DOCUMENT RELEASE AND CHANGE FORM

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By Washington River Protection Solutions, LLC., PO Box 850, Richland, WA 99352
Contractor For U.S. Department of Energy, Office of River Protection, under Contract DE-AC27-08RV14800

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HANFORD RELEASE

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Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document

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Operations	Jarecki, Theodore D	*Jarecki, Theodore D*	12/09/2021
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8. **Description of Change and Justification**

Revision 5 is a minor change to reflect status move 241-AX-102 from Table A-2 to Table A-1 approved under TPA-CN-0922.

The following trademark attribution is applicable and should be added at the next revision:

ENRAF is a trademark of Honeywell International, Inc., Morristown, New Jersey.

9. **TBDs or Holds** ☒N/A

10. **Related Structures, Systems, and Components**

a. Related Building/Facilities ☐N/A	b. Related Systems ☐N/A	c. Related Equipment ID Nos. (EIN) ☐N/A
241-A	241-WST	241-A
241-A-302A		241-A-302A
241-A-350		241-A-350
241-A-417		241-A-417
241-AX		241-AX
241-AX-152		241-AX-101
241-B		241-AX-102
241-BX		241-AX-103
241-BY		241-AX-104
241-C		241-AX-152
241-ER-311		241-B
241-EW-151		241-B-101
241-S		241-B-102
241-S-304		241-B-103
241-SX		241-B-104
241-T		241-B-105
241-TX		241-B-106
241-TX-302C		241-B-107
241-TY		241-B-108
241-U		241-BX
241-UX-302A		241-BY
244-A		241-C
244-AR		241-ER-311
244-BX		241-EW-151
244-CR		241-S
244-S		241-S-304
244-U		241-SX
		241-T
		241-TX
		241-TY
		241-U
		244-A-DCRT
		A101-WST-TK-101
		A102-WST-TK-102
		A103-WST-TK-103

DOCUMENT RELEASE AND CHANGE FORM

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10. **Related Structures, Systems, and Components**

a. **Related Building/Facilities** ☐N/A	b. **Related Systems** ☐N/A	c. **Related Equipment ID Nos. (EIN)** ☐N/A
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11. **Impacted Documents – Engineering** ☒N/A

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OSD-T-151-00031	13	OPERATING SPECIFICATIONS FOR TANK FARM LEAK DETECTION AND SINGLE-SHELL TANK INTRUSION DETECTION
RPP-10435	00	SINGLE-SHELL TANK SYSTEM INTEGRITY ASSESSMENT REPORT
RPP-7884	00	FIELD INVESTIGATION REPORT FOR WASTE MANAGEMENT AREA S-SX, VOLUME 1 AND 2
RPP-9645	00	SINGLE-SHELL TANK SYSTEM SURVEILLANCE AND MONITORING PROGRAM
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Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document

Washington River Protection Solutions LLC

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF TERMS

Abbreviations and Acronyms

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
DIL	drainable interstitial liquid
DOE	U.S. Department of Energy
Ecology	State of Washington, Department of Ecology
DST	double-shell tank
HFFACO	Hanford Federal Facility Agreement and Consent Order
ILL	interstitial liquid level
LOW	liquid observation well
RCRA	Resource Conservation and Recovery Act of 1976
SST	single-shell tank
SSTIP	Single-Shell Tank Integrity Project
TPA	Tri-Party Agreement
WAC	Washington Administrative Code

DEFINITIONS

Assumed leaker: The integrity classification of a waste storage tank for which surveillance data indicate a loss of liquid to the environment attributed to a breach of integrity, as currently defined in the monthly Waste Tank Summary Report, HNF-EP-0182.

Quarterly: At least once in each of the periods from 00:00 hours on January 1 through 23:59 hours on March 31, 00:00 hours April 1 through 23:59 hours on June 30, 00:00 hours on July 1 through 23:59 hours on September 30, and 00:00 hours on October 1 through 23:59 hours on December 31. There shall be a minimum of 31 calendar days between successive readings.

Yearly/Annual: At least once in the period from 00:00 hours on January 1 through 23:59 hours on December 31 of the same calendar year.

Monitoring: The collection of data and determining whether a given data point is within the tolerance level.

Tolerance level: The range established above or below the baseline by which a tank is monitored.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose and scope of this document, RPP-9937, is to document the leak detection, monitoring, and initial actions required applicable to the Single-Shell Tank (SST) System, which is currently subject to interim status standards, during the pre-retrieval and post-retrieval of SST's. Leak detection and monitoring requirements that apply during retrieval are addressed in the applicable Tank Waste Retrieval Work Plan.

The leak detection, monitoring, and initial response requirements set forth in this document are based on requirements agreed upon between the U.S. Department of Energy (DOE) and the State of Washington, Department of Ecology (Ecology) in response to one of the corrective actions required by an Ecology compliance action in Calendar Year 2001[1]. The corrective action required the establishment of a *Hanford Federal Facility Agreement and Consent Order* (HFFACO or more commonly known as the "Tri-Party Agreement" (TPA)), milestone, M-023-23, to "Submit Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document for Ecology Approval." Revision A of this document was developed and submitted pursuant to Milestone M-023-23 and subsequently, in December 2002, Ecology agreed that all comments had been resolved. RPP-9937 became final on January 23, 2003 pursuant to TPA requirements for primary documents.

The requirements set forth in this document are intended to satisfy interim status standards for leak detection, monitoring, and reporting, as set forth in Title 40, Code of Federal Regulations (CFR), Part 265, Subpart J [incorporated by reference in Washington Administrative Code (WAC) 173-303-400(3)(a)]. DOE and Ecology intend to update this document as necessary so that it can be incorporated by reference into the Hanford Facility Dangerous Waste Permit.

1.2 HISTORY AND MANAGEMENT OF SST TANKS

The SST system was built between 1943 and 1964. The SST system was operated up until 1980 when the last waste transfer was received. Through authorization under the Resource Conservative and Recovery Act of 1976 (RCRA), regulations of mixed waste under the State of Washington's Hazardous Waste Management Act (RCW 70.105) and Washington's Dangerous Waste Regulations (WAC 173-303) became effective August 19, 1987.

The Hanford SST System consists of 149 100/200-series SSTs, as well as miscellaneous tanks, pits, pipes and structures, located in 12 tank farms in the 200 East and 200 West Areas at the Hanford Site. The 100/200-series SSTs (133 100-series and 16 200-series tanks) are underground, reinforced concrete, steel-lined tanks with capacities from 55,000 to 1,000,000 gallons with flat or dish-shaped bottoms and domed tops. A depiction of the SST 100/200-series tank configurations is found in Figure 2.

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[1] See Dangerous Waste Compliance Inspection Report #99-168 (Jan. 31, 2001), Corrective Measure No. 4 (addressing alleged violation of 40 CFR 265.196, incorporated by reference in WAC 173-303-400).

Over the years, most drainable liquids were removed from the SSTs in a process called interim stabilization. Interim stabilization for the SSTs began in the mid-1970s and was later performed under TPA milestones (M-05 and M-041), Interim Stabilization was completed as required under Consent Decree *State of Washington, Department of Ecology v. DOE*, Case No. CT-99-5076-EFS (September 9, 2003) (hereinafter referred to as Consent Decree). The Waste Tank Summary Report (HNF-EP-0182) provides current estimates of liquid present in single shell tanks and intrusion status.

The Interim Stabilization Program reduced the amount of drainable liquids that could be released from the SST System to the environment. The liquid part of the waste is the fraction that could most likely leak out of a tank through a corrosion-related hole in the liner. The solid components of waste (sludge and salt cake) would not be expected to migrate through a hole in the liner, between the joints in the concrete, and escape to the vadose zone. While some small particles of sludge and salt cake might escape, it is expected to be a very small amount.

The risks associated with continued storage of waste in the SST System is driven by a number of factors, including the nature and volume of the waste (greater than 25 million gallons of mixed radioactive and hazardous waste) the limitations of aging, non-compliant facilities; the inability to transform the facilities into compliant systems; and the extended time period the waste will be stored prior to treatment and disposal. Accordingly, DOE has undertaken a set of activities, in conjunction with the Interim Stabilization Program, to minimize the risk during the waste storage period. These activities include:

- Completing the removal of drainable liquids from the SSTs according to the criteria established by the Consent Decree;
- Ending waste additions to the SSTs in 1980;
- Monitoring the contents of, and the structural integrity of, the 100- and 200- Series SSTs;
- Resolving high-heat and other safety issues that posed risks to the integrity of the tanks;
- Transferring several million gallons of waste from SSTs to safer storage in double-shell tanks (DST);
- Monitoring the vadose zone and groundwater in the vicinity of the SSTs;
- Establishing a program for minimizing the potential of liquid intrusions from surrounding tank systems (e.g., water lines, pipes) and minimizing infiltration of liquids from the natural environment into the soils surrounding the tanks; and
- Developing closure strategies for the SSTs.

As required by Consent Decree, DOE completed interim stabilization of the SSTs in 2004 for all SSTs with the exception of tanks 241-S-102 and 241-S-112. The Third Amendment to the Consent Decree provided that DOE's obligation to complete interim stabilization of tanks 241-S-102 and 241-S-112 would be held in abeyance pending completion of retrieval pursuant to an accelerated schedule. Interim stabilization of tanks 241-S-112 occurred as part of retrieval. However, due to problems with retrieval of waste from tanks 241-S-102, including the release of mixed waste to the environment during retrieval, interim stabilization was declared complete for tank 241-S-102 without fully retrieving the tank contents (Letter 10-TPD-163, “Completion of Interim Stabilization (IS) of Single-Shell Tank (SST) 241-S-102 Under Interim Stabilization Consent Decree Case No. CT-99-5076-EFS”). The Consent Decree was terminated on March 8, 2011.

Following interim stabilization, management of SSTs has occurred consistent with other TPA Primary Documents and milestones, such as the M-045 series milestones that establish the SST closure planning process, including retrieval objectives, interim measures, and corrective action. Additionally, the M-062-40 System Planning milestone provides a mechanism to determine the sequencing of retrievals.

1.3 TPA MILESTONE M-023-23

TPA Milestone M-023-23 was established in August 2001 to satisfy one of the corrective measures required by Ecology’s Dangerous Waste Compliance Inspection Report No. 99-168. The milestone completion due date was originally March 31, 2002, but was updated on February 26, 2002, to be due June 15, 2002. Final Milestone M-023-23 language stated the following:

> Submit single-shell tank leak detection and monitoring functions and requirements document for Ecology approval.
>
> The SST system leak detection and monitoring functions and requirements document will identify and document the location and specification of all components of the DOE's existing SST leak detection and monitoring system and will establish specifications for system upgrades and/or programmatic improvements. The functions and requirements document shall be submitted for Ecology approval as a TPA Primary Document pursuant to the Action Plan Section 9.2.1, and shall include the following: (1) The identification and detail of SST system monitoring instruments; (2) The identification of SST system components not monitored by instrumentation; (3) Procedures for the evaluation of individual tank and ancillary equipment component status; (4) Monitoring frequencies and other parameters associated with the inspection and (leak detection) monitoring of the tank system; (5) The need for detection and monitoring system upgrades so as to achieve compliance with regulatory and DOE requirements; and (6) Associated budgetary and schedule estimates.
>
> The SST leak detection and monitoring functions and requirements document shall also contain: an adequate level of detail so as to allow Ecology to assess the adequacy of the program, a proposed implementation schedule for upgrades and programmatic changes, and a corresponding draft agreement change request.
>
> Following approval work requirements of the SST system leak detection and monitoring functions and requirements document, work requirements shall be implemented as enforceable primary document requirements under the agreement.

Additionally, this document shall include all the required elements of the Function and Requirements document as required by the TPA Milestone M-023-23 and as outlined in the following sections of this document:

1. The identification and detail of SST system monitoring instruments – Section 3.1, Tank Monitoring; Appendix A, Monitoring Device Tables
2. The identification of SST system components not monitored by instrumentation – Section 2.0, Tanks and Ancillary Equipment Subject to Monitoring
3. Procedures for evaluation of individual tank and ancillary equipment component status – Section 3.3, Tank and Inventory Accounting
4. Monitoring frequencies and other parameters associated with the inspection and (leak detection) monitoring of the tank system – Section 3.0, Tank Monitoring and Leak Detection
5. The need for detection and monitoring system upgrades so as to achieve compliance with regulatory and DOE requirements – Section 3.2, Upgrades to Tank Monitoring
6. Associated and budgetary and schedule estimates – Section 3.2, Upgrades to Tank Monitoring.

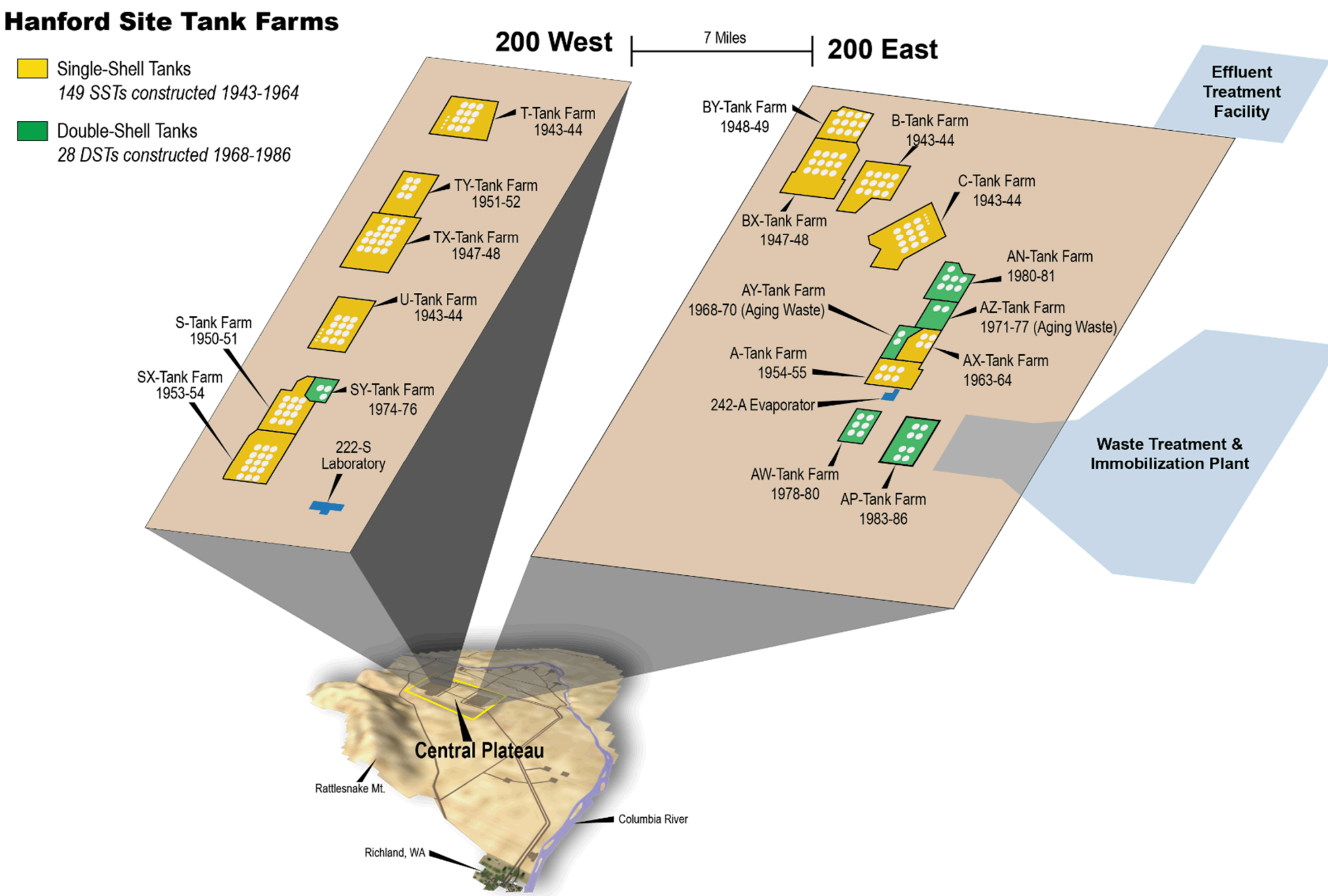

Figure 1. Single-Shell Tank Waste Management Areas

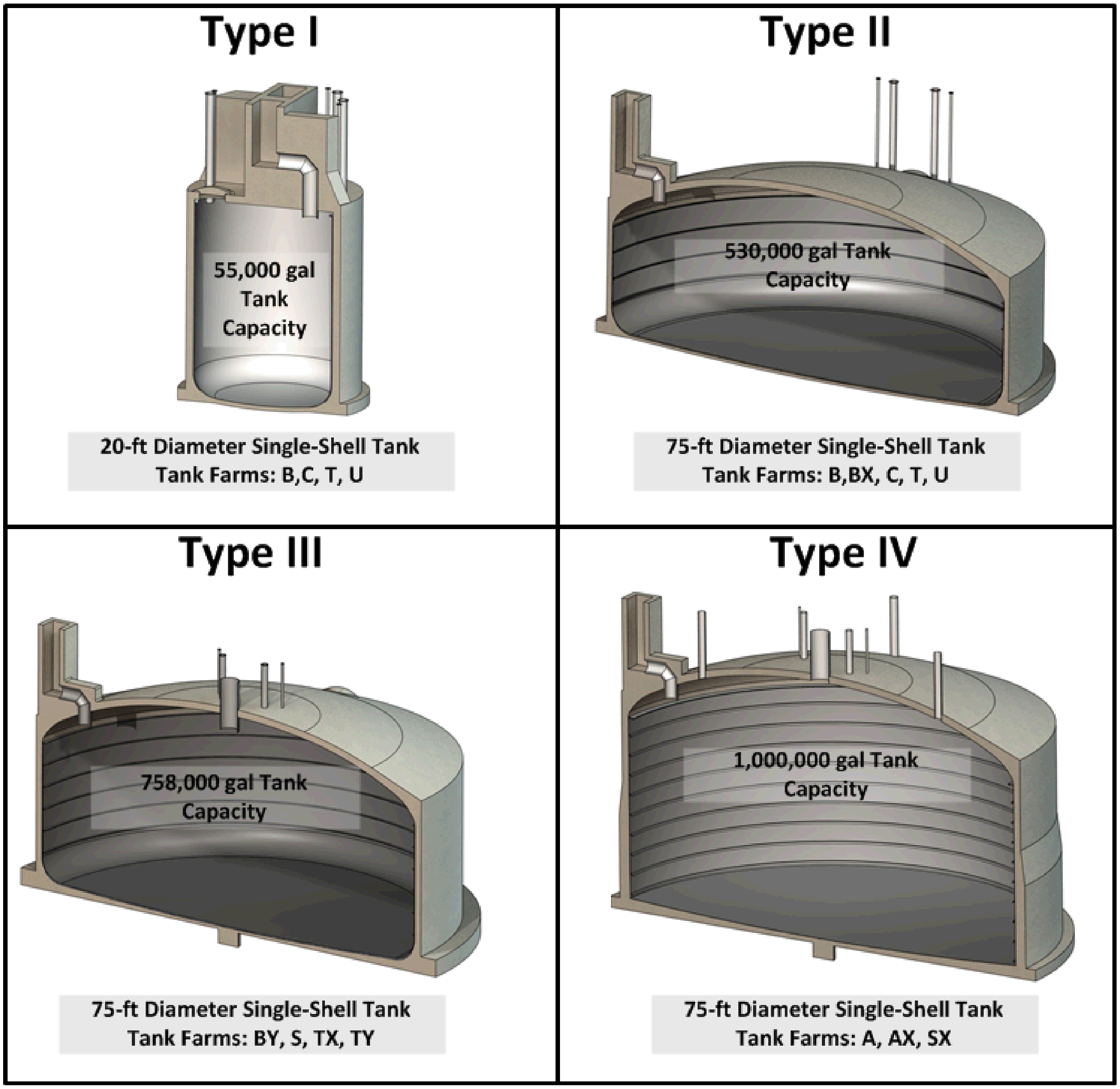

Figure 2. Configurations of Single Shell Tanks.

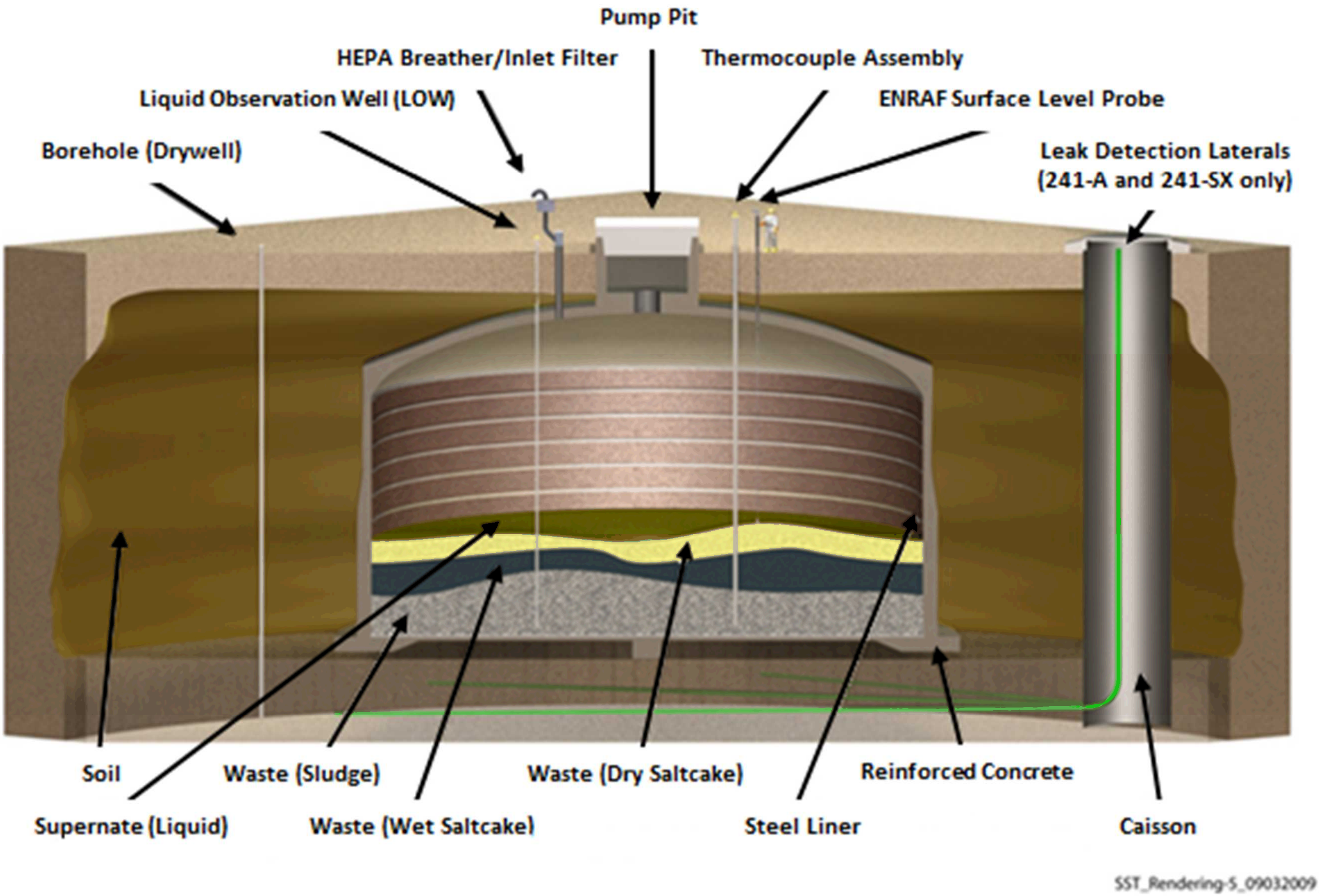

Figure 3. Waste Forms Found in Single-Shell Tanks.

2.0 TANKS AND ANCILLARY EQUIPMENT SUBJECT TO MONITORING

This TPA Primary Document memorializes the agreement reached between the DOE and Ecology on what is required for SST System leak detection and monitoring performed to meet interim status requirements. The requirements contained within are consistent with the Hanford Facility RCRA Permit, Dangerous Waste Portion ("Sitewide RCRA Permit"), Condition I.A, which provides for the use of interim status requirements under 40 CFR 265, Subpart J, Tank Systems [incorporated by reference at WAC 173-303-400(3)] until the SST System is incorporated into Part V of the Sitewide RCRA Permit.

In-tank monitoring is required for certain tanks identified as part of the Hanford Site RCRA Permit WA7890008967, SST System including the following: 100-Series tanks, 200-Series tanks, and certain miscellaneous tanks. All SST System components are identified in the SST System Part A Form (Ecology letter June 3, 2011, *Approval of the Single-Shell Tank System Dangerous Waste Permit Application Part A Form, Revision 13*).

Monitoring requirements for SSTs undergoing retrieval are specified by the applicable Tank Waste Retrieval Work Plan as required by TPA Appendix I and the Consent Decree in State of Washington v. Brouillete, et al., No. 2:08-cv-5085-RMP (E.D. Wash), as amended.

Many transfer lines, diversion boxes, valve pits, and flush pits have undergone intrusion prevention activities to reduce the amount of intrusion of atmospheric water that might enter them. The risk of a significant waste volume does not exist for these ancillary equipment components. The amount of waste that may exist in a diversion box, valve pit, and flush pit is relatively small compared to other volumes of waste in the tanks. These components will not be monitored.

3.0 TANK MONITORING

3.1 TANK MONITORING

Monitoring for the purposes of detecting and evaluating changes in tank volume will be performed for SSTs prior to retrieval in accordance with the Tables in Appendix A of this document

Monitoring methods are selected to account for drainable liquid, waste surface conditions, and tank status. SSTs and Miscellaneous Underground Storage Tanks (MUSTs) are equipped with monitoring equipment in accordance with Tables A-2 and A-3.

SSTs that are "assumed leakers" with no drainable liquid, but with a sludge form of waste, as identified in DOE document HNF-EP-0182, *Waste Tank Summary Report*, current revision, will be monitored for liquid volume increases in accordance with Section 3.0, Section 4.0, and Appendix A.

Any changes to the methods and equipment used for monitoring liquid level for the SSTs and MUSTs will be provided at the annual meeting. Changes to monitoring equipment type will be evaluated using the processes described below and will be made per Section 8.0 of this document. The engineering evaluation will be provided to Ecology upon request.

3.1.1 In Tank Monitoring

In-tank monitoring of 100/200-series SSTs and MUSTs consists of three types. Those include surface level monitoring, interstitial liquid level (ILL) monitoring, and visual inspections. Internal tank (in-tank) level measurements used for leak detection monitoring are based on sensing a change in a tank's liquid level. These methods include both direct measurement of the liquid surface, and indirect sensing of the level through a sealed liquid observation well (LOW).

The surface of the waste can be free liquid, moist solid, or dried solid. The solids can be either sludge or salt cake. Monitoring of the surface is accomplished by measuring the distance from a known reference point to the waste surface. Different types of waste surfaces and different surface contours contribute to the scatter in the surface level readings. For liquid surfaces and surfaces with moist solids, more repeatable results are obtained than for dry solids. Normally, only a single surface monitoring device is used to monitor each SST.

Solid surface monitoring, where there is an installed buoyancy device (e.g., Enraf), can provide indication of intrusion if the drainable liquid level increases or the liquid level itself increases above the solid surface level. However, since a solid surface level decrease is not necessarily indicative of a drainable liquid leak, surface level monitoring is not a primary means of in-tank level monitoring for salt solids. Drainable liquid exists as supernatant and interstitial liquid in the tanks. Non-drainable liquid is that liquid attracted to solid particulates by capillary action and generally does not drain completely to the pump within the tank. Waste may be present in each of these forms or in various combinations.

In-tank monitoring methods are determined by waste and tank characteristics such as, drainable liquid volume, retrieval status, tank integrity, and generally incorporate the following logic:

1. Retrieved tanks meeting TPA Appendix H criteria = in-tank visual monitoring
2. Liquid surface under plummet = Enraf
3. Dry surface with greater than ~30 Kgal of drainable interstitial liquid (DIL) = LOW
4. Tank with less than ~30 Kgal of DIL = Enraf or LOW

Monitoring methods currently required are identified in Appendix A. If monitoring data, field conditions, or waste properties indicate possible need to change a monitoring method, an engineering evaluation will be conducted to determine the most appropriate level monitoring device. Any proposed change will be discussed with Ecology and corresponding revisions will be provided to this document per Section 8.0.

3.1.1.1 Surface Level Monitoring

Enraf

The Enraf gauge is the most accurate level gauge currently used in the tank farms. This gauge tracks level changes in tank waste by using a load cell to monitor the weight of a plummet. For the purposes of leak detection, the Enraf gauge needs a free liquid or wetted surface below the plummet. The vendor quotes an Enraf precision of ± 0.004 in. and an accuracy of ± 0.04 inches. However, in-tank Enraf instruments are calibrated to an accuracy of ± 0.1 in. and the 2-decimal readout on the gauge provides a precision of ± 0.01 in. because the manufacturer's accuracy/precision, in general, are expected to be better than field installation, where other variables affect both. The Enraf lowers the plummet until it encounters a buoyant force from the liquid or solid surface, at which point it stops. The control system for the Enraf uses a stepper motor to continuously maintain a constant tension in the support cable. Two types of Enraf gauge installations are used, automatic and manual. The output from the automatic type is connected to the automated data collection system and is normally collected and recorded daily. Manual and automatic Enraf gauges can be manually read from local displays by operators performing rounds in the field.

Figure 4. Enraf Plummet on Liquid Waste Surface.

Figure 5. Enraf Plummet on Liquid Pool on Solid Waste Surface.

Figure 6. Enraf Plummet on Solid Waste Surface.

Manual Tape

The Manual Tape consists of a measuring tape and a plummet. The tape and plummet form an electrical circuit connected to a continuity meter. The tape and plummet are manually lowered into the tank until they contact a conductive surface (i.e., tank waste). In open air, the circuit remains open and the continuity meter displays no current flow. Contacting the waste surface closes the circuit, as indicated on the continuity meter. The level indicated on the tape indicates the level of the waste. To work properly, the plummet must contact a conductive waste surface.

Because dry waste surfaces conduct electricity poorly, Manual Tapes do not work well in tanks with dry waste surfaces. Some SSTs are still equipped with Manual Tapes, but they are not the primary leak detection monitoring device. A Manual Tape in good working order on a highly conductive surface can be accurate and repeatable to about 0.25 inches. As the waste dries out, the device becomes less accurate, until ultimately no signal is received. Uncertainty for different tanks varied from 0.25 in. to 2 inches. Drying out of the waste surface is typically observed as increasing amounts of data scatter during routine data reviews. Manual Tapes can be used for reading a dry surface by obtaining a “slack tape” measurement, which consists of trying to observe when the tape begins to go slack as the plummet begins to lean over. “Slack tape” measurements are a fairly accurate gross measurement, but they do not provide accurate and repeatable data, so are not used for official reporting purposes unless the normally used equipment is not available.

Zip Cords

Zip cords are normally used for taking level readings on a temporary basis. This may be required when other level measurement equipment is out of service, or there is a question concerning the accuracy of the normal reading. Typically, the zip cord will be installed in a different riser location than the normal level measurement equipment. A zip cord is an insulated two-conductor cord with probes separated by an insulating spacer attached at the detection end. The detector is lowered into the structure to be just above the level. The conductors at the top end of the cord are connected to an ohm meter (or similar device) and monitored by an operator to observe change in impedance.

The cord is prepared by measuring it against a tape measure and adding visible marks around the cord at incremental distances along its length. The zip cord is taken to the tank to be measured and lowered through a riser into the tank. The length of the cord corresponding to a selected tank reference elevation is noted.

Weight Factor

The weight factor is an indirect method of determining the tank liquid level by measuring the air pressure necessary to overcome the hydrostatic head in an open-end vertical steel pipe terminated about 2-in. above the tank floor. The "uncorrected weight factor" is the difference between the hydrostatic head pressure in the pipe and the air pressure in the tank headspace, expressed in inches of water. To eliminate the liquid density bias that affects the uncorrected weight factor measurement, a second vertical pipe is located in the liquid, terminated 10-in. above the first pipe. The difference in hydrostatic head between the two pipes is converted to specific gravity (i.e., ratio of the liquid density to water density); the uncorrected weight factor divided by the specific gravity yields the "corrected weight factor," which is the true liquid height in the tank.

3.1.1.2 Interstitial Liquid Monitoring

Liquid Observation Well (LOW)

The ILL can be measured using LOWs installed in many of the SSTs. A LOW consists of a 3.5-inch outer diameter tube capped at the bottom and inserted through the waste, so the cap is near the tank bottom. The tube hangs from a riser and is accessible from the ground surface above the tank.

A neutron source and detector are inserted in the tube and is used to detect the ILL outside the LOW. A neutron probe has a fast neutron source and a slow neutron detector. As the neutron probe moves down through the LOW tube the fast neutrons interact with hydrogen atoms outside the LOW tube and are slowed, reflected, and sensed by the slow neutron detector. Inside the tank, the vast majority of the hydrogen is in the water. When the neutron probe approaches a location with liquid on the outside of the well, the signal count increases. Due to the diffused nature of the neutron paths, there is a slow transition in the signal count as the probe approaches, crosses, and then moves below the ILL.

The LOW data is collected. Then the neutron probe data (counts per second) and the positions of the cable are electronically recorded and later analyzed. Data is normally collected on a quarterly basis. The LOW data is transferred from the field hard drive to a server and stored in a database. Data analysis techniques have been established for determining the liquid level. Changes in the levels are used for leak detection and intrusion monitoring. Consistent use of the data analysis techniques allows detection of small level changes.

Interpretation of data obtained using the LOW system is a complex scientific process. The evaluation can be (and is often) complicated when the liquid level moves between two or more waste layers with different densities and properties such as permeability in the salt cake and sludge. Recently (circa 2012-2014), various recently implemented LOW measurement process improvements have resulted in LOW measurements exhibiting consistent repeatability and accuracy. Improvements have included more frequent LOW equipment calibration resulting in an accuracy range of ±0.25 in.

3.1.1.3 Visual Inspection

In-Tank Video Inspections

Remote visual inspections using a video camera assembly with lighting may be used to identify characteristics of the waste surface and visible internal surfaces of the dome, side walls, and carbon steel liner of tanks. The camera assembly is inserted into the dome headspace though an available riser. The inspection is typically conducted through one riser, but sometimes multiple risers may be required in order to obtain sufficient data and information. Visual inspections are useful for determining the condition of the interface between the waste surface level monitoring plummet and the waste surface, and for investigating suspected intrusion.

Water intrusion in the form of drips or streams can sometimes be seen on the waste surface and on the dome at risers and other locations. Sometimes, changes in the tank and waste conditions can be determined by comparing recent to past visual inspections. For tanks where the waste has been retrieved, video cameras are used for inspection of the tank interior. The primary concern following retrieval is intrusion.

3.1.2 Ex-Tank Monitoring

Dry Well Logging

In the event of a known or suspected release, an ex-tank monitoring method can be used for investigation. While drywell logging is not considered a reliable method for detecting new releases to the environment from the SSTs, it is a tool for monitoring of past releases. There are over 700 drywells in the SST farm system. Drywells are vertical boreholes with 6-in. or 8-in. diameter carbon steel casings positioned radially around SSTs. A small number are located at more remote peripheral locations. They are called drywells because they do not penetrate to the water table. Drywells range between 50 and 250 ft. deep and are normally monitored between 50 and 150 ft. deep. Various sensors can be used to log drywells. While the presence of chemicals is not measured, the presence of some radionuclides can be measured. Drywell logging is not a leak detection method, but it is a leak evaluation method. Drywell logging can be used to track migration of past releases.

Electrical Resistivity Leak Detection

Electrical Resistivity Leak Detection, used during SST retrieval operations, monitors the potential change in soil electrical resistance is monitored to determine if a leak has occurred outside of an underground tank system. Soil resistance is measured by applying direct current to transmitting electrodes and measuring the induced current and voltage at receiving electrodes. Existing tank farm infrastructure is used for the transmitting and receiving electrodes. Ex-tank drywells are typically used as both transmitting and receiving electrodes. If there are large gaps between drywells short surface electrodes are installed. Tank infrastructure contacting the waste (example: an instrument riser) is used as a receiving electrode when possible. If a tank is sound, then the electrical resistance between the sensors will remain constant. However, if a tank breach occurs then conductive waste entering the soil changes the soil conductivity and electrical resistivity data trends.

3.2 UPGRADES TO TANK MONITORING

The Tank Monitoring Program continuously considers upgrades to the tank monitoring equipment in an effort to improve accuracy and effectiveness. As funding is available, upgrades are performed improving automation, monitoring capabilities and equipment optimization. In the event of complete failure of monitoring instrumentation, an evaluation of the appropriate replacement instrumentation will be performed by Engineering. Discussion of tank monitoring upgrades will be part of the annual meeting outlined in Section 7.0

3.3 TANK INVENTORY ACCOUNTING

Determination of the volume of a tank’s waste inventory requires measurement of the waste level and knowledge of tank geometry. Given unchanging tank geometry, waste volume monitoring is accomplished through waste surface level and ILL monitoring. The instrumentation is outlined in Section 3.1. The engineering evaluation used for determining tank waste volume includes the use of predictive models, trend analysis and surveillance data. Descriptions of these processes are included below. The method of inventory surveillance is evaluated for effectiveness considering the waste characteristics of each tank. Appendix A includes tables outlining the currently required instrumentation in each of the monitored tanks.

3.3.1 Determination of Tank Status

Tank status is an expression of the integrity of the tank as an isolated, waste-containing vessel, and sets expectations for future changes to tank waste inventory. Tank status is determined through the consideration of various surveillance data, in-tank visual inspections, and knowledge of the waste storage system.

Predictive models (“baselines”) for future surface level measurements are developed through the analysis of previous surface level measurements, estimations of the effects of the waste storage system on waste inventory, and evaluation of the precision and accuracy of the measurement process. Once established for a tank, the baseline provides a range of measurement values to be expected at any time for that tank. Readings falling outside the upper or lower specification limits will be evaluated within 60 days of the end of the quarterly data collection for indication of possible leakage, intrusion, or need for a baseline or specification limit change. If the level change can be explained, a Baseline Change Authorization will be initiated within 60 days of the end of the quarterly data collection. If Ecology disagrees with an implemented Baseline Change Authorization, they will document the disagreement in monthly TPA Project Manager Meeting minutes and the Ecology Project Manager can provide notification to the DOE Project Manager and/or initiate any compliance actions deemed necessary in accordance with TPA Action Plan Section 4.1. Baselines and specification limits are established through Baseline Change Authorizations and are available upon request by Ecology. These document the basis for the baseline including the results of analysis performed and are reviewed regularly for ongoing validity.

Level readings falling outside the upper specification limit for tanks being monitored under Appendix A of this document will be discussed at the TPA Monthly Project Manager Meetings to determine next steps. These actions will be documented in the TPA Project Manager Meeting minutes. If an intrusion is confirmed for a tank being monitored under Appendix A of this document, the DOE and Ecology Project Managers should reach unanimous agreement about remedial actions, and document the agreement in the TPA Project Manager Meeting minutes in accordance with TPA Action Plan Section 4.1. If unanimous agreement is not reached, it will be documented in the TPA Project Manager Meeting minutes and the Ecology Project Manager can provide notification to the DOE Project Manager and/or initiate any compliance actions deemed necessary in accordance with TPA Action Plan Section 4.1.

If level readings fall outside the lower specification limit for a tank being monitored under Appendix A of this document and a decreased level change cannot be explained, the condition will be evaluated to determine the need to initiate the Leak Assessment Process described in Section 4.1.2. The level decrease will be discussed at the Monthly Project Manager Meetings to determine next steps. The DOE and Ecology Project Managers should reach unanimous agreement about next steps, and document the agreement in the TPA Project Manager Meeting minutes in accordance with TPA Action Plan Section 4.1. If unanimous agreement is not reached, it will be documented in the TPA Project Manager Meeting minutes and the Ecology Project Manager can provide notification to the DOE Project Manager and/or initiate any compliance actions deemed necessary in accordance with TPA Action Plan Section 4.1.

The establishment of predictive models requires trend analysis. Trend analysis is the evaluation of tank surveillance data collected in the past for patterns (trends) that may provide a reasonable basis for the prediction of future values. Trend analysis includes exploration of physical phenomena that may result in the observed trend, including evaporation of liquid or a leak to explain decreasing trends, thermal expansion and contraction to explain cyclical trends, and rainwater intrusion to explain increasing trends.

Trend analysis may also require accounting for inventory transactions (retrieval and transfers) between tanks and water additions incidental to operational activities (e.g., water additions for flushing instruments, attached transfer equipment). Trend analysis concludes with either the confirmation or replacement of established baselines using the Baseline Change Authorization process. Trend analysis is performed as part of the data verification and validation process within 60 days following the calendar quarter.

Surveillance data are reviewed within 60 days of the end of the quarterly data collection requirement by the Tank Farm Contractor to ensure measurement values accurately represent tank inventory indicating properly functioning measurement instruments. This review includes comparison of data to the expectations established in the latest trend analysis. The validity of each measurement value (whether the data accurately represents the field conditions) is determined during this review and denoted in a computerized database. When a valid reading is not obtained within the required collection frequency, the topic will be discussed at the monthly Project Manager Meeting. This will be done for data analyzed in each calendar quarter. Surveillance data is collected at varying frequencies depending on the instrumentation present and associated collection frequency. Appendix A includes tables outlining the currently installed instrumentation required in each of the monitored tanks. The surveillance data can be collected by a computerized monitoring system or by physical inspection of the instrumentation. The surveillance data collected is inspected as part of the surveillance data review process. Data is not reviewed daily for validity. Some computerized data is monitored by the system and if data recorded is outside of the established bounds an alarm is indicated by the system. If an alarm were received, Engineering would review the data using the data validation process at the time. If instrumentation cannot provide surveillance data to support the trend analysis due to instrumentation being out of service, it will be repaired and placed back into service in accordance to the schedule in Section 5.0.

When trend analysis discovers an inventory decrease or an inventory increase that cannot be explained a more rigorous process is initiated to evaluate which concludes with a declaration of whether the tank may be regarded as sound. This process is outlined in Section 4.0.

3.4 OTHER INSPECTIONS

3.4.1 General Inspections

Although the SST farms are not RCRA compliant under 40 CFR 265 Subpart J [incorporated by reference in WAC 173-303-400(3)(a)] or WAC 173-303-640, general inspection requirements (WAC 173-303-320) are still applicable to meet interim status standards. Tank system inspections are performed during the daily, weekly, monthly, or quarterly Operator Rounds or by execution of a work package. Inspections are completed to satisfy requirements outlined in WAC 173-303-320, WAC 173-303-400(3)(a), and 40 CFR 265.195. Written or electronic logs of tank level monitoring inspections will include the date and time of the inspection, the printed name and the handwritten or electronic signature of the inspector, a notation of the observations made, an account of notifications that are made for spills or discharges in accordance with WAC 173-303-145(2), and the date and nature of any repairs or remedial actions taken. Deficiencies discovered during inspections and work activities such as operator rounds will be documented on the inspection log and maintained in the Operating Record.

Any problems revealed by an inspection will be remedied on a schedule that is protective of human health and the environment. Where a hazard is imminent or has already occurred, remedial action must be taken immediately. Initial response actions will be performed in accordance with Section 5.0 of this document.

3.4.2 Structural Integrity Assessments

In August 2001, TPA Change Request M-23-01-01 established requirements necessary for determining the structural integrity of the SST System. The TPA milestone M-023-24 required DOE to prepare a SST System Integrity Assessment Report (hereinafter referred to as the Assessment Report) and associated certification and determination by June 30, 2002. At the time of the integrity assessment, the TPA M-045-05 SST waste retrieval completion milestone date was September 30, 2018, and the TPA M-045-06 SST closure completion milestone date was September 30, 2024. However, following negotiations during 2007 – 2009, changes were made to the TPA M-045 milestone series. The SST closure date was extended from 2024 to 2043 reflecting continuing difficulty achieving the retrieval rate needed to meet the 2018 schedule.

In addition to extending the retrieval and closure completion schedule, the TPA Change Request M-45-09-01 added a new milestone that created an SST structural integrity panel. The panel would evaluate the existing condition of the SSTs and make recommendations for additional evaluations and program elements that would be needed to sustain the SST structural integrity for an extended period of time.

The panel made 33 recommendations based on the proceedings of two workshops. The panel further identified ten of the 33 as primary recommendations; these and six secondary recommendations formed the basis of what has become the Single-Shell Tank Integrity Project (SSTIP).

During October through December 2010, DOE, Ecology, and Washington River Protection Solutions LLC. negotiated a series of candidate TPA milestones and targets based on the Single Shell Tank Expert Panel's recommendations. The panel's recommendations were categorized as either "Phase I" or "Phase II:" Phase I recommendations were those having sufficient information available to formulate meaningful milestones at that time; Phase II recommendations were those dependent on information that would be developed during Phase I milestone execution, and would be considered for milestones at a later date.

TPA Change Request M-45-10-01 established the new SSTIP interim milestones and targets in January 2011. Interim milestone M-045-91I established the requirement for a second SST integrity assessment, to be completed by September 30, 2018.

An assessment of structural integrity (RPP-IQRPE-50028) was completed in September of 2018. The assessment found the SSTs were structurally sound such that the entire system is adequately designed, and is structurally adequate and compatible with the waste to ensure that the system will not collapse, rupture, or fail and has structural integrity. The assessment recommendations included that the next integrity assessment should be completed by the end of September 2034.

4.0 RESPONSE TO CHANGE OF TANK STATUS

4.1 TANK STATUS ASSESSMENT PROCESS

The tank status assessment process is initiated by an unexplainable change in baseline or through trend analysis and data validation. If an evaluation of the tank status is warranted an extensive engineering evaluation is conducted.

4.1.1 Intrusion

If newly identified intrusion into a tank monitored under Appendix A of this document is verified, then the status of the tank will be changed in HNF-EP-0182 and notifications will be made in accordance with Section 7.2. Remedial actions will be discussed at the subsequent Project Manager Meetings.

4.1.2 Leak Assessment

The formal leak assessment process is based on probabilistic analysis to assess the mathematical likelihood (probability) that a specific tank is leaking or has leaked. The process can be used to assess unexplained waste level increases (possible water intrusion) or waste level decreases (possible waste leakage). The technical basis for the process and additional details and examples of the methodology for implementing the process can be found in HNF-3747, "Tank Leak Assessment Technical Background."

To begin the process, the tank leak assessment team chairman assigns the team members consisting of tank integrity and monitoring subject matter experts to review available data. Data may include historical and recent in-tank surface and ILL measurements, ex-tank drywell and lateral geophysical logging data, tank process history, and all available corroboration evidence. Using the inputs available, the process uses a statistical method to determine the probability that a tank leaked or did not leak.

For any declaration of a leak to the environment, notification will occur as required under WAC 173-303-145(2), 40 CFR 265.196(d) [incorporated by reference in WAC 173-303-400(3)], and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) reporting requirements, 40 CFR 302 (Section 7.2)[2]. Upon providing this notification, DOE and Ecology will reach unanimous agreement about next steps, and document the agreement in the Project Manager Meeting minutes in accordance with TPA Action Plan Section 4.1. If unanimous agreement is not reached, it will be documented in the Project Manager Meeting minutes and the Ecology Project Manager can provide notification to the DOE Project Manager and/or initiate any compliance actions deemed necessary in accordance with TPA Action Plan Section 4.1. If not already documented as a leaker, the status of the tank will be changed in HNF-EP-0182.

[2] The mitigation and control requirements set forth in WAC 173-303-145(3) and 40 CFR 265.196(b)–(c) are outside the scope of this document.

4.2 MISCELLANEOUS TANKS

When levels determined from monitoring in miscellaneous tanks exceed or fall below the tolerance level, the requirements in RPP-PLAN-48438, *Single-Shell Tank System Catch Tank Assumed Leak Response Plan* apply. The RPP-PLAN-48438 is a primary document pursuant to TPA Milestone M-045-100.

5.0 RESPONSES TO MONITORING DATA AND CONDITIONS SUMMARY

Sections 3.0 and 4.0 of this document describe a systematic approach for taking actions in response to anomalous monitoring data, tank status determinations, and other SST monitoring conditions that may arise. Table 1 below summarizes the nature of the initial responses that will be required.

Table 1. Summary of Initial Responses.

Activity (RPP-9937 section)	Potential Observation	Initial Response Actions[3]	Documentation
Data Collection (Section 3.3.1)	Inability to physically gather monitoring data as prescribed in Appendix A	• Notification per (Section 7.2)	• Notification • Update to the Operating Record
	Monitoring equipment failure	• Notification per (Section 7.2) • Equipment evaluation and return to service per (Section 6.2)	• Notification • Corrective Action System • Work Records
Data Collection (Section 3.3.1)	When a valid reading is not able to be obtained within the quarter that is not due to a monitoring equipment failure.	• Discuss at the monthly Project Manager Meeting per (Section 3.3.1).	• Project Manager Meeting Minutes
Lower Limits (Section 3.3.1 and 4.1.2)	Data shows that a lower limit is exceeded	If change can be explained, issue a Baseline Change Authorization (BCA) and report per (Section 7.1) • If change cannot be explained, discuss and document next steps at the Project Manager Meeting. Evaluate condition to determine the need to initiate a Leak Assessment Process per (Sections 3.3.1 and 4.1.2)	• Project Manager Meeting Minutes • Corrective Action System (for Bullet #2)
Upper Limits (Sections 3.3.1 and 4.1.1)	Data or observations shows an upper limit is exceeded indicating intrusion	• If change can be explained, issue a Baseline Change	• Project Manager Meeting minutes • Notification

[3] In the event DOE and Ecology do not reach agreement as to the appropriate next steps, the disagreement will be documented in the Project Manager Meeting minutes and the Ecology Project Manager can provide notification to the DOE Project Manager and/or initiate any compliance actions deemed necessary in accordance with TPA Action Plan Section 4.1.

Table 1. Summary of Initial Responses.

Activity (RPP-9937 section)	Potential Observation	Initial Response Actions[3]	Documentation
		Authorization (BCA) and report per (Section 7.1) • If the change cannot be explained, discuss and document next steps at the Project Manager Meeting per (Sections 3.3.1 and 4.1.1) • If newly identified intrusion is confirmed notify per (Section 7.2) and change tank status per (Section 4.1.1)	• HNF-EP-0182 • Corrective Action System (for Bullet #2 & #3)
Leak Assessment (Section 4.1.2)	Determination of high probability of leak	Report in accordance with WAC 173-303-145(2), 40 CFR 265.196(d), WAC 173-303-320(2)(d) and 40 CFR 302 per (Section 4.1.2) • Notification per (Section 7.2) • Discuss and document next steps at the Project Manager Meeting and change tank status per (Section 4.1.2)	• Notification(s) • Leak Assessment Report • HNF-EP-0182

6.0 MAINTENANCE OF INSTRUMENTATION FOR TANK MONITORING

6.1 ROUTINE MAINTENANCE

The facility will maintain monitoring equipment in working order. Scheduled preventative maintenance and calibrations will be in accordance with manufacturer's guidelines, best management practice or engineering recommendation. Out of service time for scheduled preventative maintenance and periodic functional testing of an Enraf, manual tape, zip cord, or weight factor is not expected to exceed 24 hours unless unplanned circumstances arise that prevent completion within the 24-hour time period. The activity will then be completed as soon as practicable. Instrumentation may experience extended outages associated with system-wide maintenance outages, including electrical outages. If data is not available to perform the quarterly evaluation due to preventative maintenance or periodic functional testing activities it is documented as identified in Section 5.0 and will be noted during the annual data review outlined in Section 7.1.

6.2 MAINTENANCE OF FAILED EQUIPMENT

Failure of instrumentation requires evaluation and will be returned to service as soon as possible. Maintenance outages exceeding 90 days will be reported per Sections 5.0 and 7.2. Repairs and replacements of Enrafs will be completed within 135 days of discovery of failed equipment. In cases where repairs and replacements of ENRAFs exceed 135 days, an alternate repair time may be approved by Ecology. LOW repairs and replacements will be completed within an agreed upon schedule with Ecology. Alternatively, a replacement monitoring method could be proposed and approved by Ecology. In the event the monitoring device must be replaced, any change to instrumentation will be approved per Section 8.0.

7.0 REPORTING

7.1 REPORTING OF TANK STATUS

Where this document requires reporting of information or status as part of the TPA Project Manager Meeting, such reporting will occur by a schedule consistent with the DOE TPA monthly report development and review timelines, as agreed to by Ecology.

A summary of any implemented Baseline Change Authorizations (BCA) or Specification Limit Exceedances will be reported to Ecology at the subsequent monthly Project Manager Meeting.

DOE will make available through publicly accessible means (currently PNNL-Hanford Online Environmental Information eXchange), all level monitoring data confirmed as valid required under this document. The data provided will be verified and validated data as described in Section 3.0. Publicly available data will include:

- Validated tank monitoring data
- Trend analysis data (including baselines and specification limits)

DOE will provide an update on the status of the SST and MUST systems at an annual meeting, prior to April 30 of every year. An account of the annual meeting will be documented in the TPA Administrative Record. Information provided will include:

- Status of all tanks, including any change to status (e.g. Leaker, Intrusion);
- Results of any leak evaluations as described in Section 4.0;
- Updates to the estimate of drainable liquids;
- Summary of changes to monitoring instrumentation;
- Summary of extended instrumentation maintenance outage(s);
- Summary of changes to trend analysis baselines; and
- Improvements or upgrades to the monitoring system.

In the event the parties determine further discussion or actions are necessary to prevent intrusion or respond to a leak situation, further discussion will be added to the agenda for the TPA Milestone M-045-56 meeting on Interim Measures.

7.2 NOTIFICATIONS

Ecology and other agencies will be provided notification in the following circumstances:

- Inability to complete monitoring or data validation as described in Section 3.3.1 and Appendix A. Notification will be provided to Ecology within 14 calendar days.

- A monitoring device specified in Appendix A that is anticipated to be or is out of service for a period exceeding 90 days. Reasons for service interruptions may include equipment failure, preventative/corrective maintenance, SST retrieval preparation interferences, periodic functional testing, or system-wide outages. Notification will include a schedule for recovery and will be provided to Ecology no later than 90 days from discovery the monitoring device was unavailable for use.

- If newly identified intrusions into a tank monitored under Appendix A of this document are confirmed, Ecology will be notified within 14 calendar days of intrusion confirmation.

- Leak Assessment Process specified in Section 4.1.2 is initiated. Notification will be provided to Ecology within 30 days of starting the leak assessment process.

- In the event a new leak is determined, following the Leak Assessment Process in Section 4.1.2, the responsible Agency (National Response Center) will be notified as outlined in CERCLA release reporting requirements under 40 CFR Part 302, “Designation, Reportable Quantities and Notification.” Proper notification will also occur in accordance with 40 CFR 265.196(d), “Response to leaks or spills and disposition of leaking or unfit-for-use tank systems” and WAC 173-303-145(2), “Spills and discharges to the Environment”. The Leak Detection evaluation will be provided to the Ecology Nuclear Waste Program office as a follow-up to the declaration of a release.

8.0 CHANGE CONTROL

This document is established under the TPA as a primary document, submitted pursuant to Milestone M-023-23. Modifications to this document will follow the criteria outlined in TPA, Section 9.3, “Document Revisions.”

Upon approval of a change notice or document revision, the Tank Operations Contractor will maintain and update, as necessary, procedures and internal documents required to implement this document. In addition, procedures and internal documents will be updated as necessary when conditions change in the SST System. The Tank Operations Contractor’s internal procedures and documents are not subject to the change control process specified in this section. Changes to the Tank Operations Contractor’s documents will be maintained and controlled in accordance with the Tank Operations Contractor’s document control process.

9.0 REFERENCES

02-OMD-036, 2002, "Submittal of *M-23-24 Single-Shell Tank (SST) System Integrity Assessment Report*" (letter from J. E. Rasmussen, Office of River Protection U.S. Department of Energy, to M. A. Wilson, State of Washington Department of Ecology, Richland, Washington.

11-NWP-054, 2011, "Re: Approval of the *Single-Shell Tank System Dangerous Waste Permit Application Part A Form, Revision 13*" (letter from J. A. Hedges to S. L. Samuelson, Office of River Protection, U.S. Department of Energy and C. G. Spencer, Washington River Protection Solutions LLC, June 3), Nuclear Waste Program, State of Washington Department of Ecology, Richland, Washington.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart J, Tank Systems, *Code of Federal Regulations*, as amended.

40 CFR 302, "Designation, Reportable Quantities, and Notification," *Code of Federal Regulations*, as amended.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement*, 2 vols., as amended, State of Washington Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

CT-99-5076-EFS, 2003, *Consent Decree for Stabilization of Single-Shell Tanks at Hanford Site, Washington v. DOE*, Third Amendment dated September 9, 2003.

HNF-2944, 1998, *Single-Shell Tank Retrieval Program Mission Analysis Report*, Appendix C, Table C-1, Rev.0, Fluor Daniel Hanford Inc., Richland, Washington.

HNF-EP-0182, 2014, *Waste Tank Summary Report for Month Ending April 30, 2014*, Current Revision, Washington River Protection Solutions LLC, Richland, Washington.

RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PLAN-48438, *Single-Shell Tank System Catch Tank Assumed Leak Response Plan*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

TFC-ENG-CHEM-D-42, "Tank Leak Assessment Process," Washington River Protection Solutions LLC, Richland, Washington, as amended.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-303-320, "General inspection," *Washington Administrative Code*, as amended.

WAC 173-303-400, "Interim Status Facility Standards," *Washington Administrative Code*, as amended.

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

APPENDIX A

MONITORING DEVICE TABLES

Table A-1. Monitoring Post Retrieval Tanks.

Tank	Monitoring Device	Data Collection Frequency
241-AX-102	Post Retrieval: Video	Once every 10 years.
241-C-101	Post Retrieval: Video	Once every 10 years.
241-C-102	Post Retrieval: Video	Once every 10 years.
241-C-103	Post Retrieval: Video	Once every 10 years.
241-C-104	Post Retrieval: Video	Once every 10 years.
241-C-105	Post Retrieval: Video	Once every 10 years.
241-C-106	Post Retrieval: Video	Once every 10 years.
241-C-107	Post Retrieval: Video	Once every 10 years.
241-C-108	Post Retrieval: Video	Once every 10 years.
241-C-109	Post Retrieval: Video	Once every 10 years.
241-C-110	Post Retrieval: Video	Once every 10 years.
241-C-111	Post Retrieval: Video	Once every 10 years.
241-C-112	Post Retrieval: Video	Once every 10 years.
241-C-201	Post Retrieval: Video	Once every 10 years.
241-C-202	Post Retrieval: Video	Once every 10 years.
241-C-203	Post Retrieval: Video	Once every 10 years.
241-C-204	Post Retrieval: Video	Once every 10 years.
241-S-112	Post Retrieval: Video	Once every 10 years.

Table A-2. Tank Monitoring Devices.

Tank	Monitoring Device	Data Collection Frequency
241-A-101	LOW	Quarterly
241-A-102	Enraf	Quarterly
241-A-103	Enraf	Quarterly
241-A-104	Enraf	Quarterly
241-A-105	Enraf	Quarterly
241-A-106	LOW	Quarterly
241-AX-101	LOW	Quarterly
241-AX-103	LOW	Quarterly
241-AX-104	Enraf	Quarterly
241-B-101	LOW	Quarterly
241-B-102	Enraf	Quarterly
241-B-103	Enraf	Quarterly
241-B-104	LOW	Quarterly
241-B-105	LOW	Quarterly
241-B-106	Enraf	Quarterly
241-B-107	LOW	Quarterly
241-B-108	LOW	Quarterly
241-B-109	LOW	Quarterly
241-B-110	Enraf	Quarterly
241-B-111	Enraf	Quarterly
241-B-112	Enraf	Quarterly
241-B-201	Enraf	Quarterly
241-B-202	Enraf	Quarterly
241-B-203	Enraf	Quarterly
241-B-204	Enraf	Quarterly
241-BX-101	Enraf	Quarterly
241-BX-102	Enraf	Quarterly
241-BX-103	Enraf	Quarterly
241-BX-104	Enraf	Quarterly
241-BX-105	Enraf	Quarterly
241-BX-106	Enraf	Quarterly
241-BX-107	Enraf	Quarterly
241-BX-108	Enraf	Quarterly
241-BX-109	LOW	Quarterly
241-BX-110	Enraf	Quarterly
241-BX-111	LOW	Quarterly
241-BX-112	Enraf	Quarterly
241-BY-101	LOW	Quarterly
241-BY-102	LOW	Quarterly
241-BY-103	LOW	Quarterly
241-BY-104	LOW	Quarterly
241-BY-105	LOW	Quarterly
241-BY-106	LOW	Quarterly
241-BY-107	LOW	Quarterly
241-BY-108	LOW	Quarterly
241-BY-109	LOW	Quarterly
241-BY-110	LOW	Quarterly
241-BY-111	LOW	Quarterly

Table A-2. Tank Monitoring Devices.

Tank	Monitoring Device	Data Collection Frequency
241-BY-112	LOW	Quarterly
241-S-101	LOW	Quarterly
241-S-102	Enraf	Quarterly
241-S-103	LOW	Quarterly
241-S-104	Enraf	Quarterly
241-S-105	LOW	Quarterly
241-S-106	LOW	Quarterly
241-S-107	Enraf	Quarterly
241-S-108	LOW	Quarterly
241-S-109	LOW	Quarterly
241-S-110	LOW	Quarterly
241-S-111	LOW	Quarterly
241-SX-101	LOW	Quarterly
241-SX-102	LOW	Quarterly
241-SX-103	LOW	Quarterly
241-SX-104	LOW	Quarterly
241-SX-105	LOW	Quarterly
241-SX-106	LOW	Quarterly
241-SX-107	Enraf	Quarterly
241-SX-108	Enraf	Quarterly
241-SX-109	Enraf	Quarterly
241-SX-110	Enraf	Quarterly
241-SX-111	LOW	Quarterly
241-SX-112	LOW	Quarterly
241-SX-113	Enraf	Quarterly
241-SX-114	Enraf	Quarterly
241-SX-115	Enraf	Quarterly
241-T-101	Enraf	Quarterly
241-T-102	Enraf	Quarterly
241-T-103	Enraf	Quarterly
241-T-104	LOW	Quarterly
241-T-105	Enraf	Quarterly
241-T-106	Enraf	Quarterly
241-T-107	Enraf	Quarterly
241-T-108	Enraf	Quarterly
241-T-109	LOW	Quarterly
241-T-110	LOW	Quarterly
241-T-111	LOW Enraf	Quarterly
241-T-112	Enraf	Quarterly
241-T-201	Enraf	Quarterly
241-T-202	Enraf	Quarterly
241-T-203	Enraf	Quarterly
241-T-204	Enraf	Quarterly
241-TX-101	Enraf	Quarterly
241-TX-102	LOW	Quarterly
241-TX-103	LOW	Quarterly
241-TX-104	LOW	Quarterly
241-TX-105	LOW	Quarterly
241-TX-106	LOW	Quarterly

Table A-2. Tank Monitoring Devices.

Tank	Monitoring Device	Data Collection Frequency
241-TX-107	Enraf	Quarterly
241-TX-108	Enraf	Quarterly
241-TX-109	LOW	Quarterly
241-TX-110	LOW	Quarterly
241-TX-111	LOW	Quarterly
241-TX-112	LOW	Quarterly
241-TX-113	LOW	Quarterly
241-TX-114	LOW	Quarterly
241-TX-115	LOW	Quarterly
241-TX-116	LOW	Quarterly
241-TX-117	LOW	Quarterly
241-TX-118	LOW	Quarterly
241-TY-101	Enraf	Quarterly
241-TY-102	Enraf	Quarterly
241-TY-103	LOW	Quarterly
241-TY-104	Enraf	Quarterly
241-TY-105	LOW	Quarterly
241-TY-106	Enraf	Quarterly
241-U-101	Enraf	Quarterly
241-U-102	LOW	Quarterly
241-U-103	LOW	Quarterly
241-U-104	Enraf	Quarterly
241-U-105	LOW	Quarterly
241-U-106	LOW	Quarterly
241-U-107	LOW	Quarterly
241-U-108	LOW	Quarterly
241-U-109	LOW	Quarterly
241-U-110	LOW	Quarterly
241-U-111	LOW	Quarterly
241-U-112	Enraf	Quarterly
241-U-201	Enraf	Quarterly
241-U-202	Enraf	Quarterly
241-U-203	Enraf	Quarterly
241-U-204	Enraf	Quarterly

Table A-3. MUST Monitoring Devices.

Tank Number	Monitoring Device	Data Collection Frequency
240-S-302	Enraf	Quarterly
241-A-302-A	Enraf	Quarterly
241-ER-311	Enraf	Quarterly
241-S-304	Enraf	Quarterly
241-TX-302-B	Enraf	Quarterly
241-TX-302C	Enraf	Quarterly
241-U-301-B	Enraf	Quarterly
241-UX-302A	Enraf	Quarterly
244-CR-001	Enraf	Quarterly
244-CR-003	Enraf	Quarterly
244-TX-DCRT	Enraf	Quarterly
241-A-302-B	Manual Tape	Quarterly
241-AX-152-CT	Manual Tape	Quarterly
241-EW-151-CT	Manual Tape	Quarterly
244-BX-DCRT	Manual Tape	Quarterly
241-A-350	Weight Factor	Quarterly
241-A-417	Weight Factor	Quarterly
244-A DCRT	Weight Factor	Quarterly
244-AR-001	Weight Factor	Quarterly
244-AR-002	Weight Factor	Quarterly
244-AR-003	Weight Factor	Quarterly
244-AR-004	Weight Factor	Quarterly
244-S-DCRT	Weight Factor	Quarterly
241-AZ-154[4]	Zip Cord	None
241-BY-ITS1-TK2	None	None
241-BY-ITS1-SSCT	None	None
241-BY-ITS2-TK1	None	None
241-BY-ITS2-TK2	None	None
241-C-301	None	None
241-ER-311-A	None	None
241-S-302-A	None	None
241-S-302-B	None	None
241-SX-302	None	None
241-T-301-B	None	None
241-TX-302-A	None	None
241-TX-302BR	None	None
241-TX-302XB	None	None
241-TY-302-A	None	None
241-TY-302-B	None	None
244-BXR-001	None	None
244-BXR-002	None	None
244-BXR-003	None	None
244-BXR-011	None	None
244-CR-002	None	None
244-CR-011	None	None

[4] AZ-154 is a DST component listed in the SST Part A and is not monitored. Permittees will submit a revision to remove AZ-154 from the SST Part A, and include it in DST supplemental permit application material by September 30, 2021.

Table A-3. MUST Monitoring Devices.

Tank Number	Monitoring Device	Data Collection Frequency
244-TXR-001	None	None
244-TXR-002	None	None
244-TXR-003	None	None
244-U-DCRT	None, Never in Service	None
244-UR-001	None	None
244-UR-002	None	None
244-UR-003	None	None
244-UR-004	None	None