent leakage include maintaining pH greater than 8, composition and chemical reaction protection, hydrostatic head limitation, and temperature control to prevent excessive structural stresses (SD-WM-TI-356).

Additional information about the C-200 SSTs, including operational history and waste received during operations, is provided in the RCRA Tier 2 Plan, Section 2.0, and in the documents listed in Table 1-1.

Table 1-1. References for Additional 241-C-200 Single-Shell Tanks Information.

Description	Document
Tank Components	State of Washington Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, 1989, *Hanford Federal Facility Agreement and Consent Order*, Attachment 2: Action Plan
	DOE/RL-88-21, *Hanford Facility Dangerous Waste Part A Permit Application*, Rev. 35
	RPP-13774, *Single-Shell Tank System Closure Plan*
Operations	RPP-15408, *Origin of Wastes in C-200 Series Single-Shell Tanks*
Waste Received	RPP-15408, *Origin of Wastes in C-200 Series Single-Shell Tanks*

1.4.2 Waste Volume Decreases and Unplanned Releases

In 1988, decreases in waste volume were noted for the C-200 SSTs in HNF-EP-0182, *Waste Tank Summary Report for Month Ending September 30, 2005*, Rev. 210. The waste volume decreases associated with tanks C-201, C-202, and C-204 were assumed to be associated with leak events.

The waste volume data for these tanks were evaluated in RPP-ENV-33418, *Hanford C-Farm Leak Inventory Assessments Report* and the change in liquid levels during operation was attributed to evaporation. RPP-ENV-33418 further notes that ^{235}U and ^{238}U have been detected in the vadose zone in groundwater monitoring well 299-E27-7, approximately 61 m (200 ft) northeast of the tanks, and suggests the C-200 SSTs appear to be the most likely source for uranium and cyanide in well 299-E27-7. Finally, RPP-ENV-33418 concludes there is no basis to estimate magnitude of releases to the soil from the C-200 SSTs or associated pipelines. Leak events from the C-200 SSTs or associated pipelines are a potential source of releases to soils; however, DOE has no basis to estimate the magnitude of such releases.

The Waste Information Data System (WIDS) records one UPR associated with the C-200 SSTs, UPR-200-E-137. This UPR is purported to have occurred when water entered SST C-203, migrated through the saltcake, and either became entrained in the saltcake or leaked out of the

tank. Soil contamination is not relevant to this RCRA Tier 3 Plan, and is instead addressed in RPP-RPT-59379, *Waste Management Area C Phase 2 Corrective Measures Study Report*, in accordance with the RCRA Corrective Action process.

Groundwater remediation will be managed through the 200-BP-5 and 200-PO-1 CERCLA Groundwater Operable Units, as documented in Letter 18-NWP-088, "Re: Department of Ecology's (Ecology) Comments on the United States Department of Energy (USDOE) Submittal of the *Phase 2 RCRA Facility Investigation Report for Waste Management Area C* (RFI), RPP-RPT-58339, Revision 0, and *Waste Management Area C Phase 2 Corrective Measures Study Report* (CMS), RPP-RPT-59379, Revision 0."

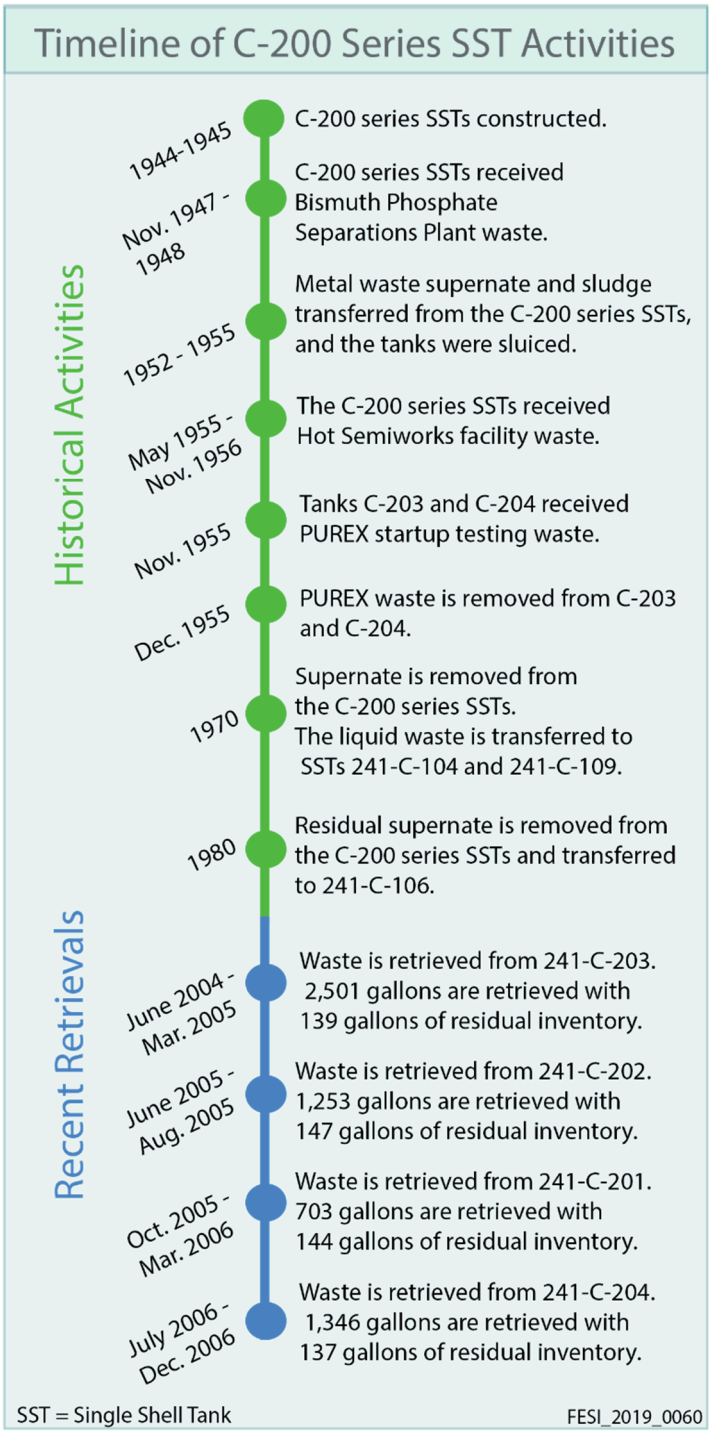
1.4.3 241-C-200 Series Tank Retrieval Activities and Current Status

Closure of the SSTs is required by Milestone M-045-00, as found in Appendix D of the HFFACO Action Plan. Milestone M-045-00 states that "Closure will follow retrieval of as much tank waste as technically possible." In 2003, during preparation for tank retrieval activities, manual liquid level gauges were installed in all of the C-200 SSTs as liquid level indicators for waste volume estimates. Tank waste was retrieved from the C-200 SSTs in 2005 and 2006 (HNF-EP-0182) (Figure 1-4 provides a brief timeline of activities leading up to this). The C-200 SSTs currently contain less than 150 gal of sludge each (RPP-ENV-33418).

Waste retrieval activities for tanks C-202 and C-203 were performed in accordance with RPP-16525, "*C-200-Series Tanks Retrieval Functions and Requirements*," Rev. 6. Waste retrieval activities for tanks C-201 and C-204 were performed in accordance with Rev. 6a of RPP-16525. Following successful retrieval operations, the retrieval methods and residual waste characterization data for each C-200 SST were documented in Retrieval Data Reports (RDRs). RDRs document the completion of retrieval operations and give waste residual assessments as required by the HFFACO Action Plan, Appendix I, Section 2.1.7. Information from the RDRs relevant to this RCRA Tier 3 Plan is summarized in Table 1-2. Following waste retrieval activities, in January 2008, Ecology agreed that the C-200 SSTs had been retrieved to the limit of waste retrieval technology capability, and that the waste retrieval criteria established by Milestones M-45-00 and M-45-00B had been met [Letter 0800207, "Re: Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204"].

Retrieval actions have been completed for all four C-200 SSTs. Following retrieval, residual tank waste was sampled and analyzed for three of the four tanks. The post-retrieval sample results were used as the basis of the residual inventory calculation. Tank C-201 could not be sampled, as documented in the RDR, due to insufficient residual waste volume directly under the riser used for sampling. Therefore, for tank C-201, the pre-retrieval sample results were used to support the post-retrieval inventory calculation. The residual waste inventory estimates are presented in RPP-RPT-42323, *Hanford C-Farm Tank and Ancillary Equipment Residual Waste Inventory Estimates*. The residual waste inventory is used in the RCRA closure analysis documented in RPP-ENV-58806, *RCRA Closure Analysis of Tank Waste Residuals Impacts at Waste Management Area C, Hanford Site, Washington*.

Figure 1-4. Historical and Recent 241-C-200 Series Single-Shell Tank Activities.



PUREX = Plutonium Uranium Extraction (Plant)

References:

RPP-15408, *Origin of Wastes in C-200 Series Single-Shell Tanks*.
RPP-RPT-26475, *Retrieval Data Report for Single-Shell Tank 241-C-203*.
RPP-RPT-29095, *Retrieval Data Report for Single-Shell Tank 241-C-202*.
RPP-RPT-30181, *Retrieval Data Report for Single-Shell Tank 241-C-201*.
RPP-RPT-34062, *Retrieval Data Report for Single-Shell Tank 241-C-204*.

Table 1-2. Retrieval Operations and Waste Residual Assessments.

Tank	Retrieval Data Report	Retrieval		Initial	Retrieved	Residual Inventory	
		Start	Complete			Nominal	95% UCL
241-C-201	RPP-RPT-30181 Rev 0-B	10/25/2005	03/23/2006	860 gal (115 ft^3)	703 gal (94 ft^3)	144 gal (19.2 ft^3)	153 gal (20.5 ft^3)
241-C-202	RPP-RPT-29095 Rev 0	06/30/2005	08/11/2005	1,400 gal (187 ft^3)	1,253 gal (167 ft^3)	147 gal (19.7 ft^3)	156 gal (20.9 ft^3)
241-C-203	RPP-RPT-26475 Rev 1A	06/30/2004	03/24/2005	2,640 gal (353 ft^3)	2,501 gal (334 ft^3)	139 gal (18.5 ft^3)	149 gal (19.9 ft^3)
241-C-204	RPP-RPT-34062 Rev 0	07/23/2006	12/11/2006	1,489 gal (199 ft^3)	1,346 gal (180 ft^3)	137 gal (18.3 ft^3)	147 gal (19.6 ft^3)

ft^3 = cubic feet gal = gallon UCL = upper confidence limit

References:
RPP-RPT-26475, *Retrieval Data Report for Single-Shell Tank 241-C-203*, Rev. 1-A.
RPP-RPT-29095, *Retrieval Data Report for Single-Shell Tank 241-C-202*, Rev. 0.
RPP-RPT-30181, *Retrieval Data Report for Single-Shell Tank 241-C-201*, Rev. 0-B.
RPP-RPT-34062, *Retrieval Data Report for Single-Shell Tank 241-C-204*, Rev. 0.

Post-retrieval waste residual volumes for each C-200 SST were presented in the RDRs as two values: a nominal inventory and a bounding inventory. The nominal inventory for each tank represents a mean, or average, value calculated. Nominal inventories are calculated by multiplying mean concentration, mean density, and waste volume. Bounding inventories represent a reasonable upper limit for the mean value. Bounding inventories are 95% upper confidence limit (UCL) inventories that are determined using a statistical method described in RPP-6924, *Statistical Methods for Estimating the Uncertainty in the Best Basis Inventories*, and RPP-RPT-27233, *Tank 241-C-203 Residual Waste Inventory Estimates for Tank Component Closure Risk Assessment*. Table 1-2 shows both nominal and 95% UCL residual inventory values for each C-200 SST, as reported in its respective RDR.

Following retrieval activities, quarterly monitoring of the C-200 SSTs continues to be conducted in accordance with best management practices as defined by RPP-9937, Section 5.2. Periodic monitoring includes liquid level and liquid intrusion monitoring. If intrusion is detected, response actions are included in RPP-9937, Appendix B.

1.5 WASTE CONSTITUENTS

The waste managed in WMA C is mixed waste, as defined in WAC 173-303-040, "Definitions," meaning that it contains both dangerous and radioactive constituents. DOE/RL-88-21, *Hanford Facility Dangerous Waste Part A Permit Application, Part A Form* for the SST system does not provide a list of waste codes specific to the C-200 SSTs. The Part A Form for the SST system provides a list of all the waste codes assigned to the SST system. Waste codes applicable to all tanks in the SST system are D001-011, D018-019, D022, D028-030, D033-036, D038-041, D043, WP01-02, WT01-02, and F001-005. As noted in the RCRA Tier 1 Plan, Section 1.2.3,

and RCRA Tier 2 Plan, Section 2.4, the bulk of the tank waste constituents are sodium hydroxide; sodium salts of nitrate, nitrite, carbonate, aluminate, oxalate, and phosphate; and hydrous oxides of aluminum, iron, and manganese. Radioactive isotopes constitute less than 1% of the overall waste volume, but contribute a substantial portion of the overall risk to human health and the environment. A wide variation in the waste type, volume, and inventory exists among SST farms and from tank to tank within individual WMAs.

The list of constituents provided in the Part A Form includes the entire Hanford SST system; it does not include individual waste constituents for the C-200 SSTs. Information specific to the waste processes contributing to waste managed at WMA C as a whole is contained in the Phase 2 RFI report (RPP-RPT-58339) and Section 2.2 of the RCRA Tier 2 Plan for WMA C (RPP-RPT-59389). Information pertaining to the waste processes contributing to waste specifically managed in the C-200 SSTs is contained in Section 1.4 of this RCRA Tier 3 Plan.

2.0 SPECIFIC CLOSURE REQUIREMENTS FOR THE 241-C-200 SINGLE-SHELL TANKS

WAC 173-303-610 provides Washington State requirements for closure and post-closure of DWMUs such as WMAs within the SST system, referencing additional standards in WAC 173-303-640(8) pertaining to closure of tank systems and standards in WAC 173-303-665(6) specific to closure of a landfill. DOE will close WMA C in compliance with applicable performance standards referenced in WAC 173-303-610 subsection (2) "Closure performance standard," item (a).

This Tier 3 Closure plan addresses all C-200 tanks together as a group for the following reasons:

- The tanks are of the same size and are very similar structurally
- The tanks are in a close proximity to each other
- The tanks have similar waste transfer history
- These tanks will be closed using the same processes, equipment, and technologies.

Appendix A lists the specific RCRA closure requirements from the WAC, includes the compliance strategy for meeting each WAC requirement, and identifies the sections within the RCRA Tier 1 Plan, RCRA Tier 2 Plan, and this RCRA Tier 3 Plan, where the strategy is described in more detail. This section provides a brief overview of the closure requirements and performance standards for the C-200 SSTs. Detailed closure procedures will be described in field work packages.

The closure performance standards of WAC 173-303-610(2) will be met through the component closure activities specified in this RCRA Tier 3 Plan. These standards require the closure of treatment, storage, and disposal (TSD) units in a manner that achieves the items listed below.

- Minimize the need for further maintenance.

- Control, minimize, or eliminate, to the extent necessary to protect human health and the environment: post-closure escape of dangerous waste[1]; dangerous-waste constituents; leachate[2]; contaminated run-off; or dangerous-waste decomposition products to the ground, surface water, groundwater, or the atmosphere.

- Return the land to the appearance and use of surrounding land areas to the degree possible, given the nature of the previous dangerous-waste activity.

Stabilizing the four C-200 SSTs with grout will address items one and two. Grout will stabilize the residual waste within the tanks, minimize the mobility of the dangerous waste components, and reduce the possibility of release to the environment. In addition, the grout stabilization will minimize the need for further maintenance by completely filling the tanks and preventing the

[1] A post-closure care plan will be developed after final closure activities for WMA C closure are completed. See Appendix A, page A-6.

[2] Leachate collection is not part of the required closure activities for closure of WMA C. See Appendix A, page A-5.

potential for future subsidence. The design and placement of the final closure cover over WMA C, consistent with the requirements of RCRA Subtitle C, will address all three of the above items. Current institutional controls will be maintained prior to final closure cover (i.e., fencing, postings, and route maps). A post-closure groundwater monitoring plan will be developed as WMA C closure is completed. The final closure cover is not addressed in this RCRA Tier 3 Plan, but is discussed in the RCRA Tier 2 Plan, Sections 4.1 and 5.4.

Because WMA C will be closing under RCRA landfill regulations, closure must meet the requirements of WAC 173-303-665(6). These requirements state that the final cover must be designed and constructed to:

- Provide long-term minimization of migration of liquids through the closed landfill
- Function with minimum maintenance
- Promote drainage and minimize erosion or abrasion of the cover
- Accommodate settling and subsidence so that the cover's integrity is maintained
- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

The design and specifications for the final closure cover are outside the scope of this RCRA Tier 3 Plan. Engineering design and planning will accommodate the effects of closing components or groups of components on other groups of components or other WMA closures. The component closure activities performed under this RCRA Tier 3 Plan will not address the landfill closure requirements of WAC 173-303-665(6) in its entirety. Ancillary equipment, including pipelines, are listed in the Tier 1 plan. Ancillary equipment for WMA C will be landfill closed. Ancillary equipment will be addressed through the permit process, and will be included at the Tier 3 level as appropriate. The Tier 3 plans will include additional steps for component closure, including any ancillary equipment that may need to be grouted to satisfy void-space requirements for landfill closure. Additional information regarding landfill closure is presented in the RCRA Tier 2 Plan, Sections 1.2.1, 1.2.3, 4.0, and 5.0.

3.0 CLOSURE ACTIVITIES FOR THE 241-C-200 SINGLE-SHELL TANKS

This Section describes C-200 SST closure activities, including tank preparation activities and grouting stages. Closure monitoring strategies, waste management, and the closure barrier are also discussed. Table 3-1 summarizes closure performance standards applicable to this Tier 3 closure plan.

Table 3-1. Applicable Closure Performance Standards.

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	Explanatory Notes	Location within this Plan
-610(3)(a)(iv) Closure plan contents: Detailed description of methods to be used during partial closure and final closure, including methods to manage dangerous wastes and types of off-site dangerous waste management units to be used	The required information is provided in the *Resource Conservation and Recovery Act of 1976* (RCRA) Tier 2 Plan and will be further addressed in each RCRA Tier 3 component closure activity plan for Waste Management Area (WMA) C component closure activities.	Section 3
-610(3)(a)(v) Closure plan contents: Detailed description of steps needed to remove or decontaminate all dangerous waste residues and contaminated containment system components, equipment, structures and soils …. including… procedures for cleaning equipment and removing contaminated soil	The requirement for removing contaminated soil applies to the closure of WMA C and will be addressed under the Corrective Action process, in accordance with Appendix I of the *Hanford Federal Facility Agreement and Consent Order* Action Plan. Containment system components for the single-shell tanks (SSTs) and other components will not be removed under the landfill closure approach.	Section 3
-610(3)(a)(vii) Closure plan contents: Schedule for closure of WMAs and SST System	Schedule information is provided, as required and managed under the *Hanford Federal Facility Agreement and Consent Order*.	Section 4
-610(5) Management of waste generated during closure	Management of dangerous or mixed waste generated during closure activities will be described in the various RCRA Tier 3 component closure activity plans.	Section 3.5
-610(6) Certification of closure	Closure certifications will be provided, as required.	Section 5

References:
WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.
WAC 173-303-610, "Closure and Post Closure," *Washington Administrative Code*, as amended.

3.1 OVERVIEW OF CLOSURE ACTIVITIES

Tank closure activities included in this RCRA Tier 3 Plan are based on implementing landfill closure as described in the RCRA Tier 2 Plan. Closure activities for the C-200 SSTs involve tank preparation activities to remove and/or cut off above-grade equipment, establishing access for grout placement, and filling the tanks with grout to isolate the residual waste remaining in each tank and stabilize the tank structures. After filling the bulk of the tank**,** the head space in

the tank above the bottom of the tank risers will be filled, followed by the tank risers and the pits. Additional information on the steps involved in filling the tank structures is provided in the following sections.

This Tier 3 Closure Plan presents a phased approach to grout placement. Engineering documents that will support this approach will be developed at a later date. Closure activities for the C-200 SSTs involve removing existing equipment from the tanks as necessary to provide tank access, filling the tanks with grout to immobilize residual waste in each tank, and stabilizing the tank structures. The phased approach to grouting will include the following general activities, which are further addressed in Sections 3.2.1 through 3.2.4:

- Tank Preparation Activities for Stage 1 Grout Fill
- Stage 1 Grout Fill
- Tank Preparation Activities for Stage 2 Grout Fill
- Stage 2 Grout Fill
- Demobilization.

3.2 TANK PREPARATION ACTIVITIES

Tank preparation activities are prerequisite to placing grout into the tanks and include the activities below.

- Remove and/or relocate existing above-grade equipment, as necessary, to establish equipment access to the tank risers for removal and/or installation of equipment to support tank closure. The photo in Figure 3-1 is a view from the west side of the tank farm, facing east, that shows the above-grade equipment near the C-200 SSTs.

- Install active ventilation systems where necessary (e.g., portable exhauster).

- Remove in-tank and above-grade equipment as necessary to establish tank access.

- Remove or modify existing in-tank equipment that extends above grade to the extent necessary so as to prevent interference with construction of the closure cap.

- Set up support stands and grout delivery system interfaces on select tank risers.

3.2.1 Ventilation

Removal of in-tank equipment and Stage 1 grouting may require active ventilation to control potential airborne contamination. The active ventilation system will include a ventilation skid with high-efficiency particulate air (HEPA) filtration. A ventilation skid will be used to maintain the interior of the tank at a slight negative pressure relative to atmosphere by drawing air into the tank through an inlet filter and out of the tank through a bank of HEPA filters using a ducted fan. This reduces the risk of contamination from residuals during grouting activities. Either an existing portable exhauster or a new ventilation skid would be designed to meet the needs for

tank closure. Ventilation system requirements will be addressed through the detailed design and the notice of construction process following evaluation of the potential-to-emit.

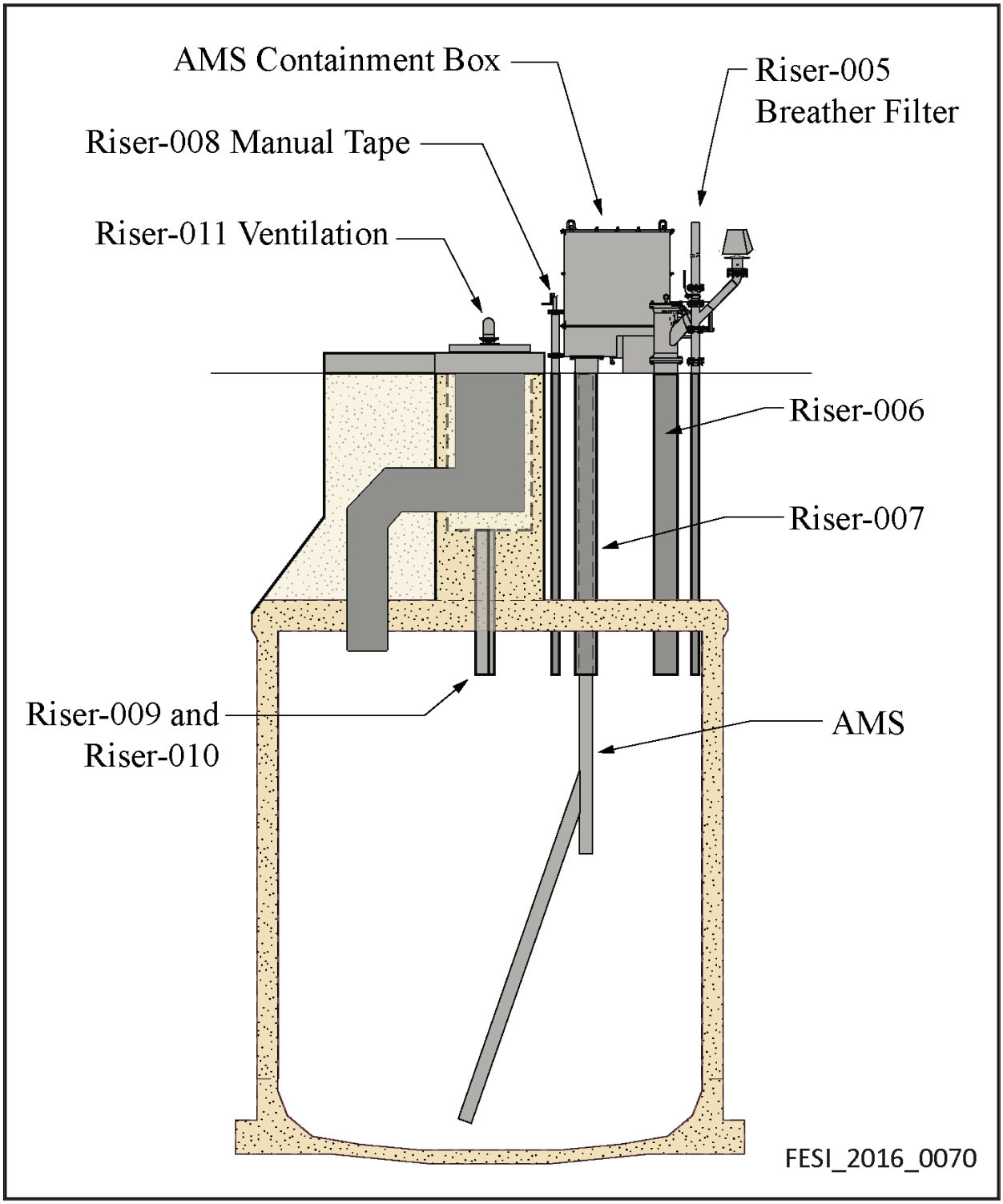
Figure 3-1. Eastern View of 241-C-200 Single-Shell Tanks.

3.2.2 Removal and Disposition of In-Tank Equipment

Minimum tank access requirements for tank stabilization include tank riser access suitable for ventilation (inlet and exhaust), camera access for periodic in-tank monitoring, and riser access suitable for grout placement into the tank. This RCRA Tier 3 Plan will be modified as needed through the permit modification request process, in compliance with WAC 173-303-830, "Permit Changes," to address any significant change as a result of detailed design. Existing in-tank equipment will be left in the tank unless removal is required to facilitate grouting activities. All equipment removed from the tanks will be packaged, managed, and disposed in an approved disposal facility, preferably on-site, in accordance with existing procedures and regulatory requirements.

Engineering and design efforts are under way to evaluate the in–tank equipment and access requirements for performing tank closure activities. An enabling assumption is that most of the in-tank equipment will be entombed in the grout. Final decisions regarding in-tank equipment will consider whether any of the risers containing equipment are required for closure activities. Figure 3-2 shows a cross-section of one of the C-200 SSTs, providing an example of current in-tank equipment.

Figure 3-2. 241-C-200 Single-Shell Tank Cross Section.

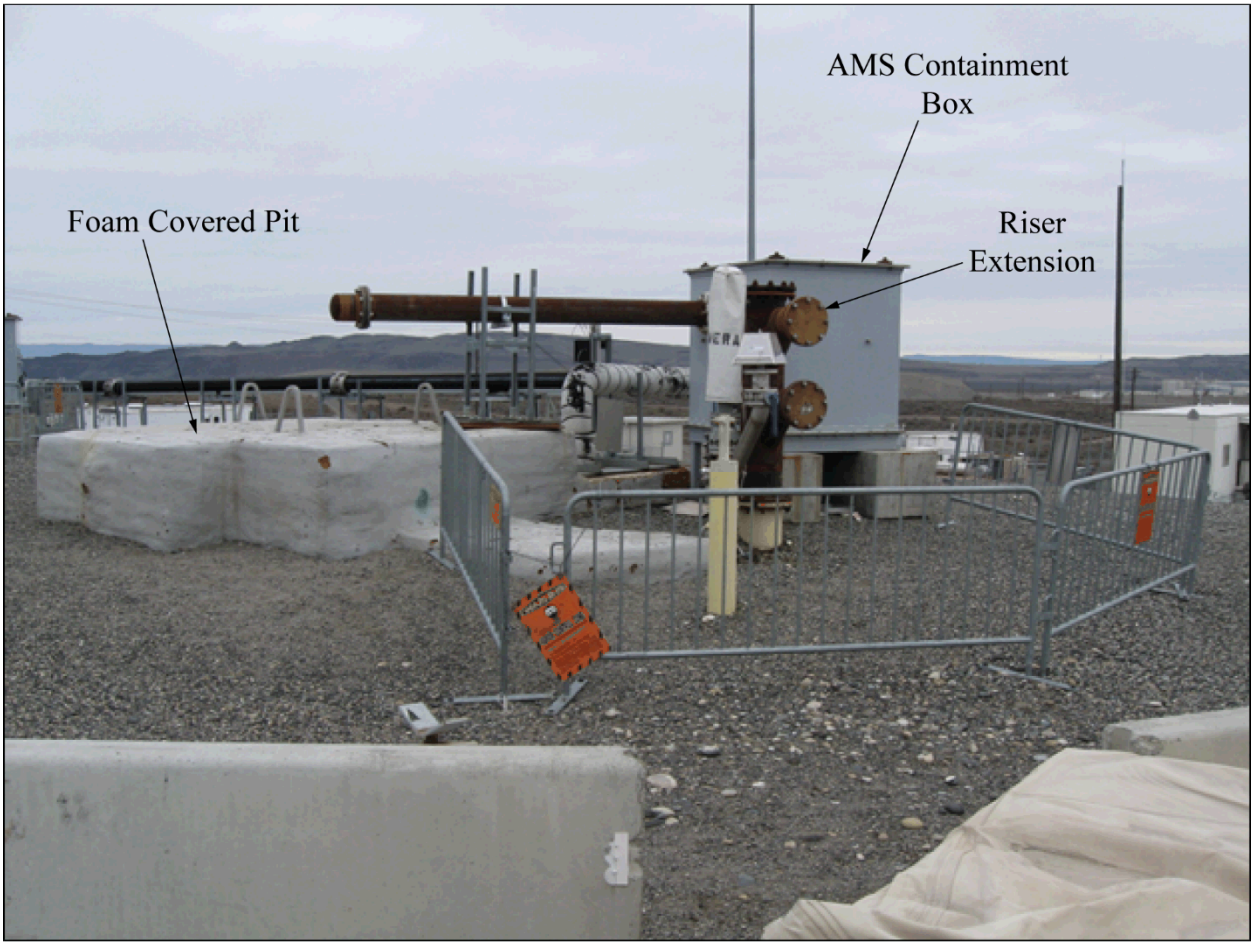


AMS = articulating mast system

Each of the C-200 SSTs has equipment installed that extends vertically above the tank risers (e.g., the containment box assembly, riser extensions, level instrumentation). Figure 3-3 shows

the components and equipment installed at tank C-201. The concrete tank pits are an integral part of the tank structure and will remain in place following grout filling. Any components or equipment extending above the height of the pits may be removed or cut off so that the height is at or below the elevation of the pit structure. The AMS containment box assembly (grey metal box supported on concrete blocks) extends approximately 6 ft vertically above the tank riser. If this were to remain in place, it would substantially increase the amount of fill material required to establish the base layer of the closure cap. The bottom of the AMS will be entombed in grout. The AMS will be cut near the top of the riser and sealed at grade. Other installed components such as riser extensions and support stands will be removed to limit the height of equipment extending above the permanent tank structure. In-tank equipment not requiring removal to support closure activities or that is left in the bottom of the tanks (e.g., thermocouple trees, plummets, lead bricks, steel tapes, sludge jet eductor) will be abandoned in place and entombed in grout during tank filling activities.

Figure 3-3. Tank 241-C-201 Above-Grade Equipment.



AMS = articulating mast system

3.2.3 Isolation

The purpose of tank and component isolation is to preclude infiltration of precipitation after retrieval has been completed. The tank pits have been covered with foam to prevent rainwater intrusion into the tanks. The buried waste transfer lines and the transfer lines routed in the concrete pipe trenches are sloped to the C-200 SSTs. These lines have been isolated at their point of origin within the diversion boxes using process blanks to preclude drainage. The hose-in-hose transfer lines used for the vacuum waste retrieval system have been removed in accordance with RPP-12711, *Temporary Waste Transfer Line Management Program Plan* and blind flanges installed on risers.

Tank waste level instrumentation is currently installed in each of the C-200 SSTs and is used for periodic intrusion monitoring.

Buried waste transfer lines penetrate the sidewall of each tank. These lines were used during active operations to transfer waste into the tanks. There are also buried transfer lines in concrete pipe trenches that terminate at jumper nozzles within the tank pits. These lines are open at the tank; grout will flow into these lines during tank grouting operations. No actions will be taken to isolate the out-of-service waste transfer lines. All of the waste transfer lines routed to the C-200 SSTs drained toward the tanks; any grout flowing into the lines during grout filling activities would be flowing upslope and would travel a limited distance. The network of buried transfer lines within WMA C will not be remediated, based on the results of RPP-PLAN-47559, *Single-Shell Tank Waste Management Area C Pipeline Feasibility Evaluation*, the DOE O 435.1 Performance Assessment (RPP-ENV-58782, *Performance Assessment of Waste Management Area C, Hanford Site, Washington*), and RPP-ENV-58806.

3.2.4 Tank Modifications for Equipment Interface

No tank modifications are anticipated for interfacing with equipment that will be used to close the tanks. Existing risers will be utilized to temporarily install equipment (e.g., in-tank cameras). Current plans include core drilling through the pump pit cover block to install a temporary riser for grouting the pump pit.

3.3 GROUTING

Cementitious grout will be used to fill the tanks and provide long-term structural stability following component and WMA C closure. Additives may be used in the mixture design to aid in grout production, delivery, placement, or performance (e.g., improve working time, improve flowability, or reduce bleed water). The grout mixture design will be a combination of cement, supplementary cementitious materials (e.g., fly ash), sand, and admixtures. Mixture designs will be established during detailed closure design to provide a mixture that is highly flowable with low bleed water and low shrinkage characteristics.

Grout testing conducted in 2018 and 2019 evaluated 22 grout formulas used, or proposed for use, at DOE facilities for filling waste tanks and other purposes as the starting point for the

development of formulas for a bulk-fill grout and a highly-flowable grout, as described in RPP-RPT-60566, *C-200 Series Tank Closure Grout Formulation Review and Recommendations for Testing*, Rev. 0. The primary functions of the bulk-fill grout formula are to isolate residual waste remaining in the tank/component and fill the void space created by the tank structure. The primary function of the highly-flowable grout formula is to flow greater distances than bulk-fill grout so as to be capable of stabilizing below-grade structures with limited access. The evaluation identified grout formulas for larger scale testing. A formula for a highly-flowable grout, based on Idaho National Laboratory's Tank Closure Pipe Fill grout was selected for use at WMA C for filling pipe encasements associated with the C-200 series tanks. A bulk-fill grout formulation is still in development.

It is anticipated that tank stabilization will be completed in two stages. The number of stages could change based on field evaluations, safety considerations, and administrative controls that require additional steps. Each C-200 SST has a flat top with tank risers that penetrate into the headspace. Active ventilation may be used in Stage 1, while the residual waste heel is encapsulated and the tank is filled to a level just below the tank risers. Passive ventilation will be used during Stage 2, while filling the tank headspace, risers, and pits. It is anticipated that Stage 1 grout filling will occur in a single pour based on the relatively simple geometry of the space to be filled in Stage 1 grouting. Stage 2 grouting is likely to require a number of pours based on the more complex geometry of the features to be filled in Stage 2 grouting. The risers and pits to be filled in Stage 2 grouting will likely be filled individually, which could be performed in one or more steps.

Current plans for grout production, delivery, and placement in the C-200 SSTs are based on obtaining the grout from a local batch plant, using mix trucks to deliver the grout to the site, and using a pump truck to transfer the grout from the edge of the farm to the tanks.

3.3.1 Stage 1

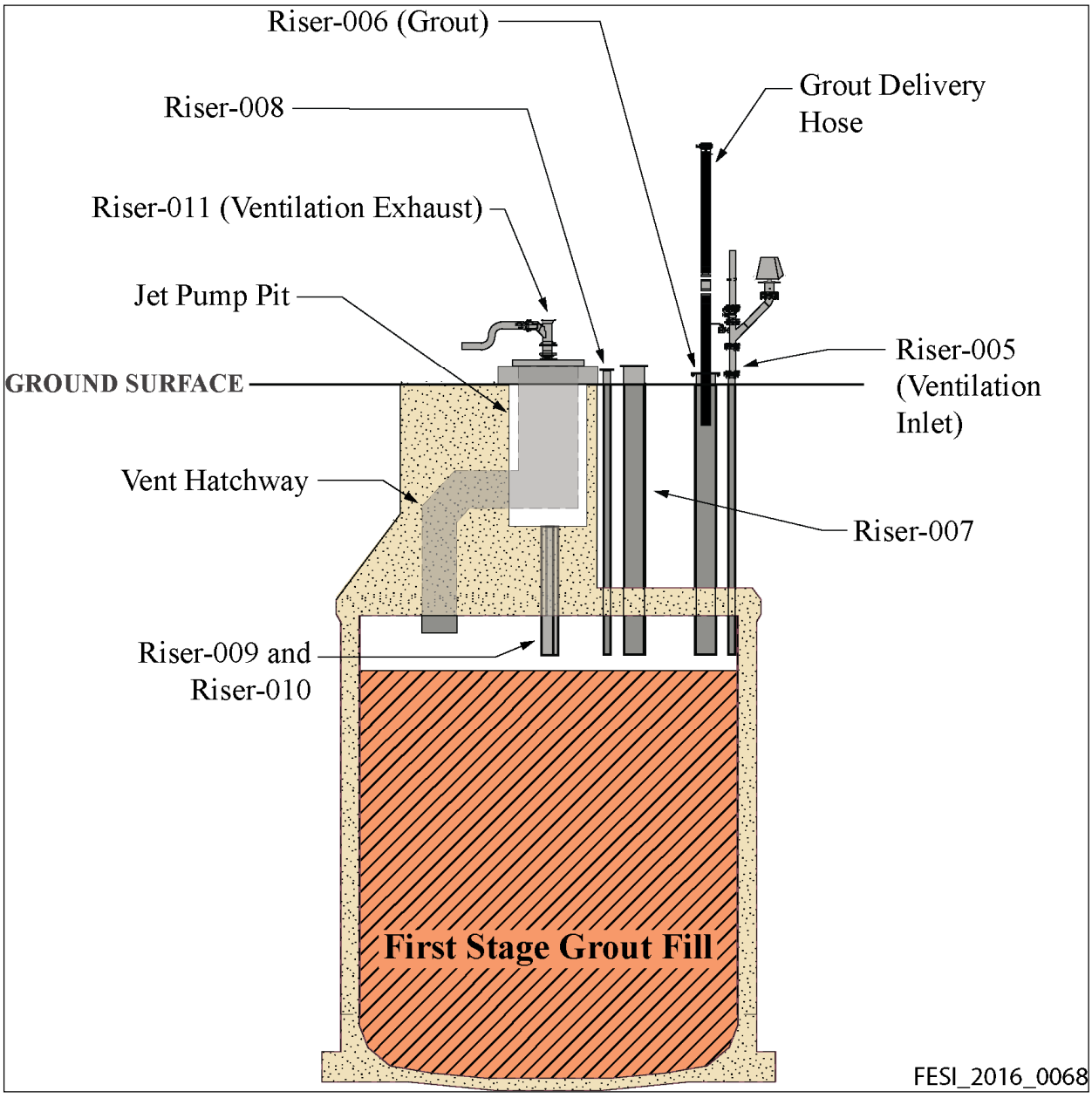
The purpose of Stage 1 grouting is to immobilize residual waste remaining in the tanks and fill the bulk of the tank volume. Stage 1 grouting will involve delivery and placement of grout into a tank. Based on current plans for grout production and delivery, grout placement into the C-200 SSTs during Stage 1 can be performed at a near-continuous pour, allowing for the possibility of Stage 1 grouting of a single tank to be completed in one day, depending on grout transport and delivery logistics. Each tank would be grouted separately.

Active ventilation with filtration may be used during Stage 1 grouting to control airborne contamination displaced by the grout, and to provide positive inflow of air for installation of the in-tank camera and for grout placement at the tank riser.

Approximately 270 cubic yards of grout will be placed in each tank during Stage 1 grouting. This will bring the grout to approximately 7.3 m (24 ft) above the base of each tank, which is approximately 0.3 m (1 ft) below the tank risers that penetrate through the top of each tank. Prior to introduction of bulk fill grout into the tank, approximately 68 kg (150 lbs) of hydrated lime will be placed into the tank. After placement of the hydrated lime, bulk fill grout will be placed. Figure 3-4 illustrates the grout fill level at the completion of Stage 1. After completion

of Stage 1 grout placement, in-tank conditions will be monitored to ensure excess bleed water has evaporated or been absorbed by the addition of a dry grout mix before initiating Stage 2 grout placement. This will reduce the potential for having excess water in the tank risers during Stage 2 grouting activities.

Figure 3-4. Stage 1 Grouting.



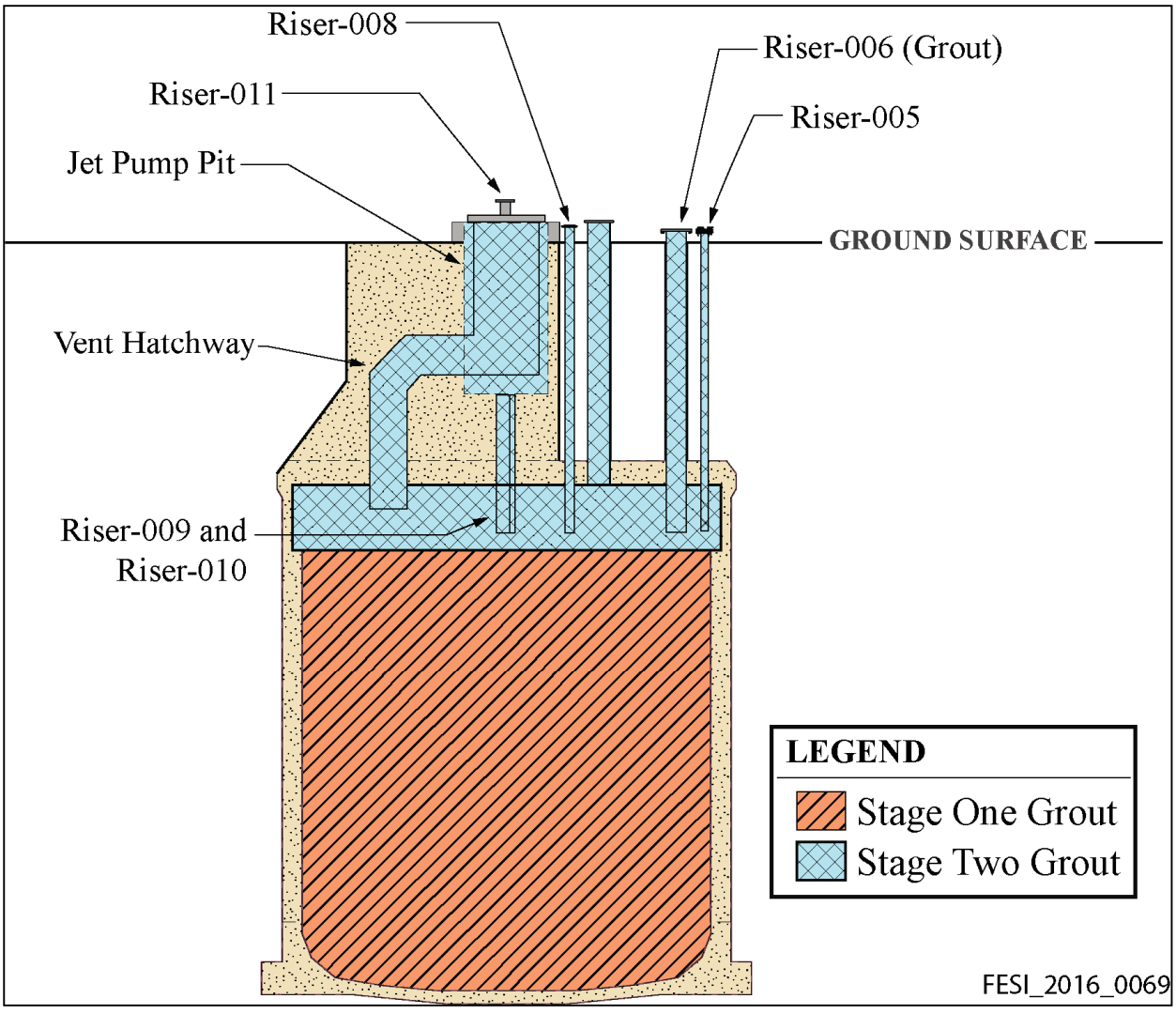
3.3.2 Stage 2

The purpose of Stage 2 grouting is to fill the remaining void spaces and tank access risers with grout. Stage 2 grouting will provide controlled delivery of wet grout to fill the remaining tank

headspaces, to the extent practicable, as well as the tank risers and the tank pits. Before initiating Stage 2 grouting activities, the active ventilation will need to be shut down, if in use, and the ventilation connections to each tank removed. Control of potential airborne contamination will be maintained using glove bags with HEPA filtration. Alternatively, a portable exhauster could be used to capture air displaced by grout placement if detail work planning identifies the need for active ventilation to address industrial safety or radiological control requirements.

Approximately 20 cubic yards of grout is required to fill the risers, pits, and ventilation hatchway in each tank. Figure 3-5 illustrates the grout fill disposition at the completion of Stage 2. After each tank headspace is filled above the bottom of the tank riser penetrations, the risers will need to be filled individually. The rate of grout delivery will be based on the size and geometry of the void space being filled.

Figure 3-5. Stage 2 Grouting.



Stage 2 grouting will raise the grout level to cover the transfer lines that penetrate the tank sidewalls and the jumper nozzles in the pump pits. These penetrations are open where they terminate at each tank and are isolated where the lines originate, each in one of the diversion boxes. Grout will flow a short distance into these lines as the grout fill progresses. However, since the grout will be flowing upslope into the lines, flow into the lines will be limited.

3.4 MONITORING DURING TANK CLOSURE

During Stage 1 and portions of Stage 2 grouting, the in-tank conditions will be periodically monitored with a camera to visually confirm placement and monitor progress. Additionally, process parameters, such as volume of grout placed, will be monitored to track progress against design requirements.

3.5 MANAGEMENT OF WASTE GENERATED DURING CLOSURE

Waste generated during closure activities will include personal protective equipment, contaminated equipment removed from the tank, grout delivery hose sections that go into the tank, and glove bags and HEPA filters used for contamination control during grouting operations.

All waste generated during closure activities will be managed in accordance with waste generation procedures including the planning, accumulation, packaging, shielding, survey requirements, and requirements to ensure compliance with regulations and TSD facility waste acceptance criteria.

Equipment utilized during closure that is not suitable for reuse will be packaged and disposed of as mixed waste onsite in accordance with the approved waste acceptance criteria for an approved disposal facility. If contaminated equipment is reused, it will be controlled as specified in Contaminated Equipment Management Practices documents.

Mix truck washout will be performed in a designated washout area using best management practices as defined in *Categorical State Waste Discharge Permit Number ST0004511* (Ecology 2014).

The grout will likely be procured from a commercial supplier.

A waste planning checklist will be prepared, as part of the work planning process, in accordance with existing tank farm operating procedures.

3.6 CLOSURE BARRIER

No closure barrier will be constructed as part of component closure. Barriers will be evaluated and addressed in a corrective measure study to mitigate past leaks, spills and UPRs.

A permanent, modified RCRA Subtitle C closure barrier will be addressed as part of WMA C closure. Additional information is presented in Section 5.4.2 of the RCRA Tier 2 Plan.

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4.0 CLOSURE SCHEDULE

The schedule for, and sequencing of, all activities for closure of the C-200 SSTs are provided through HFFACO milestones. The existing HFFACO milestones specifically related to the C-200 SSTs which remain to be completed are found in the M-045 series, as amended.

Tank closure preparation activities and grout filling of the tanks is anticipated to be completed within 360 days. Should unanticipated conditions arise, and an extension to the 360-day period become necessary, a permit modification request will be submitted to Ecology for approval at least 30 days before the anticipated completion date. Closure certification for completion of the C-200 SSTs component closure will be submitted within 60 days of completion of the grout filling of the four tanks.

Table 4-1 includes activities anticipated during closure of the C-200 SSTs, along with expected durations for field activities. Additional details regarding these activities and their sequencing are included in Section 3.0. For efficiencies and worker safety, the sequencing of some field activities may vary. Note that 60-day notice will be provided to Ecology prior to start of field activities, according to WAC 173-303-610(3)(c)(i). Should an unexpected event require a modification of the 360-day duration shown in Table 4-1, a written notification of or request for a permit modification to authorize a change in the approved plan will be submitted to Ecology no later than 30 days after the unexpected event, in accordance with WAC 173-303-610(3)(b)(ii).

Table 4-1. 241-C-200 Single-Shell Tank Closure Activity Durations. (3 sheets)

Tank	Component Closure Activities		Expected Duration[1] (days)
	Primary Activity	**Secondary Activity**	
241-C-201 (60-90 Days)	Tank Preparation Activities for Grout Fill	Remove, relocate, and modify existing in-tank and above-grade equipment, as necessary.	45-75
		Install equipment to support tank closure, as necessary.	
		Reconfigure ventilation system, as necessary.	
		Set up support stands and grout delivery system interfaces on select tank risers.	
		Develop work packages for grouting activities.	
	Stage 1 Grout Fill	Grout single-shell tank (SST) 241-C-201.	10
	Tank Preparation Activities for Stage 2 Grout Fill	Reconfigure ventilation system, as necessary.	
	Stage 2 Grout Fill	Fill tank risers.	
		Fill tank pits.	
	Demobilization	Dispose of waste generated during closure activities.	5
	Develop lessons learned from grouting SST 241-C-201	Not applicable (NA)	NA[2]

Table 4-1. 241-C-200 Single-Shell Tank Closure Activity Durations. (3 sheets)

Tank	Component Closure Activities		Expected Duration[1] (days)
	Primary Activity	Secondary Activity	
241-C-202 (60-90 Days)	Tank Preparation Activities for Grout Fill	Remove, relocate, and modify existing in-tank and above-grade equipment, as necessary.	45-75
		Install equipment to support tank closure, as necessary.	
		Reconfigure ventilation system, as necessary.	
		Set up support stands and grout delivery system interfaces on select tank risers.	
		Develop work packages for grouting activities.	
	Stage 1 Grout Fill	Grout SST 241-C-202.	10
	Tank Preparation Activities for Stage 2 Grout Fill	Reconfigure ventilation system, as necessary.	
	Stage 2 Grout Fill	Fill tank risers.	
		Fill tank pits.	
	Demobilization	Dispose of waste generated during closure activities.	5
	Develop lessons learned from grouting SST 241-C-202	NA	NA[2]
241-C-203 (60-90 Days)	Tank Preparation Activities for Grout Fill	Remove, relocate, and modify existing in-tank and above-grade equipment, as necessary.	45-75
		Install equipment to support tank closure, as necessary.	
		Reconfigure ventilation system, as necessary.	
		Set up support stands and grout delivery system interfaces on select tank risers.	
		Develop work packages for grouting activities.	
	Stage 1 Grout Fill	Grout SST 241-C-203.	10
	Tank Preparation Activities for Stage 2 Grout Fill	Reconfigure ventilation system, as necessary.	
	Stage 2 Grout Fill	Fill tank risers.	
		Fill tank pits.	
	Demobilization	Dispose of waste generated during closure activities.	5
	Develop lessons learned from grouting SST 241-C-203	NA	NA[2]

Table 4-1. 241-C-200 Single-Shell Tank Closure Activity Durations. (3 sheets)

Tank	Component Closure Activities		Expected Duration[1] (days)
	Primary Activity	Secondary Activity	
241-C-204 (60-90 Days)	Tank Preparation Activities for Grout Fill	Remove, relocate, and modify existing in-tank and above-grade equipment, as necessary.	45-75
		Install equipment to support tank closure, as necessary.	
		Reconfigure ventilation system, as necessary.	
		Set up support stands and grout delivery system interfaces on select tank risers.	
		Develop work packages for grouting activities.	
	Stage 1 Grout Fill	Grout SST 241-C-204.	10
	Tank Preparation Activities for Stage 2 Grout Fill	Reconfigure ventilation system, as necessary.	
	Stage 2 Grout Fill	Fill tank risers.	
		Fill tank pits.	
	Demobilization	Dispose of waste generated during closure activities.	5
	Develop lessons learned from grouting the SST 241-C-204	NA	NA[2]

[1] It is expected that some activities will be performed concurrently and that the total duration for closure activities will be 360 days from the start of component closure of the 241-C-200 single-shell tanks.
[2] Lessons learned are a best management practice and not a closure requirement.

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5.0 CLOSURE CERTIFICATION, NOTICE IN DEED, AND SURVEY PLAT

This section describes closure certification, notice to local land authority, notice in deed to property, and survey documentation required after the completion of final closure of WMA C.

5.1 CLOSURE CERTIFICATION

As described in the RCRA Tier 2 Plan, Section 7.1, final closure of WMA C will require the completion of closure activities for a number of components, which will be conducted over a period of time. Therefore, closure certifications will be prepared and submitted for each of the individual components or for groups of components in accordance with WAC 173-303-610(6), as stated below.

> *Within sixty days of completion of closure of each dangerous waste management unit (including tank systems and container storage areas), and within sixty days of the completion of final closure, the owner or operator must submit to the department by registered mail or other means that establish proof of receipt (including applicable electronic means), a certification that the dangerous waste management unit or facility, as applicable, has been closed in accordance with the specifications in the approved closure plan. The certification must be signed by the owner or operator and by an independent qualified registered professional engineer.*

5.2 NOTICE IN DEED AND SURVEY PLAT

DOE will provide a survey plat that indicates the location and dimensions of the closed dangerous waste units with respect to permanently surveyed benchmarks to Benton County, pursuant to WAC 173-303-610 subsections (9) “Notice to local land authority” and (10) “Notice in deed to property.”

A survey plat will be submitted by the owner or operator to Ecology and to the Benton County Planning Department no later than the submission of the certification of closure of each dangerous waste disposal unit. The survey plat will indicate the location and dimensions of landfill cells or other dangerous waste disposal units with respect to permanently surveyed benchmarks. The plat will be prepared and certified by a professional land surveyor. The plat filed with the Benton County Planning Department will contain a note, prominently displayed, which states the owner’s or operator’s obligation to restrict disturbance of the dangerous waste disposal unit in accordance with WAC 173-303-610, subsection (7) “Post-closure care and use of property,” item (d).

No later than 60 days after certification of closure of each dangerous waste disposal unit, a record of the type, location, and quantity of dangerous wastes disposed of within each cell or other disposal unit will be submitted by the owner or operator to Ecology and to the Benton County Planning Department. For wastes disposed of before November 19, 1980 (March 12,

1982, for facilities subject to this chapter but not subject to Title 40, CFR, Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities" [40 CFR 264]), the owner or operator must identify the type, location, and quantity of the dangerous wastes to the best of his or her knowledge and in accordance with any records he or she has kept.

A notation on the deed to the facility property will be submitted by the owner or operator to the Auditor of Benton County no later than 60 days after certification of closure of each DWMU, in accordance with WAC 173-303-610(10)(b)(i). After submitting this notice, a certification signed by the owner or operator will be submitted to Ecology stating that the notice has been recorded in accordance with WAC l73-303-610(10)(b)(ii), along with a copy of the notice in deed.

The survey plat is required no later than the date of submission of the certification of closure of WMA C. The survey plat will be prepared and certified by a professional land surveyor. After the final closure, the survey plat of the WMA will be submitted to Benton County and Ecology. In addition, any restrictive covenants on the use of the land also will be submitted to Benton County for attachment to the property deed, as necessary.

6.0 REFERENCES

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WAC 173-303-640, "Tank Systems," *Washington Administrative Code*, as amended.

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WAC 173-340-360, "Selection of Cleanup Actions," *Washington Administrative Code*, as amended.

APPENDIX A

CLOSURE PERFORMANCE STANDARDS

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Table A-1. Closure Performance Standards. (6 sheets)

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	RCRA Tier 1 Plan Section	RCRA Tier 2 Plan Section	RCRA Tier 3 Plan Section	Explanatory Notes
General Closure and Post-Closure Requirements				
-610(2)(a)(i) General closure performance standards: Minimize need for further maintenance	Section 3	Section 4	—	Landfill closure, including grout stabilization and the final cover, will reduce the potential for infiltration or intrusion. The final cover will be constructed in such a way as to minimize need for future maintenance.
-610(2)(a)(ii) General closure performance standards: Control, minimize, or eliminate to the extent necessary to protect human health and the environment post-closure escape of dangerous waste (DW)	Section 3	Section 4	—	Isolation and stabilization of single-shell tanks (SSTs) and other remaining below-grade equipment, along with the final cover, will minimize post-closure release to the environment.
-610(2)(a)(iii) General closure performance standards: Return land to appearance of surrounding land areas	Section 3	Section 4	—	Following closure of the SSTs, the appearance and use of the land will be consistent with future uses of the 200 Areas.
-610(2)(b) Clean closure levels	—	—	—	This requirement would apply to the closure of Waste Management Area (WMA) C, but for the practicability determination. As discussed in the clean closure practicability demonstration document, it is not practicable to accomplish clean closure for the SST system, and the SST system will be landfill-closed.
-610(3)(a)(i) Closure plan contents: How each WMA will be closed in accordance with -610(2)	Section 1	Section 4	—	Closure activities for each WMA will be detailed in the RCRA Tier 2 Plan specific to the WMA.
-610(3)(a)(ii) Closure plan contents: How final closure of the SST System (facility) will be conducted in accordance with -610(2)	Section 3	Section 4	—	This requirement applies to the final closure of the SST system and is addressed in the RCRA Tier 1 Plan. Additional details are provided in the RCRA Tier 2 Plan and the RCRA Tier 3 Plan, as appropriate.
-610(3)(a)(ii) Closure plan contents: Maximum extent of operation which will be unclosed during the active life of the SST System (facility)	Section 1	—	—	This requirement applies to the closure of WMA C and is addressed in the RCRA Tier 1 Plan.

Table A-1. Closure Performance Standards. (6 sheets)

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	RCRA Tier 1 Plan Section	RCRA Tier 2 Plan Section	RCRA Tier 3 Plan Section	Explanatory Notes
-610(3)(a)(iii) Closure plan contents: An estimate of the maximum inventory of waste ever on-site over the active life of the SST System (facility)	Section 1	—	—	This requirement applies to the closure of WMA C and is addressed in the RCRA Tier 1 Plan.
-610(3)(a)(iv) Closure plan contents: Detailed description of methods to be used during partial closure and final closure, including methods to manage DW and types of off-site DW management units to be used	—	Section 5	Section 3	The required information is provided in the RCRA Tier 2 Plan and will be further addressed in each RCRA Tier 3 component closure activity plan for WMA C component closure activities.
-610(3)(a)(v) Closure plan contents: Detailed description of steps needed to remove or decontaminate all DW residues and contaminated containment system components, equipment, structures and soils …. including… procedures for cleaning equipment and removing contaminated soil	—	Section 5	Section 3	The requirement for removing contaminated soil applies to the closure of WMA C and will be addressed under the Corrective Action process, in accordance with Appendix I of the *Hanford Federal Facility Agreement and Consent Order* (HFFACO) Action Plan. Containment system components for the SSTs and other components will not be removed under the landfill closure approach.
-610(3)(a)(v) Closure plan contents: Detailed description of methods for sampling and testing surrounding soils	—	—	—	This requirement applies to the closure of WMA C and will be addressed in the Corrective Measures Implementation Work Plan.
-610(3)(a)(v) Closure plan contents: Detailed description of criteria for determining the extent of decontamination required to satisfy the closure performance standard in -610(2)(a)	—	—	—	Decontamination of equipment will not be undertaken under the landfill closure approach.
-610(3)(a)(vi) Closure plan contents: Detailed description of other activities – Groundwater monitoring	Section 2	Section 3	—	Groundwater monitoring will be conducted according to current approved groundwater monitoring plans until WMA C closure actions are completed. A post-closure monitoring plan will be developed as WMA C closure is completed.

Table A-1. Closure Performance Standards. (6 sheets)

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	RCRA Tier 1 Plan Section	RCRA Tier 2 Plan Section	RCRA Tier 3 Plan Section	Explanatory Notes
-610(3)(a)(vi) Closure plan contents: Detailed description of other activities – Leachate collection	—	—	—	A leachate collection will not be part of the landfill closure of WMA C. The grout stabilization of the SSTs and other system components, and the final closure cover, will minimize infiltration and thus, minimize or prevent the development of leachate.
-610(3)(a)(vi) Closure plan contents: Detailed description of other activities – Run-on and run-off control	—	Section 5	—	The current configuration of WMA C and current procedures provide run-on/run-off control. These will be maintained during component closure activities. The final cover design will also incorporate run-on/run-off controls.
-610(3)(a)(vii) Closure plan contents: Schedule for closure of WMAs and SST System	Section 5	Section 6	Section 4	Schedule information is provided, as required and managed under the HFFACO.
-610(3)(a)(ix) Closure plan contents: Use of alternative requirements under -610(1)(e)	—	—	—	This will apply only if needed for establishing requirements alternative to regulatory requirements.
-610(3)(b) Amendment of Plan	Section 1	—	—	This requirement applies to modification made to the RCRA Tier 1, 2, and 3 Plans and is addressed in the RCRA Tier 1 Plan.
-610(3)(c)(i) Notification of partial closure and final closure	—	—	—	Under the HFFACO, compliance agreements are developed to address notification of partial closure and final closure.
-610(4)(a) Time allowed for closure: Schedule extension for removal of waste within 90 days	—	—	—	Under the HFFACO, compliance agreements are developed to address notification of partial closure and final closure.
-610(4)(b) Time allowed for closure: Schedule extension for closure of WMA within 180 days	—	—	—	Under the HFFACO, compliance agreements are developed to address notification of partial closure and final closure.
-610(5) Management of waste generated during closure	—	—	Section 3.5	Management of dangerous or mixed waste generated during closure activities will be described in the various RCRA Tier 3 component closure activity plans.
-610(6) Certification of closure	Section 6	Section 7	Section 5	Closure certifications will be provided, as required.

Table A-1. Closure Performance Standards. (6 sheets)

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	RCRA Tier 1 Plan Section	RCRA Tier 2 Plan Section	RCRA Tier 3 Plan Section	Explanatory Notes
-610(7)(a)(i) Post-closure care and use of property: Groundwater monitoring	Section 7	Section 8	—	A post-closure groundwater monitoring plan will be developed as WMA C closure is completed.
-610(7) (a)(ii) Post-closure care and use of property: Maintenance and monitoring of waste containment systems	Section 7	Section 8	—	A post-closure care plan will be developed after final closure activities for WMA C are completed.
-610(7)(c) Post-closure care and use of property: Security	Section 7	Section 8	—	A post-closure care plan will be developed after final closure activities for WMA C are completed.
-610(7)(d) Post-closure care and use of property: Post-closure use of property	Section 7	Section 8	—	A post-closure care plan will be developed after final closure activities for WMA C are completed.
-610(8)(a) Post-closure plan: Submit post-closure plan	Section 7	Section 8	—	A post-closure care plan will be developed after final closure activities for WMA C are completed.
-610(8)(b)(i) Post-closure: Post-closure groundwater monitoring	Section 7	Section 8	—	A post-closure groundwater monitoring plan will be developed as WMA C closure is completed.
-610(8)(b)(ii) Post-closure plan: Post-closure maintenance	Section 7	Section 8	—	A post-closure care plan will be developed after final closure activities for WMA C are completed.
-610(8)(b)(iii) Post-closure plan: Point of contact	—	Section 8	—	A post-closure care plan will be developed after final closure activities for WMA C are completed. This information will be updated as required.
-610(8)(b)(iv) Post-closure plan: Alternative requirements	—	—	—	Used only if alternative requirements are proposed. No alternative requirements are currently proposed.
-610(8)(d) Amendment of post-closure plan	Section 7	Section 8	—	A written notification of request for a permit modification to authorize a change in the approved post-closure plan will be submitted when required.
-610(9) Notice to local land authority for disposed waste	Section 6	Section 7	—	This requirement applies to the closure of WMA C and is addressed in the RCRA Tier 1 Plan.
-610(10) Notice in deed to property for disposed waste, including certification that the notation has been recorded	Section 6	Section 7	—	This requirement applies to the closure of WMA C and is addressed in the RCRA Tier 1 Plan.

Table A-1. Closure Performance Standards. (6 sheets)

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	RCRA Tier 1 Plan Section	RCRA Tier 2 Plan Section	RCRA Tier 3 Plan Section	Explanatory Notes
Unit-Specific Closure Requirements for Tank Systems, Landfills, and Groundwater Monitoring				
-640(8)(a) Closure and post-closure care: Clean closure approach for tank system	—	—	—	This requirement would apply to the closure of WMA C, but for the practicability determination. As discussed in the clean closure practicability demonstration document, it is not practicable to accomplish clean closure for the SST system, and the SST system will be landfill-closed.
-640(8)(b) Closure and post-closure care: Practicability demonstration	—	—	—	This requirement applies to the closure of WMA C. As discussed in the clean closure practicability demonstration document, it is not practicable to accomplish clean closure for the SST system, and the SST system will be landfill-closed.
-640(8)(b) Closure and post-closure care: Close in accordance with landfills in -665(6)	Section 1	—	—	This requirement applies to the closure of WMA C and is addressed in the RCRA Tier 1 Plan.
-665(6)(a)(i)-(v) Closure and post-closure care: Provide landfill cover designed and constructed to provide long-term minimization of migration of liquids through the closed landfill; function with minimum maintenance; promote drainage and minimize erosion or abrasion of cover; accommodate settling and subsidence; meet permeability requirements	Sections 3 & 7	Section 8	—	This requirement applies to the closure of WMA C and will be addressed in the design specification for the final closure cover and in the post-closure care plan.
-665(6)(b)(i) Post-closure care: Maintain integrity and effectiveness of final cover	Sections 3 & 7	Section 8	—	This requirement applies to the closure of WMA C and will be addressed in a post-closure care plan.
-665(6)(b)(iv) Post-closure care: Maintain & monitor groundwater monitoring system	Sections 2, 3 & 7	Section 8	—	This requirement applies to the closure of WMA C and will be addressed in the post-closure groundwater monitoring plan.
-665(6)(b)(v) Post-closure care: Prevent run-on and run-off from damaging cover	Section 7	Section 5.4.3, Section 8	—	This requirement applies to the closure of WMA C and will be addressed in a post-closure care plan.

Table A-1. Closure Performance Standards. (6 sheets)

Regulatory Requirement Summary (from *Washington Administrative Code* 173-303 unless otherwise specified)	RCRA Tier 1 Plan Section	RCRA Tier 2 Plan Section	RCRA Tier 3 Plan Section	Explanatory Notes
-665(6)(b)(vi) Post-closure care: Protect and maintain surveyed benchmarks	Section 7	Section 8	—	This requirement applies to the closure of WMA C and will be addressed in a post-closure care plan.
-645 Releases from regulated unit (groundwater monitoring program)	Section 2	Section 3	—	This requirement applies to the closure of WMA C and will be addressed in the groundwater monitoring plan.
Additional Requirements Negotiated between U.S. Department of Energy and Washington State Department of Ecology				
Reserved for any agreements reached from the M-45 Milestone discussions or from managing the "list" of components being discussed as part of RPP-9937, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document* revision.	—	—	—	—

RCRA = *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq.

References:

RPP-9937, 2014, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document*, Rev. 3E, Washington River Protection Solutions, LLC, Richland, Washington.
WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.
WAC 173-303-610, "Closure and Post Closure," *Washington Administrative Code*, as amended.
WAC 173-303-640, "Tank Systems," *Washington Administrative Code*, as amended.
WAC 173-303-645, "Releases from Regulated Units," *Washington Administrative Code*, as amended.
WAC 173-303-665, "Landfills," *Washington Administrative Code*, as amended.