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Office of River Protection, State of Washington Department of Ecology
Tank Waste Retrieval Work Plan/Functions and Requirements Change Notice
(Per Hanford Federal Facility Agreement and Consent Order Section 9.3)

1. Document Title and Number: RPP-37739, Rev. 1, 241-C-111 Tank Waste Retrieval Work Plan		
2. Minor Field Change: (Section 12.4 HFFACO Action Plan) ☐ Yes: (WRPS Signature Only – Attach signed form to Primary Document for record purposes) x No: Proceed to Box 3	**3.** Document Issue Date: 09/1/10 **4.** Document Modification Notice Date: 5/08/13	**5.** Notice Number: 2013-07 RECEIVED AUG 01 2013 EDMC
6. Do proposed changes require schedule changes? (Would this extend completion of retrieval beyond 12 months from date of initiation?) ☐ Yes x No	**7.** Do proposed changes include specific additions, deletions, or modification to scope and/or requirements which affect the overall intent of the plan? ☐ Yes x No	**8.** (Check only one box) ☐ Significant Modification (Check if the answer to question in either section 6 or 7 is "yes". Significant modifications require revision of the primary document.) Minor Modification x Requires modification of the document x Can be accomplished with Modification Notice.

9. Description and Justification of Change:

Change Description: Changes are made to identify the second and third retrieval technologies that will be used, as needed, to meet the volume target listed in the consent decree. Changes are also included to align this TWRWP with others. To align the TWRWP changes include describing annulus leak detection devices, limit of technology, consent decree requirements and references, equipment performance justification, equivalent rinse, and clarification of ENRAF use for leak detection. Reference updates are also included.

Justifications:

- pg vi—added ERSS to abbreviations and trademark designators.
- Section 1, pg 1-1—added references to the consent decree in place of HFFACO.
- Section 2.1.1, pg 2-1—Added the consent decree completion deadline.
- Section 3 pg 3-1—Listed retrieval technologies and added consent decree requirements. Added ERSS and high pressure water to system description.
- Section 3.1.1, pg 3-1 to 3-3—Added waste retrieval system components.
- Section 3.1.2, pg 3-4— Added a description of high pressure water operation and waste softening with various liquids.
- Section 3.1.2, pg 3-5 to 3-6—Added limit of technology description and explanation requirement for operating with diminished capability equipment.
- Section 3.1.3, pg 3-7 to 3-8—Added a description of chemical retrieval.
- Section 3.2, pg 3-10—Added an option for equivalent rinsing of supernate from the solids.
- Section 3.3, pg 3-14—Added an wording for the second and third technology selection.

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- Section 3-6, pg 3-15 and 3-19—Updated table reference and deleted HFFACO reference
- Section 3.8, pg 3-23—Added an updated reference for IQRPE assessment.
- Section 3.10, pg 3-24—Updated references for air monitoring program.
- Section 4.1.2, pg 4-1 – Deleted reference to outdated PNNL groundwater monitoring plan and reference included up to date reference.
- Section 4.1.3, pg 4-2 to 4-3—Updated annulus leak detection monitoring description.
- Section 4.1.3, pg 4-5—Deleted outdated groundwater monitoring well map.
- Section 4.2.1.2, pg 4-10 to 4-11—Added clarification for using ENRAF as a leak detector.
- Section 4.2.1.5, pg 4-12-- Updated annulus leak detection monitoring description.
- Section 5, pg 5-1—Updated air permit reference.
- Section 9—Updated references

See the attached redline strikeout pages.

10. Impact of Change: These changes allow for deployment of the second and third technologies that may be needed to complete the retrieval of waste from C-111. The changes also make this TWRWP consistent with the other TWRWPs.

11. Additional Requirements and/or Provisions

Approvals

Washington River Protection Solutions, LLC.	Office of River Protection	State of Wash. Dept. of Ecology
☐ Provisional Approval[2] Date	☐ Provisional Approval[2] Date	☐ Provisional Approval[2] Date
☒ Final Approval Date 7/24/13	☒ Final Approval Date 7/26/13	☒ Final Approval Date 7/31/13

Notes

1 - For use by Ecology to identify any additional information needed to make a decision regarding the request for modifications. In addition, Ecology will identify actions, if any, regarding the modification request that DOE may take pending Ecology's final decision

2 – Provisional approval allows DOE and it's contractors to take specific actions identified in section 11, prior to final approval of this modification.

LIST OF TERMS

Abbreviations, Acronyms, and Initialisms

ALARA	as low as reasonably achievable
BBI	best-basis inventory
CH2M HILL	CH2M HILL Hanford Group, Inc.
COPC	constituent of potential concern
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
ERSS	Extended Reach Sluicing System
HFFACO	*Hanford Federal Facility Agreement and Consent Order*
HI	hazard index
HIHTL	hose-in-hose transfer line
HRR™	high-resolution resistivity
IH	industrial hygiene
ILCR	incremental lifetime cancer risk
IQRPE	independent, qualified registered professional engineer
IRIS	Integrated Risk Information System
ITEM	Integrated Training Electronic Matrix
k_d	distribution coefficient
LDM™	leak detection and monitoring
MRS	mobile retrieval system
NOC	notice of construction
ORP	U.S. Department of Energy, Office of River Protection
OWW	organic wash waste
PCB	polychlorinated biphenyls
PUREX	plutonium-uranium extraction
RAS	radionuclide assessment system
RCRA	*Resource Conservation and Recovery Act of 1976*
RMS	radionuclide monitoring system
SGLS	spectral gamma system
SST	single-shell tank

™ High-Resolution Resistivity (HRR) is a trademark of hydroGEOPHYSICS, Inc., Tucson, Arizona.
™ Leak Detection and Monitoring (LDM) is a trademark of hydroGEOPHYSICS, Inc., Tucson, Arizona

1 INTRODUCTION

The U.S. Department of Energy, Office of River Protection (ORP) River Protection Project mission includes storage, retrieval, immobilization, and disposal of radioactive mixed waste presently stored in underground tanks located in the 200 East and 200 West Areas of the U.S. Department of Energy (DOE) Hanford Site. Single-shell tank 241-C-111 (C-111) located in the 200 East Area (Figure 1-1), is scheduled for waste retrieval using a modified sluicing system retrieval technology. Tank C-111 is classified as an "assumed leaker" as specified in HNF-EP-0182, *Waste Tank Summary Report for Month Ending October 31, 2008*. The tank history was reevaluated as described in RPP-ENV-33418, *Hanford C-Farm Leak Assessments Report; Tanks 241-C-101, 241-C-110, 241-C-111, 241-C-105 and Unplanned Waste Releases*, Rev. 1, and there was a consensus agreement that the apparent waste loss from this tank which led to it being classified an "assumed leaker" was due to evaporation. Tank leak assessment RPP-ASMT-39155, *Tank 241-C-111 Leak Assessment Report*, evaluated the information available for C-111 and reached consensus that the level decrease observed from 1965 to 1969 was the result of evaporation and thermal contraction, and that the tank did not leak. The leak assessment recommended that the tank status be revised from Assumed Leaker to Sound.

This document was originally developed to meet the requirements identified in Hanford Federal Facility Agreement and Consent Order (HFFACO) Appendix I, Section 2.1.3 for Tank Waste Retrieval Work Plans (TWRWP). As of 10/25/10 Consent Decree No. 08-5085-FVS (Decree) became the regulating direction for TWRWPs for tanks retrieved as Project B-1 and Project B-4 of the Decree. ~~This is a primary document developed to meet the requirements identified in Change Request M-45-04-01 of Ecology, et al. (1989), *Hanford Federal Facility Agreement and Consent Order* (HFFACO).~~ The purpose of this document is to provide the Washington State Department of Ecology (Ecology) information on the planned approach for retrieving waste from C-111 to allow Ecology to approve the waste retrieval action.

~~The relationship of the tank waste retrieval work plans (TWRWP) to the overall single-shell tank (SST) waste retrieval and closure process is described in Appendix I of the HFFACO, along with requirements for the content of TWRWPs. These requirements were subsequently clarified in letter 04-TPD-083, "Agreement on Content of Tank Waste Retrieval Work Plans" (04-TPD-083 – Letter). For clarity and guidance, the requirements from 04-TPD-083 – Letter are repeated where applicable at the beginning of a section in this document.~~

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the *Atomic Energy Act of 1954*) has been incorporated into this TWRWP, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this tank waste retrieval work plan or *Revised Code of Washington,* Chapter 70.105 RCW, "Hazardous waste management."

2 TANKS AND/OR ANCILLARY EQUIPMENT CONDITION AND CONFIGURATION AND WASTE CHARACTERISTICS

2.1 TANK

List of tank(s) associated with the proposed waste retrieval action

Tank 241-C-111 is the subject of this TWRWP.

2.1.1 Start Date

Retrieval start dates for each component

The planned start date for C-111 waste retrieval operations is July 2010 but is subject to change depending on priorities and availability of resources. ~~In accordance with the HFFACO, Appendix I, Section 2.1.5, it is understood waste retrieval is to be completed within 12 months of this retrieval start date. The tank retrieval process will be completed within this time frame or the TWRWP will be revised to provide an estimated completion date for the retrieval process.~~The completion date for Project B-1, complete retrieval from the remaining SSTs in WMA-C, is 9/30/14.

2.1.2 History of Tank

History of tank (date of construction, dimensions of tank, etc.)

Summary-level historical data related to the configuration and operating history for tank C-111 is provided in Table 2-1.

Table 2-1. Summary-Level Data for Tank C-111.*

Constructed	1943-44
In service	1946
Diameter (ft)	75
Operating depth (in.)	185
Design capacity (gal.)	530,000
Bottom shape	Dish
Ventilation	Passive
Nominal burial depth (ft)	6
Declared inactive	1978
Interim stabilized	3/84

* Adapted from RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report.*

The tank was constructed in place with a carbon steel lining on the bottom and sides and a reinforced concrete shell. The welded liner is independent of the reinforced-concrete tank and

3 PLANNED RETRIEVAL TECHNOLOGY

This section provides a description of the waste retrieval technologies that will be used, if needed, in C-111. The first technology is modified sluicing using standard modified sluicer or an extended reach sluicer (ERSS). The second technology is high pressure water using the ERSS. The third technology, if needed to meet the Consent Decree volume target, is chemical dissolution. The rationale for selection technologies is provided in Section 3.3. However, in accordance with Appendix C, Part 1 of the Decree:

> "If 360 cubic feet is reached with the first retrieval technology, the first retrieval technology shall be used to the "limits of technology" and a second retrieval technology shall not be required."

Retrieval activities will switch from one technology to the other as required to reach the Consent Decree residual waste goal.

In accordance with the Decree, Appendix C, Part 1:

> "If the waste residual goal of 360 cubic feet is not achieved using the established two technologies, an additional retrieval technology established in a revised TWRWP shall be deployed to the "limits of technology;" provided that DOE may request that the State agree that DOE may forego implementing a third retrieval technology if DOE believes implementing such technology is not practicable under the criteria set forth above [in Appendix C, Part 1 of the Decree]. If DOE and Ecology are unable to reach agreement, the resolution of the issue of whether a third retrieval technology shall be deployed shall be resolved through the dispute resolution process set forth in Section IX of this Decree."

For efficiency, DOE may use the third technology, chemical dissolution, as needed between sluicing and high pressure water applications.

3.1 SYSTEM DESCRIPTION

System description (physical and operating)

This section provides a description of the waste retrieval system (WRS) and how it will be operated. Continued design development and incorporation of lessons learned may lead to changes in the design and/or operating strategy.

3.1.1 Physical Description

The physical equipment will consist of a modified sludge sluicing system to mobilize and retrieve waste from tank C-111. The sluicing system will include two ~~(or more)~~ modifed sluicers or ERSS ~~nozzles~~ sluicers and a slurry pump in the tank. The sluice nozzles will be controlled from a control trailer located outside the tank farm fence. The sluice nozzles can be installed in existing tank risers located around the perimeter of the tank. The sluice nozzles will have the capability to direct liquid at various locations in the tank. The WRS will have the capability to use high pressure water to break apart hard agglomerations of waste. Double-shell tank

supernate will be used as the primary sluicing liquid. The WRS will also have the capacity to use raw water for sluicing with minor modifications.

The new slurry pump will be installed in a riser located in the center pit. The slurry pump design for C-111 will allow the pump installation height to be adjusted to facilitate maximum waste removal. The C-111 pump will be installed using a crane so that the inlet will be just under the waste surface to start, as determined by the in-tank camera. Little or no water should be required for this pump installation. This same installation method would be used for replacement pumps. The C-111 pump will be mounted on a system that will allow the pump to be lowered to the bottom of the tank as waste retrieval progresses. Other designs or arrangements may be used to optimize the pump installation or operation.

Double-shell tank 241-AN-101 (AN-101) is planned to be used for both waste receipt and as the source tank for supernate recycle. Tank AN-101 was selected based on its location, available space, and existing equipment.

Camera(s) will be installed in tank C-111 to provide the capability to visually monitor and aid in control of waste retrieval operations. Instrumentation will also be provided to monitor process control data (e.g., pressures and flow rates). This information will be used to support material balance calculations. The existing ENRAF[1] level gauge in tank C-111 will be retracted during waste retrieval operations and will be used periodically to monitor waste levels. The AN-101 ENRAF will be used to monitor the waste level in that tank.

During waste retrieval operations, tank C-111 will be actively ventilated. The ventilation system will consist of skid-mounted high-efficiency particulate air filtered portable exhauster(s).

Condensate drainage from the exhauster(s) will be routed back to an SST being retrieved or an SST undergoing equipment installation in preparation for retrieval. Any change to this drainage routing will be covered by a change to this TWRWP.

The configuration of tank C-111 includes no concrete pits and only a single central corrugated metal caisson. The drain in this caisson will be closed off and a sump pump used to pump leakage into the tank. The WRS for tank C-111 may require design and construction of riser extensions to support the installation of the sluice nozzles and a slurry pump. Table 3-1 provides the planned riser use for tank C-111. This riser use may change.

Table 3-1. Planned Riser Use for Tank C-111 Waste Retrieval System.

Riser Number	Tank C-111
1	~~Spare, camera, or as required if need arises during detailed design~~ CCTV or Chemical Addition Adapter
2	Sluicer/ERSS
3	Ventilation exhaust duct/camera
4	ENRAF level gauge

[1] ENRAF is a trademark of Enraf, Inc., Enraf B.V., Delft, The Netherlands.

5	Spare, camera, or as required if need arises during detailed design
6	Vacuum relief/camera/breather filter
7	Sluicer/ERSS
8	Spare, camera, or as required if need arises during detailed design
13	Slurry pump

A portable valve box serves to control the routing and flow of liquid to the sluice nozzles and to control water additions to the waste retrieval process. The valve box provides secondary containment and the collection/detection of any leakage in a sump. The portable valve box has a leak detector that is connected to the pump shutdown system in the control trailer. In the event that a leak is detected in the portable valve box, the transfer pumps in tank C-111 and in the receiver DST would be shut down. The portable valve box has a sump and a sump pump that can be configured to transfer any leakage to the SST being retrieved.

A valve/transfer line diversion and throttling valve flowmeter box may be needed to permit and monitor routing of solutions to and from tank C-111 and other tanks which may be undergoing retrieval concurrently. If a suitable pump cannot be obtained that will provide adequate capacity, a booster pump may also be required. Any booster pump will be located within a separate steel pit. Any new pits required will be inspected, will have a leak detector, and will either drain to a tank or have a sump pump. Leak detectors may be a conductivity probe, a thermal leak detector, or another type of leak detector as appropriate.

Should a transfer leak from the primary hose occur, the leak detection system is designed to shut the pump off when liquid covers the leak detection element contacts. Secondary containment structures will not overflow as a result of the transfer line leakage, including any transfer line drainback, because either the free volume of the structure exceeds the volume of leaked waste plus drainback, or there are openings in the structure which allow free-drain to the tank.

Transfer of waste from tank C-111 to AN-101 and the transfer of supernate from DST back to tank C-111 will be performed using transfer lines that provide secondary containment. The waste retrieval project currently plans to use overground hose-in-hose transfer lines (HIHTL) and the *Resource Conservation and Recovery Act of 1976* (RCRA)-compliant DST transfer system.

The receiver DST will have a supernate pump that will be used to pump liquid back to tank C-111. The receiver DST will also have a slurry distributor to distribute the sludge received from tank C-111.

Because the elevation of the AN tank farm is approximately 22 ft higher than the C tank farm, the slurry distributor and the supernate pump incorporate anti-siphon devices to prevent unintentional flow from the DST to the SST.

The transfer lines and DSTs are RCRA compliant.

3.1.2 Operating Description

The retrieval process will be monitored using closed-circuit television to facilitate waste retrieval and aid in minimizing any liquid in the tanks. Supernate will be used as the primary retrieval liquid to minimize DST storage space. Raw water will be used in limited quantities as necessary for waste mobilization and conveyance, transfer line flushing, equipment flushing, heel flushing, or as required for miscellaneous use. During all retrieval activities the tank liquid level will be maintained below the maximum waste level designated in the process control plan.

During routine operations, waste retrieval will be initiated by starting the supernate pump in the DST source tank and using the pumped supernate to provide sluicing fluid to the selected sluice nozzle. Initial sluicing will be focused in the center portion of the tank to minimize the time required to get liquid to the slurry pump to allow it to be started. The in-tank camera will be used to provide visual input for directing the sluice nozzle. The slurry pump in tank C-111 will be started when liquid from the sluicer operation reaches the area of the pump inlet and there is enough liquid present to prime and operate the pump. As the sluice liquid contacts the tank waste, the sludge will be mobilized and retrieved via the slurry pump. Typically, one sluicer will be operated at a time at a flow rate of approximately 60 to 120 gal/min. If the pump suction is too shallow when waste retrieval is started, the sluice nozzle discharges can be aimed at the pump inlet to enable the pump to be inserted a little deeper. The flow rate through the sluice nozzles will be adjusted based on the pump-out rate so that the rate of liquid introduction will approximately equal the rate of solution removal with the objective of minimizing the liquid waste volume in the retrieval tank while maximizing waste retrieval efficiency. The slurry removed will consist of the mobilized tank waste and the DST supernate or water. Maintaining a balanced pumping rate into and out of the tank is integral to minimizing the liquid volume in tank C-111 and reducing the potential for leakage.

An additional technology provided by the ERSS is the capability to add high pressure water to break up particles that resist breakup or mobilization with the lower pressure supernate (or water) stream. High pressure water could be used at any time during the retrieval process but it is not envisioned that much will be needed until towards the end of retrieval.

If initial sluicing efforts show the tank C-111 sludge is not readily mobilized, it may be necessary to add sufficient liquid to the tank to cover the sludge and allow it to sit for a period of time to soften the solid waste before sluicing is resumed. Liquid can break down bonds in dried waste or dissolve salt crystals holding the waste together. The DST supernate, caustic, or water used will not be saturated and thus will be expected to dissolve such salts or break the crystal structure down sufficiently to permit retrieval. The volume of free liquid added to soften any waste would be minimized by keeping the free liquid height above the waste to as small as practical. The time needed to soften the waste is unknown but would likely not be more than a few days.

During all field activities, standard operating procedures and safety precautions will be implemented to protect worker health and safety, the public, and the environment. In accordance with standard operating procedures, health physics and industrial health technicians will monitor conditions within the tank farm in accordance with approved monitoring plans.

Before initiating waste retrieval, a formal waste compatibility assessment will be performed in accordance with HNF-SD-WM-OCD-015, *Tank Farm Waste Transfer Compatibility Program.* HNF-SD-WM-OCD-015 provides a formal process for determining waste compatibility through the preparation of documented waste compatibility assessments for waste transfers. The primary purpose of the program is to ensure that sufficient controls are in place to prevent the formation of incompatible mixtures during waste transfer operations. Waste compatibility assessments are prepared before all waste transfers into the DST system to ensure that the waste transfer will comply with specific administrative control, safety, regulatory, programmatic, and operational decision rules related to waste chemistry and waste properties. Waste compatibility assessments require the preparation of calculations to determine source tank and/or receiver tank compositions and to assess those compositions against specified decision rules that are provided in HNF-SD-WM-OCD-015.

Formal issuance of the compatibility assessment will not be completed until just before waste retrieval operations begin to ensure that current conditions are captured in the assessment.

Meeting the informational requirements for waste transfers meets the requirements of *Washington Administrative Code* (WAC) 173-303-300, "General Waste Analysis." Compliance with the following documents is required before initiating a waste transfer:

a. RPP-29002, *Double-Shell Tank System Waste Analysis Plan.* Single-shell tank transfers into the DSTs for any reason must meet the waste acceptance criteria presented in this plan. This plan is written pursuant to WAC 173-303-300(5) and EPA guidance document OSWER 9938.4-03, *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste.*

b. Waste Stream Profile Sheet (RPP-29002, ~~Attachment A~~). The sheet addresses the applicable sections of WAC 173-303-300; Title 40, *Code of Federal Regulations*, Part 761, "Polychlorinated Biphenyls (PCB) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions" (40 CFR 761); 40 CFR 268, "Land Disposal Restrictions"; and WAC 173-303-140, "Land Disposal Restrictions," and also requires a waste compatibility assessment pursuant to HNF-SD-WM-DQO-001, *Data Quality Objectives for Tank Farms Waste Compatibility Program*, to meet WAC 173-303-395(1).

When the level of residual solids gets low in the tank, the volume of solids removed per unit volume of sluicing fluid removed from the tank or per unit of time or transfer will be tracked. The units used will be selected by engineering personnel.

The project will determine when a tank retrieval is complete by following the Consent Decree requirements stating "that the recovery rate of that retrieval technology for that tank is, or has become, limited to such an extent that it extends the retrieval duration to the point at which continued operation of the retrieval technology is not practicable, with the consideration of practicability to include matters such as risk reduction, facilitating tank closures, cost, the potential for exacerbating leaks, worker safety and the overall impact on the tank waste retrieval and treatment mission."

Until a risk evaluation is available, the limit of technology for modified sluicing is defined in RPP-50910, *Single-Shell Tank Waste Retrieval Limit of Technology Definition for Modified*

Sluicing as when the concentration of SST waste in the retrieved slurry sent to the DST is within, or bracketing, the range of 0 to 0.6 volume percent.

There is no limit of technology definition for an ERSS waste retrieval process. A limit of technology definition will not be developed until sufficient ERSS retrieval operations have been performed to enable development of a justifiable definition. Until an ERSS limit of technology definition is developed the same value used for modified sluicing in RPP-50910 is applied to ERSS retrieval operations.

There is no limit of technology definition for a chemical retrieval process. A limit of technology definition will not be developed until sufficient chemical heel retrieval operations have been performed to enable development of a justifiable definition. It is estimated that this will take 3 to 4 heel retrieval operations.

Appendix C, Part 1 of the Decree defines the limit of technology as follows:

> "The "limits of technology" means that the recovery rate of that retrieval technology for that tank is, or has become, limited to such an extent that it extends the retrieval duration to the point at which continued operation of the retrieval technology is not practicable, with consideration of practicability to include matters such as risk reduction, facilitating tank closures, costs, the potential for exacerbating leaks, worker safety, and the overall impact on the tank waste retrieval and treatment missions."

Experience has shown that unexpected waste forms and tank conditions may be encountered and that equipment performance can degrade with time. The ORP will inform Ecology at least every 2 weeks, through normally scheduled meetings, about unexpected waste forms, behavior and tank conditions along with retrieval equipment performance changes that would impact overall retrieval rates and retrieval volume. If a normally scheduled meeting does not occur Ecology will initiate a meeting for this information exchange.

At these meetings, ORP will provide to Ecology the basis and rationale for continuing retrieval when it is suspected that waste form behavior, tank condition and/or equipment performance has diminished significantly or performance impacted the ability of the deployed equipment to operate in order to meet the waste residual goal of 360 ft^3. ~~Waste retrieval operations will continue until the limits of technology have been reached for this retrieval method. The limit of technology will occur when there are little or no waste solids being removed per unit volume of sluicing fluid used or per unit of time or transfer.~~

The following information will be used to evaluate termination of retrieval and will be shared with Ecology prior to a decision to terminate field retrieval activities:

a. System performance and efficiency data.

b. In-tank visual confirmation of tank condition and waste retrieval.

c. Preliminary volume estimates using tank geometry and in-tank structural features.

d. Presentation and discussion of alternate system configurations and process modifications to enhance retrieval performance.

e. Presentation and discussion of residual sample location.

TFC-ENG-CHEM-P-47, *Single-Shell Tank Retrieval Completion Evaluation*, provides the methodology to follow for determining when an SST undergoing waste retrieval has reached the end of the retrieval process. The following summary of this procedure does not take the place of TFC-ENG-CHEM-P-47, and for any differences between this summary and the latest version of the procedure, the procedure takes precedence. Refer to TFC-ENG-CHEM-P-47 for details of the summary steps.

a. When waste retrieval starts, engineering personnel will begin tracking retrieval performance (e.g., percent of waste retrieved) and provide a weekly status report. Weekly status information will be forwarded to Ecology to brief them on retrieval activities, including residual volume estimates and performance parameters. Ecology will be invited to view waste retrieval activities and video images of the in-tank operations.

b. Engineering shall recommend configuration or procedure changes to enhance recovery as warranted. Management is notified after performance efficiency or retrieval rate has reduced significantly.

c. An attachment to TFC-ENG-CHEM-P-47 provides guidance for retrieval performance and limit of technology evaluations. Establishment of when the limits of technology have been reached includes the following:

   1. Examination of in-tank images to observe/record waste contours and characteristics.
   2. Estimation of waste retrieval performance efficiency and remaining waste volume.
   3. Using performance data to demonstrate that a consistent pattern is present indicating limits of technology have been reached.
   4. Evaluation of waste retrieval performance against system limitations.

~~Ecology is notified when it appears that the limits of technology have been reached.~~ Status reports are continued until waste retrieval operations cease. An SST ~~waste retrieval evaluation~~ completion of retrieval certification ~~form~~ and a retrieval data report are then prepared and issued in accordance with the Decree and the HFFACO respectively.

Following completion of waste retrieval and final tank flushing, the residual waste volume will be determined using the methodology defined in RPP-23403 and RPP-PLAN-23827.

3.1.3 Chemical Retrieval Process

Chemical retrieval process details are contained in the process control plan for each tank using a chemical retrieval process. When samples are available the retrieval process is tested on samples of tank waste. If hard heel samples are not obtained the hard heel composition is deduced from tank historical data. The hard heel volume to be treated is normally not known until sluicing retrieval is complete. The hard heel volume can be determined from visual observation, level

sensors, or liquid displacement using tank level sensors. The composition and volume of the heel are used to determine the quantity and type of chemicals used for chemical retrieval process.

The chemical retrieval process may be a series of steps or a single action depending on how the waste reacts to the process. If a single step will dissolve sufficient solids to achieve the volume reduction mandated by the Decree, only one chemical retrieval process step will be deployed. The chemical retrieval process may include one or more of the following:

- water to remove compounds insoluble in the caustic liquids found in the tanks,
- high molarity caustic solution to break down aluminum hydroxide compounds, or
- other chemicals to aid the retrieval of sludge.

Ecology will be informed of the pre-retrieval estimated volume of liquid(s) to be added to the tank prior to the initial addition(s). Water additions for dissolution and volume reduction associated with a chemical retrieval process are separate actions from the heel rinse described in section 3.2.

Unlike modified sluicing, there is no operational data available that can be used to estimate the recovery rate for a limit of technology determination for a chemical retrieval process planned for C-111. If the first step of a multiple step dissolution achieves the Decree volume target the limit of technology will be considered to have been met for the chemical retrieval process technology. Using unnecessary chemical retrieval process steps adds risk to worker safety and has retrieval schedule impacts, DST storage volume impacts, and thus possible mission impacts.

If the Decree target volume is not achieved, and all steps of the chemical retrieval process have been deployed as specified in the process control plan, the limit of technology will be considered to have been met for the chemical retrieval process provided the data show that additional chemical retrieval process steps are not practicable.

3.2 LIQUID ADDITIONS DURING WASTE RETRIEVAL

Identify range (volume) and timing of liquid additions to be added during waste retrieval.

The pump adjustment features described previously should allow the tank C-111 pump to be installed with little or no water addition However, if tank conditions require water additions to successfully install the pump (e.g., debris under the pump installation riser), water additions would be controlled in accordance with OSD-T-151-00013, *Operating Specifications for Single-Shell Waste Storage Tanks*, Section 4.1). This water would be added through one or both of the sluicers, by lancing, or by back flushing through the pump.

Water could also be added to the tank as needed to flush equipment removed from the tank or for a number of operational reasons. The use of water is minimized to avoid taking up DST storage space. Experience to date with sludge retrieval in other C-Farm tanks has shown little water use during retrieval operations.

The use of supernatant will be limited by the following:

a. The waste compatibility assessment for supernatant recycle will be completed and reported to Ecology. This compatibility assessment shall be made to determine if the solution is acceptable for use in retrieving the tank C-111 solids. Ecology will be notified of the results of this assessment before initiation of retrieval operations. Following notification of the results of this assessment, a copy of the assessment report shall be provided to Ecology.

b. Ecology will be notified when the cumulative volume of supernatant liquid being recycled exceeds the estimated quantity of 1,000,000 gal, and for each incremental million gallon quantity recycled. Timely notification by e-mail will be sufficient.

c. Following the use of supernatant, a minimum of three tank heel rinses using a minimum volume of raw water that is three times the estimated residual waste volume will be required to ensure that residual waste is removed to the extent practical. If the DOE shows that a comparable reduction in soluble supernate constituents has been accomplished through other retrieval actions, the rinse may be omitted.

d. Should tank C-111 be shown to leak during the retrieval process, a liquid sample will be taken if needed to verify the ^{99}Tc concentration in the DST supernate used for sluicing.

e. Should a DST sample be required during the C-111 retrieval process for corrosion control or other reasons, a ^{99}Tc analysis will be requested on the sample.

When adding liquid to the SST for the sole purpose of obtaining a waste level measurement, the following conditions apply:

1. The HRR leak detection system for the tank described in Section 4.2.1 must be continuously operable for at least 48 hours prior to the liquid addition.

2. The benchmark level described in Section 4.6.1 will not be exceeded during the liquid addition.

3. Excess liquid will be removed from the tank as soon as practical once a usable waste level measurement is obtained.

4. The liquid to be used for volume displacement measurement should only be supernate. Use of raw water for volume displacement instead of or in addition to supernate shall be discussed with Ecology prior to use.

At the cessation of waste retrieval operations, the tank walls and heel will be flushed to the extent practical with water. Flush water will not be purposely sprayed on the walls above the maximum level stated in the process control plan. When performing the tank flushes, the flush water may be used to push some of the residual waste to a convenient sampling location.
For each flush, the volume of water added will be metered and recorded. The flush liquid will be pumped to a minimum heel following each flush addition. It is assumed that performing the final tank flushes will remove residual solids to the extent practical on the walls and dilute soluble radionuclides and chemicals in the tank liquid. Any ENRAF level gauge readings taken

When modified sluicing is performed using DST supernate, the overall volume of waste requiring management (storage and/or volume reduction) in the DST system is significantly reduced over that associated with the MRS. The retrieval duration is also significantly less with modified sluicing.

After considering both candidate waste retrieval technologies and evaluation of the tank as discussed in Section 2.1.3.2, modified sluicing using recycled DST supernate was selected as the preferred technology for deployment in tank C-111.

The second technology alternatives, if necessary, should one be required for residual waste removal following modified sluicing, are an in-tank vehicle, high pressure water, and a chemical retrieval process.

Generally, an in-tank vehicle is desirable for large or monolithic particles since it can break these apart for sluicing, while a chemical retrieval of larger aggregates may be slow or ineffective due to the small surface area for dissolution. High pressure water or an in-tank vehicle is preferred as the heel volume increases because a chemical retrieval process may take up too much DST space and, for caustic or acid dissolutions, will have proportionally more impact to the DST space. A chemical retrieval process is preferable for heels where the volume is relatively low so the impact on DST space and the WTP throughput volume is less. A chemical retrieval process may also be preferable if the particles are small because the surface area for dissolution is greater and an in-tank vehicle may just push the fine particles around the tank.

High pressure water was selected as the second technology for C-111 as it can be deployed in less time than an in-tank vehicle when the first technology is no longer effective and the tank residual waste volume in the Decree is exceeded. The third technology, should it be needed, is chemical dissolution. Sluicing with supernate and size reduction with high pressure water are both mechanical methods to reduce agglomerations to pumpable size. Chemical dissolution compliments the mechanical technologies and has shown to be effective for waste forms resistant to size reduction by mechanical methods. Second and third technology selection inherently relies on past experience and assumptions on the tank waste characteristics that will be present after the first technology is deployed to its limits.

The technologies selected are anticipated to provide the best methods to achieve the 360 cubic feet target volume goal specified in the Decree, when deployed to their "limits of technology."

3.4 ANTICIPATED PERFORMANCE COMPARED TO AGREEMENT CRITERIA

Anticipated performance compared to agreement criteria

The WRS for tank C-111 will be designed to retrieve as much waste from the tank as technically possible with waste residues not to exceed 360 ft^3 or the limit of technology, whichever is less in accordance with the requirements of HFFACO Milestone M-45-00.

3.5 WASTE RETRIEVAL SYSTEM DIAGRAM

A simplified diagram of the retrieval system (include flow path, elevation changes, and tank layout).

Figure 3-1 is a proposed installation of ventilation system(s) equipment to support waste retrieval operations. Alternate layouts may also be used. A sketch of the WRS installation planned for tank C-111 is provided in Figure 3-2. A potential HIHTL flow path routing and equipment layout in the tank farm is provided in Figure 3-3. As noted in Section 3.1.1, the elevation in the AN tank farm is approximately 22 ft higher than the elevation in the C tank farm.

3.6 FUNCTIONS AND REQUIREMENTS FOR WRS DESIGN

Functions and corresponding requirements necessary to support design of proposed waste retrieval system. Functions and requirements are to be provided at a level of detail consistent with a Level 1 specification (see RPP-7825 [S-112 F&R], Section 4 and/or RPP-18811 [C-103/105 F&R]).

This section defines the upper-level functions and corresponding requirements to which the C-111 WRS must be designed and operated. This TWRWP is not a system specification that defines design criteria for the WRS. However, the system specification for the C-111 WRS will be consistent with this TWRWP. The functions and requirements are provided in Table 3-~~3~~4 and are focused on defining the upper-level requirements for the tanks.

Table 3-4. Tank C-111 Waste Retrieval System Functions and Requirements. (2 Sheets)

Function	Requirement	Basis*	Key Elements
Control gaseous and particulate discharges	The ventilation system exhaust shall be filtered to restrict emissions to the environment.	WAC 173-303 WAC 173-400 WAC 173-460 WAC 246-247 TFC-ESHQ-ENV-STD-03 TFC-ESHQ-ENV-STD-04	Mitigate potential release to the public and the environment.
Mitigate potential for leaks to occur during waste retrieval	Prevent inadvertent release from tank C-111 to the environment.	RPP-13033, Section 3.3.2.3.4	Do not raise waste level above benchmark level. (Benchmark level is discussed in Section 4.6).
Control waste level in DST receiver tank	The WRS shall be operated to maintain waste level within specified allowable maximum and minimum values.	OSD-T-151-00007	Provide for safe waste storage in DSTs.
Remove waste from tank C-111	The retrieval technologies will be designed, deployed, and operated to each of their "limits of technology" in an effort to achieve the waste residue goal of 360 ft^3 of waste or less for each tank. The limit of technology is defined in the Decree.~~The WRS shall be capable of removing as much waste as technically possible, with tank waste residues not to exceed 360 ft^3, or the limit of the waste retrieval technology, whichever is less.~~	WAC 173-303 ~~HFFACO Milestone M-45-00~~	The WRS shall provide the ability to retrieve as much waste as technically possible.
Control and monitor the waste removal process in tank C-111	The WRS shall provide the monitor and control capability to control the waste retrieval and transfer process. This includes controlling and monitoring the following WRS process parameters: • Pressures • Flow rates • Differential pressures across exhaust ventilation filters • Leak detection systems.	RPP-13033 HNF-SD-WM-TSR-006 WAC 173-303 WAC 246-247 TFC-ENG-STD-26 Consent Decree No. DV-08-5085-FVS	Provide for safe and effective operation of the WRS.
Minimize waste generation	The WRS shall minimize waste generation to the greatest extent practical.	WAC 173-303 40 CFR 264.73(b)(9)	No numerical requirement.
Nuclear safety	The WRS shall be designed and operated to protect workers, public, the environment, and equipment from exposure to radioactive tank waste and emissions during the retrieval campaign.	WAC 246-247 10 CFR 830 RPP-13033 HNF-SD-WM-TSR-006 HNF-IP-1266	Ensure protection of workers and the public from routine operations and potential accident conditions.
Occupational	The WRS shall be designed for safe	WAC 173-303-2 83(3)(i)	OSHA standards.

The requirements for an IQRPE assessment need and the permitting decision logic for new equipment or repairs/upgrades to equipment will be performed in compliance with ~~RPP-16922~~TFC-ESHQ-ENV-PP-C-11, ~~*Environmental Specification Requirements*, latest revision, Section 13.0, *IQRPE Assessment Need and Permitting Decision Logic*~~*Independent Qualified Registered Professional Engineer*.

Risers were reviewed as part of the original SST System Integrity Assessment (RPP-10435). SST system components (e.g., risers, pits, etc.) that were identified as part of the SST system for the original Integrity Assessment are not part of the retrieval system (unless specifically identified as such) and do not require a separate or additional integrity assessment if the function of the equipment doesn't change from its original purpose (e.g., the original purpose of risers is to provide tank access) and changes to the component are not outside the original component design basis and specifications.

3.9 DISPOSITION OF WASTE RETRIEVAL SYSTEM FOLLOWING WASTE RETRIEVAL

Describe the disposition of the system at the completion of waste retrieval.

3.9.1 Disposition of New Waste Retrieval System Components

Following completion of waste retrieval, the in-tank equipment will be left in place for disposition during component closure actions. The above-grade equipment (e.g., transfer lines, valve box, and related enclosures) will be reused to the extent possible for future waste retrieval activities. Transfer lines and related equipment will be flushed to reach acceptable exposure rates for disconnecting and relocating the equipment. Any above-grade equipment that needs to be removed and is not suitable for reuse will be packaged and disposed of as mixed waste onsite in accordance with the approved waste acceptance criteria for the Hanford Site burial grounds. If contaminated equipment is reused it will be controlled as specified in TFC-OPS-WM-C-10, *Contaminated Equipment Management Practices*. Where or if required and needed to support the retrieval of SSTs, the HIHTLs will be managed to ensure the availability and functionality of each as needed for future retrievals. At the conclusion of their mission, or on reaching the end of life for an HIHTL, the HIHTL will be managed in accordance with RPP-12711, *Temporary Waste Transfer Line Management Program Plan*.

3.9.2 Disposition of Existing Ancillary Equipment

Ancillary equipment associated with tank C-111 is limited to waste transfer lines and equipment installed in pits and above-grade risers. The current status of the ancillary equipment associated with tank C-111 is described in Section 2.2. Any existing contaminated ancillary equipment located within risers that needs to be removed following waste retrieval will be packaged and disposed of onsite in accordance with the approved waste acceptance criteria for the Hanford Site burial grounds or controlled as specified in TFC-OPS-WM-C-10.

In accordance with the SST System Closure Plan (RPP-13774), disposition of the ex-tank ancillary equipment, including pipelines, will be performed in accordance with a separate component closure activity plan. Closure plans will be incorporated into the Sitewide permit.

3.10 AIR MONITORING PLAN

ORP and the tank farm contractor, pursuant to federal requirements for protection of their workers, will develop and implement industrial hygiene (IH) monitoring plans for exhauster stack emissions for the retrieval of tank C-111. The plans will be developed and implemented pursuant to the requirements of TFC-PLN-~~43~~34, ~~*Tank Operations Contractor Health And Safety Plan*~~*Industrial Hygiene Exposure Assessment Strategy*. The constituents of potential concern (COPC) for which exhauster stack sampling and analysis will be conducted will be identified in the IH monitoring plan for the retrieval. The COPC identified in the IH monitoring plans will be all or a subset, as determined to be appropriate by the tank farm contractor IH, of those constituents listed in RPP-20949, *Data Quality Objectives for the Evaluation of Tank Chemical Emissions for Industrial Hygiene Technical Basis*, Table 4-1, developed with input from Ecology and RPP-22491, *Industrial Hygiene Vapor Technical Basis*. ~~Once the initial subset of COPC is identified and listed in the IH monitoring plans, n~~No COPC shall be dropped from ~~that~~ the Tank Vapor Information Sheet (TVIS) list developed for C-Farm without 90 days prior notification to and approval from Ecology. If ORP notifies Ecology of its desire to cease exhauster stack sampling for a COPC initially identified and listed in an IH monitoring plan and no response is received from Ecology within 90 days, the COPC will be deleted from the IH monitoring plan and sample and analysis activities for that COPC will cease. New COPCs may be added to an IH monitoring plan without notification to or approval from Ecology and without modifying or revising this TWRWP.

The sampling and analysis methods shall be U.S. Environmental Protection Agency (EPA), National Institute for Occupational Safety and Health, or Occupational Safety and Health Administration approved methods or an equivalent the tank farm contractor approved method, as identified in RPP-20949. The exhauster stack samples will be analyzed at the 222-S Laboratory, the Waste Sampling and Characterization Facility, or an equivalent laboratory consistent with the quality assurance/quality control procedures for that laboratory. Further, laboratory analysis data will be kept on file at the laboratory consistent with the laboratory record keeping procedures for that laboratory for a period of not less than 5 years and will be available to Ecology within 24 hr on request.

Ecology and ORP understand and agree that the activities discussed above do not restrict ORP and the tank farm contractor from taking any and/or all steps necessary as ORP and the tank farm contractor deem appropriate to protect its workforce in response to data and information generated by an IH monitoring plan or incidents as they might arise during waste retrieval. Ecology and ORP also understand and agree that the preceding sampling and analysis discussion is presented to ensure ORP is achieving the agreed to sampling and analysis for the protection of the public and its workers and does not modify the exemption from the requirements of 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart CC, granted to ORP under 40 CFR 265.1080(b)(6). Therefore, this discussion does not imply any change to the respective authority of either Ecology or ORP regarding the sampling, analysis, monitoring, and control of airborne emissions from Hanford Site tanks.

4 DESCRIPTION OF PLANNED LEAK DETECTION AND MONITORING TECHNOLOGIES

4.1 EXISTING TANK LEAK MONITORING

This section describes tank leak monitoring activities that have been historically performed or are currently being performed.

Prior to beginning retrieval operations, single-shell tanks are in waste storage mode. The requirements for leak detection while in waste storage mode are provided in OSD-T-151-00031, *Operating Specifications for Tank Farm Leak Detection and Single-Shell Tank Intrusion Detection.* When retrieval operations are ready to commence for C-111 the tank enters retrieval mode as described in 4.2.

4.1.1 Drywell Monitoring

Identify the number and location of drywells near the subject tank. Identify ongoing routine drywell monitoring activities. (configuration, depth, frequency of and methodology for sampling)

Seven drywells are spaced around tank C-111 that are between 5 and 25 ft from the edge of the tank (Figure 4.1). The seven drywells include 30-11-01, 30-11-05, 30-11-06, 30-10-02, 30-10-01, 30-11-09 and 30-11-11. All seven of the drywells are 100 ft deep (GJ-HAN-93, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank C-111*).

For tanks in waste storage mode there is no routine drywell logging performed.

4.1.2 Groundwater Monitoring

Identify the number and location of groundwater monitoring wells associated with the Waste Management Areas (WMA). Summarize current groundwater monitoring activities.

Groundwater monitoring at WMA C was begun in 1990 using four RCRA groundwater monitoring wells constructed in 1989 (299-E27-12, 299-27-13, 299-E27-14, and 299-E27-15). ~~The groundwater beneath the C tank farm is monitored in accordance with the RCRA groundwater monitoring plan established in 2001 (PNNL-13024, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area C at the Hanford Site*). Figure 4-2 provides a plan view of the C tank farm and the surrounding RCRA groundwater monitoring wells. There are nine groundwater monitoring wells surrounding the C tank farm (four new wells were constructed in 2003). Since June 2002, groundwater sampling for the groundwater wells 299-E-27-7, 299-E-27-12, 299-E-27-13, 299-E-27-14, and 299-E-27-15 has been performed on a quarterly basis (PNNL-13024, ICN-1). Since December 2003, new groundwater monitoring wells 299-E-27-4, 299-E-27-21, 299-E-27-22, and 299-E-27-23 have also~~Additional monitoring wells have been added since 1989. A current list of the WMA C ground water monitoring wells can be found in DOE/RL-2009-77. The wells are sampled

quarterly ~~been sampled on a quarterly basis~~ to meet prior agreements made with Ecology. Quarterly samples are analyzed at a minimum for anions, cyanide, inductively coupled plasma metals, gross beta, ^{99}Tc, and total uranium, and a low-level gamma scan is performed. Sampling is conducted in accordance with DOE/RL-2009-77 and DOE/RL-2001-49.

The quarterly groundwater monitoring that is currently performed is adequate for the purpose of supplementary data collection during waste retrieval. Ecology is provided quarterly groundwater monitoring sample results in the quarterly and annual groundwater monitoring reports. These reports are issued by the groundwater project..

If a leak is detected during retrieval, groundwater monitoring frequency will be reevaluated in accordance with the regulatory requirements in WAC 173-303, "Dangerous Waste Regulations."

4.1.2.1 Use of Groundwater Monitoring for Retrieval Process Control.

(1) Evaluate the use of appropriately located existing groundwater monitoring wells for retrieval process control.

Based on the limitations of flow transport calculations and the time required for a retrieval leak to show up in groundwater samples, groundwater monitoring data will not be used for retrieval process control, but is available, for background reference information only, through the site groundwater monitoring program.

4.1.2.2 Groundwater Sampling Prior to and Following Retrieval.

(2) Ensure that appropriately located existing groundwater monitoring wells will be sampled within a two month period prior to and following the retrieval (quarterly sampling satisfies this requirement).

~~PNNL-13024, ICN 5, requires q~~Quarterly groundwater sampling is performed for the C-farm groundwater monitoring wells. In accordance with 04-TPD-083 – letter, it was agreed to in writing by ORP, Ecology, and the tank farm contractor that quarterly groundwater sampling satisfies the TWRWP outline requirement C.1.b.(2) (this wording is in italics at the start of Section 4.1.2.2) to take groundwater samples within a 2-month period prior to and following retrieval.

4.1.3 Existing Tank Level Monitoring Equipment and Activities

Identify existing level measurement instrumentation in the subject tank and receiver tank. Identify ongoing tank level monitoring activities.

Tank C-111 currently has an operable ENRAF level gauge installed. The receiver DST ~~currently~~ has the same type of level gauge installed. The receiver DST annulus ~~also~~ has ~~three conductivity probe gauges~~three leak detection devices installed such as Enraf level gauges or similar instruments and continuous air monitors ~~in the annulus. These annulus level gauges are used~~ for detection of leaks from the tank primary tank liner.

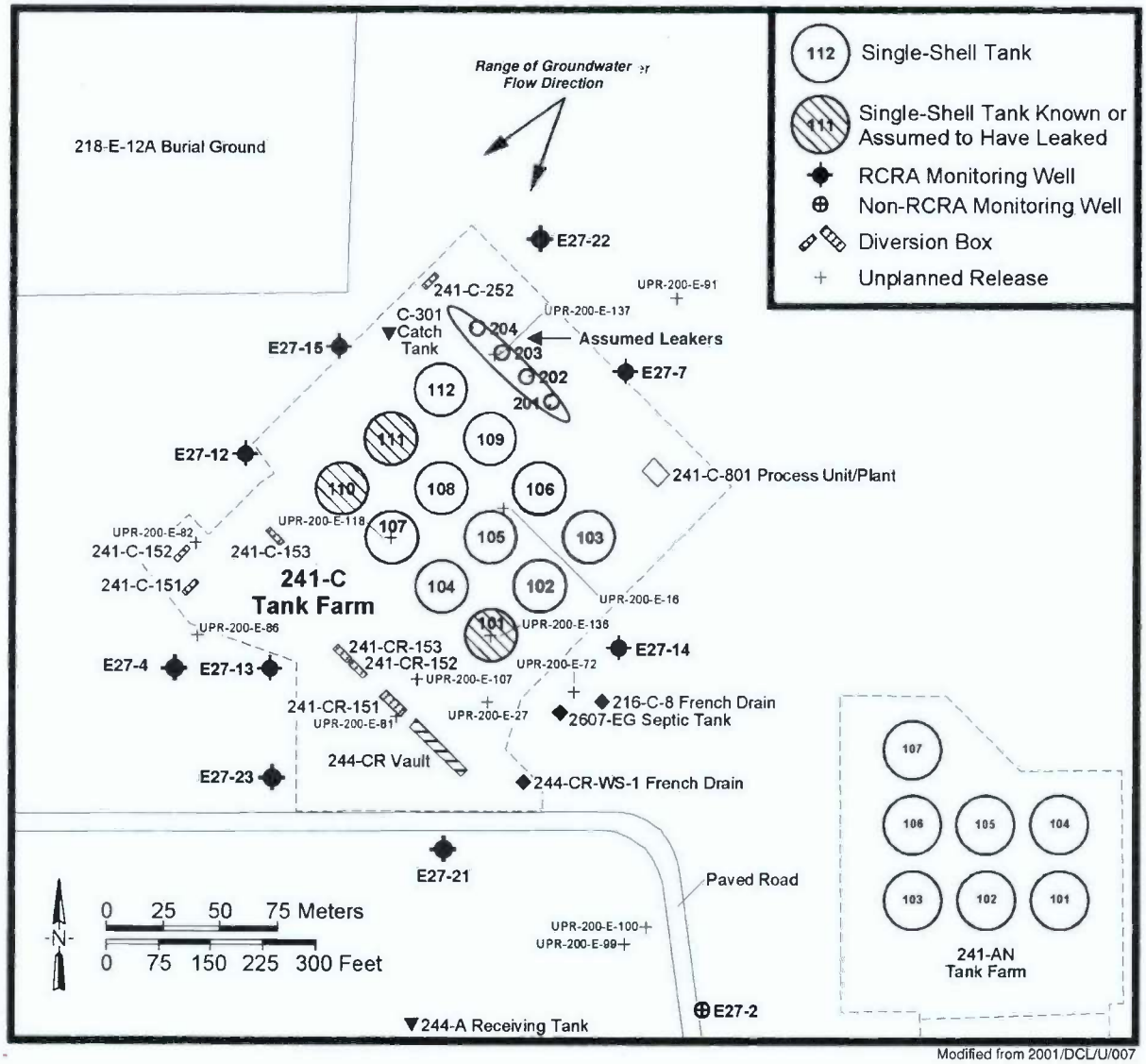
The waste level in C-111, while in storage mode, is monitored for intrusion only on a quarterly basis (OSD-T-151-00031, *Operating Specifications for Tank Farm Leak Detection and Single-*

Shell Tank Intrusion Detection). The basis for in-tank leak detection and intrusion monitoring is provided in RPP-9937, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document*.

The primary level monitoring in the receiver DST is performed as described in OSD-T-151-00031, Section 4.0. The ~~three~~ three annulus leak detector ~~probes~~ instruments provide indication of tank leaks as described in OSD-T-151-00031, Section 4.0.

Level monitoring for the tank receiving the exhauster condensate, if not C-111, will be performed as specified in the applicable Ecology approved TWRWP for that tank.

~~Figure 4-2. Waste Management Area C and Regulated Structures.*~~



Modified from 2001/DCL/U/007

~~* Adapted from Figure B.18 in PNNL-14548, Hanford Site Groundwater Monitoring for Fiscal Year 2003.~~

The SGLS logging system was used to establish baseline conditions in 1995-2000. This logging system is based on a liquid nitrogen cooled high purity germanium detector, which provides excellent gamma energy resolution for identification and quantification of individual radionuclides from background levels (method detection limit about 0.1 pCi/g ^{137}Cs under typical conditions) up to about 10,000 pCi/g ^{137}Cs. A high rate detector with internal and external shields is available to extend the measurement range to about 10^9 pCi/g ^{137}Cs.

The SGLS truck can also be used to operate a neutron moisture logging system, which measures in situ vadose zone moisture over the range of 0 to about 25 vol% moisture content. The neutron moisture logging system uses a similar source-detector relationship as the handheld moisture gauge.

It takes about one shift of operation to obtain moisture logging data from all the drywells around a tank with the hand-held moisture probe. It takes about one shift of operation to obtain RAS data from one drywell.

The handheld moisture gauge will be deployed by qualified personnel in accordance with TO-320-022, *Operate Model 503DR Hydroprobe Neutron Moisture Detection.*

The logging systems will be deployed by qualified personnel in accordance with the applicable procedures for that equipment.

The results from drywell monitoring, as well as a summary and analysis of this monitoring, including tools used, calibration, boreholes logged, depth of logging, frequency, logging rate, and data analysis will be submitted to Ecology within the retrieval data report in accordance with Appendix I of the HFFACO.

4.2.1.2 Leak Detection Using SST Liquid Level Measurement. SST level measurement data are normally limited during periods when active retrieval operations are not being performed due to the strategy of minimizing liquid in the tank. In addition, because of the dished bottoms of the tanks and the location of the level instrumentation near the side in the C-100 series SSTs, waste levels cannot be measured below approximately 12,000 gal. However, should conditions exist where a continuous liquid surface measurement is available (e.g., a pump fail prior to removing as much liquid as practical from the tank and replacement of the pump cannot occur immediately) this measurement could provide an additional means of leak detection superior to either drywell monitoring or HRR. SST Liquid level measurement can be used for leak detection during waste retrieval under the following conditions:

a. The tank level gauge must be an ENRAF level gauge of the type normally used in tank farms

b. There must be a liquid surface under the ENRAF plummet, with no part of the plummet touching any waste solids or the tank bottom

c. There are no active retrieval operations being performed

d. The tank is not being actively exhausted except as required to meet air permit requirements*

e. The measured waste level is not increasing, such as can occur if liquid is slowly draining from waste solids above the liquid surface

*If the exhaust is applied to the tank for > 7 days and causes a significant level decrease rate, moisture logging will be evaluated as an alternative leak detection method.

Material balance will not be credited for SST leak detection during the retrieval of C-111.

4.2.1.3 High-Resolution Resistivity. HRR will be used for leak detection during the retrieval of the waste in C-111. The equipment operates continuously except when down for repairs, calibrations, electrical outages, or similar reasons. Should a problem occur which renders the HRR leak detection system inoperable, drywell monitoring would be used as a backup means of leak detection, within the conditions specified in Figure 4-3 and 4.2.1.1.

The HRR method uses geophysical resistivity measurements as a means to detect changes in baseline soil moisture levels. The electrical resistivity of the soil around and beneath a waste tank depends on a number of parameters, one of which is moisture content. The leakage of water or tank waste into these sediments changes the soil resistivity. The HRR method detects a potential leak by comparing a present resistivity measurement against a previously obtained baseline measurement. Comparison to a baseline allows the HRR method to discount existing resistivity differences in the soil caused by factors that include conductive structures or prior leaks. Changes in soil moisture from precipitation need to be taken into consideration during monitoring to reduce the potential for making an incorrect leak determination.

HRR data processing, data review, leak evaluation methodology and definitions of anomalies and unexplained anomalies are described in RPP-32477, *High Resolution Resistivity Leak Detection Data Processing and Evaluation Methods and Requirements.* The HRR leak detection requirements in RPP-32477 and in this TWRWP will be implemented in approved procedures by trained and designated personnel prior to the start of waste retrieval operations.

The basic resistivity measurement concept utilizes the existing drywells and/or a tank electrode (normally the tank thermocouple) as measurement electrodes. There are reference transmitter and receiver electrodes located a nominal 1,500 ft or more from the tank farm. Power is applied to a drywell-reference transmitter electrode pair and an amperage measurement obtained. Concurrently, a voltage measurement is obtained at another electrode-reference receiver electrode pair. Soil resistivity is calculated by dividing the voltage measured across the receiver electrode pair by the current measured across the transmitter pair. These measurements are repeated continuously and the subsequent resistivity data analyzed for changes with time.

The HRR data may be reviewed any time. When the system is operating the raw data is normally less than an hour old.

Ecology will be informed via e-mail or phone if an unexplained HRR anomaly exists. The response to an unexplained HRR anomaly is described in 4.6. It is anticipated that three months or more may be needed to analyze all the available data and obtain any needed supporting information to enable resolution of the unexplained HRR anomaly. If, after three months, the unexplained HRR anomaly has not been resolved, Ecology will be consulted as to possible changes in groundwater and analyte monitoring frequency.

A limitation to the HRR system is that it provides data primarily as a two-dimensional diagram from the viewpoint of looking down on the tank. Thus a leak may be detected by HRR, and the general location of the leak around the tank noted, but the actual depth may or may not be able to be discerned from the data.

4.2.1.4. Leak Detection in Transfer Lines and Pits During Waste Retrieval. Supernate will be transferred from the receiver DST and liquid waste and slurry will be transferred from C-111 back to the receiver DST using temporary hose-in-hose overground transfer lines and pits. Leak detectors located in pits will be monitored during waste transfers. Leaks may also be detected by monitoring flows and by radiation monitoring of the HIHTL in accordance with the requirements of RPP-13033 and RPP-12711, *Temporary Waste Transfer Line Management Program Plan.* Pits associated with the receiver tank will also be monitored.

Leakage from the primary overground transfer hose (inner hose) will be contained by the secondary confinement system (outer hose). The secondary confinement system is designed to drain any fluid released from the primary hose to a common point for collection, detection, and removal. Leak detection elements are installed in pits at the ends of the transfer lines. If a leak occurs the liquid will contact the detector, which will actuate an alarm and the transfer pumps shut down either automatically or manually.

4.2.1.5 Leak Detection in Receiver DST During Waste Retrieval. The existing leak detection systems in the receiver DST will be utilized as required in OSD-T-151-00031. ~~A leak from the primary vessel of the receiver DST will be detected by a conductivity probe~~Leak detection instruments are installed in the annulus to detect a leak from the primary tank.

4.2.2 Use of Drywells and Groundwater Wells During and After Waste Retrieval

b. Describe the proposed use of existing drywells and groundwater monitoring wells during and after waste retrieval operations.

During waste retrieval operations existing drywells will be monitored if needed as a backup means of leak detection as described in Section 4.2.1.1.

The post-retrieval gamma scans may be done by any of the gamma logging methods discussed in Section 4.2.1.1 within 6 months following the completion of waste retrieval on the tank.

Groundwater monitoring wells will be sampled and the samples analyzed both during and after waste retrieval operations as described in Section 4.1.2.

5 REGULATORY REQUIREMENTS IN SUPPORT OF RETRIEVAL OPERATIONS

Summaries of documents (training plans, contingency plans, emergency response plans, reporting, record keeping, inspection summaries, etc.) as required for waste retrieval by WAC 173-303.

Retrieval of waste from the SSTs will be performed under the requirements of the ~~HFFACO~~Decree, the *Atomic Energy Act of 1954*, and RCRA, RCW 70.105, "Hazardous Waste Management Act" and their implementing regulations. The SSTs do not provide secondary containment and are not compliant with RCRA and RCW 70.105 interim facility standards of Subpart J of 40 CFR 265. The SSTs are currently authorized to continue operations under RCW 70.105 pending closure in accordance with WAC 173-303-610, "Closure and Post-Closure," under the authority of HFFACO Milestones M-45-~~00~~83, M-045-84, and M-045-85~~"Complete Closure of all Single Shell Tanks Farms." Except as otherwise modified by HFFACO Milestone M-45-00,~~ DOE conducts day-to-day operations of the SSTs in accordance with the interim facility standards established in WAC-173-303-400(3), "Interim Status Facility Standards." WAC 173-303-400(3) incorporates by reference the interim status performance standards set forth by the EPA in 40 CFR 265. Additionally, the SSTs are governed by federal regulations promulgated under the authority of the *Atomic Energy Act of 1954* and various DOE directives incorporated into the contract between ORP and the tank farm contractor (DE-AC27-99RL-14047). These requirements are implemented through operating plans and procedures by the tank farm contractor.

Interim status facility standards in WAC 173-303-400(3)(a) incorporate by reference the interim status standards set forth by EPA in 40 CFR 265 Subpart J for tank systems. Elements of the interim status standards relevant to the WRS along with the WRS features and/or operating plans and procedures are summarized in Table 5-1.

If required, approval to retrieve waste that could contain polychlorinated biphenyls (PCBs) from tank C-111 using supernate from the receiver DST and transfer the resulting slurry to the receiver DST will be obtained from EPA before initiating waste retrieval operations. The DST supernate is classified as PCB remediation waste in accordance with Ecology et al. (2000), *Framework Agreement for Management of Polychlorinated Biphenyls (PCBs) in Hanford Tank Waste*. Because the DST supernate is classified as PCB remediation waste, the retrieval of waste from SSTs when using DST supernate requires a Risk-Based Disposal Approval, approved by EPA, pursuant to the *Toxic Substances Control Act of 1976*.

The ventilation system(s) used during waste retrieval operations are designed to pass air through the tank, thereby reducing condensation and fog within the tank. The ventilation systems required by the Washington State Department of Health include a heater, prefilter, demister, two high-efficiency particulate air filters and test sections, exhaust fan, and stack. Details of the ventilation systems are provided in ~~AIR 09-704, *Categorical Tank Farm Facility Waste Retrieval and Closure: Phase II Waste Retrieval Operations* (including as amended in updates) and DE05NWP-002R2, *Approval of Criteria and Toxics Air Emissions Notice of Construction (NOC) Application for Hanford Single-Shell Tank Waste Retrieval* (as amended in updates)~~00-05-006, *Hanford Site Air Operating Permit*, as amended and succeeded.

9 REFERENCES

00-05-006, Hanford Site Air Operating Permit, Washington State Department of Ecology, Olympia Washington, as amended and succeeded.

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

29 CFR 1926, "Safety and Health Regulations for Construction," *Code of Federal Regulations*, as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

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

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

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

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