Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

09-AMCP-0201

OCT 1 2009

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton
Richland, Washington 99354

Dear Ms. Hedges:

241-CX TANK SYSTEM CLOSURE PLAN, DOE/RL-2008-51, REVISION 1

This letter provides the 241-CX Tank System Closure Plan, DOE/RL-2008-51, Revision 1, for approval by the State of Washington Department of Ecology (Ecology). This document represents agreement by the U.S. Department of Energy, Richland Operations Office and Ecology after holding workshops on the document earlier this year. Revision 0 was transmitted to meet Tri-Party Agreement Milestone M-020-54 on December 22, 2008, (09-AMCP-0041). Also enclosed to the December 22, 2008, transmittal was a State Environmental Policy Act Checklist. Ecology provided concurrence on the State Environmental Policy Act Checklist via electronic mail, therefore, it is not being resubmitted at this time.

We appreciate Ecology's willingness to hold workshops and arrive at the approvable closure plan. We look forward to reviewing the draft permit conditions for the 241-CX Tank System as part of reissuing the Hanford Facility Dangerous Waste Permit. Please respond to this letter providing Ecology's approval.

If there are any questions, please contact me, or your staff may contact Briant Charboneau, of my staff on (509) 373-6137.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:KDL

Attachment

cc: See Page 2

cc w/attach:
G. Bohnee, NPT
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G. P. Davis, Ecology
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L. A. Fort, Ecology
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S. L. Leckband, HAB
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R. Skinnarland, Ecology
Administrative Record, (HF RCRA Permit, TPA M-20, 241-CX)
Ecology NWP Library
Environmental Portal

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DOE/RL-2008-51
Revision 1

241-CX Tank System Closure Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY Richland Operations Office

P.O. Box 550
Richland, Washington 99352

DOE/RL-2008-51
Revision 1

241-CX Tank System Closure Plan

Date Published
August 2009

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY Richland Operations Office
P.O. Box 550
Richland, Washington 99352

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EXECUTIVE SUMMARY

This closure plan presents the plan to close portions of the 241-CX Tank System, a *Resource Conservation and Recovery Act of 1976*[1] treatment, storage, and/or disposal (TSD) unit. This tank system is located in the 200 East Area of the Hanford Site in the now demolished Strontium Semiworks Complex. The 241-CX Tank System consists of belowgrade tanks 241-CX-70, 241-CX-71, and 241-CX-72 and ancillary equipment (piping). A Hanford Facility Dangerous Waste Part A Form exists for this tank system and the tank system will close as a TSD unit under closure provisions of WAC 173-303, "Dangerous Waste Regulations."[2] This closure plan provides the TSD unit clean closure performance standards established in accordance with WAC 173-303-610, "Closure and Post-Closure,"[3] and identifies the physical closure activities necessary to achieve clean closure for the closing portions.

The portions of the unit that will be clean closed under this plan include tanks 241-CX-70 and 241-CX-71, all tank system waste transfer piping (including tank 241-CX-72 piping) from each tank to the first isolation point, and the soil beneath the removed tanks and piping. Tanks 241-CX-70 and 241-CX-71 and the piping will be clean closed by removal and disposal. If releases to soil occurred, the contaminated soil will be removed and the removal area soils will be sampled in accordance with an approved sampling and analysis plan (Appendix A of this plan) to verify achievement of clean closure standards. Clean closure of soil beneath tank system components will show that this unit did not impact groundwater.

Because sufficient information does not exist to specify a closure pathway for tank 241-CX-72, tank contents will undergo sampling and analysis in conjunction with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[4] 200-IS-1 Operable Unit (OU) remedial investigation and in accordance with the approved sampling and analysis plan (DOE/RL-2002-14, *Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit*

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1 Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

2 WAC 173-303, "Dangerous Waste Regulations," Washington Administrative Code, as amended, Washington State Department of Ecology, Olympia, Washington.

3 WAC 173-303-610, "Closure and Post-Closure," Washington Administrative Code, as amended, Washington State Department of Ecology, Olympia, Washington.

4 Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq.

Sampling Plan; Includes 200-IS-1 and 200-ST-1 Operable Units, Appendix C[5]). Characterization results will be used to designate tank contents and to support a tank disposition study that will evaluate tank closure options, after which this closure plan will be revised to identify an appropriate tank 241-CX-72 closure approach.

Revision 0 of this closure plan was submitted to the Washington State Department of Ecology (Ecology) on December 22, 2008, to meet the *Hanford Federal Facility Agreement and Consent Order*[6] (Tri-Party Agreement [Ecology et al., 1989a]) Milestone M-020-54 requirement to submit a closure plan for the 241-CX Tank System by December 31, 2008. RL letter DOE-AMCP-C-2009-0077 documents agreement between RL and Ecology to expedite closure plan approval by resolving Ecology comments on Revision 0 of the closure plan using a workshop process in lieu of the Tri-Party Agreement, Figure 9-2, closure plan approval process. A workshop occurred February 3, 2009, to resolve Ecology closure plan comments received January 28, 2009. Revision 1 incorporates resolution of Ecology comments developed by RL and Ecology in a workshop held February 3, 2009.

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5 DOE/RL-2002-14, 2003, Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-IS-1 and 200-ST-1 Operable Units, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

6 Ecology, EPA, and DOE, 1989a, Hanford Federal Facility Agreement and Consent Order, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. http://www.hanford.gov/?page=91&parent=0

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Appendix

Figures

Tables

Terms

AEA	*Atomic Energy Act of 1954*
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
d/min	disintegrations per minute
Ecology	Washington State Department of Ecology
NA	not applicable
OU	operable unit
Permit	WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*
PUREX	Plutonium-Uranium Extraction Plant
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation Plant
SAP	sampling and analysis plan
SSC	Strontium Semiworks Complex
SST	single-shell tank
Tri-Party Agreement	Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and/or disposal (unit)
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System database
XRF	X-ray fluorescence

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1 Introduction

Revision 0 of this 241-CX Tank System closure plan was submitted to the Washington State Department of Ecology (Ecology) on December 22, 2008, in accordance with Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-020-54, *Submit 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, 241-CX-72 Storage Tank Closure/Post Closure Plan to Ecology in Coordination with the 200-IS-1 Tanks/Lines/Pits/Boxes Operable Unit Work Plan Feasibility Study Scheduled Under M-13-00M*, due date December 31, 2008. RL letter DOE-AMCP-C-2009-0077 documents agreement between RL and Ecology to expedite closure plan approval by resolving Ecology comments on Revision 0 of the closure plan using a workshop process in lieu of the Tri-Party Agreement, Figure 9-2 closure plan approval process. A workshop occurred February 3, 2009, to resolve Ecology closure plan comments received January 28, 2009. Revision 1 incorporates resolution of Ecology comments developed by RL and Ecology in a workshop held February 3, 2009.

The 241-CX-70 and 241-CX-71 tanks, piping, and soil beneath the tanks will be clean closed under this plan with regard to dangerous waste contamination from tank system operations. Clean closure will be to performance standards established in accordance with WAC 173-303-610, "Closure and Post-Closure," and as specified in this closure plan. The tank system will be removed from the Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*) if physical activities identified in this plan achieve the clean closure performance standards specified in this plan for all tank system locations. The waste transfer piping from the tank to the first isolation point will be closed under this plan. This tank system is not expected to have impacted groundwater and clean closure of soil beneath this unit will demonstrate that this unit did not impact groundwater.

Because sufficient information is not available to specify a closure pathway for tank 241-CX-72, additional characterization of the tank contents will be conducted in conjunction with the 200-IS-1 Operable Unit (OU) remedial investigation and in accordance with the approved sampling and analysis plan (SAP) (DOE/RL-2002-14, *Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-IS-1 and 200-ST-1 Operable Units*, Appendix C). Characterization results will be evaluated in a tank disposition study, after which the closure plan will be revised to identify an appropriate closure approach for this tank.

This tank system received waste containing both chemical constituents and *Atomic Energy Act of 1954* (AEA) regulated material. However, treatment, storage, and/or disposal (TSD) of such waste (i.e., source, special nuclear, and by-product materials as identified in the AEA) are not within the scope of the *Resource Conservation and Recovery Act of 1976* (RCRA) or WAC 173-303, "Dangerous Waste Regulations." Information regarding AEA-regulated material is provided for general knowledge.

Receipt of all waste preceded November 19, 1980, the effective date of RCRA regulation of hazardous waste. Waste remaining in the tanks never was subject to "point of generation" under WAC 173-303. No further additions to any tank of the 241-CX Tank System occurred after initial waste receipt during the 1952 to 1958 timeframe. However, the Hanford Facility Dangerous Waste Part A Form was filed on July 10, 1990, for tank 241-CX-70, as a protective filing in case this tank later received newly generated waste regulated under WAC 173-303. The Part A Form currently subjects this tank system to closure under TSD unit provisions. Later revisions to the 241-CX Tank System Part A Form added tanks 241-CX-71 (1992) and 241-CX-72 (1993).

This tank system is part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) 200-IS-1 OU and tank system closure could be coordinated with the 200-IS-1 OU remedial action. Final TSD unit closure could occur in conjunction with the OU remedial action, through a past-practice process, as identified in the Tri-Party Agreement, Chapter 7.0. The OU activities also would satisfy RCRA corrective-action requirements under the Permit, Condition II.Y (or the current version at the time of closure) in accordance with Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Section 5.5.

2 Facility Description

This chapter provides the 241-CX Tank System operating history, description, and site security information. The tank system is located within the larger Stabilized Hot Semiworks Area, identified in the *Waste Information Data System* (WIDS) database as approximately 2.3 ha (5.6 a). The process areas of this site were demolished in the mid-1980s.

2.1 241-CX Tank System Operating History

The 241-CX Tank System is located in the 200 East Area (Figure 2-1) of the Hanford Site in the Strontium Semiworks Complex (SSC), sometimes referred to as the Hot Semi-Works, Strontium Semi-Works, 201-C Area, or C Plant. The 241-CX Tank System is a belowgrade tank system, consisting of tanks 241-CX-70, 241-CX-71, and 241-CX-72 and ancillary (waste feed) piping. The tanks of this system operated from 1952 to 1958 to support the Reduction-Oxidation Plant (REDOX) and Plutonium-Uranium Extraction Plant (PUREX) process pilot studies at the SSC that began in 1952 and ended in 1956. The three tanks received liquid waste from the 201-C Process Building and Hot Shop of the SSC via underground piping. Figure 2-2 depicts the tanks in the 241-CX Tank System, piping layout, and current configuration.

Tank 241-CX-70 operated for approximately one year during 1952 and 1953; tank 241-CX-71 operated from 1952 to 1957; and tank 241-CX-72 operated for approximately one year during 1957 and 1958. All of the 241-CX tanks received waste from the 201-C Process Building; only tank 241-CX-70 received liquid waste from Hot Shop sink drains. The waste streams contained chemical constituents and AEA-regulated material at unknown concentrations.

After completion of the REDOX and PUREX pilot study operations in 1956, the SSC was placed in stand-by operating mode on July 1, 1957, for major cleaning and decontamination in preparation for the new strontium recovery mission. The SSC reopened in 1961 and operated until 1967 to support strontium recovery. The 241-CX Tank System did not receive strontium recovery waste. In 1967, the SSC (including the 201-C Process Building and Hot Shop) was permanently removed from service and placed in safe standby mode, after which time waste would not have been generated at these facilities.

The 241-CX tanks and waste transfer piping remain in place, but have been isolated physically by cutting and permanently sealing off the pipe ends. As a part of the SSC decommissioning, the tanks were verified as physically isolated as of 1985. Tank 241-CX-70 contains only waste residues, while tanks 241-CX-71 and 241-CX-72 contain waste overlain with grout added in 1986 for stabilization. A containment building currently exists over tank 241-CX-72.

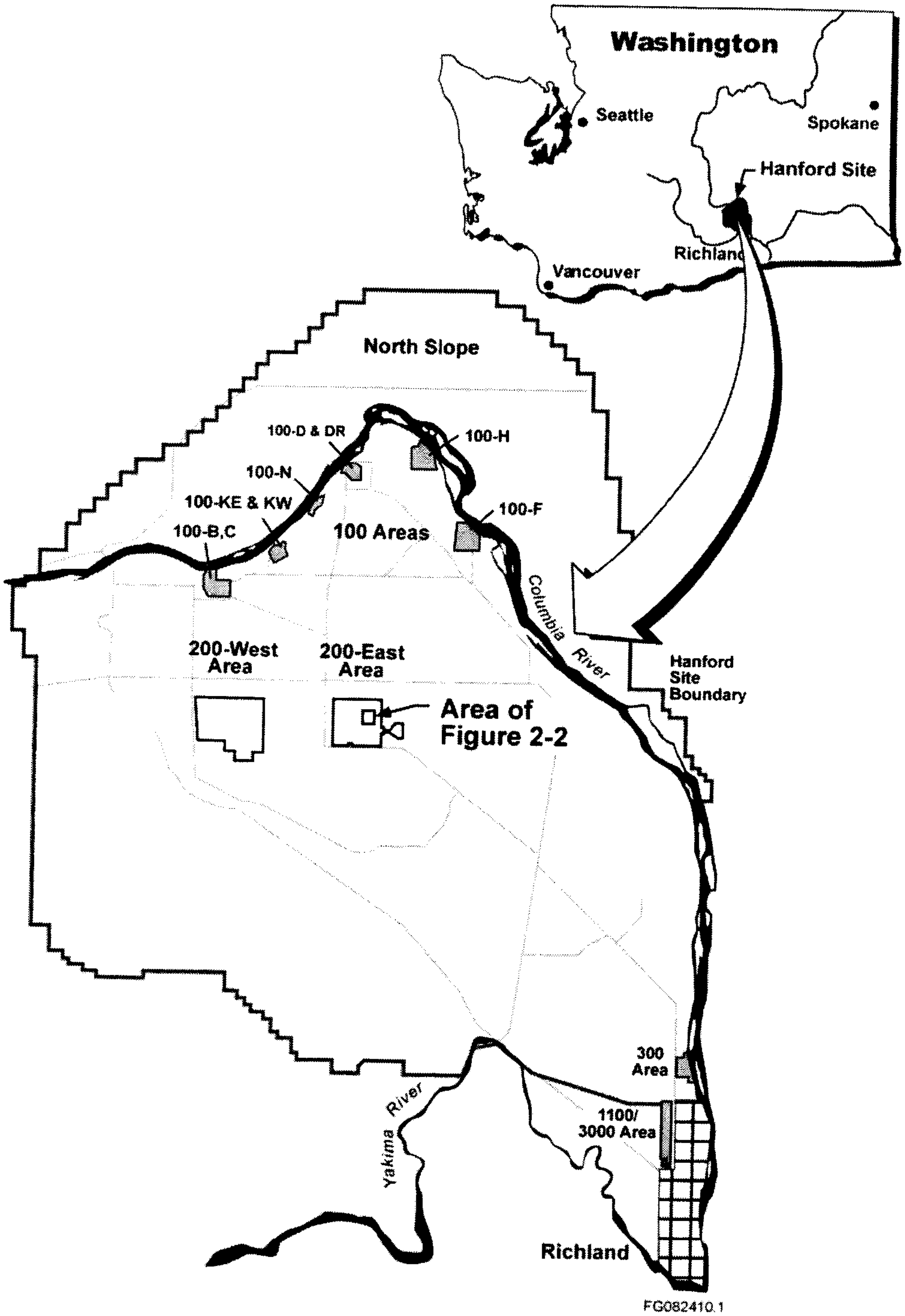


Figure 2-1. 241-CX Tank System Location and Site Plan

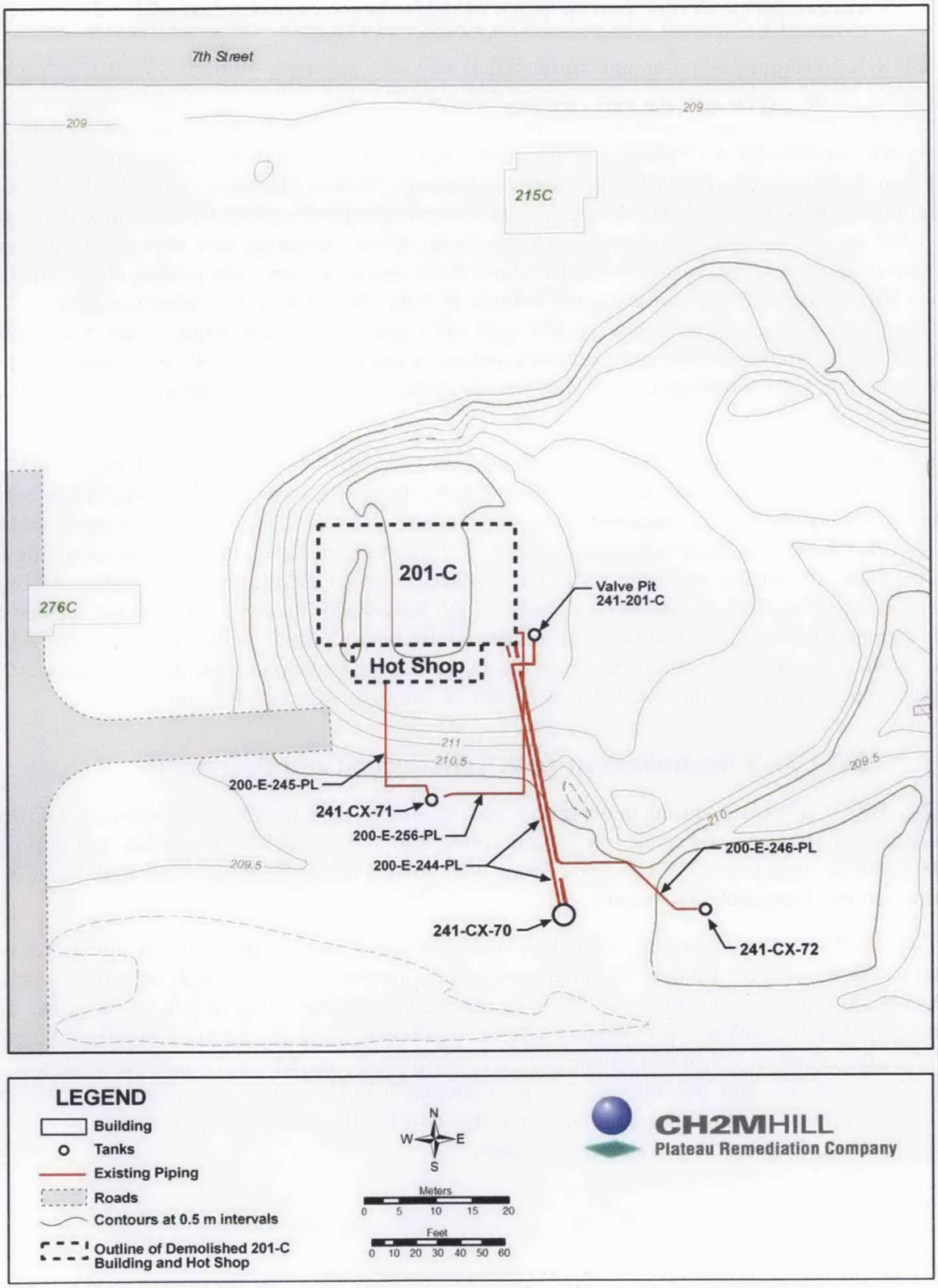


Figure 2-2. 241-CX Tanks and Piping Layout and Current Configuration

2.2 Description of 241-CX-70 Tank Construction and Operations

Tank 241-CX-70 (Figure 2-3) is an underground tank that received waste from the SSC REDOX process pilot studies for approximately one year during 1952 and 1953. The tank is a cylindrical concrete vessel, 6.1 m (20 ft) outside diameter and 4.6 m (15 ft) tall, constructed with 30.5 cm (12 in.) thick concrete walls and top, and a bottom 0.6 m (2 ft) thick at the edges, tapering to 22.9 cm (9 in.) in the center. It is lined with 1/4-in. stainless steel. The design capacity of tank 241-CX-70 is 113,550 L (30,000 gal). The tank top is approximately 3.4 m (11 ft) below grade, with nine vertical risers generally extending above grade and a 106.7 cm (42-in.) manway having a concrete cover. Waste entered the tank through two horizontal 5 cm (2-in.) diameter stainless steel waste feed lines at the side of the tank. The portion of this pipeline near the 201-C Process Building was routed inside a 45.7 cm (18-in.) diameter corrugated pipe encasement. Waste was removed between 1987 and 1991; currently the tank contains only waste residues. As part of waste removal, access to the manway and risers was required and resulted in excavating to the top of the tank in 1991. Plywood used to shore up the excavation has since collapsed and obscured the view of the tank.

As-Built Drawing H-2-4335, *Hot Semiworks Waste Line Bldg 201-C to TK-70,* revised May 1, 1957, verifies that by this date, the east pipeline (200-E-244-PL, Figure 2-2) was cut and a blind flange installed near the tank when the line was rerouted to discharge to tank 241-CX-72. As-Built Drawing H-2-4494, *Diversion Box Assembly*, Sheet 1, revised October 11, 1961, verifies that by this date the remaining (west) line (200-E-244-PL, Figure 2-2) from Valve Pit 241-201-C was cut and the open ends sealed. As-Built Drawing H-2-71672, *Piping Plans 241CX Tanks 70, 71, 72*, revised October 15, 1985, also verified that by this date both of these lines were capped or blanked. Because piping from the tank to the first isolation point is within the scope of closure, and given the above existing isolation points, approximately 50.3 m (165 ft) of pipe associated with tank 241-CX-70 will be within the scope of TSD unit closure.

2.3 241-CX-71 Neutralization Tank Construction and Operations

Tank 241-CX-71 (Figure 2-4) is an underground tank used from 1952 to 1957 to neutralize 201-C Process Building condensate, coil, and condenser cooling water prior to disposal. This waste was first disposed to the 216-C-1 Crib, then to the 216-C-5 Crib. Along with 201-C Process Building waste, tank 241-CX-71 also received Hot Shop sink drain waste.

Tank 241-CX-71 is an underground, vertically placed, cylindrical vessel constructed of stainless steel. This tank is approximately 1.5 m (5 ft) in diameter, approximately 2.1 m (7 ft) high, and was constructed on a reinforced concrete foundation pad. The tank top is approximately 1.1 m (3.5 ft) below grade. The design capacity of the tank is approximately 3,785 L (1,000 gal). Tank 241-CX-71 currently has a bottom layer of sludge containing chemical compounds, AEA-regulated materials, and limestone used as a neutralizing agent. The tank was filled to the top of the riser with low-density grout, added in 1986 during Semiworks decommissioning (in accordance with SD-DD-PP-001, *Strontium Semiworks Decommissioning Project Plan*) to stabilize the tank.

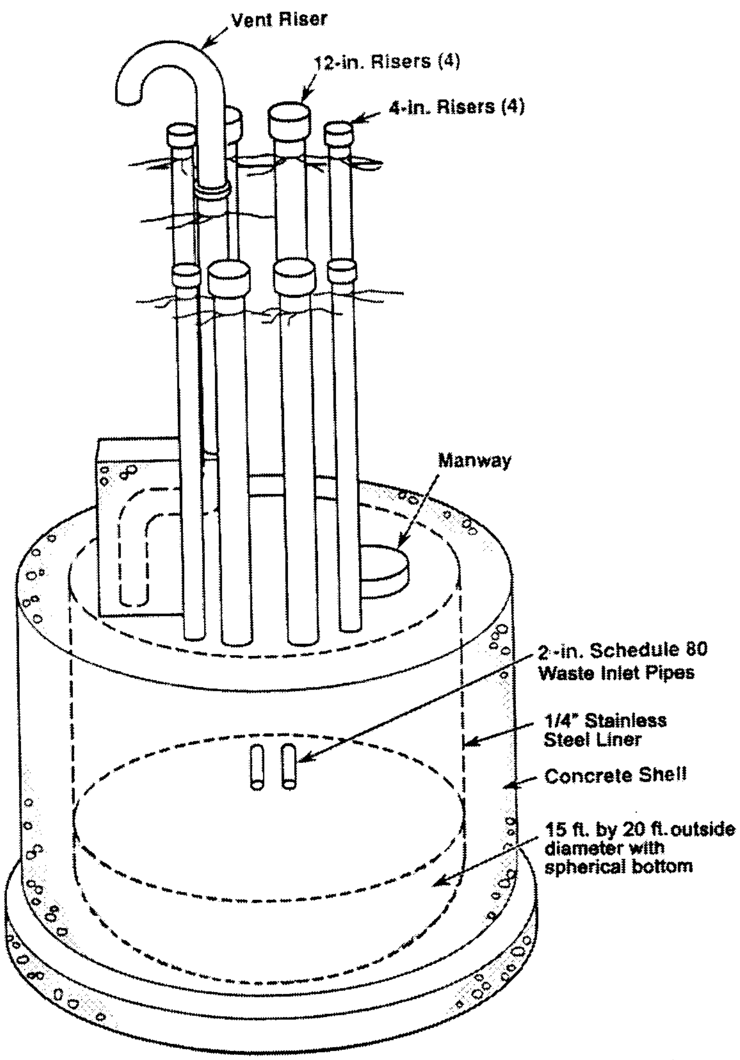


Figure 2-3. Tank 241-CX-70 Diagram

Tank 241-CX-71 received liquid waste through two 5 cm (2-in.) diameter stainless steel waste inlet pipes (pipeline 200-E-156-PL from the 201-C Process Building and pipeline 200-E-245-PL from the Hot Shop sink drains). As-Built Drawing H-2-4535, *Site Plan & Underground Piping Strontium Facilities, Hot Semiworks*, revised January 31, 1962, verifies that by this date, the line from the 201-C Process Building was cut and a blind flange installed near the tank. As-Built Drawing H-2-71672, revised October 15, 1985, verifies that by this time, the 201-C Process Building line was cut and capped and the 201-C Hot Shop sink line was capped. Because piping from the tank to the first isolation point is within the scope of closure, and given the above existing isolation points, approximately 21.9 m (72 ft) of pipe associated with tank 241-CX-71 will be within the scope of TSD unit closure.

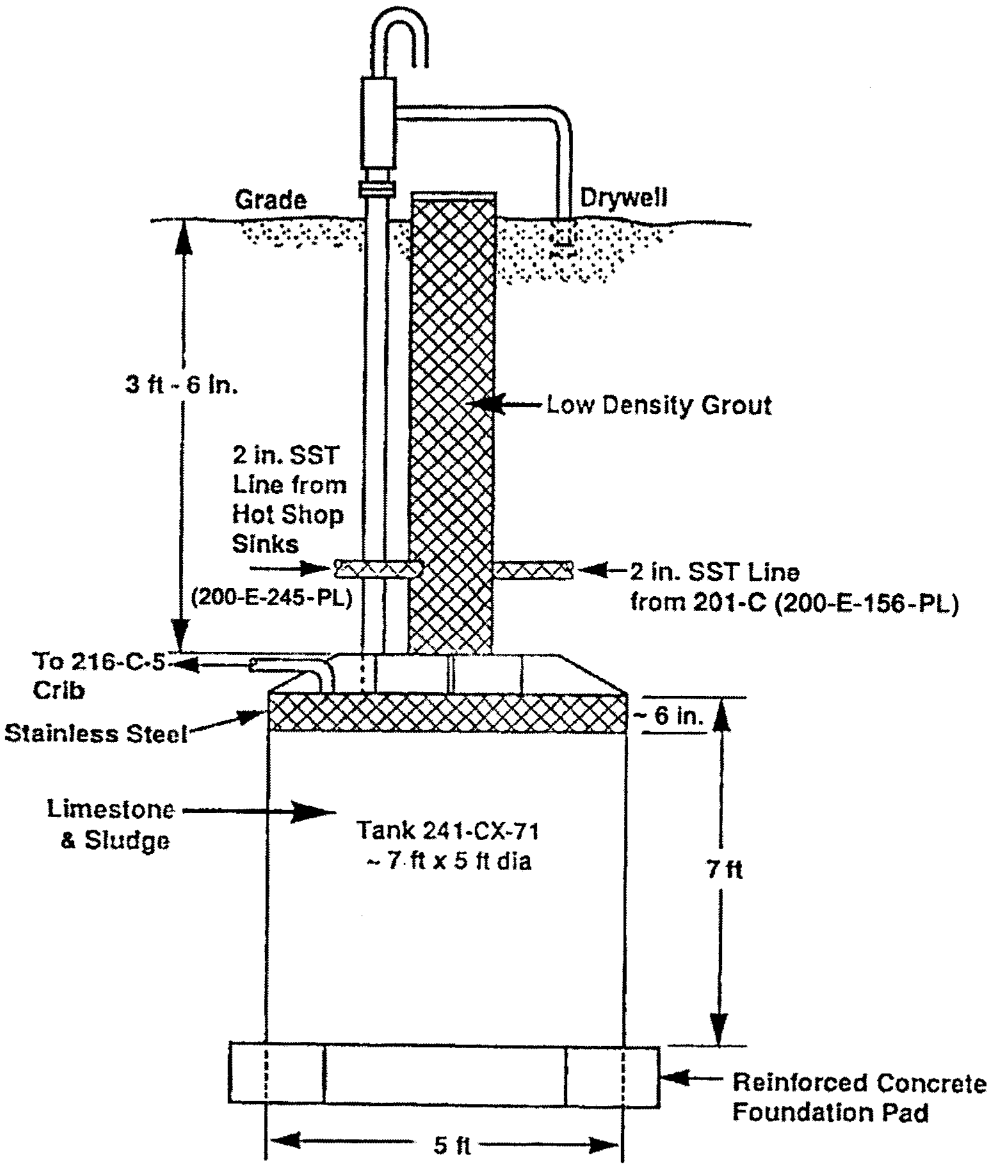


Figure 2-4. Tank 241-CX-71 Cross Section View

2.4 241-CX-72 Storage Tank Construction and Operations

Tank 241-CX-72 (Figure 2-5) is a belowgrade storage tank that operated approximately one year during 1957 and 1958, and stored 8,725 L (2,305 gal) of SSC waste generated from PUREX process pilot studies. This tank was used as an experimental tank to study the self-concentration of PUREX process waste by the application of heat. The waste in the tank was heated until nearly dry by cylindrical heaters located above each stiffening ring.

Tank 241-CX-72 is a vertical, cylindrical vessel made of 3/8-in. carbon steel. The tank measures 101.6 cm (40 in.) in diameter and approximately 10.7 m (35 ft) long. The tank is enclosed in a 1.8 m (6-ft) diameter caisson made of 1/2-in. carbon steel placed on a 30.5 cm (12-in.) thick reinforced concrete base pad. In addition to two 20 cm (8-in.) risers, a 7.2 cm (3-in.) test well is located at the periphery of the tank. Waste entered the tank through a 5 cm (2-in.) diameter stainless steel pipeline (200-E-246-PL) buried along side of the pipeline to the tank. The design capacity is 8,860 L (2,340 gal). The tank top is approximately 4.2 m (14 ft) below grade.

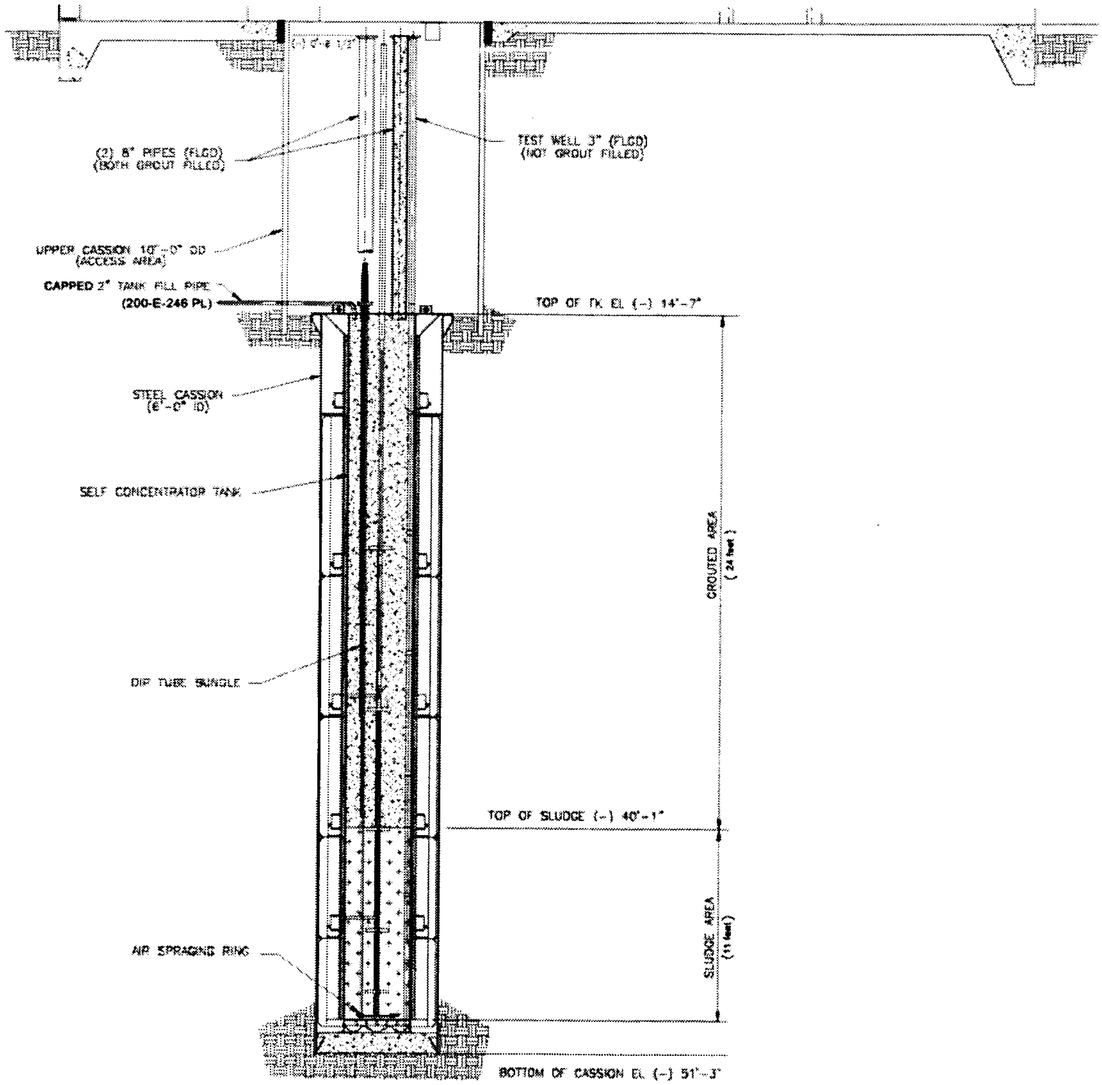
Drawing H-2-4494, Sheet 1, revised October 11, 1961, verifies that by this date the waste line (200-E-246-PL) was cut and capped just outside the 201-C Process Building wall when waste was diverted to the 216-C-1 Crib. Demolition Project Drawing H-2-71672, revised October 15, 1985, verifies that by this date only the fill line from the 201-C Process Building was cut, the open ends capped, and a blind flange installed in 201-C Process Building cell A. Because piping from the tank to the first isolation point is within the scope of closure, and given the above existing isolation points, approximately 49.4 m (162 ft) of pipe associated with tank 241-CX-72 are within the scope of TSD unit closure.

In 1986, as a part of SSC decommissioning and to stabilize the tank, low-density grout was injected through the 20.3 cm (8-in.) risers over approximately 3.4 m (9.5 ft) of sludge, filling the tank with grout to the top of the risers. A 6.1 by 14.6 by 6.1 m (20- by 48- by 20-ft) tall containment structure on a 6.7 by 14.6 m (22- by 48-ft) reinforced concrete pad was placed over tank 241-CX-72. Sampling of tank contents is planned in accordance with the approved SAP (DOE/RL-2002-14, Appendix C) as a portion of 200-IS-1 OU remedial investigation/feasibility study activities and in support of TSD unit closure.

2.5 Security Information

Security information for the Hanford Facility is discussed in Attachment 33, Section 6.1 to the Permit. Because the 241-CX Tank System is located in the 200 East Area, the security information pertaining to the 200 Area applies to this site.

Tanks 241-CX-70 and 241-CX-71 are buried, surrounded with a chain barrier, and appropriately posted with Dangerous Unauthorized Personnel Keep Out, or equivalent signs. Tank 241-CX-72 is buried and is located within a containment building that is locked and appropriately posted. Security measures that limit unit entry to authorized personnel and that preclude unknowing access by unauthorized individuals will remain in place.



NOTE: Above grade portion of containment building over tank location not shown.

Figure 2-5. Tank 241-CX-72 Cutaway Diagram

3 Process Information

This chapter identifies the source of the waste received by the 241-CX Tank System and the tank system processes. Tank 241-CX-70 was used mainly as a waste storage tank. Tank 241-CX-71 was used for waste neutralization treatment. Tank 241-CX-72 was used to store pilot PUREX process waste during experimental studies.

3.1 Past Strontium Semi works Complex Waste-Generating Facilities and Process

All SSC waste streams received by the 241-CX Tank System were generated in the 201-C Process Building and/or the adjacent Hot Shop. The SSC ceased transferring waste to the 241-CX tanks in 1958 and ceased operating and generating waste in 1967. Use of the term "hot" indicates operational use of AEA-regulated nuclear materials. All of the 241-CX tanks received 201-C Process Building waste; only tank 241-CX-71 received Hot Shop sink drain waste.

The 201-C Process Building was divided into cell areas used for pilot REDOX and PUREX process testing, materials handling, and storage. The wastes discharged to the tanks or processed through the 201-C Hot Shop primarily were generated in 201-C Process Building cells. Cell A, cell C, and portions of cell B were below grade. Process studies and high-activity waste handling primarily were conducted in cell A. Cell B contained solvent extraction and ion exchange columns. Cell C was used for radioactive solvent handling and limited batch rework handling. The Hot Shop supported 201-C Process Building operations and generated unspecified waste streams.

The 201-C Process Building operated from 1949 to 1967, recovering AEA-regulated materials during three distinct operational modes. It was built in 1949, and first operated until 1954, as a pilot plant for the study of the REDOX chemical separations process that would be used at S Plant. The REDOX process study waste streams included large volumes of aluminum nitrate, zirconium oxide, sodium fluoride, sodium nitrate, and potassium fluoride that were slightly acidic and contained fission products. From 1954 to 1956, the SSC was used as a pilot plant for study of the PUREX chemical separation process used at A Plant. The PUREX waste streams were mixed waste that included aluminum and zircaloy coating removal waste, condensates, and spent organic solvent waste that contained fission products and sodium nitrate, sodium carbonate, manganese oxide, and were acidic (before being neutralized). Table 3-1 summarizes 201-C Process Building REDOX and PUREX process pilot study waste streams and major chemical constituents.

By the end of the REDOX and PUREX process study operations in 1956, the plant was contaminated with a full spectrum of fission products. The plant was shut down from 1957 to 1961 for extensive modifications, cleaning, and decontamination in support of facility conversions for the new mission of recovering strontium from process waste. The plant reopened for strontium recovery operations in 1961 and remained opened until 1967, when the SSC was permanently shut down. Strontium recovery process waste streams are not listed in Table 3-1 because the 241-CX tanks were removed from service prior to initiation of strontium recovery operations. By 1981, the SSC was identified as retired and ready for demolition (SD-DD-FL-001, *Rockwell Retired Contaminated Facility Listing and Description*). The SSC demolition began in 1983 and was completed by 1986, in accordance with SD-DD-PP-001, as a part of the larger Project B-231, *Isolation of Auxiliary Tank Farm Facilities*. Demolition included removal of the external features, contaminated equipment and entombment in concrete of belowground structures (cells), entombment in concrete of the 201-C Process Building core (cell B) to 3.0 m (10 ft) above grade, and stabilizing the location with a 3.0 m (10 ft) covering made of clean soil and ash from the 200-E Powerhouse Ash Pit. In addition, the 201-C Process Building Valve Pit 241-201-C was filled with grout. The decommissioned SSC location is now identified as the Stabilized Hot Semiworks Area (WIDS Site Code 200-E-41). Figure 3-1 is an aerial photograph taken in 1990 of the SSC after demolition and stabilization. This photograph shows a visible concrete cover over cell B of the demolished 201-C Process Building as a rectangular white area in the center of the ash stabilization cover.

Table 3-1. Summary of 201-C Process Building REDOX and PUREX Process Pilot Study Waste Streams and Major Chemical Constituents

Waste Generated	Major Chemical Constituents
Aluminum coating waste	Sodium hydroxide Sodium aluminate Sodium nitrate Sodium nitrite Sodium silicate
Zircaloy coating	Aluminum nitrate Zirconium oxide Sodium fluoride Sodium nitrate Potassium fluoride
REDOX spent solvent	Hexone
Other REDOX wastes	Sodium aluminate Sodium hydroxide Sodium nitrate Chromate Sodium sulfate Ferric hydroxide Aluminum nitrate *
PUREX organic wash waste	Sodium nitrate Sodium carbonate Manganese oxide
PUREX acid process waste	Nitric acid Ferrous sulfate Ferrous phosphate Sodium Aluminum Fluoride * Chromium *
PUREX spent solvent waste	Tributyl phosphate Kerosene

Source: DOE/RL-92-18, Semiworks Source Aggregate Area Management Study Report.

*From WHC-EP-0560, Miscellaneous Underground Radioactive Waste Tanks.

PUREX = Plutonium-Uranium Extraction Plant

REDOX = Reduction-Oxidation Plant

Photo taken in 1990.

Figure 3-1. Strontium Semiworks Complex Soon After Demolition and Stabilization

3.2 241-CX Tank System Storage and Treatment Processes

For approximately one year, beginning in 1952, the 241-CX-70 Tank received SSC process waste from the 201-C Process Building for storage. This activity later was identified on the 241-CX Tank System Part A Form as permitted storage activity S02. The tank received waste through two buried pipes that entered from the side. Waste was removed by 1991 and the tank currently contains only waste residues (WHC-SD-DD-TI-071, *Facility Decommissioning Report for Tank 241-CX-70*).

From 1952 to 1957, tank 241-CX-71 received acidic process condensate and coil and condenser cooling waste for storage and neutralization prior to discharge to the soil column, first to the 216-C-1 Crib, and later to the 216-C-5 Crib. Tank storage later was identified on the 241-CX Tank System Part A Form as permitted storage activity S02. The tank received waste from the 201-C Process Building and the Hot Shop through two pipes and contained a layer of limestone as the neutralizing agent. The tank currently contains sludge and limestone overlain with grout.

For approximately one year during 1957 and 1958, tank 241-CX-72 received pilot PUREX process waste from the 201-C Process Building. This activity later was identified on the 241-CX Tank System Part A Form as permitted storage activity S02. The tank was used to study the characteristics of self-concentrating waste through the application of heat. The tank was filled by one pipe that entered from the top. The tank currently contains a layer of sludge waste overlain with grout.

4 Waste Inventory and Characteristics

This chapter identifies the inventory and the characteristics of the waste received by the 241-CX Tank System.

4.1 Waste Inventory

The design capacity of tank 241-CX-70 was 113,550 L (30,000 gal). This tank operated for approximately one year from 1952 to 1953 and received liquid waste containing AEA-regulated materials and unspecified quantities of chemicals from the 201-C Process Building. The estimated annual quantity of waste stored in this tank was approximately 8,630 kg (19,000 lb). All waste has been removed and only residues remain.

The design capacity of tank 241-CX-71 was 3,785 L (1,000 gal). From 1952 to 1957, this tank operated as a flow-through tank and received corrosive liquids for neutralizations from the 201-C Process Building and waste from the Hot Shop. The estimated annual quantity of waste neutralized in this tank was approximately 15,171 kg (33,400 lb). The tank currently contains sludge and limestone overlain with a layer of low-density grout to the top of the risers added in 1986 to stabilize the tank. The volume of waste and limestone beneath the grout is approximately 3,407 L (900 gal).

The design capacity of tank 241-CX-72 was 8,860 L (2,340 gal). This tank operated for approximately one year during 1957 and 1958, receiving 201-C Process Building liquid waste. The estimated annual quantity of waste received by this tank was approximately 8,870 kg (19,530 lb). The tank currently contains an approximate 3.4 m (9.5-ft) layer (approximately 2,498 L [660 gal]) of sludge overlain with a layer of low-density grout to the top of the risers added in 1986 to stabilize the tank.

4.2 Waste Characteristics

Until 1958, the 241-CX Tank System received waste that remains in tanks 241-CX-71 and 241-CX-72 as sludge and remains in tank 241-CX-70 as residues. The waste contains AEA-regulated materials and unspecified quantities of chemical constituents. Because all waste in the 241-CX tanks was received before the effective date of RCRA, a "point of generation" under WAC 173-303 has not occurred. Information is not available regarding the concentrations of chemical constituents in SSC waste streams. The 241-CX Tank System Part A Form identifies potential characteristics of the waste in the tanks using waste numbers for the chemicals potentially received.

The Part A Form shows tank 241-CX-70 waste as having the characteristics of corrosivity (D002) because of receipt of sodium hydroxide and of toxicity (D007) because of potential receipt of chromium. Tank 241-CX-70 waste also was considered to be a toxic state only waste (WT02). The Part A Form shows 241-CX-71 Tank waste as a toxic state only waste (WT02) because of the presence of cyanides and nitrates found during tank content characterization (WHC-SD-DD-TI-058, *Tank 241-CX-71 Waste Characterization*). The Part A Form shows that based on a conservative designation, tank 241-CX-72 waste could have corrosive and toxic characteristics (D002, D004 through D011), and/or would be toxic and corrosive state only waste (WC02, WT01, and WT02). Information is not sufficient to clearly establish that tank 241-CX-72 waste would be designated a mixed waste (i.e., contains both AEA-regulated materials and dangerous waste constituents at greater than dangerous waste designation levels) upon removal. Table 4-1 is a summary of the Part A forms waste characteristics.

Table 4-1. Summary of 241-CX Tank System Waste Characteristics

Waste Characteristic	241-CX-70	241-CX-71	241-CX-72
Corrosivity (D002)	X		X
Toxicity (D007)	X		
Toxic state only (WT02)	X	X	X
Toxicity (D004-D011)			X
Toxic state only (WT01)			X

5 Groundwater Monitoring

The 241-CX Tank System is not a regulated unit under the definitions of WAC 173-303-040, "Definitions" (i.e., surface impoundment, waste pile, land treatment unit, landfill) that would require groundwater monitoring. Consequently, no RCRA interim status groundwater-monitoring program was required.

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6 Closure Approach and Performance Standards

This chapter identifies the 241-CX Tank System closure approach and performance standards. These standards were established to meet WAC 17-303-610 requirements for clean closure of portions of the tanks, piping, and soil beneath the tanks and piping. Clean closure of the soils will be used as a basis to demonstrate the TSD unit did not impact groundwater.

6.1 Closure Approach

The 241-CX Tank System includes tanks 241-CX-70, 241-CX-71, and 241-CX-72 and their associated piping. WAC 173-303-640(8), "Closure and Post-Closure Care," provides requirements for the closure of a tank system. This subsection states the following, "At the closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment systems components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste." Figure 6-1 provides a diagram of the closure logic.

Enough information is available to specify a closure pathway for tanks 241-CX-70 and 241-CX-71. Both of these tanks and all 241-CX Tank System piping and soil will be clean closed under this plan, with regard to dangerous waste and dangerous constituents from TSD unit operations, after completion of closure activities identified in this plan. Clean closure of tanks 241-CX-70 and 241-CX-71 and their piping will be achieved by removal and disposal and by removal of any soil potentially contaminated above numerical clean closure standards. Waste transfer piping from the tanks to the first isolation point constitutes the tank system ancillary piping within the TSD unit boundary and the scope of closure under this plan. Soil beneath the tanks and piping will be clean closed through visual inspections and soil screening that demonstrate there were no releases from the unit and, where releases occurred, that the contaminated soil has been removed to meet clean closure standards, as shown by sampling of the removal area.

Sufficient information is not available to specify a closure pathway for tank 241-CX-72. Because an appropriate closure approach is yet to be identified for tank 241-CX-72, this tank will not be closed under this plan. Additional characterization data of the tank waste will be obtained in conjunction with the 200-IS-1 OU remedial investigation. Tank 241-CX-72 contents will undergo sampling and analysis in accordance with the approved SAP (DOE/RL-2002-14, Appendix C) for chemicals and AEA-regulated materials. Sampling is intended to identify the tank waste characteristics in support of a tank disposition study that will help to identify a tank closure approach and to perform a waste designation on tank contents. Once the additional characterization data have been obtained and evaluated, this closure plan will be revised to reflect the appropriate closure pathway. The final closure of the 241-CX Tank System will be coordinated with the remedial activities associated with implementation of the 200-IS-1 OU final remedy.

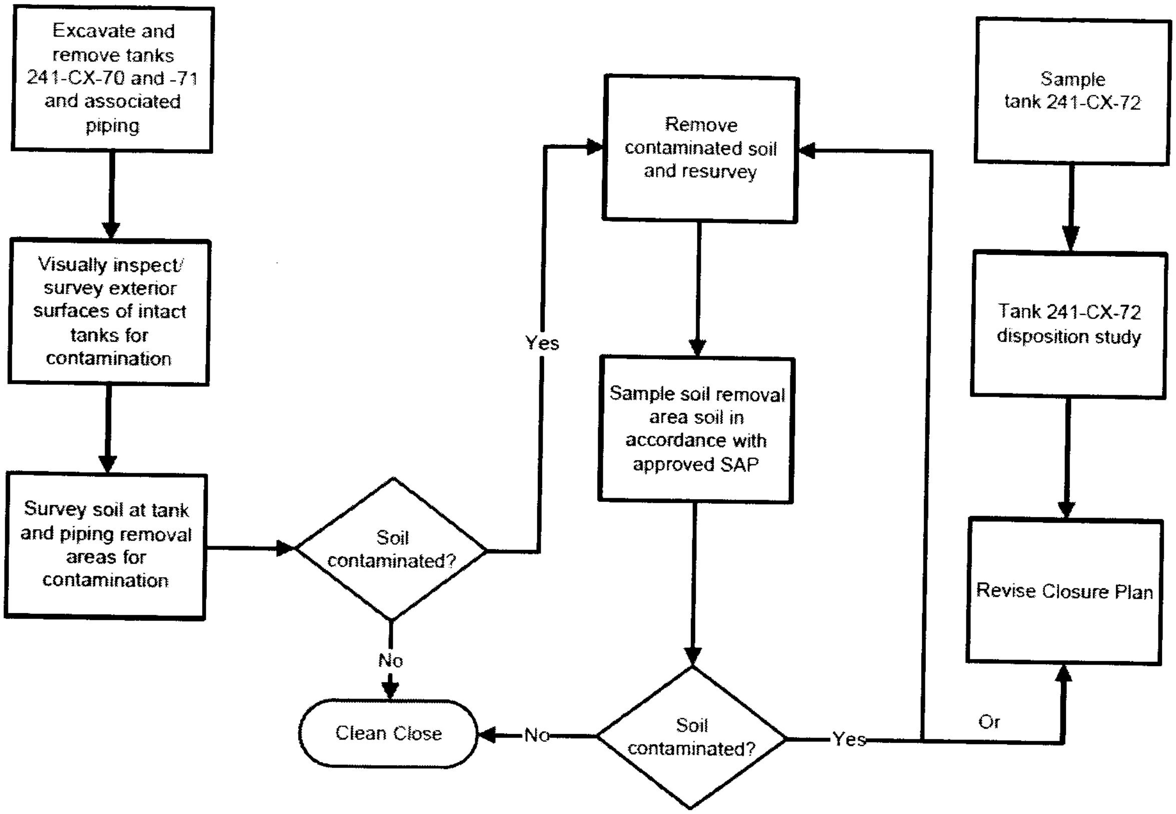

Figure 6-1. Closure Logic Flow Diagram

The unit will remain unclosed until the plan is revised. During this period, steps would be taken as described in Chapter 7 to prevent threats from the unclosed unit. The 241-CX Tank System Part A Form could be modified to remove clean closed portions from the TSD unit description and identify unclosed portions for tracking until final closure. Remaining contamination, if any, also would be identified in WIDS for tracking to final disposition.

6.2 Closure Performance Standards

This section presents 241-CX Tank System closure performance standards. As provided for in this plan, the closing portions will be closed in a manner that meets the closure requirements of WAC 173-303--640(8) for tank systems and meets closure performance standards of WAC 173-303-610(2)(a), "Closure Performance Standard," by closing the unit in a manner that:

1. Minimizes the need for future maintenance;
2. Controls, minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere; and
3. Returns the land to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity.

Clean closure will be achieved when dangerous waste, waste residue, or contaminated equipment and soil are removed and when concentrations of dangerous constituents in potentially contaminated soil do not exceed numerical clean closure performance standards identified in this plan and established in accordance with WAC 173-303-610(2)(b)(i). Closure performance standards for tanks 241-CX-70 and 241-CX-71, their piping, and the soil beneath the tanks and piping are presented in the following sections.

6.2.1 Clean Closure Standards for Tanks and Piping

Under this plan, contaminated tanks 241-CX-70 and 241-CX-71 and all 241-CX Tank System piping will be clean closed by removal and disposal as described in Chapter 7. Further characterization will not be required for removal.

Because of the unknown nature of chemical constituents and AEA-regulated material in tank 241-CX-72 waste, the closure approach for this tank will be determined through a tank disposition study. To support the study and tank waste designation, contents will be sampled in accordance with the approved SAP (DOE/RL-2002-14, Appendix C) for chemical constituents and AEA-regulated materials. Upon completion of the planned disposition study, the closure plan will be revised to identify an appropriate closure approach and performance standards.

6.2.2 Closure Standards for Soil Beneath Tanks and Piping

This section contains visual inspection, field screening, and numerical analytical standards used to demonstrate that soil beneath the tanks and piping removed under this plan would meet clean closure standards for soil of WAC 173-303-610(2)(b)(i).

6.2.2.1 Visual Inspections and Field Screening

The tanks constitute primary containment and while remaining intact prevent the waste from reaching the soil. The tanks are not expected to have leaked because there are no reported leaks or unplanned releases associated with this tank system. Because the tanks received waste for only a short period of time and waste transfer piping was used for only a short duration, piping failure is not anticipated. However, the absence of soil contamination at tank and piping removal areas will be verified for clean closure of the soil.

The use of radiological field screening is an appropriate method for determining whether waste releases from this unit occurred and to reliably identify the potential presence of TSD unit chemical constituents. The liquid waste streams received by the 241-CX Tank System contained chemical constituents and radionuclides. Any subsequent releases of tank waste would contain both chemical and radiological constituents due to the intrinsic nature of solutions. Because the radionuclides are readily detectable at pico curie (one trillionth of a curie) concentrations using field survey techniques, the radiological field screening described in this section would readily locate any radionuclides on tank exteriors and/or in site soils from tank waste releases. The extreme sensitivity of radiological field screening in comparison to generally less-sensitive chemical field screening techniques, such as X-ray fluorescence (XRF), will provide a higher degree of confidence that all waste releases are identified. Consequently, the absence of radionuclides would demonstrate that releases from the unit did not occur and subsequently that TSD unit constituents did not reach site soil and so do not exist in site soil above WAC 173-303-610(2)(b)(i) clean closure performance standards.

Initially, soil beneath the removed tanks 241-CX-70 and 241-CX-71 and all 241-CX Tank System piping can be clean closed through visual inspections and field screening of tank and piping excavation areas, demonstrating that releases from the tank system components did not occur. Because tank waste contained high concentrations of AEA regulated materials, the absence of contamination in site soil above background as determined using the field survey methods and values shown in Table 6-1 will be used to demonstrate that no releases from the unit occurred and the soil will be clean closed. Visual inspection of removal area soil for staining or discoloration indicating the potential presence of waste will be used to location contamination in support of soil field screening.

Table 6-1. Field-Screening Methods

Measurement Type	Emission Type	Method/Instrument	Detection Limit
Exposure/dose rate	Beta/gamma	RO-20/RO-03 portable ionization chamber	0.5 mrem/h
Contamination level	Alpha	100 cm^2 portable alpha meter or equivalent instrument	90 d/min α/100 cm^2 (10 sec static count) 250 d/min α/100 cm^2 (1 in./sec scan speed)
Contamination level	Beta/gamma	100 cm^2 ruggedized scintillation detector or equivalent	500 d/min β–γ/100 cm^2 (20 sec static count @ 13% efficiency) 1,400 d/min β–γ/100 cm^2 (2 in./sec scan speed)
Contamination level	Gamma	2- by 2-in. NaI detector (e.g., Ludlum 44-3 or equivalent)	3 pCi/g Cs-137 in soils
Contamination level	Gamma	2 in. by 10 mm NaI low-energy gamma detector (e.g., PG-2 or equivalent)	20 pCi/g Am-241 in soils

Ludlum is a trademark of Ludlum Measurements, Inc., Sweetwater, Texas.

PG-2 is a trademark of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham Massachusetts

RO-20 and RO-03 are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham Massachusetts

d/min = disintegrations per minute

Visual inspection and field screening of tank exterior surfaces for contamination also will be performed to locate potential component leaks to help identify and locate possible soil contamination. When a tank is removed intact, the tank exterior surfaces will be visually inspected for holes or cracks and other evidence of contamination, such as staining or discoloration from waste. The field screening of intact tank surfaces would be performed in the same manner as soil field screening.

6.2.2.2 Soil Analytical Performance Standards

If visual inspections and field screening identify soil contamination from tank system release(s), the contaminated soil will be removed. Analytical sampling of removal area soil will be required to verify that the area meets clean closure performance standards for chemical constituents established in accordance with WAC 173-303-610(2)(b)(i) for unrestricted use and as soil shown in Table 6-2. The condition will be documented in the 241-CX Tank System unit operating record. Analytical sampling will occur in accordance with an approved SAP (Appendix A) for TSD unit dangerous waste constituents (Table 6-2). The constituent list was derived from the unit-specific Part A Form for tanks 241-CX-70 and 241-CX-71 and is a subset of the constituents identified in the data quality objective process for the 200-IS-1 OU characterization sampling.

Table 6-2. Clean - Closure Levels for 241-CX Tank System TSD Unit Dangerous Constituents

TSD Unit Dangerous Waste, Dangerous Waste Constituents, and Residues	Hanford Site Soil Background (mg/kg)[a]	Soil Concentration Protective of Groundwater[b] (mg/kg)	Human Health Protection Soil Direct Contact[c] (mg/kg)		Ecological Protection[d] (mg/kg)
	90% Log Normal percentile		Carcinogen	Noncarcinogen	
		Tank 241-CX-70[e]			
pH[g]	NA	NA	NA	NA	NA
Chromium VI	NA	18.4	NA	240	NA
		Tank 241-CX-71[e]			
Cyanide	NA	0.8	NA	1,600	NA
Nitrate	52	40	NA	1.281E+5	NA
		Tank 241-CX-72[e,f]			
Arsenic	6.47	0.03	0.667	24	7 (As III)
Barium	132	1,650	NA	1.610E+4	102
Cadmium	1.0[h]	NA	NA	80	14
Chromium VI	NA	18.4	NA	240	NA
Lead	10.2	270	NA	250	118
Mercury	0.33	2.09	NA	24	5.5
Selenium	0.78[h]	5.20	NA	400	0.3
Silver	0.73	13.6	NA	400	NA
pH[g]	NA	NA	NA	NA	NA

a. DOE/RL-92-24, Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes, Vol. I.

b. WAC 173-340-740(3)(b)(iii)(A), "Ground Water Protection." Point of compliance is soils throughout the Site (WAC 173-340-740(6), "Point of Compliance").

c. WAC 173-340-740(3)(b)(iii)(B), "Soil Direct Contact," (I), "Noncarcinogens," and (II), "Carcinogens." Equations are found in (I) and (II) for human health direct contact. Point of compliance is surface to 4.6 m (15 ft) (WAC 173-340-740(6))

d. WAC 173-340-740(3)(b)(ii), "Environmental Protection." Only wildlife industrial values from Table 749-3 are used because the 241-CX Tank System is located in the industrial-exclusive area of the Central Plateau. Point of compliance is surface to 4.6 m (15 ft) (WAC 173-340-740(6)). Table 749-3 values are screening levels and were not intended to be clean-up levels (WAC 173-340-7493(2)(a)(i), "The Chemicals of Ecological Concern"). If soil sample analytical results exceed these screening level results, the U.S. Department of Energy may develop another number to be used as the clean-up level in accordance with the provisions of WAC 173-340, "Unrestricted Land Use Soil Cleanup Standards.

e. Tank dangerous constituents for all 241-CX tanks added from the unit-specific Part A Form for individual tanks of the 241-CX Tank System.

f. This plan does not address closure of the 241-CX-72 analytes, but analytes are included in soil verification sampling for closure of ancillary equipment associated with tank 241-CX-72.

Table 6-2. Clean - Closure Levels for 241-CX Tank System TSD Unit Dangerous Constituents

TSD Unit Dangerous Waste, Dangerous Waste Constituents, and Residues	Hanford Site Soil Background (mg/kg)[a]	Soil Concentration Protective of Groundwater[b] (mg/kg)	Human Health Protection Soil Direct Contact[c] (mg/kg)		Ecological Protection[d] (mg/kg)
	90% Log Normal percentile		Carcinogen	Noncarcinogen	

g. The unrestricted clean closure level for pH (D002 corrosivity characteristic) is the noncorrosive waste designation level from WAC 173-303-090(6), "Characteristic of Corrosivity," of greater than 2.0 and less than 12.5.

h. The value shown is the 90th percentile Washington State background value from Ecology Publication 94-115, Natural Background Soil Metals Concentrations in Washington State.

NA = not applicable

TSD = treatment, storage, and/or disposal (unit)

7 Closure Activities

This chapter documents the physical activities that will be performed to implement and verify clean closure of tanks 241-CX-70 and 241-CX-71 and all piping of the 241-CX Tank System. Tank 241-CX-72 will not be closed under this plan. This chapter addresses removal of waste inventory; tank, piping, and contaminated soil removal activities; and supporting visual inspections, field screening, and potential soil verification sampling. This chapter also identifies characterization sampling for tank 241-CX-72 in support of 200-IS-1 OU remedial investigation/feasibility study characterization and future tank 241-CX-72 closure. Separate closure certifications are proposed for each tank and its associated piping. A schedule for tank system closure activities is presented at the end of this chapter.

7.1 Introduction

Prior activities have contributed to closure of the 241-CX Tank System. These activities include cessation of waste receipt by 1958, permanent shutdown of the SSC in 1967, demolition of SSC waste-generating facilities by 1986, isolation of the tanks by cutting and sealing off all waste inlet piping, removal of waste from tank 241-CX-70, and sampling of tank 241-CX-71 waste. Piping configuration (Figure 7-1) shows the piping within the scope of TSD unit closure.

Figure 6-1 shows the general activities to clean close the 241-CX Tank System under this plan. These activities include the following:

- Removal of tanks 241-CX-70 and 241-CX-71
- Removal of all tank system piping; visual inspection and field screening of any tank removed intact
- Visual inspection and field screening of soil beneath tanks and piping to determine that waste releases from the unit have not occurred
- Soil removal and sampling if releases have occurred.

Sampling of tank 241-CX-72 waste in support of a planned tank disposition study to determine an appropriate closure approach for this tank also is discussed.

7.1.1 Removal of Waste Inventory

As described in Chapter 2, waste was removed from tank 241-CX-70 by 1991. This tank now contains only waste residues and residue removal is not necessary before removing the tank. Removal of waste inventory from tank 241-CX-71 before removal currently is not planned because this tank contains sludge overlain with solidified grout. The waste in this configuration allows removal of the tank and its contents in one removal operation. Also, because sampling results have designated tank 241-CX-71 contents as WT02, there are no land-disposal restrictions that must be met to dispose of the tank and its contents intact.

7.1.2 Field Documentation

Personnel conducting removal and inspection activities will maintain daily activity reports. The reports will be held in a binder system and have consecutively numbered pages. All information pertinent to the activities will be recorded in the daily activity reports in a legible fashion and maintained in the TSD unit operating record. The daily activity reports will be reviewed and signed or initialed by the person in charge on days when work is performed. If review identifies that changes are necessary, the changes will be indicated by a single line drawn through the affected text or text will be modified, as necessary. The individual responsible for the change will initial and date the entry.

Verification checklists (Figure 7-2) will be initiated to verify performance and results of component removal, visual inspections, field screening, and any sampling activities. Copies of all completed checklists will be maintained in the operating record.

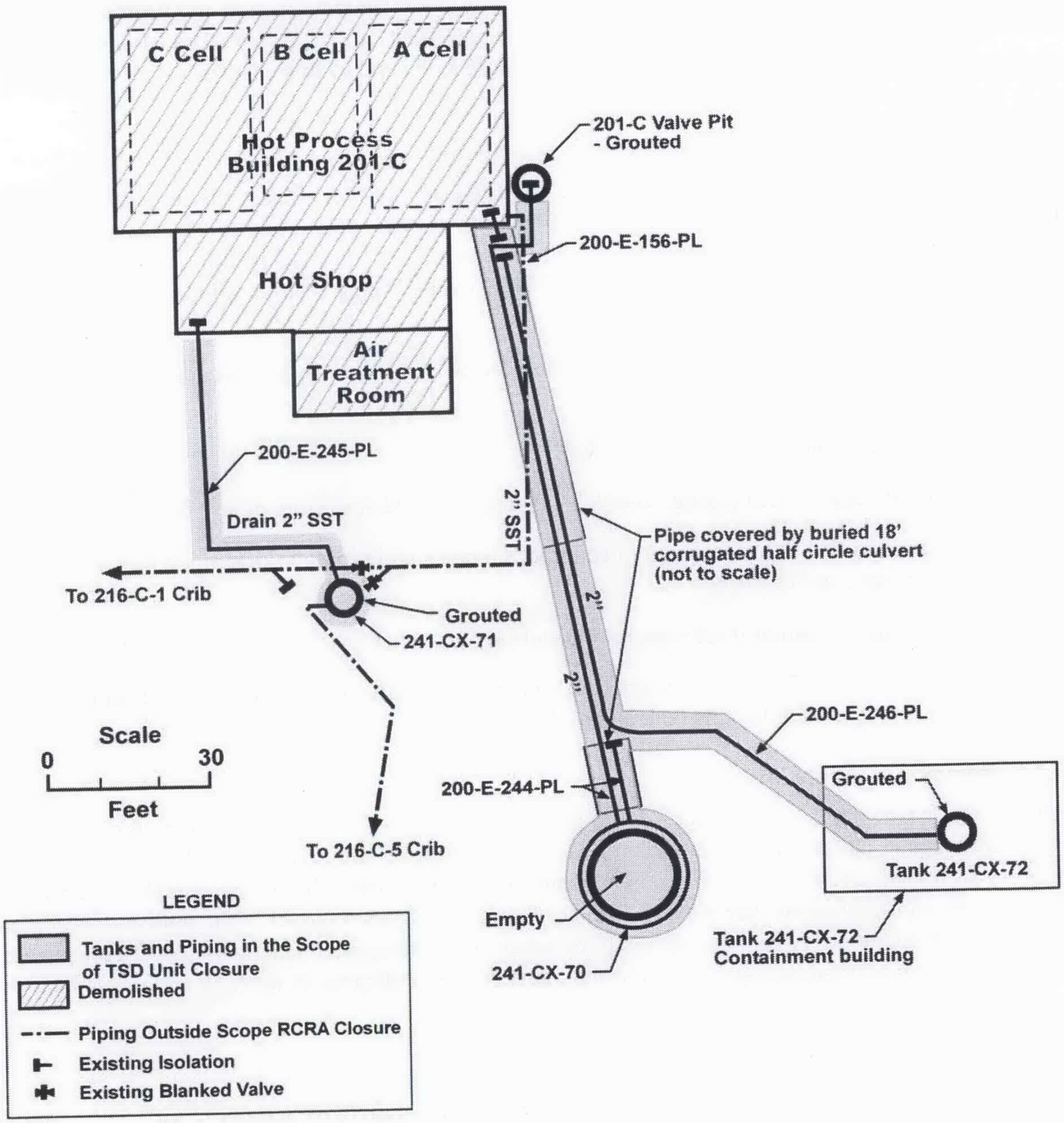

Figure 7-1. 241-CX Tanks and Piping within the Scope of TSD Unit Closure

7.1.3 Designation and Disposal of Material Removed During Closure

Designation of closure waste and debris will meet the requirements of WAC 173-303. Applicable land-disposal restriction notification and certification requirements of WAC 173-303-140, "Land Disposal Restrictions," will be met. Designation of waste generated during closure activities will be based on the Part A Form and available process knowledge and sampling results, as necessary to complete a disposal unit waste profile.

Closure waste and debris will be accumulated, as necessary, in satellite accumulation areas at appropriate locations at the unit, in accordance with WAC 173-303-200, "Accumulating Dangerous Waste On-Site," or within an approved CERCLA storage area, while awaiting designation and transfer to an approved storage or disposal unit. Containers used for transfer of regulated materials will be compatible with the waste and will be labeled. Appropriate waste acceptance documentation will be completed for the receiving unit.

All tank system closure waste will contain AEA-related material and so could designate as low-level waste or mixed waste. All 241-CX Tank System closure waste will be disposed at an approved onsite or offsite disposal facility.

7.1.4 Closure Verification Sampling

Clean closure of potentially contaminated soil at tank and piping component removal areas would be verified by sampling and analysis. The sampling would be used to verify that concentrations of TSD unit chemical constituents in soil are below analytical clean closure levels (Section 6.2.2.2). Sampling would be in accordance with an approved SAP (Appendix A). The SAP would identify target analytes and would document the number of samples, type and quality of data, sampling and analytical procedures, and the appropriate field and laboratory quality control.

7.2 241-CX Tank System Closure Activities

This section identifies the physical activities for clean closure of tanks 241-CX-70 and 241-CX-71, all 241-CX Tank System piping, and soil beneath the removed tanks and piping. Access to locations undergoing closure will be controlled during the closure period. Closure activities will be performed to keep personnel exposure as low as reasonably achievable. Upon completion of physical closure activities, the site will be restored consistent with land use for the surrounding area.

7.2.1 Tank Closure Activities

Tanks 241-CX-70 and 241-CX-71 and all tank system piping are proposed to be clean closed by removal for disposal, as described in Section 7.1.3. Tanks 241-CX-70 and 241-CX-71 are planned to be removed without further characterization. The vent piping and risers from the buried tanks to the ground surface are integral portions of the tank and will be removed along with the tank. Tank 241-CX-70 is planned to be demolished in place and removed as contaminated debris. Tank 241-CX-71 currently is planned to be removed intact because this tank is relatively small and readily removable. However, if removal of the tank intact is not feasible, it could be demolished in place and removed as debris.

This checklist is to document performance and results of 241-CX Tank System closure activities.

1. Identify component/location (e.g., Piping/200-E-246-PL) ____________________

2. ☐ Component entirely removed
   Sign: ______________________ Date: ____________

3. Surface visual inspection and field screening of exterior surfaces of tanks removed intact
   Visual inspection:
   - ☐ No visible cracks, openings, or waste staining indicating potential component leak(s).
   - ☐ Cracks, openings, and/or waste staining are visible indicating potential leak(s).

   Field Screening (NA if not performed, such as for piping):
   - ☐ No contamination from waste identified.
   - ☐ Surface contamination identified.

   Sign: ______________________ Date: ____________

4. Visual inspection and field screening of soil at component removal area
   - ☐ No soil contamination identified. (To Step 5)
   - ☐ Contamination identified in soil and the location mapped. (To Step 4a)

   Sign: ______________________ Date: ____________

   a. ☐ Soil contamination removed to below field screening levels. Location requires closure verification sampling. (To Step 4b)
   Sign: ______________________ Date: ____________

   b. ☐ Sampling of removal area soil complete in accordance with the approved sampling and analysis plan (DOE/RL-2008-51, Appendix A).
   Sign: ______________________ Date: ____________

5. Steps 1 through 4 for the listed component and associated soil are complete.
   - ☐ Component removed (Step 2) and soil contamination not found (Step 4).
   - ☐ Component removed (Step 2) and soil contamination found, removed, and verified as removed by sampling (Steps 4a and 4b).
   - ☐ Other. Explain: ______________________________

   Sign: ______________________ Date: ____________

Figure 7-2. Example of a 241-CX Tank System Closure Activity Verification Checklist

Tank 241-CX-72 will not be closed under this plan. Closure will not occur until completion of sampling of tank waste and completion of the tank disposition study. Sampling will be in accordance with the already approved SAP (DOE/RL-2002-14, Appendix C) and will include analysis of chemical constituents and AEA-regulated materials in support of TSD unit closure and the 200-IS-1 OU remedial action process. The planned tank 241-CX-72 disposition study will proceed based on sample results and will include a determination of dangerous waste characteristics and will evaluate tank disposition and closure approaches. Until final closure, tank 241-CX-72 will remain in a safe, secure, and stable condition while this plan is revised to identify an appropriate closure approach.

Tanks or tank debris removed for disposal will be cleaned and containerized only to the extent necessary to facilitate waste handling and meet disposal unit waste acceptance criteria.

7.2.2 Piping Closure Activities

All 241-CX Tank System waste transfer piping (Figure 7-1) will be removed for disposal under this plan. It remains uncertain whether this piping would designate as a dangerous waste upon removal. However, piping removal without further characterization will require less time and resources than potentially would be expended in further piping characterization, the results of which still could lead to removal.

The 241-CX tanks have been isolated by cutting and capping of waste pipelines as described in Chapter 2. Waste transfer piping from each tank to the first isolation point from the tank is considered to be within the scope of closure and will be removed (Figure 7-1). Waste transfer piping from the waste-generating facility to the first isolation point (e.g., piping from 201-C to tank 241-CX-71) will be addressed outside the scope of tank system closure. Piping from tank 241-CX-71 to the disposal crib also will be closed outside the scope of this plan. Piping that was grouted in-place during SSC facility demolition and stabilization (e.g., piping in Valve Pit 241-201-C) will be considered outside the scope of closure and will not be removed under this plan.

A 1990 photograph of the SSC after demolition (Figure 3-1) shows the placement of an approximately 3.0 m (10 ft) deep layer of stabilization soil and ash over much of the tank system piping. This layer could add up to 3.0 m (10 ft) to the depth of excavation for the piping located beneath the ash cover.

Approximately 43.9 m (144 ft) of pipe from tank 241-CX-70 to the grouted Valve Pit 241-201-C will be excavated for removal and disposal. This piping is approximately 4.0 m (13 ft) deep below grade at the tank location and up to 7.3 m (24 ft) deep where located beneath the stabilization cover.

Approximately 21.9 m (72 ft) of pipe associated with tank 241-CX-71 will be excavated for removal and disposal. Figure 2-4 indicates that this piping is buried approximately 0.9 m (3 ft) below grade at the tank location and up to 4.0 m (13 ft) deep where located beneath the stabilization cover.

Approximately 49.4 m (162 ft) of pipe associated with tank 241-CX-72 will be excavated for removal and disposal. As shown in Figure 7-1, much of the tank 241-CX-72 piping is co-located with tank 241-CX-70 piping and will be removed concurrently with 241-CX-70 piping. Figure 2-5 indicates that this piping is buried approximately 4.3 m (14 ft) below grade at the tank and up to approximately 7.3 m (24 ft) deep where located beneath the stabilization cover.

7.2.3 Closure Activities for Soils Beneath Tanks and Piping

The soils beneath tanks 241-CX-70 and 241-CX-71 and all 241-CX Tank System piping will be closed as described in the following subsections. In general, the potential for soil contamination because of releases from tanks or piping is limited. Tank 241-CX-70 had no outlet piping and could only have received a maximum of one tank volume of waste, all which has been removed from the tank. Piping operated for only a short duration after installation and leaks because of failure of piping during waste conveyance activities are not expected to have occurred. Therefore, the general closure approach as identified in Chapter 6 is based on demonstrating through visual inspections and field screening that waste releases from the unit did not occur.

7.2.3.1 Closure of Soil Beneath 241-CX-70 Tank and Piping

Tank 241-CX-70 is planned to be demolished in place and removed as contaminated debris. After tank demolition, the soil at the tank and piping removal areas will be visually inspected and will undergo field screening. As the tanks and piping are removed, qualified personnel will perform field screening for

AEA-regulated materials of 100 percent of removal area surface soils to identify any activity that appears to be above background as determined using the methods and values shown in Table 6-1. The absence of contamination found by field screening above Table 6-1 values would demonstrate that no tank system releases occurred. Where no soil contamination is identified indicating that releases have not occurred, the soil at this location will be clean closed. Acceptance will be documented on the inspection checklist (Figure 7-2).

If the soil is found to be contaminated, the condition will be noted on the checklist. Contaminated soil would be removed, containerized, designated, and disposed. The removal area would be documented and sampled in accordance with the approved SAP (Appendix A). The soil would be clean closed when sample results verify achievement of clean closure standards for TSD unit dangerous constituents (Table 6-2). As shown in Figure 6-1, the contamination removal and soil sampling process can be repeated as appropriate until clean closure levels are achieved. Alternatively, if sampling shows contamination above clean closure values that will not be removed under this plan, the closure plan would be revised as necessary to identify different clean closure activities or to identify another closure approach.

7.2.3.2 Closure of Soil Beneath 241-CX-71 Tank and Piping

Tank 241-CX-71 and piping from the Hot Shop (Figure 7-2) will be removed. If the tank is removed intact as planned, upon removal, the exterior of tank 241-CX-71 will undergo visual inspections and field screening to support demonstration that the tank did not leak. The tank exterior surfaces would be visually inspected for holes or cracks that could have provided a pathway for dangerous waste or dangerous waste residues and for other evidence of leaks, such as stains or discoloration from waste. The tank exterior surfaces will undergo field screening for AEA-regulated materials above background as determined using the methods and values shown in Table 6-1 to help locate potential leaks. A survey plan will be generated at the time of closure to ensure that, as practicable, 100 percent of tank external surfaces will undergo field screening in accordance with site processes. The inspection will be documented on the checklist (Figure 7-2) for this location.

The soil at the tank and piping removal areas will be visually inspected and 100 percent of the soil will undergo field screening using the same methods and values as identified for screening of tank 241-CX-70 and the tank 241-CX-70 piping removal area soils. The absence of contamination above background using Table 6-1 methods and values would demonstrate that tank waste was not released to the soil. If soil contamination is not identified, releases did not occur and the soil at this location will be clean closed. Acceptance will be documented on the checklist used to document the inspection.

If the soil is found to be contaminated, the contaminated soil would be removed, containerized, designated, and disposed. The removal area would be documented for closure verification sampling in accordance with an approved SAP (Appendix A). The soil would be clean closed when sample results verify achievement of clean closure standards. As shown in Figure 6-1, the contamination removal and sampling process can be repeated, as appropriate, until clean closure levels are achieved. Alternatively, if sampling shows contamination above clean closure values that will not be removed under this plan, the closure plan would be revised as necessary to identify different clean closure activities or to identify another closure approach.

7.2.4 Other Activities Required for Closure

The 241-CX Tank System TSD unit closure action will comply with all applicable air permitting requirements and with any activity-specific air monitoring plan requirements for radiological and nonradiological air emissions implemented by a coordinated CERCLA remedial action.

Equipment used during closure activities will be decontaminated, reused, or disposed as waste.

The 241-CX Tank System will remain unclosed until revision of this plan to identify the closure approach for tank 241-CX-72 and disposition of remaining contamination. The 241-CX Tank System Part A Form will remain open but could be modified to identify the portions of the unit that met clean closure standards and identify the unclosed portions for tracking until final disposition. During this period, steps will be taken to prevent threats to human health and the environment from the unclosed portions of the unit by ensuring that conditions do not develop that could mobilize remaining contamination. If ongoing inspections of unclosed areas (Section 7.3) are determined to be necessary, such inspections may occur in conjunction with 200-IS-1 OU surveillance and maintenance activities. Inspections of the unclosed unit during this extended closure are not postclosure activities.

7.3 Inspections

The 241-CX Tank System TSD unit has been inspected to meet interim-status requirements. Annual inspections are performed based on Ecology approval in 2003 (0059691, "Modification of Inspection Frequency of Certain Hanford Facility Treatment Storage, and/or Disposal (TSD) Units"). Until final closure certification (Section 7.6), inspections for the unclosed portions of the 241-CX Tank System will continue.

7.4 Training

A dangerous waste training plan has been maintained for the TSD unit to meet interim-status requirements. The duties associated with dangerous waste management activities include performing inspections, and notifying Ecology of any potential threats to human health and the environment. Until final closure certification (Section 7.6), the dangerous waste training plan addressing the 241-CX Tank System waste management duties for the unclosed portion of the 241-CX Tank System will be continued.

Training is provided to personnel who perform the annual inspection of the TSD unit and to emergency coordinators for emergency response. Training also will be provided to personnel who perform closure verification sampling activities to ensure that sample data are obtained properly. Following certification of TSD unit closure, training requirements will be discontinued.

7.5 Schedule of Closure

Figure 7-3 provides a schedule for the 241-CX Tank System closure activities under this plan. The schedule includes the time required to prepare design documents, remove tanks and piping, perform closure verification sampling at any contaminated soil removal areas (if necessary), and submit a closure certification plan. The 241-CX-72 tank schedule includes time to design a waste management system to contain the investigation-derived waste from tank 241-CX-72, obtain and analyze samples, evaluate data in a report, perform a closure options study, and modify this closure plan.

Given the duration of closure activities identified in Figure 7-3, tank system closure would require more than 180 days after closure plan approval to complete. Approval of this closure plan represents approval of an extended closure period. If final closure activities cannot be completed in accordance with Figure 7-3, an extension of closure in accordance with the requirements of WAC 173-303-610(4)(b), "Closure; Time Allowed for Closure," would be requested.

7.6 Certification of Closure

The 241-CX Tank System in its entirety will not be closed under this plan. Portions of this TSD unit are planned to be clean closed in accordance with the specifications in this closure plan. Because of the potential for closure to occur over an extended period, certification of completion of closure activities by location could be obtained incrementally as closure activities are completed. Upon final closure of the 241-CX Tank System, certification of final closure will be submitted in accordance with WAC 173-303-610(6), "Certification of Closure." At the time of final closure certification, the RCRA corrective action status of the 241-CX Tank System will be determined, in accordance with Hanford Facility RCRA Permit Condition II.Y.2.c.

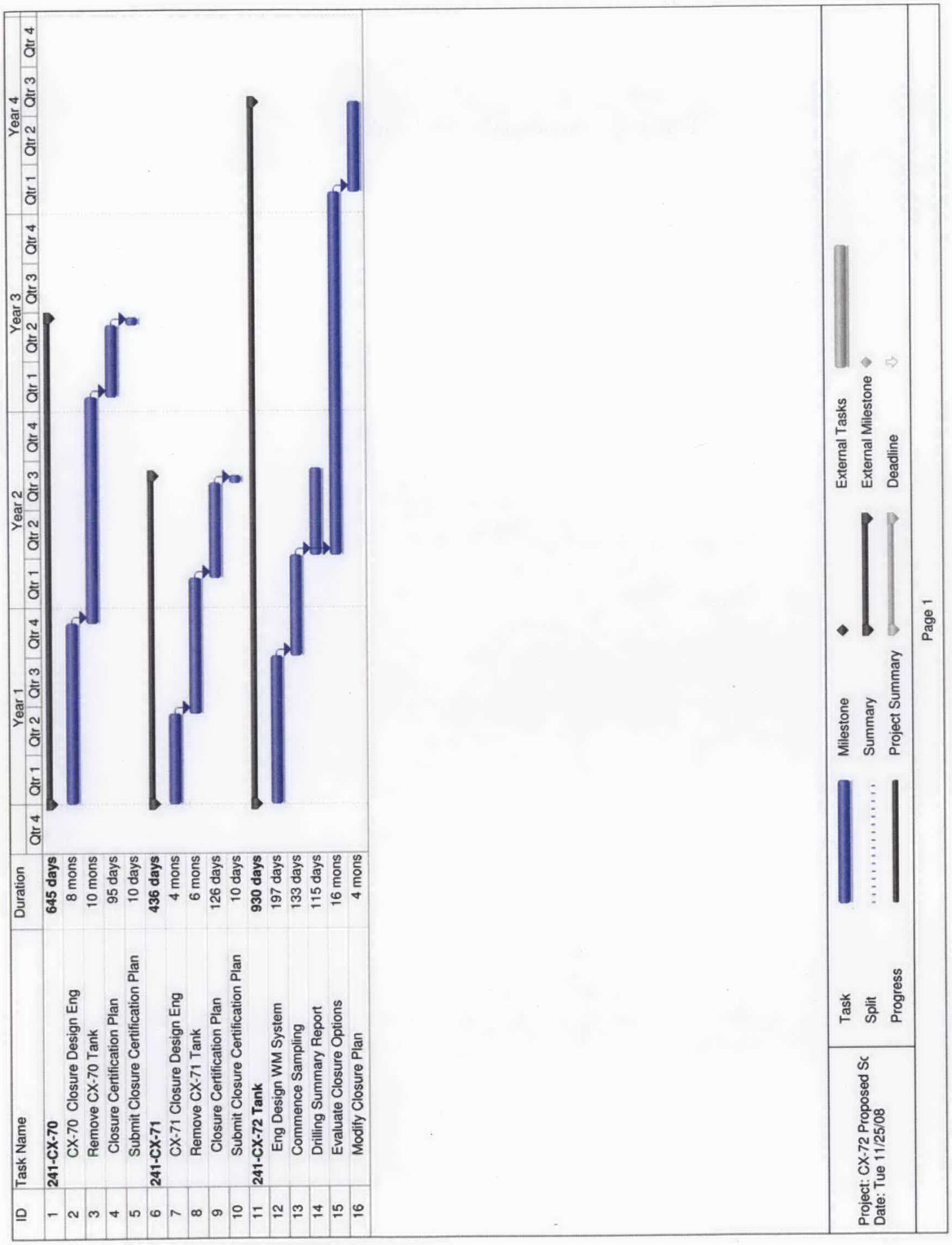

Figure 7-3. 241-CX Tank System Closure Schedule

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8 Post-Closure Plan

Tanks 241-CX-70 and 241-CX-71 and all 241-CX Tank System piping are proposed to be clean closed under this plan. Subsequently, no constituent subject to the requirements of WAC 173-303-610(2) requiring disposition under a postclosure plan will remain at these tank system locations after closure.

Upon completion of clean closure activities under this plan for tanks 241-CX-70 and 241-CX-71, all tank system piping, and soils beneath the tanks and piping, the 241-CX Tank System will enter an extended closure period during which completion of tank 241-CX-72 closure will be addressed. During the extended closure period, steps would be taken (Section 7.2.4) to prevent threats from the unclosed portion(s) of the unit.

Before tank 241-CX-72 can be closed, planned tank sampling will occur and a tank disposition study will be initiated to evaluate sample results and identify possible closure approaches for this tank. Based on disposition study results, the closure plan will be revised to identify the approach and activities necessary for final tank 241-CX-72 closure. The revised plan would identify any postclosure care necessary to meet WAC 173-303-610(1)(b), "Applicability." Also, because the 241-CX Tank System does not have secondary containment that meets the requirements of WAC 173-303-640(4)(b) through (f), WAC 173-303-640(8(c) requires that the revised closure plan include a contingent plan to meet the closure and postclosure requirements for landfills of WAC 173-303-665(6), "Landfills," in case the unit cannot be clean closed.

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173-303-610(4), "Closure; Time Allowed for Closure."

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Appendix A

Sampling and Analysis Plan for Clean Closure Verification Sampling of 241-CX Tank System Contaminated Soil Removal Areas

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Contents

Terms

AEA	*Atomic Energy Act of 1954*
ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
CAS	Chemical Abstracts Service
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CLARC	*Cleanup Levels and Risk Calculations under the Model Toxics Control Act Regulation* (CLARC Version 3.1) (Ecology 94-145)
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GEA	gamma energy analysis
GPC	gas proportional counting
GW	groundwater
HEIS	Hanford Environmental Information System database
IC	ion chromatograph
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma/mass spectrometry
N/A	not applicable
NaI	sodium iodide
NCEA	National Center for Environmental Assessment
OU	operable unit
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RESRAD	RESidual RADioactivity (dose model)

RfD	reference dose
RL	DOE, Richland Operations Office
SAP	sampling and analysis plan
STOMP	Subsurface Transport Over Multiple Phases (code)
TBD	to be determined
TSD	treatment, storage, and/or disposal (unit)
VOA	volatile organic analyte
WAC	*Washington Administrative Code*
WTPH-D	Washington State total petroleum hydrocarbons – diesel range
WTPH-G	Washington State total petroleum hydrocarbons – gasoline range

A1 Introduction

The 241-CX Tank System is a *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and/or disposal unit (TSD). This sampling and analysis plan (SAP) is for focused closure verification soil sampling. This SAP applies at 241-CX Tank System locations where closure activities identified soil contamination from unit releases and the contaminated soil has been removed. This sampling will provide objective data to confirm the absence of TSD unit contaminants at concentrations above clean closure standards at the contaminated soil removal areas. As identified in the closure plan (Chapter 6.0), this sampling addresses the WAC 173-303-640(8), "Closure and Post-Closure Care," requirement for contaminated tank system soil removal areas to meet WAC 173-303-610, "Closure and Post-Closure," decontamination and removal standards.

Activities described in the SAP were defined using the U.S. Environmental Protection Agency (EPA) data quality objective (DQO) process. Elements of this SAP were derived from a previous DQO processes undertaken for the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation of the CX-241 Tank System, and include content previously presented in DOE/RL-2002-14, *Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-IS-1 and 200-ST-1 Operable Units,* Appendix C.

A1.1 Site Description and History

The 241-CX Tank System is located in the 200 East Area of the Hanford Site in the Strontium Semiworks Complex, also referred to as the Hot Semi-Works, Strontium Semi-Works, 201-C Area, or C Plant. The 241-CX Tank System is a below-grade tank system, comprised of the 241-CX-70 Tank, 241-CX-71 Tank, and 241-CX-72 Tank. The tanks of this system operated from 1952 to 1958 in support of the Reduction-Oxidation process and Plutonium-Uranium Extraction process pilot studies at the Strontium Semiworks Complex began in 1952 and ended in 1956. The three tanks of this system received liquid waste from the 201-C Process Building and/or Hot Shop of the Strontium Semiworks Complex via underground piping.

The 241-CX tanks and waste transfer piping remain in place but have been physically isolated by cutting and permanently sealing off the pipe ends. As a portion of the Strontium Semiworks Complex decommissioning, the tanks were verified as physically isolated as of 1985. Tank 241-CX-70 is considered empty, while Tanks 241-CX-71 and Tanks 241-CX-72 contain waste overlain with grout added in 1986 to stabilize the tanks. A containment building currently exists over 241-CX-72. Figure A1-1 shows the 241-CX Tank System piping within the scope of TSD unit closure.

A1.2 Data Quality Objectives

EPA/600/R-96/055, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, was used to support the development of this SAP. The DQO process is a strategic planning approach for defining the criteria that a data collection design should satisfy. The DQO process is used to ensure that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application.

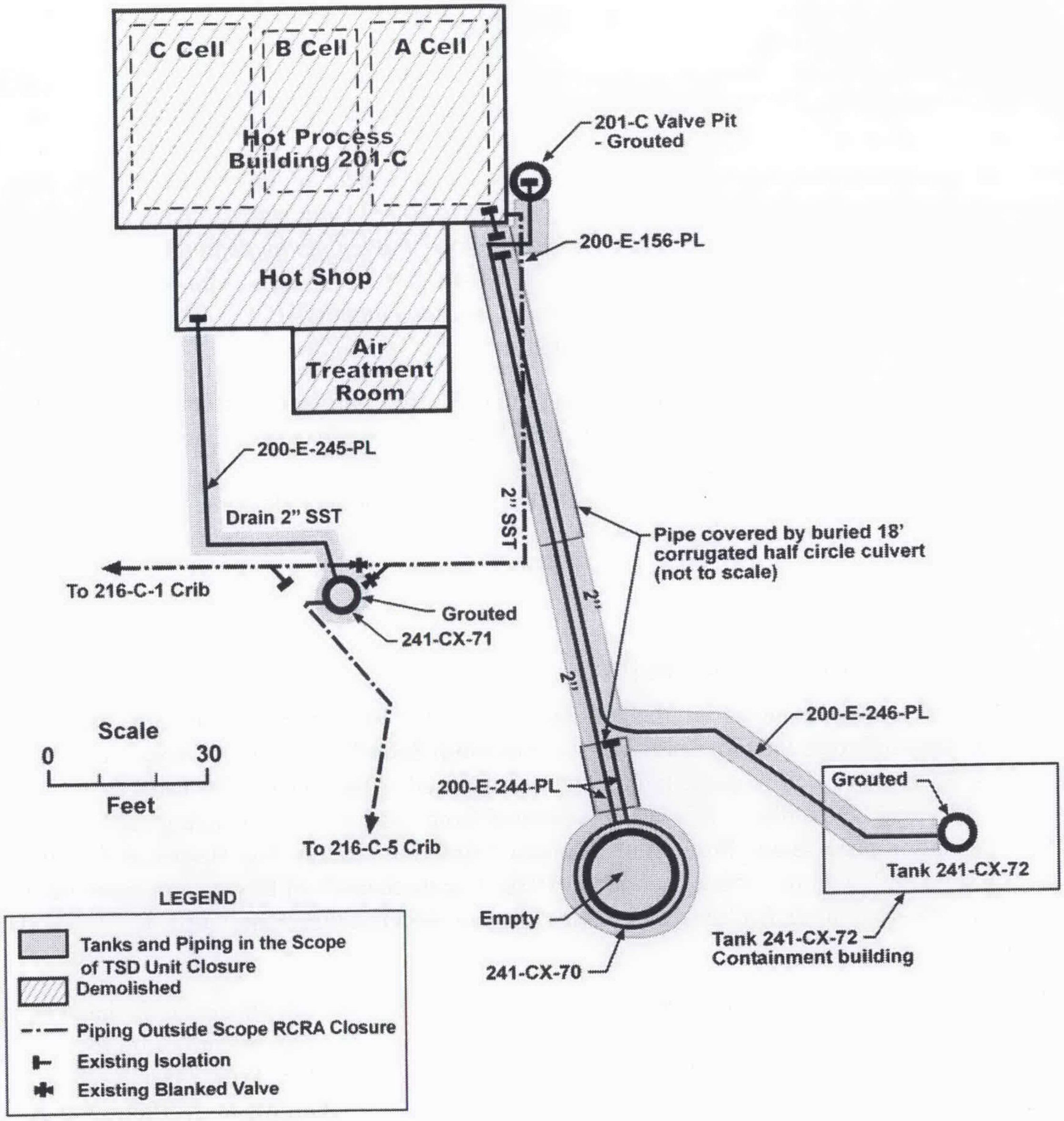

Figure A1-1. 241-CX Tanks and Piping within the Scope of TSD Unit Closure

A1.2.1 Statement of the Problem

The problem is to verify that locations where unit releases were identified during closure plan activities and contaminated soil was removed, TSD unit constituents at contaminated soil removal area(s) do not exceed levels established to meet WAC-173-303-610(2)(b)(i), "Closure Performance Standard," clean closure requirements. Based on the results of sampling under this plan, soil that meets these requirements will be clean closed.

A1.2.2 Decision Statements and Decision Rules

The decision statement consolidates potential questions and alternative actions. Decision rule(s) are generated from the decision statement(s). A decision rule is an "IF…THEN…" statement that incorporates the parameter of interest, unit of decision making, action level, and action(s) that would result from resolution of the decision. Table A1-1 present the decision statement and decision rules for tanks 241-CX-70 and 241-CX-71 and piping removal area soil clean closure. Data generated under this SAP will be used, as appropriate, for the decision rules listed in Table A1-1.

Table A1-1. Decision Rules/Decision Rules

Decision Statement	Decision Rules
Decision statements #1 – Determine whether any treatment, storage, and/or disposal unit constituents remain in the soil above WAC 173-303-610 clean closure standards at contaminated soil removal areas.	Decision rule #1a – If sampling does not identify contamination in removal area soil above WAC-173-303-610 clean closure standards, then soil at the location will be clean closed. Decision rule #1b – If sampling identifies contamination above clean closure standards, then additional soil could be removed and the location re-sampled or the closure plan could be revised and other closure activities identified.

WAC 173-303-610, "Closure and Post-Closure."

A1.3 Contaminants of Concern for TSD Unit Closure

The TSD unit constituents that will require verification of removal to meet clean closure standards are derived from the unit-specific 241-CX Tank System, Hanford Facility Dangerous Waste Part A Form for individual tanks 241-CX-70, 241-CX-71, and 241-CX-72. Although, tank 241-CX-72 will not be removed under the approved closure plan, waste feed piping to this tank will be removed and any releases to soil from the piping could contain tank 241-CX-72 constituents. The 241-CX Tank System closure plan, Table 6-2 shows these constituents and the applicable closure criteria. This list of TSD unit constituents is a subset of the final list of contaminants of potential concern (COPC) developed for the CERCLA 200-IS-1 Operable Unit (OU) characterization process. To arrive at a final list of COPCs for the 200-IS-1 OU, the DQO process is summarized in Section 4.0 of DOE/RL-2002-14. The list of TSD unit constituents considered appropriate to verify TSD unit closure is identified in Table A1-2. However, 200-IS-1 OU CERCLA analytes, including *Atomic Energy Act of 1954* (AEA) regulated material and chemicals, as discussed in Section A2.0, could be added to the list for the TSD unit closure verification samples at the discretion of the Permittee, to address any future RCRA corrective action and/or CERCLA decisions.

Table A1-2. 41-CX Tank System TSD Unit Constituents

CAS Number	Analyte Name
22569-72-8	Arsenic
7440-39-3	Barium
7440-43-9	Cadmium
18540-29-9	Chromium (VI)
57-12-5	Cyanide
7439-92-1	Lead
7439-97-6	Mercury (inorganic)
14797-55-8	Nitrate
7782-49-2	Selenium
7440-22-4	Silver
N/A	pH

CAS = Chemical Abstracts Service N/A = not applicable

A1.4 Summary of Data Quality Objective Process Results (Sampling Design)

Where documented closure activities, including visual inspections and field screening, identified that releases had occurred, the contaminated soil was removed to remove the indications. The soil at the contamination removal area requires sampling under this plan to verify that unit constituents do not remain above clean closure standards established in accordance with WAC 173-303-610(2)(b)(i) requirements for unrestricted use as described in Table A1-3. A focused sampling design will verify that no TSD unit constituents exist in contaminant removal area soils above the clean closure standards.

Table A1-3. Required Sample Data

Decision Rule #	Required Data	Samples or Measurements
1a and 1b	Soil Sampling	After contaminated soil has been removed, soil samples will be taken from the removal area to verify that no residual soil contamination remains above clean closure standards established in accordance with WAC 173-303-610(2)(b)(i) requirements for unrestricted use. Soil samples will be analyzed for the suite of chemical constituents identified in Table A1-2.

A2 Quality Assurance Project Plan

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The QAPjP complies with the requirements of the following:

- DOE O 414.1C, Quality Assurance
- 10 CFR 830, Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, 2001, EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5
- The performing contractor's applicable quality assurance program.

A2.1 Project Management

This section addresses the basic areas of project management and ensures that the project has a defined goal, that the participants understand the goal and approach to be used, and that the planned outputs have been appropriately documented.

A2.1.1 Project/Task Organization

The project organization is described in the subsections that follow and is shown in Figure A2-1.

A2.1.1.1 Waste Site Remediation Manager

The waste site remediation manager provides oversight for all activities and coordinates with the U.S. Department of Energy (DOE), Richland Operations Office (RL) and regulators in support of sampling activities. In addition, support is provided to the task lead to ensure that the work is performed safely and cost-effectively.

A2.1.1.2 Remediation Task Lead

The remediation task lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead ensures that the field team lead, samplers, and others responsible for implementation of this SAP and the QAPjP are provided with current copies of this document and any revisions thereto. The task lead works closely with quality assurance, health and safety, and the field team lead to integrate these and the other lead disciplines in planning and implementing the workscope. The task lead also coordinates with, and reports to, RL, regulators, and the performing contractor on all sampling activities.

A2.1.1.3 Quality Assurance Engineer

The quality assurance engineer is matrixed to the remediation task lead and is responsible for quality assurance issues on the project. Responsibilities include oversight of implementation of the project quality assurance requirements; review of project documents, including SAPs and the QAPjP; and participation in quality assurance assessments on sample collection and analysis activities, as appropriate.

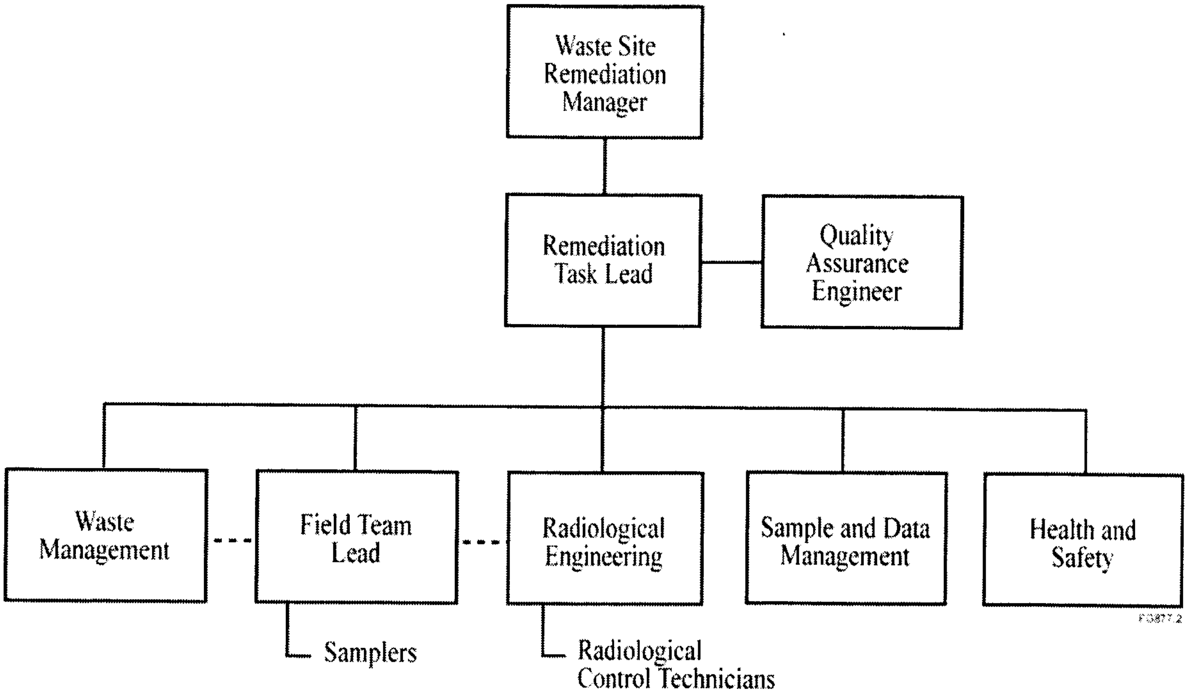

Figure A2-1. Project Organization

A2.1.1.4 Waste Management

The waste management lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance interpretation (e.g., with WAC 173-303, "Dangerous Waste Regulations") of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with Environmental Restoration Disposal Facility waste acceptance criteria specified in BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria.*

A2.1.1.5 Field Team Lead

The field team lead has the overall responsibility for the planning, coordination, and execution of the field characterization activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The field team lead communicates with the remediation task lead to identify field constraints that could affect the sampling design. In addition, the field team lead directs the procurement and installation of materials and equipment needed to support the fieldwork.

The field team lead oversees field-sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities (i.e., logbooks and chain-of-custody documentation), and packaging and transportation of samples to the laboratory or shipping center.

The field team leads, samplers, and others responsible for implementation of this SAP and the QAPjP will be provided with current copies of this document and any revisions thereto.

A2.1.1.6 Radiological Engineering

The radiological engineering lead is responsible for the radiological engineering and health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to the hazards ALARA. Radiological engineering interfaces with the project safety and health representative and plans and directs radiological control technician support for all activities.

A2.1.1.7 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory quality assurance requirements, or their equivalent, as approved by RL, the EPA, and the Washington State Department of Ecology (Ecology). The Sample and Data Management organization initiates periodic audits of the laboratories to ensure compliance. Sample and Data Management receives the analytical data from the laboratories, enters the data into the *Hanford Environmental Information System* (HEIS) database, and arranges for data validation. Validation will be performed on completed data packages (including quality control [QC] samples) by performing contractor's Sample and Data Management group or by a qualified independent contractor.

For radioactive samples, ALARA principles may limit the amount of sample the laboratory can process for analysis. This may result in elevated levels of detection (greater than the Required Detection Limits listed in Tables A2-1 and A2-2 of DOE/RL-2007-02, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units*, Volume I) and provide limitations on the analytical batch quality control analyses that can be completed. The overarching SAP also includes the list of contaminants of potential concern identified for each of the supplemental waste sites (Volume I, Appendix A, Table A2-3). The overarching SAP was approved by the Tri-Parties to support all supplemental waste-site sampling activities.

A2.1.1.8 Health and Safety

Responsibilities include coordination of industrial safety and health support within the project, as carried out through safety and health plans, job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal performing contractor work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Engineering.

A2.1.2 Background and Problem Definition

The 241-CX Tank System is a RCRA TSD unit included in the 200-IS-1 OU Tanks/Lines/Pits/Boxes Waste Group. Prior to sampling under this SAP, interim closure activities will have been completed for the TSD unit, including excavation and removal of tank system components under the approved closure plan. Where soil at tank system component removal area(s) was identified as contaminated, it was removed. The removal area requires verification that TSD unit constituents do not remain in soil above clean closure standards.

A2.1.3 Project and Task Description

The field activities described in the SAP include use of surface soil sampling (0 to 6in.) and analysis for evaluation of the contaminated soil removal areas beneath removed tank system components. The Field

Sampling Plan (Chapter A3.0) includes site specific sampling details defined during project team discussions on November 12, 2008, in addition to those identified in the original (200-IS-1 OU) DQO. As arrived at during those discussions, contamination removal areas will be identified for sampling by creating a quadrilateral made up of four cells of similar area, each of which will be divided into numbered, equal size grids. A sample will be taken from one randomly selected grid within each cell. A minimum of four surface soil samples will be obtained from each contamination removal area. Samples will be analyzed for TSD unit constituents to verify achievement of clean closure standards. Chemical and AEA regulated COPCs for the 200-IS-1 OU also could be analyzed to assist with OU remedial decision making.

At the completion of sampling, a verification report will be prepared to summarize the sample locations, the number and types of samples collected, and associated HEIS numbers.

A2.1.4 Quality Objectives and Criteria for Measurement Data

EPA/600/R-96/055 was used to support the development of this SAP. The DQO process is a strategic planning approach that provides a systematic process for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application. This section summarizes the key outputs resulting from the implementation of the DQO process.

A2.1.4.1 Contaminants of Concern

The TSD unit constituents requiring verification of removal to meet clean closure standards are derived from the unit-specific 241-CX Tank System, Part A Form for tanks 241-CX-70, 241-CX-71, and 241-CX-72 and are listed in Table 6-2 of the closure plan. Although tank 241-CX-72 will not be removed under the approved closure plan, the waste piping that would have contained this tank's constituents will be removed. The list of TSD unit constituents is a subset of the final list of COPCs developed for the 200-IS-1 OU characterization process. The DQO process to arrive at a final list of COPCs for the 200-IS-1 OU and development of this list is summarized in Section 4.0 of DOE/RL-2002-14. The TSD unit constituents are identified in Table A2-1 and compared against clean closure levels.

Table A2-1. Comparison of Soil Data to Residential Clean-Closure Levels for 241-CX Tank System TSD Unit Dangerous Constituents

TSD Unit Dangerous Waste, Dangerous Waste Constituents, and Residues	Hanford Site Soil Background (mg/kg)[a]	Soil Concentration Protective of Groundwater[b] (mg/kg)	Human Health Protection Soil Direct Contact[c] (mg/kg)		Ecological Protection[d] (mg/kg)
	90% Log Normal Percentile		Carcinogen	Noncarcinogen	
		Tank 241-CX-70[e]			
pH[f]	N/A	N/A	N/A	N/A	N/A
Chromium VI	N/A	18.4	N/A	240	N/A
		Tank 241-CX-71[e]			
Cyanide	N/A	0.8	N/A	1,600	N/A
Nitrate	52	40	N/A	1.28E+05	N/A

Table A2-1. Comparison of Soil Data to Residential Clean-Closure Levels for 241-CX Tank System TSD Unit Dangerous Constituents

TSD Unit Dangerous Waste, Dangerous Waste Constituents, and Residues	Hanford Site Soil Background (mg/kg)[a]	Soil Concentration Protective of Groundwater[b] (mg/kg)	Human Health Protection Soil Direct Contact[c] (mg/kg)		Ecological Protection[d] (mg/kg)
	90% Log Normal Percentile		Carcinogen	Noncarcinogen	
		Tank 241-CX-72[e,g]			
Arsenic	6.47	0.03	0.667	24	7 (As III)
Barium	132	923	N/A	1.6 E+04	102
Cadmium	1.0 [h]	N/A	N/A	80	14
Chromium (VI)	N/A	18.4	N/A	240	N/A
Lead	10.2	270	N/A	250	118
Mercury	0.33	2.09	N/A	24	5.5
Selenium	0.78[h]	5.20	N/A	400	0.3
Silver	0.73	13.6	N/A	400	N/A
pH[f]	N/A	N/A	N/A	N/A	N/A

Clean closure evaluations for treatment, storage, and/or disposal units are required to use unrestricted (residential) levels in WAC 173-340-740(3), "Method B Soil Cleanup Levels for Unrestricted Land Use," based on WAC 173-303-610(2)(b)(i), "Closure Performance Standard."

a. DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Vol. I.

b. WAC 173-340-740(3)(b)(iii)(A), "Ground Water Protection."

c. WAC 173-340-740(3)(b)(iii)(B), "Soil Direct Contact," (I), "Noncarcinogens," and (II), "Carcinogens." Equations are found in (I) and (II) for human health direct contact.

d. WAC 173-340-740(3)(b)(ii), "Environmental Protection." Only wildlife industrial values from Table 749-3 are used because the 241-CX Tank System is located in the industrial-exclusive area of the Central Plateau.

e. Tank dangerous waste constituents added from the unit-specific Part A Form for individual tanks of the 241-CX Tank System.

f. The unrestricted level for clean closure for pH (D002 corrosivity characteristic) is the noncorrosive waste designation level from WAC 173-303-090(6), "Characteristic of Corrosivity," greater than 2.0 and less than 12.5.

g. This plan does not address closure of tank 241-CX-72, but because tank system piping associated with this tank will be removed, tank 241-CX-72 constituents are included.

The value shown is the 90th percentile Washington State background value from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State.*

N/A = not applicable

TSD = treatment, storage, and/or disposal (unit)

If additional analytes not identified as TSD unit constituents (or CERCLA COPCs) are detected by the analytical methods used for laboratory analysis, the additional detected analytes and their concentrations will be evaluated against regulatory standards and existing process knowledge. All detected analytes will be reported.

A2.1.4.2 Tolerance and Decision Consequences

At the removal areas, a focused sampling approach will be used to verify that all residual waste material was sufficiently removed.

A2.1.4.3 Analytical Quality Objectives

Analytical quality objectives and criteria for laboratory measurement data are presented in Table A2-2 for TSD unit constituents that must meet clean closure standards. Table A2-3 identifies the requirements for non-TSD unit constituents, including AEA regulated material and chemical analytes, to meet RCRA corrective action and CERCLA remedial investigation requirements.

In the event of a laboratory analytical failure, the laboratory is required to initiate corrective actions with the Sample and Data Management team of the Environmental Information Systems group. As part of the data package transmittal procedure, a sample disposition record is generated to define the problem and to indicate the agreed-upon solution reached with discussions by the project manager or task lead. As part of the sample disposition process, quarterly trend reports containing quality statistics are compiled based on the sample disposition records. This provides an insight into emerging problems and the effectiveness of past responses to problems.

A2.1.4.4 Laboratory Sample Custody

Sample custody during laboratory analysis will be addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

Table A2-2. Analytical Performance Requirements for TSD Unit Dangerous Constituents

COPCs	CAS #	Overall Clean Closure Level[a] (mg/kg)	Name/Analytical Technology[b]	Required Target Quantitation Limits[c] Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil
			Metals			
Arsenic	7440-38-2	6.47[d]	EPA Method 6010/200.8	10	±35%[e]	65 - 135%[e]
Barium	7440-39-3	102	EPA Method 6010/200.8	2	±35%[e]	65 - 135%[e]
Cadmium	7440-43-9	14	EPA Method 6010/200.8 (trace)	0.2	±35%[e]	65 - 135%[e]
Chromium VI	18540-29-9	18.4	EPA Method 7196 – colorimetric	0.5	±35%[e]	65 - 135%[e]
Lead	7439-92-1	118	EPA Method 6010/200.8	10	±35%[e]	65 - 135%[e]
			EPA Method 6010/200.8 (trace)	1	±35%[e]	65 - 135%[e]
Mercury	7439-97-6	2.09	EPA Method 7470/200.8	N/A	±35%[e]	65 - 135%[e]
			EPA Method 7471/200.8	0.2	±35%[e]	65 - 135%[e]

Table A2-2. Analytical Performance Requirements for TSD Unit Dangerous Constituents

Selenium	7782-49-2	0.78	EPA Method 6010/200.8	1	±35%[e]	65 - 135%[e]
Silver	7440-22-4	13.6	EPA Method 6010/200.8 (trace)	0.5	±35%[e]	65 - 135%[e]
			Inorganics			
Cyanide	57-12-5	0.80	Total cyanide – EPA Method 9010 – colorimetric	0.5	±35%[e]	65 - 135%[e]
Nitrate	14797-55-8	40	EPA Method 300.0	2.5	±35%[e]	65 - 135%[e]
			General Chemistry			
pH	PH	N/A	EPA Method 9045	0.1 pH unit	N/A	N/A

a. The overall clean closure level is the most restrictive level from Table A2-1, provided that it is not below background.

b. All four-digit numbers refer to SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition*.

c. Target quantitation limit requirements for analytical laboratories (dependent on method and laboratory capabilities).

d. The most restrictive Table A2-1 clean closure value is less than statewide background value for arsenic of 6.5 mg/kg. Therefore, the background value is used as the clean closure level.

e. Accuracy criteria for associated batch matrix spike percent recoveries.

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
COPC = Contaminant of potential concern
N/A = not applicable

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Radionuclides								
		Preliminary Action Levels Used[a]				Target Quantitation Limits[d]		
COPCs	CAS #	15 mrem/yr[b] (pCi/g)	100 mrem/yr[b] (pCi/g)	GW Protection[b] (pCi/g)	Name/Analytical Technology[c]	Soil/ Solids Activity (pCi/g)	Precision Soil	Accuracy Soil
Americium-241	14596-10-2	335	2,240	N/A	Americium isotopic – alpha energy analysis	1	±35%[e]	65 - 135%[e]
Antimony-125	14234-35-6	32.4	216	N/A	GEA	0.1	±35%[e]	65 - 135%[e]
Carbon-14	14762-75-5	33,100	221,000	N/A	Chem. separation – liquid scintillation	15	±35%[e]	65 - 135%[e]
Cesium-134	13967-70-9	8.43	56.2	N/A	GEA	0.1	±35%[e]	65 - 135%[e]
Cesium-137	10045-97-3	23.4	156	N/A	GEA	0.1	±35%[e]	65 - 135%[e]
Cobalt-60	10198-40-0	4.90	32.7	N/A	GEA	0.05	±35%[e]	65 - 135%[e]
Europium-152	14683-23-9	11.4	75.7	N/A	GEA	0.1	±35%[e]	65 - 135%[e]
Europium-154	15585-10-1	10.3	68.9	N/A	GEA	0.1	±35%[e]	65 - 135%[e]
Europium-155	14391-16-3	426	2,840	N/A	GEA	0.1	±35%[e]	65 - 135%[e]
Iodine-129	15046-84-1	3,081	20,500	0.024	Chem. separation – low-energy photon spectroscopy	2	±35%[e]	65 - 135%[e]
Neptunium-237	13994-20-2	59.2	395	N/A	Neptunium-237 isotopic – alpha energy analysis	1	±35%[e]	65 - 135%[e]
Nickel-63	13981-37-8	4,026	20,500,000	N/A	Chem. separation – liquid scintillation	15	±35%[e]	65 - 135%[e]
Plutonium-238	13981-16-3	470	3,130	N/A	Plutonium isotopic – alpha energy analysis	1	±35%[e]	65 - 135%[e]
Plutonium-239/240	Pu-239/240	425	2,840	N/A	Plutonium isotopic – alpha energy analysis	1	±35%[e]	65 - 135%[e]
Radium-226	13982-63-3	7.03	46.9	N/A	Chem. separation – liquid GEA – solid	0.1	±35%[e]	65 - 135%[e]

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Radium-228	15262-20-1	8.15	54.3	N/A	Chem. separation – liquid GEA – solid	0.2	±35%[e]	65 - 135%[e]
Strontium-90	Rad-Sr	2,410	16,100	N/A	Chem. separation – GPC	1	±35%[e]	65 - 135%[e]
Technetium-99	14133-76-7	412,000	2,740,000	171	Chem. separation – liquid scintillation	15	±35%[e]	65 - 135%[e]
Thorium-232	7440-29-1	4.8	32	N/A	Thorium isotopic – alpha energy analysis/ICP/MS	1	±35%[e]	65 - 135%[e]
Tritium (H-3)	10028-17-8	66,900	446,000	4,100	Chem. separation – liquid scintillation	400	±35%[e]	65 - 135%[e]
Uranium-233/234	13966-29-5	2,660	3,280	39.5	Uranium isotopic – alpha energy analysis/ICP/MS	1	±35%[e]	65 - 135%[e]
Uranium-235/236	15117-96-1	101	67.4	3.92	Uranium isotopic – alpha energy analysis/ICP/MS	1	±35%[e]	65 - 135%[e]
Uranium-238	U-238	504	3,360	38.1	Uranium isotopic – alpha energy analysis/ICP/MS	1	±35%[e]	65 - 135%[e]

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Nonradionuclides								
		Preliminary Action Level[a]				Required Target Quantitation Limits[d]		
COPCs	CAS #	WAC 173-340-74 5 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil
Metals								
Aluminum	7429-90-5	11.800[i]	45	N/A	EPA Method 6010	5	±35%[j]	65 - 135%[j]
Antimony	7440-36-0	1,400	5.4	k	EPA Method 6010/200.8	0.6	±35%[j]	65 - 135%[j]
Chromium (total)	7440-47-3	N/A	2,000	135	EPA Method 6010/200.8 (trace)	0.2	±35%[j]	65 - 135%[j]
Cobalt	7440-48-4	70,000[l]	290[l]	k	EPA Method 6010/200.8	2	±35%[j]	65 - 135%[j]
Copper	7440-50-8	130,000	22[m]	550	EPA Method 6010/200.8	2.5	±35%[j]	65 - 135%[j]
Lithium	7439-93-2	70,000[n]	1,930[o]	N/A	EPA Method 6010	2.5	±35%[j]	65 - 135%[j]
Manganese	7439-96-5	490,000	65.3	23,500	EPA Method 6010/200.8	0.5	±35%[j]	65 - 135%[j]
Molybdenum	7439-98-7	17,500	32.3	71	EPA Method 6010/200.8	2	±35%[j]	65 - 135%[j]
Nickel	7440-02-0	70,000[p]	130	1,850	EPA Method 6010/200.8	4	±35%[j]	65 - 135%[j]
Strontium	7440-24-6	2,100,000	2,920	N/A	EPA Method 6010/200.8	1	±35%[j]	65 - 135%[j]
Thallium	7440-28-0	245	1.59	N/A	EPA Method 6010/200.8	0.5	±35%[j]	65 - 135%[j]
Tin	7440-31-5	2,100,000	25,000	k	EPA Method 6010/200.8	10	±35%[j]	65 - 135%[j]
Uranium (total)	7440-61-1	1,050	1.32	N/A	Uranium total – kinetic phosphorescence analysis/ EPA Method 200.8	0.001	±35%[j]	65 - 135%[j]
Vanadium	7440-62-2	24,500	2,240	k	EPA Method 6010/200.8	2.5	±35%[j]	65 - 135%[j]
Zinc	7440-66-6	1,050,000	5,970	570	EPA Method 6010/200.8	1	±35%[j]	65 - 135%[j]

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Nonradionuclides								
		Preliminary Action Level[a]				Required Target Quantitation Limits[d]		
COPCs	CAS #	WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil
Inorganics								
Ammonia/ ammonium	7664-41-7	N/A	N/A	N/A	EPA Method 350/300.7	0.5	±35%[j]	65 - 135%[j]
Chloride	16887-00-6	N/A	1,000	N/A	EPA Method 300.0	5	±35%[j]	65 - 135%[j]
Fluoride	16984-48-8	210,000	24.1	N/A	EPA Method 300.0	5	±35%[j]	65 - 135%[j]
Iodine	7553-56-2	N/A	N/A	N/A	EPA Method 345.1	20	±35%[j]	65 - 135%[j]
Nitrite	14797-65-0	350,000	4	N/A	EPA Method 300.0	2.5	±35%[j]	65 - 135%[j]
Phosphate	14265-44-2	N/A	N/A	N/A	EPA Method 300.0	5	±35%[j]	65 - 135%[j]
Sulfate	14808-79-8	N/A	1,030	N/A	EPA Method 300.0	5	±35%[j]	65 - 135%[j]
Sulfite	14265-45-3	N/A	N/A	N/A	EPA Method 377.1	20	±35%[j]	65 - 135%[j]
Organics								
1,1-Dichloroethylene	75-35-4	219	0.0005	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
1,1,2-Trichloroethane	79-00-5	2,300	0.00427	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
1,1,2,2-Tetrachloroethane	79-34-5	656	0.00123	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
1,2-Dichlorobenzene	95-50-1	315,000	7.03	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
1,3-Dichlorobenzene	541-73-1	105,000[r]	3.09[r]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
2,4-Dinitrotoluene	121-14-2	7,000	0.189	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
2-Hexanone	591-78-6	140,000[s]	2.73[s]	N/A	EPA Method 8260/5035A	0.01	±35%[q]	50 - 150%[q]
Benzene	71-43-2	2,390	0.00448	N/A	EPA Method 8260/5035A	0.0015	±35%[q]	50 - 150%[q]
Benzo[a]anthracene	56-55-3	180[i]	0.856[i]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Benzo[a]pyrene	50-32-8	18[q]	0.232[q]	300	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Nonradionuclides								
		Preliminary Action Level[a]				Required Target Quantitation Limits[d]		
COPCs	CAS #	WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil
Benzo[b]fluoranthene	205-99-0	180[l]	2.95[l]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Benzo[k]fluoranthene	207-08-9	1,800[l]	29.5[l]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
n-Butyl alcohol	71-36-3	350,000	6.62	N/A	EPA Method 8015	5	±35%[q]	50 - 150%[q]
Carbon tetrachloride	56-23-5	1,010	0.0031	N/A	EPA Method 8260/5035A	0.0015	±35%[q]	50 - 150%[q]
Chlorobenzene	108-90-7	70,000	0.874	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Chloroform	67-66-3	21,500	0.0381	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Chrysene	218-01-9	18,000[l]	95.6[l]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Butyl benzene; n	104-51-8	240[t]	110[t]	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Dibenz[a,h]anthracene	53-70-3	18	0.429	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Dichloroethane; 1,1	75-34-3	350,000	4.37	N/A	EPA Method 8260/5035A	0.01	±35%[q]	50 - 150%[q]
Dichloroethane; 1,2	107-06-2	1,440	0.00232	N/A	EPA Method 8260/5035A	0.0015	±35%[q]	50 - 150%[q]
Dichloroethylene; 1,2- (trans)	156-60-5	31,500[u]	0.36[v]	N/A	EPA Method 8260/5035A	0.001	±35%[q]	50 - 150%[q]
Dichloroethylene; 1,2-cis-	156-59-2	31,500[u]	0.36[v]	N/A	EPA Method 8260/5035A	0.001	±35%[q]	50 - 150%[q]
Ethylbenzene	100-41-4	350,000	6.05	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Indeno[1,2,3-cd]pyrene	193-39-5	180[l]	8.33[l]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Methyl ethyl ketone (MEK; 2-butanone)	78-93-3	2,100,000	19.6	N/A	EPA Method 8260/5035A	0.01	±35%[q]	50 - 150%[q]
Naphthalene	91-20-3	14,000[w]	2.03[w]	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Methyl isobutyl ketone (MIBK hexone)	108-10-1	280,000	2.71	N/A	EPA Method 8260/5035A	0.01	±35%[q]	50 - 150%[q]
Methylene chloride (dichloromethane)	75-09-2	17,500	0.0218	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

COPCs	CAS #	Preliminary Action Level[a]: WAC 173-340-745 Method C[f] (mg/kg)	Preliminary Action Level[a]: GW Protection[g] (mg/kg)	Preliminary Action Level[a]: Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Required Target Quantitation Limits[d]: Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil
Nonradionuclides								
Polychlorinated biphenyls	1336-36-3	10[x]	0.0021[y]	2	EPA Method 8082	0.0165	±35%[q]	50 - 150%[q]
Tetrachloroethylene	127-18-4	243	0.00086	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Toluene	108-88-3	28,000	4.65	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Trichlorethane; 1,1,1	71-55-6	3,150,000	1.58	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Trichloroethylene	79-01-6	328	0.00072	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Xylene (total)	1330-20-7	700,000	14.6	N/A	EPA Method 8260/5035A	0.005	±35%[q]	50 - 150%[q]
Total petroleum hydrocarbons – diesel to oil range (kerosene)	68334-30-5	2,000[x]	2,000[x]	15,000	WTPH-D/Analytical Methods for Petroleum Hydrocarbons (Ecology 97-602)	5	±35%[q]	50 - 150%[q]
Oil and Grease	8008-20-6	2,000	2,000	N/A	EPA 413.N	200	±35%[q]	50 - 150%[q]
2-Methylphenol (o-cresol)	95-48-7	175,000	10.3	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
4-Methylphenol (p-cresol)	106-44-5	17,500	1.01	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Total petroleum hydrocarbons – (gasoline range)	8006-61-9	30[x]	30[x]	12,000	WTPH-G/Analytical Methods for Petroleum Hydrocarbons (Ecology 97-602)	5	±35%[q]	50 - 150%[q]
Normal paraffin hydrocarbons (n-dodecane)	112-40-3	2,000[x]	2,000[x]	15,000	Nonhalogenated VOA - EPA Method 8015M – gas chromatography modified for hydrocarbons	5	±35%[q]	50 - 150%[q]
Phenol	108-95-2	1,050,000	22	N/A	EPA Method 8270	0.330	±35%[q]	50 - 150%[q]
Physical Properties								
Alkalinity	N/A	N/A	N/A	N/A	EPA Method 310	TBD	±35%[j]	65 - 135%[j]
Gross alpha	14127-62-9	N/A	N/A	N/A	GPC	TBD	N/A	N/A

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Nonradionuclides								
		Preliminary Action Level[a]				Required Target Quantitation Limits[d]		
COPCs	CAS #	WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil
Gross beta	12587-47-2	N/A	N/A	N/A	GPC	TBD	N/A	N/A
Gross gamma	N/A	N/A	N/A	N/A	NaI or germanium detectors in scan mode	TBD	N/A	N/A
Moisture content	N/A	N/A	N/A	N/A	ASTM D2216	wt%	N/A	N/A
Bulk Density	N/A	N/A	N/A	N/A	ASTM D2937	wt%	N/A	N/A
Particle size distribution	N/A	N/A	N/A	N/A	ASTM D422	wt%	N/A	N/A

a. The preliminary action level is the regulatory- or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.

b. 15 mrem/yr = nonrad worker industrial exposure scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors. 100 mrem/yr = rad-worker industrial scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors. GW = groundwater protection radionuclide values based on RESRAD modeling of drinking water exposure with the entire vadose zone presumed to be contaminated. Groundwater protection may be evaluated using the STOMP code or another model to predict movement of contaminants through the vadose zone.

c. All four-digit numbers refer to SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition*.

d. Target quantization limit requirements for analytical laboratories (dependent on method and laboratory capabilities). Water values for sampling quality control (e.g., equipment blanks/rinses) or drainable liquid (if recovered). For water and soil media, matrix affects may have an impact on a specific sample basis.

e. Accuracy criteria for associated batch laboratory control sample percent recoveries. Except for GEA, additional analysis-specific evaluations also preformed for matrix spikes, tracers, and carriers as appropriate to the method. Precision criteria for batch laboratory replicate sample analyses.

f. WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties," Method C industrial soil values for direct exposure from the CLARC Version 3.1 tables, updated November 2001.

g. WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection," soil concentrations protective of groundwater based on Method B values for groundwater from the CLARC Version 3.1 tables, updated January 2008, except as noted.

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Nonradionuclides								
		Preliminary Action Level[a]				Required Target Quantitation Limits[d]		
COPCs	CAS #	WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil

h. Value is from Table 749-2 of WAC 173-340-900, "Tables," amended February 12, 2001.

i. Hanford Site background concentration for soil.

j. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analysis.

k. According to Footnote d of Table 749-2, Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure, referenced in WAC 173-340-7492, "Simplified Terrestrial Ecological Evaluation Procedures," safe concentration has not yet been established for these constituents. See WAC 173-340-7492 (2)(c).

l. Calculated using RfD from Oak Ridge National Laboratory, July 14, 2004.

m. Value is less than Hanford Site soil background. Therefore, the soil background concentration is used as the preliminary action level.

n. Accuracy criteria is the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also preformed for matrix spikes, and surrogates as appropriate to the method. Precision criteria for batch laboratory replicate matrix spike analyses.

o. Based on reference dose from Region 3; NCEA.

p. Based on soluble salts value.

q. Values are from the *Integrated Risk Information System* database.
   r. Calculated using RfD from Region 3.
   s. Calculated from EPA Region 3 toxicity values; NCEA.

t. WAC 173-340-747(4) fixed-parameter three-phase partitioning model equation value for soil protection of groundwater calculated using drinking water standards from EPA Region 9.

u. Values reported for mixed isomers rather than cis/trans-1,2-dichloroethylene because both are present and the mixed isomers value is more protective.

v. Calculated using WAC 173-340-720 drinking water standards as inputs to the three-phase model for protection of drinking water [WAC 173-340-747(4), amended February 12, 2001], except as noted.

w. Calculated from Rfd in the *Integrated Risk Information System* database, which first appeared December 22, 2003.

x. Based on WAC 173-340-900, Tables 740-1 and 745-1, amended February 12, 2001.

y. Based on soil concentration that is protective of the river.

Table A2-3. Analytical Performance Requirements for Opportunistic CERCLA Soil Sampling

Nonradionuclides								
		Preliminary Action Level[a]				Required Target Quantitation Limits[d]		
COPCs	CAS #	WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)	Name/Analytical Technology[c]	Soil Concentration (mg/kg)	Precision Soil	Accuracy Soil

ASTM, 1993 Annual Book of ASTM Standards, Volume 04.08.
Ecology Publication 94-145, Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1.
Ecology Publication 97-602, 1997, Analytical Methods for Petroleum Hydrocarbons.
EPA, Integrated Risk Information System database.
PNNL-11216, STOMP -- Subsurface Transport Over Multiple Phases: Application Guide.
SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition.
WAC 173-340, "Model Toxics Control Act -- Cleanup."
WAC 173-340-720, "Ground Water Cleanup Standards."
WAC 173-340-750(3)(b)(ii)(B), "Cleanup Standards to Protect Air Quality," "Method B Air Cleanup Levels," "Applicability," "Human Health Protection," "Carcinogens."

For EPA Method 200.8, see EPA/600/R-94/111, Methods for the Determination of Metals in Environmental Samples, Supplement 1.
For EPA Method 300.7, see EPA/600/4-86/024, Development of Standard Methods for the Collection and Analysis of Precipitation.
For EPA Methods 150.1, 300.0, 310, 345.1, 377.1, and 413.N, see EPA/600/4-79/020, Methods of Chemical Analysis of Water and Wastes.

ASTM = American Society for Testing and Materials
CAS = Chemical Abstracts Service
CLARC = *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Regulation* (CLARC Version 3.1) (Ecology 94-145)
COPC = contaminant of potential concern
CVAA = cold vapor atomic absorption
EPA = U.S. Environmental Protection Agency
GEA = gamma energy analysis
GPC = gas proportional counting
GW = groundwater
ICP/MS = inductively coupled plasma/mass spectrometry
N/A = not applicable
NaI = sodium iodide
NCEA = National Center for Environmental Assessment
RESRAD = RESidual RADioactivity (dose model)
RfD = reference dose
STOMP = Subsurface Transport Over Multiple Phases (code) (PNNL-11216)
TBD = to be determined
VOA = volatile organic analyte
WAC = *Washington Administrative Code*
WTPH-D = Washington state total petroleum hydrocarbons – diesel range
WTPH-G = Washington state total petroleum hydrocarbons – gasoline range

A2.1.5 Quality Assurance Objective

The quality assurance objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality and adhere to the approved performing contractor QAPjP. Data quality is assessed by representativeness, comparability, accuracy, precision, completeness, and detection limits. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed in the following subsections.

A2.1.5.1 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration and distribution of the chemical and radiological constituents in the matrix sampled. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, transportation) have been developed and are discussed in subsequent sections of this document. The documentation will establish that protocols have been followed and that sample identification and integrity are ensured.

A2.1.5.2 Comparability

Comparability expresses the confidence with which one data set can be compared to another. For this closure demonstration, the collected data will be compared to a specific regulatory threshold (WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards," unrestricted calculation). Data comparability will be maintained using standard procedures (from SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition*, as available, or other EPA or national standard methods) and consistent methods and units. Tables A2-2 and A2-3 list applicable fixed-laboratory methods for analytes and target detection limits. Actual detection limits will depend on the sample matrix and the sample quantity available. Data will be reported as defined for specific samples.

A2.1.5.3 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Opportunistic radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generation of in-house statistical limits based on three standard deviations (+/-3 standard deviation). Tables A2-2 and A2-3 lists the accuracy provided for fixed-laboratory analyses for the project.

A2.1.5.4 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for triplicates. Tables A2-2 and A2-3 lists the analytical precision for fixed-laboratory analyses.

A2.1.5.5 Completeness

The completeness criterion for the data will be 100 percent for any soil samples for the closure parameters shown in Tables A2-2 and A2-3.

A2.1.5.6 Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Method detection limits for the TSD unit constituents are in Table A2-2 and the 200-IS-1 OU COPC are presented in Table A2-3.

A2.1.6 Special Training Requirements/Certification

The below training requirements pertain to opportunistic CERCLA actions that may be performed concurrent with TSD unit closure activities but that do not pertain to TSD unit training requirements as defined in WAC 173-303. Section 7.4 in the 241-CX Tank System closure plan identifies training requirements for TSD unit personnel who perform annual inspections, coordinate emergency response, and for those who perform closure verification sampling.

Typical training or certification requirements have been instituted by the performing contractor team to meet training requirements imposed by the regulations, DOE orders, contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers standards, and *Washington Administrative Code*. For example, training or certification requirements needed by sampling personnel will be in accordance with site analytical quality requirements.

The environmental safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste-site experience
- Eight-hour hazardous waste worker refresher training (as required)
- Hanford Site general employee radiation training
- Radiological worker training.

A graded approach is used to ensure that workers receive a level of training (commensurate with their responsibilities) that complies with applicable DOE orders and government regulations. Specialized employee training includes pre-job briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

A2.1.7 Documents and Records

Planning for sample collection and analysis shall be in accordance with the programmatic requirements governing fixed-laboratory sample collection activities as discussed in the sample teams' procedures. In the event that specific procedures do not exist for a particular work evolution, or if it is determined that additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities. Examples of the sample teams' requirements include the activities associated with the following:

- Chain-of-custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks and checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document measurements (e.g., field screening for AEA regulated materials) when implementing this SAP. Examples of the types of documentation for field data for AEA regulated material include the following:

- Instructions regarding the minimum requirements for documenting controls information for AEA regulated material as discussed in 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site records for AEA regulated material
- The minimum standards and practices necessary for preparing, performing, and retaining AEA regulated material records
- The indoctrination of personnel on the development and implementation of survey/sample plans
- The requirements associated with preparing and transporting AEA regulated material.

A2.2 Data Generation and Acquisition

A2.2.1 Sample Process Design

Chapter A3.0 presents the field-sampling plan for this effort. Chapter A3.0 includes information on sampling objectives and methodologies.

A2.2.1.1 Sample Location

The sample location(s) will be derived from closure activity documentation of the contaminated soil removal areas that require verification sampling. The sample locations will be identified in the field before starting the activity. The location will be marked by the technical lead or field team lead assigned by the project manager. After the location has been marked, minor adjustments to the location may be made to mitigate unsafe conditions and avoid structural interferences. Sample location identification numbers will be defined during or after sampling. Changes in sample locations that do not affect the DQOs will require approval of the task lead. Changes to sample locations that result in impacts to the DQOs will require concurrence by RL and Ecology (the lead regulatory agency).

A2.2.1.2 Summary of Sampling Activities

Table A2-4 summarizes the number and types of characterization and field QC samples to be collected at the 241-CX Tank System contaminated soil removal area(s). One set of four QC samples will be required to be collected during sampling of contaminated soil removals for tank 241-CX-70 and its associated piping and tank 241-CX-71 and its associated piping.

Table A2-4. Summary of Projected Sample Collection Requirements

Sampling Method	Contaminated soil removal area(s) at tank or piping excavations
Surface Soil Sample Collection	Four samples per contamination removal area
Quality Control Samples	
Duplicates	1
Splits	1
Equipment blanks	1
Field blank	1
Number of quality control samples per tank and associated piping	4
Potential total number of quality control samples	8*

*Based on two tanks and associated piping.

A2.2.2 Field Sample Handling and Custody

A2.2.2.1 Sample Identification

The *Sample Data Tracking* database will be used to track the samples from the point of collection through the collection and laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with onsite organizational procedures. Each radiological/nonradiological and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed water-resistant labels:

- Sampling Authorization Form
- HEIS number
- Sample collection date and time
- Name or initials of person collecting the sample
- Analysis required
- Preservation method (if applicable).

A2.2.2.2 Field Sampling Logbook

All information pertinent to field sampling and analysis will be recorded in field checklists and bound logbooks in accordance with existing sample collection protocols. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual who made the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records within the performing contractor will be followed.

A2.2.2.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Samples will be sent to the laboratory in accordance with applicable shipping procedures. The analyses requested for each sample will be indicated on the accompanying Chain-of-Custody Form. Custody tape will be used to provide indication of tampering with the samples. The custody tape will be inscribed with the sampler's initials and the date. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The shipper will make a copy of the signed record before sample shipment and will transmit the copy to Sample and Data Management within 48 hours of shipping.

A2.2.2.4 Sample Containers and Preservatives

Level I EPA precleaned sample containers will be used for samples collected for chemical and radiological analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content within the sample exceeds levels acceptable by a laboratory, smaller volumes may be sent to the laboratory after consultation with Sample and Data Management to determine acceptable volumes. Sample preservation, containers, and holding times for radiological and nonradiological analytes in are shown in Table A2-5.

Table A2-5. Sample Preservation, Container, and Holding Time Guidelines and Analytical Priorities for TSD Unit Closure Verification Sampling

Analytes[a,b]	Analytical Priority[c]	Matrix	Bottle Number	Bottle Type	Amount[d,e]	Preservation	Packing Requirements	Holding Time
				Chemicals				
IC anions – EPA Method 353.1 for nitrate/nitrite	1	Soil/Solids	1	G/P	50 to 500 g	None	Cool 4 °C	28 days/ 48 hours
ICP metals – EPA Method 6010A	2	Soil/Solids	1	G/P	10 to 500 g	None	None	6 months
Chromium hexavalent – EPA Method 7196	1	Soil/Solids	1	G/P	5 to 500 g	None	Cool 4 °C	30 days
Mercury – EPA Method 7471 – (CVAA)	3	Soil/Solids	1	G	5 to 125 g	None	None	28 days
Total cyanide – EPA Method 9010	1	Soil/Solids	1	G	10 to 1,000 g	None	Cool 4 °C	14 days
pH (solid) – EPA Method 9045	4	Soil/Solids	1	G/P	10 to 250 g	None	None	Within 24 hrs of lab receipt

Table A2-5. Sample Preservation, Container, and Holding Time Guidelines and Analytical Priorities for TSD Unit Closure Verification Sampling

Analytes[a,b]	Analytical Priority[c]	Matrix	Bottle		Amount[d,e]	Preservation	Packing Requirements	Holding Time
			Number	Type				

a. For EPA Methods 353.1, see EPA/600/4-79/020, Methods of Chemical Analysis of Water and Wastes.

b. For 4-digit methods, see SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition.

c. Analytical priority may be adjusted

d. Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of small amount of sample. Minimum sample size will be defined on the Sampling Authorization Form

e. Mixed soil samples may be obtained and submitted to the analytical laboratory for analyses for specific chemical analytes. A 10 g soil sample is required for all ICP analyses; 10 g soil sample is required for IC anion analysis; 5 g soil sample for hexavalent chromium analysis; and 10 g soil sample for 9010 analysis.

CVAA = cold vapor atomic absorption
EPA = U.S. Environmental Protection Agency
G = glass
IC = ion chromatography
ICP = inductively coupled plasma
P = plastic

A2.2.2.5 Sample Shipping

The technician will measure the levels of AEA regulated material contamination on the outside of each sample jar and the dose rates on each sample jar. The technician also will measure the levels of AEA regulated material contamination on the outside of the sample container (through the container) and will document the highest contact reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork, in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. Copies of the shipping documentation will be provided to Sample and Data Management within 48 hours of sample shipment. Based on the measured radiological activity, the samples will be shipped to the appropriate Hanford Site-approved laboratory.

A2.2.3 Analytical Methods

Tables A2-2 and A2-3 lists the applicable fixed-laboratory methods for analytes and target detection limits.

A2.2.4 Quality Control

A2.2.4.1 Field Quality Control

Field QC samples shall be collected to evaluate the potential for cross-contamination and laboratory performance. Field QC for sampling this 200-IS-1 OU dangerous waste TSD unit will require the collection of field duplicate, field split, equipment rinsate blank, and field blank samples. The QC samples and the required frequency for collection are described in the following subsections.

Field Duplicates

Each field duplicate shall be retrieved from the sample interval using the same equipment and sampling technique as the original sample. Field duplicates are collected and homogenized before being divided into two samples in the field. If volatile organic analyte (VOA) samples are required, they should be collected before homogenization. The duplicate samples shall be sent to the primary laboratory in the same manner as the routine site samples. Field duplicates provide information regarding the homogeneity of the sample matrix and can be used to evaluate the precision of the analysis process.

At least 5 percent of the total collected samples (or one per tank) will be duplicated. At least one field duplicate shall be collected from the waste site. The duplicate sample(s) shall be suitable for analysis by an offsite laboratory and shall be analyzed for all of the constituents listed in Tables A2-2 and A2-3.

Field Splits

Field split samples will be collected at the same frequency as field duplicate samples from each waste site. Each split sample shall be retrieved from the same sample interval using the same equipment and sampling technique as the original sample. Samples shall be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. If VOA samples are required, they should be collected before homogenization. The splits will be used to verify the performance of the primary laboratory.

The split samples will be obtained from a sample medium expected to have some contamination and that is suitable for analysis in an offsite laboratory. Split samples shall be analyzed for all of the COPCs listed in Tables A2-2 and A2-3.

Equipment Rinsate Blanks

Equipment rinsate blanks are used to verify the adequacy of sampling equipment decontamination procedures and shall be collected for each sampling method or from each type of nondisposable equipment used. Rinsate blanks need only be collected from equipment that undergoes decontamination and is used for repeated sample collection. An equipment rinsate blank shall be taken from each type of decontaminated sampling equipment used for the collection of samples. Rinsate blanks need only be collected from equipment that undergoes field decontamination and is used for repeated sample collection. The field team lead can request that additional equipment blanks be taken. Equipment blanks shall consist of deionized water washed through decontaminated sampling equipment and placed in containers identified on the Sampling Authorization Forms. Note that the bottle and preservation requirements for water may differ from the requirements for soil. Equipment rinsate blanks shall be analyzed for the following:

- Gross alpha
- Gross beta
- Cyanide
- Metals (excluding hexavalent chromium and mercury)
- Anions (except cyanide)
- VOAs of interest
- Semivolatile organic analytes of interest.

Field Blanks

The volatile organic field blanks will constitute approximately 5 percent of all VOA samples or one per tank. If applicable, at least one field blank shall be collected. Field blanks shall consist of laboratory-grade deionized water added to a clean sample container in the field during the time frame that the characterization samples are being collected. The field blanks shall travel to the field with the associated bottle sets and will be returned to the laboratory with the samples. They will remain closed during subsequent transport and handling. Field blanks are prepared as a check for possible contamination originating from ambient conditions at the site during sample collection. The field blank shall be analyzed for VOAs only.

Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of samples. Particular care will be exercised to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting them on or near potential contamination sources, such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

A2.2.4.2 Laboratory Quality Control

The laboratory method blanks, duplicates, laboratory control sample/blank spike, and matrix spikes are defined in Chapter 1 of SW-846. These samples will be run at the frequency specified in Chapter 1 of SW-846.

A2.2.5 Instrument and Equipment Testing, Inspection, and Maintenance

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate or verify calibration of their equipment in accordance with manufacturer or other applicable guidelines. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization quality assurance plan or operating procedures (as appropriate).

A2.2.6 Instrument and Equipment Calibration and Frequency

Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable Hanford Site-wide and contractual requirements. Calibration of radiological field instruments will be performed as indicated in the discussion regarding radiological field instrumentation data.

A2.2.7 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the acquisition system and the responsibilities and interfaces necessary to ensure that structures, systems, and components, or other items and services procured/acquired, meet the specific technical and quality requirements. The procurement process ensures that purchased items and services comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users before use. Supplies and consumables obtained by the analytical laboratories are procured, checked, and used in accordance with the laboratories' quality assurance plans.

A2.2.8 Non-Direct Measurements

From an investigation of historical sources, (including process documents, logbooks, and original plant technical manuals), a master list of potential contaminants was identified during the DQO process. The list was used to determine the analytical requirements.

A2.2.9 Data Management

Data generated as a result of sampling and data analysis activities will follow requirements outlined in this SAP and shall be managed and stored in accordance with applicable programmatic requirements governing data management procedures. At the direction of the task lead, all analytical data packages shall be subject to final technical review by qualified personnel before the results are submitted to the regulatory agencies or before inclusion in reports. Electronic data access, when appropriate, shall be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*.

Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results. Errors reported by the laboratories are reported to the Sample Management Project coordinator, who initiates a Sample Disposition Record in accordance with performing contractor procedures. This process is used to document analytical errors and to establish the resolution with the project task lead. In addition, the Project Hanford Management Contractor Quality Assurance engineer receives quarterly reports that provide narrative summaries and summary statistics of the analytical errors.

A2.3 Assessment and Oversight

Routine evaluation of data quality described for this project will be documented and filed along with the data in the project file.

A2.3.1 Assessments and Response Action

The performing contractor's Compliance and Quality Programs group may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. Deficiencies identified by these assessments shall be reported in accordance with existing programmatic requirements. The central quality assurance group coordinates the corrective actions/deficiencies in accordance with the performing contractor's Quality Assurance Program. When appropriate, corrective actions will be taken by the task lead.

A2.3.2 Reports to Management

Management will be made aware of all deficiencies identified by self-assessments. Identified deficiencies will be reported to the performing contractor 200 Areas Waste Site Remediation manager, as appropriate.

A2.3.3 Changes in Workscope

Changes to the workscope detailed in this SAP may be required because of unexpected field conditions, new information, health and safety concerns, or other anomalies. Minor changes that have no adverse effect on the DQOs or project schedule can be made in the field with the approval of the project manager or assigned task lead and then documented in the daily field logbook and/or field summary reports. Changes that affect the DQOs will require concurrence by RL and Ecology and can be documented through unit managers' meetings. Alternatively, if substantial changes are required, this SAP can be revised and reissued, requiring RL and regulator approval.

A2.4 Data Validation and Usability

A2.4.1 Data Review, Verification, and Validation

Data review and verification activities include checking completeness of laboratory analytical data packages (e.g., complete laboratory QC documentation, all data results present, complete data narrative summary, and all report pages present). Verification shall consist of confirming the required deliverables, requested versus reported analyses, and transcription errors. Validation shall include the evaluation and qualification of results based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate to the methods used. No other validation or calculation checks will be performed.

A2.4.2 Verification and Validation Methods

Verification activities will be completed by qualified Groundwater Remediation Project Sample Management personnel. Validation shall be performed on completed data packages by qualified Groundwater Remediation Project Sample Management personnel or by a qualified independent contractor. At least 5 percent of all data shall be validated. Validation requirements will be consistent with Level C validation. No validation will be performed for physical data.

A2.4.3 Reconciliation with User Requirements

The data quality assessment process compares completed field-sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R, and EPA/240/B-06/003, *Data Quality Assessment: Statistical Methods for Practitioners*, EPA QA/G-9S, will be used as guidance for the date quality assessment process.

A3 Field - Sampling Plan

A3.1 Sampling Objectives

The primary objective of the field-sampling plan is to identify and describe activities for sampling of contaminated soil removal areas identified during 241-CX Tank System TSD unit closure activities under the approved closure plan. The field-sampling plan describes pertinent elements of the sampling program. Sample methods, procedures, locations, and frequencies are identified in this section.

Issues with sample collection, sample custody, or data acquisition that affect the quality of data or impair the ability to acquire data because of failure to meet contract requirements or failure to follow procedures shall be documented. When a problem is encountered with performing or conducting sampling, cognizant field personnel shall communicate the problem to the task lead for evaluation and resolution.

A3.1.1 Surface Soil Sampling and Analysis

Where contaminated soil was removed during closure plan activities, surface samples will be collected to demonstrate the absence of TSD unit constituents above clean closure standards. Sampling design features are described in Table A3-1.

If soil samples are required in order to verify TSD unit clean closure, the opportunity to determine concentration of additional constituents potentially helpful to the CERCLA 200-IS-1 OU Remedial Investigation could also be taken.

Table A3-1. 241-CX Tank System Contaminated Soil Removal Area(s) Sampling Design

Sampling Method	Key Features of Design	Basis for Sample Design
Surface soil sample	Collect surface soil samples from contaminated soil removal areas. Removal areas will be identified for sampling by creating a quadrilateral made up of four cells of equivalent surface area that are then divided into 0.09 m^2 (1 ft^2) numbered grids, to a maximum of 25 grids for each cell. A sample will be taken from one randomly selected grid within each cell.	At locations where soil contamination has been identified and removed during closure activities, discrete soil samples will be collected from the contaminated soil removal area to verify compliance with clean closure performance standards

A3.1.1.1 Defining the Grid

After contaminated soil within the excavation has been removed and is considered ready for verification sampling, the remediated area will be staked for focused verification sampling. Stakes will be placed at the four corners of a quadrilateral, which encompasses the contaminated soil removal area. Care will be taken to size the boundary such that it contains the footprint of the original contamination but includes a minimum of clean perimeter area. If a number of small contaminated areas were detected, they may be combined for this verification sampling.

This quadrilateral will be divided into four cells of equivalent area, each with an area of no more than 2.3 m^2 (25 ft^2). A second quadrilateral will be established if a contiguous removal area is larger than 9.3 m^3 (100 ft^2). The cells of the quadrilateral need not be the same shape, but must be equivalent in area. Each cell of quadrilateral will be divided into appropriately sized (e.g., 0.09 m^2 [1 ft^2]) numbered grids, to a maximum of 25 grids for each cell. Alternatively, for removal areas of 0.09 m^2 (1 ft^2) or smaller, one sample will be taken.

A3.1.1.2 Location of Samples

A soil sample will be collected from one randomly-selected grid within each cell. The grid location will be determined using a 2-digit random number generator. The two digits will represent the x-y coordinates of the location within the grid cell.

A3.1.1.3 Sampling Procedures

Samples will be collected from the top 0 to 6 in. at the identified location using hand tools. Large particles (greater than 0.25 in. diameter) will be removed prior to placing the collected soil into sample bottles. Sufficient sample will be taken for the laboratory analysis of TSD unit closure parameters (Table A2-2), as well as opportunistic 200-IS-1 OU target analytes (Table A2-3). These tables list the methods and QC performance requirements for the total possible suite of project analytes. Table A2-5 identifies the sample bottle size, preservative, packing requirements, and holding times for TSD unit target analytes.

A3.1.1.4 Field Quality Control Samples

Field duplicates, equipment rinsate blanks, and field blanks will be collected in accordance with the QAPjP. One field duplicate, one equipment rinsate blank (if not using disposable or pre-cleaned sampling equipment), and one field blank per tank excavation will be collected.

A3.1.2 Pre-Shipment Sample Screening

A representative portion of each sample will be shipped to an offsite laboratory, or will be submitted to the Radiological Counting Facility, 222-S Laboratory, or other suitable onsite laboratory for total activity analysis before shipment. Total radiological activities will be used for sample pre-shipment characterization. As all samples will be taken from contamination soil removal areas surveyed and verified not to contain measurable radiological contamination above background, there is little chance that laboratory acceptance criteria will be exceeded. However, samples that slightly exceed the offsite laboratory criterion may be reduced in volume, which reduces total activity and allows offsite shipment. Onsite and offsite laboratories will be identified before initiating field activities and will be mutually acceptable to the performing contractor, Sample and Data Management group, and the task lead.

A3.2 Location Surveying

The location of the surface soil samples will be surveyed after the sampling but before abandonment activities are completed. Data will be recorded in the NAVD88, 1988, *North American Vertical Datum of 1988*, and the Washington State Plane (South Zone) NAD83, 1991, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet. Global positioning system survey instrumentation will be used.

A3.3 Waste Management Sampling

A waste designation DQO effort will be performed immediately before the excavation activities to ensure that the proper information is collected during the field effort to support the designation of all project waste. Any additional sampling requirements or analytes needed to support waste designation activities will be identified and implemented through the waste designation DQO summary report prepared at that time.

In addition, the data needs of other projects (e.g., Office of River Protection (DOE), or the Science and Technology Project) will be solicited at this time. If practicable, these data needs will be integrated into the waste management DQO as additional sampling requirements or analytes.

A4 Health and Safety

All field operations will be performed in accordance with health and safety requirements and procedures. In addition, documentation will be prepared that will further control site operations. This documentation will consist of an activity hazard analysis, a site-specific health and safety plan, and applicable work permits. Work shall be performed in accordance with site-specific health and safety plans and applicable work permits. The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques to minimize the sampling team's exposure.

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A5 Management of Investigation - Derived Waste

The waste generated by closure activities will be managed in accordance with existing approved performing contractor waste management documents, which identify the requirements and responsibilities for containment, labeling, and tracking of waste. Procedures have been prepared to implement the requirements found in Ecology et al., 1999, "Strategy for Management of Investigation Derived Waste." Management of Investigation Derived Waste, minimization practices, and waste types applicable to 200-IS-1 OU waste control will be described in the waste control plan (to be prepared).

Unused samples and associated laboratory waste from offsite laboratory analysis will be dispositioned in accordance with the laboratory contract, which in most cases will allow the laboratory to dispose of this material. The approval of the Remedial Project manager is required before unused samples or waste may be returned from offsite laboratories. Unused sample material from onsite laboratories will be returned to the project for disposal.

A waste designation DQO will be completed immediately before initiating excavation activities to ensure that information necessary to support designation of all project waste is collected during the field effort. During the waste management DQO effort, any listed waste issues will be resolved. Additional sampling or analysis required to support designation activities will be identified in the waste designation DQO summary report.

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