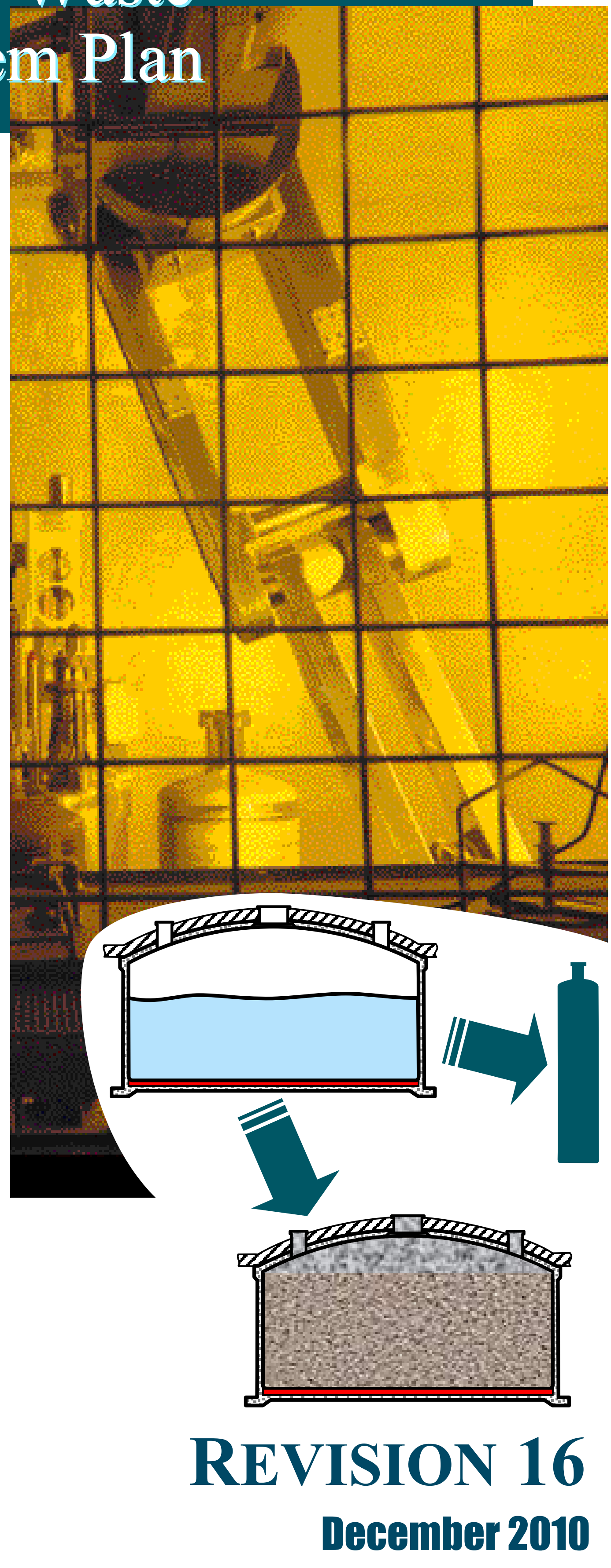
SRR-LWP-2009-00001

SRS®

Savannah River Site Liquid Waste Planning Process

LIQUID Waste System Plan

An Integrated System at the Savannah River Site



REVISION 16

December 2010

SRR-LWP-2009-00001
REVISION: 16
December 6, 2010
KEYWORDS: Tank Farm, Salt Program, DWPF, Liquid Waste, ETF, Sludge Washing, Lifecycle, Waste Solidification, MCU, ARP, CSSX, SWPF

RETENTION: PERMANENT

UNCLASSIFIED
DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
ADC & Reviewing Official: David P. Olson
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Liquid Waste System Plan

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Table of Contents

Index of Tables

Index of Figures

1. Executive Summary

This sixteenth revision of the *Liquid Waste System Plan* aligns the end of salt processing with the end of sludge processing, thus reducing the life cycle of the Liquid Waste (LW) system by six years with a concomitant savings of approximately $3.25 billion. It accomplishes this by the addition of additional salt processing capability with respect to Revision 15 including the addition of the Small-Column Ion Exchange (SCIX) process and the deployment of next generation extractant in the Modular Caustic Side Solvent Extraction (CSSX) Unit (MCU) and the Salt Waste Processing Facility (SWPF).

The additional salt processing capability supplements the innovations described in Revision 15 of the *Plan* "…to optimize Liquid Waste system performance, i.e., accelerate tank closures and maximize waste throughput at the Defense Waste Processing Facility (DWPF)[1]." These innovations included deployment of several new technologies such as:

- Enhanced chemical cleaning of tanks after bulk waste removal efforts (BWRE) are complete
- Melter bubbler technology to improve the capacity of the DWPF melter
- DWPF feed preparation improvements to reduce processing time within DWPF
- Rotary microfiltration (RMF) to decrease sludge preparation cycle time
- Low temperature aluminum dissolution (LTAD) of sludge to minimize DWPF canister count
- Optimization of the tank removal from service process to enable a reduction in the tank removal from service process cycle time.

These actions result in maximizing sludge and salt processing, doubling DWPF throughput, closing Type I, II, and IV tanks ahead of the schedule required by regulatory agreements, and managing available Type III tank space.

Purpose

The purpose of the *Liquid Waste System Plan* (hereinafter referred to as "this *Plan*") is to integrate and document the activities required to disposition approximately 37 million gallons of existing and future HLW and to remove from service radioactive LW tanks and facilities at the Department of Energy (DOE) Savannah River Site (SRS). It records a planning basis for waste processing in the LW System through the end of the program mission. Its development is a joint effort between DOE-Savannah River (DOE-SR) and Savannah River Remediation LLC (SRR).

This *Plan* meets the contract deliverable described in Contract № DE-AC09-09SR22505; Part III — List of Documents, Exhibits, and Other Attachments; Section J — List of Attachments; Appendix M — Deliverables; Item № 1 — *Liquid Waste System Plan*.[2]

This sixteenth revision (Revision 16) of the *Plan*:

- Provides one of the inputs to development of financial submissions to the complex-wide Integrated Planning, Accountability, & Budgeting System (IPABS)
- Provides one of the inputs for updating the *Savannah River Site Environmental Management Program Project Execution Plan* (PEP)[3]
- Provides a basis for LW contract and Contract Performance Baseline changes
- Forecasts compliance with the currently approved *Federal Facility Agreement* (FFA)[4] and its Waste Removal Plan and Schedule and the *Site Treatment Plan* (STP)[5].

Goals

The goals of this *Plan* are to meet the following programmatic objectives:

- Continue storing liquid radioactive wastes in a safe and environmentally sound manner
- Meet tank BWRE regulatory milestones in the currently-approved FFA
- Meet tank removal from service regulatory milestones in the currently-approved FFA
- Meet the waste treatment goals identified in the STP
- Conduct operations consistent with the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[6], the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7], and future waste determination (WD) and bases documents for F- and H-Areas
- Comply with applicable permits and consent orders, including the Landfill Permit for the SRS Z Area Saltstone Disposal Facility (SDF) and the Consent Order for Dismissal in Natural Resources Defense Council, et al. v. South Carolina Department of Health and Environmental Control, et al. (South Carolina Administrative Law Court, August 7, 2007)

- Optimize program life cycle cost and schedule
- Provide tank space to support staging of salt solution adequate to feed the SWPF at system capacity
- Provide tank space to support staging of salt solution adequate to feed the SCIX at system capacity
- Sustain sludge vitrification in the DWPF
- Remove the tetraphenylborate (TPB) laden waste from Tank 48 so this tank is available to support DWPF feed batch preparation, tank removal from service, and salt feed batch preparation; treat and destroy the TPB in the waste
- Minimize the quantity of radionuclides (as measured in curies) dispositioned in the SDF, keeping the total curies at or below the amount identified in the *Savannah River Site – Liquid Waste Disposition Processing Strategy*[8] (SRS LW Strategy) and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*
- Support continued nuclear material stabilization of legacy materials in H-Canyon through at least 2019.

There is currently limited processing and storage space in the SRS radioactive liquid waste tanks. To enable continuation of risk reduction initiatives encompassed by the goals above, this *Plan* follows a processing strategy to provide the tank space required to support meeting, or minimizing impacts to meeting, programmatic objectives. During the period prior to startup of SWPF in 2014, near-term retrieval, treatment, and disposal of salt waste are required. This is performed using operation of the Actinide Removal Process (ARP) and MCU facilities. Operation of these salt treatment processes frees up working space in the 2F and 2H Evaporators' concentrate receipt tanks (Tanks 25 and 38, respectively). This provides support for near-term handling of waste streams generated from early-year tank removals from service, DWPF sludge batch preparation, DWPF recycle handling, and H-Canyon processing.

Revisions

The significant updates from the previous version of this *Plan,* the *Life-cycle Liquid Waste Disposition System Plan, Revision 15* (Rev 15)[9], include:

- **Salt Processing**:
  - **SWPF Processing:** SWPF operations initiation delayed to July 2014 from May 2013
  - **SCIX Processing**: SRR's proposal of a new salt process to supplement SWPF processing beginning in October 2013
  - **Next Generation Extractant:**
    - deploy next generation extractant to MCU to improve decontamination factor and to inform SWPF
    - deploy next generation extractant to SWPF to increase processing rate to a nominal 7.2 Mgal/year from 6.0 Mgal/yr
- **Tank Storage Space:**
  - **Tank 48**: Tank 48 return-to-service was revised to October 2016 from December 2014
  - **Tank 50**: Tank 50 will be available for High Level Waste (HLW) service in February 2012; however, this *Plan* projects Tank 50 utilization as the feed tank for the Saltstone Production Facility (SPF) for the duration of the LW program
- **Accomplishments:**
  - **Deliquification, Dissolution, & Adjustment (DDA) Processing:** DDA-solely processing of salt is completed and no further DDA-solely processing is planned
  - **Salt Storage**: Tank 25 was recovered as the 2F Evaporator concentrate receipt tank, having the salt successfully removed and prepared for salt processing

Results of the Plan

Table 1-1 — *Results of the Plan* describes the major results as compared to Revision 15 of the *Plan*. A description of these results follows.

Table 1-1 — *Results of the* Plan

Parameter	Rev 15	This *Plan*
Date last LW facility removed from service	2032	2026
All BWRE currently-approved FFA commitments met	Yes	Yes
All yearly tank removal from service currently-approved FFA commitments met	Yes	Yes
Final FY2022 currently-approved FFA commitment met	Yes	Yes
Final Type I, II, and IV tank removed from service	2018	2018

Parameter	Rev 15	This *Plan*
FY 2028 STP commitment met	No	Yes
Date when waste removal complete from all tanks	Dec 2030	Dec 2024
SCIX for supplemental salt waste treatment	No	Yes
Next generation extractant for increased SWPF throughput	No	Yes
DWPF processing complete	2031	2025
Salt only canisters	Yes	No
Maximum canister waste loading	40 wt%	40 wt%
Nominal annual canister throughput rate	400	400
Total number of canisters produced	7,235	7,557
– *Total number of salt only canisters*	*250*	*0*
Cesium concentration of initial SWPF batch	<1 Ci/gal	<1 Ci/gal
Radionuclides (curies) dispositioned in SDF within *SRS LW Strategy*	Yes	Yes
Radionuclides (curies) dispositioned in SDF within NDAA §3116	Yes	Yes
Number of Saltstone Disposal Units (SDU)	40	41
Nuclear material stabilization in H-Canyon supported	Yes	Yes
SWPF facility removed from service	2031	2025
DWPF facility removed from service	2031	2026
SPF facility removed from service	2032	2026

- **SWPF Processing**: This *Plan* maintains the tank space required to provide feed for SWPF to maintain full capacity operations. The nominal processing rate for SWPF increases to 7.2 Mgal/yr from 6 Mgal/yr due to the incorporation of an improved cesium extractant. The average rate increased to 6.8 Mgal/yr from 5.7 Mgal/yr forecast in Revision 15 of the *Plan*. This increase by itself, however, is inadequate to meet the 2028 STP waste removal commitment due to delays in the start-up of SWPF.
- **SCIX Processing**: To mitigate this situation, additional salt processing capability is provided by the SCIX process, which adds an additional average salt processing rate of 2.5 Mgal/yr beginning in October 2013, resulting in meeting the STP commitment by 2025 (three years early)
- **Radionuclides Dispositioned in SDF**: This *Plan* is consistent with the *SRS LW Strategy* and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* concerning the total curies dispositioned at SDF
- **Vitrification of Sludge at DWPF**: This *Plan* continues the accelerated vitrification of sludge at DWPF discussed in Rev 15. This, coupled with accelerated salt waste treatment, allows vitrification be completed in 2025, six years earlier than in Rev 15. The 322 canister increase over the life of the program results from
  - updated estimates of sludge mass in Tanks 4 and 12 based on sample results (see section 4.2)
  - reduction of the low temperature aluminum dissolution (LTAD) for some of the material in Tanks 13 and 15
  - lower canister loadings during the time of the delay of SWPF.

  Additional material from SCIX operation is largely offset by the elimination of salt-only canisters.
- **Supporting Nuclear Material Stabilization**: Sufficient Tank Farm space exists to support the receipt of projected H-Canyon waste through the end of H-Canyon operations in 2019 and for shutdown flows through 2022. This *Plan* accommodates receipt of additional H-Canyon waste in Tank 50, SPF, or directly to sludge batches
- **Tank Closure**: This *Plan* projects meeting or exceeding all currently approved FFA commitments
- **Waste Treatment — STP Commitment**: The delays in start-up of SWPF reduce the ability to remove and treat the waste during the STP commitment period. However, supplementing salt processing using SCIX allows removal of the backlogged and currently generated waste inventory to be complete in 2025
- **Canister Storage**: This *Plan* requires a third Glass Waste Storage Building (GWSB), consistent with previous versions of the *Plan*. Shipment of canisters from SRS is not included in this *Plan*.
- **SDU Required**: The number of SDUs increased due to:
  - five percent decrement due to constructed size (149.5′ diameter) vs. nominal size (150′ diameter)
  - five percent decrement due to bleed water recycle requirement.

2. Introduction

This revision of the *Plan* documents the current operating strategy of the LW System at SRS to receive, store, treat, and dispose of radioactive liquid waste and to close waste storage and processing facilities. The LW System is a highly integrated operation that involves safely storing liquid waste in underground storage tanks; removing, treating, and dispositioning the low-level waste (LLW) fraction in concrete Saltstone Disposal Units (SDU); vitrifying the higher activity waste; and storing the vitrified waste until permanent disposition. After waste removal and processing, the storage and processing facilities are cleaned and closed. This *Plan* assumes the reader has a familiarity with the systems and processes discussed. Section 7 — *System Description* is an overview of the LW System.

The Tank Farms have received over 150 million gallons of waste from 1954 to the present. Reducing the volumes of waste through evaporation and disposition of waste via vitrification and saltstone, the Tank Farms currently store approximately 37 million gallons of waste containing approximately 350 million curies of radioactivity. As of September 30, 2010, DWPF had produced 2,987 vitrified waste canisters. All volumes and total curies reported as current inventory in the Tank Farms are as of June 30, 2010 and account for any changes of volume or curies in the Tank Farms since Revision 15 of the *Plan* and the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*.

Successful and timely salt waste removal and disposal is integral to efforts by SRS to proceed with all aspects of tank cleanup and removal from service, extending well beyond permitted disposal of the solidified low-activity salt waste streams themselves. Removal and disposal of salt waste not only enables tanks to be removed from service, it is necessary for the continued removal and stabilization of the high-activity sludge fraction of the waste. This is because SRS uses the tanks to prepare the high-activity waste so that it may be processed in DWPF. Salt waste is filling up tank space needed to allow this preparation activity to continue. Processing salt waste through SCIX and low-activity salt waste through ARP/MCU reduces this tank space shortage and increases the likelihood that vitrification of the high-activity fraction will be able to continue uninterrupted.

Operating ARP/MCU as described in this *Plan* will enable continued stabilization of DOE Complex legacy nuclear materials. It will also increase the likelihood that SWPF may be fed at nominal capacity when it begins operation, which would not be possible without these treatment processes. This, in addition to SCIX processing, will allow DOE to complete cleanup and removal from service of the tanks years earlier than would otherwise be the case. That, in turn, will reduce the time during which the tanks — including many that do not have full secondary containment and have a known history of leak sites — continue to store liquid radioactive waste. Finally, this *Plan* will make more tank space available for routine operations, thereby reducing the number of transfers among tanks and increasing the safety of operations.

2.1 *Alternative Analyses*

Three alternatives are discussed in this *Plan*. These alternatives are analyzed qualitatively as detailed modeling was not required to describe the impacts of the pursuit of these alternatives:

- SWPF operations initiation delayed until September 30, 2015 vs. July 2014
- Deployment and operational start-up of a second SCIX Unit in October 2013
- Pu disposition in sludge batches at various concentration in glass including:
  - — disposition of 2.5 metric tons (t) of additional Pu at 897 g/m^3
  - — disposition of additional Pu at 2,500 g/m^3
  - — disposition of additional Pu at 5,400 g/m^3

2.2 *Goals*

The goals of this *Plan*, consistent with the *SRS LW Strategy* are to meet the following programmatic objectives:

- Continue storing liquid radioactive wastes in a safe and environmentally sound manner
- Meet tank removal from service regulatory milestones in the currently approved FFA
- Meet the waste treatment goals identified in the STP
- Comply with the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, and future WD and bases documents for F- and H-Areas
- Comply with applicable permits and consent orders, including the Modified Permit for the SRS Z-Area SDF (permit No. 025500-1603) and the Consent Order of Dismissal in Natural Resources Defense Council, et al.

v. South Carolina Department of Health and Environmental Control, et al. (South Carolina Administrative Law Court, August 7, 2007) and State-approved area-specific General Closure Plans

- Optimize program life cycle cost and schedule
- Provide tank space to support staging of salt solution adequate to feed the SWPF at system capacity
- Provide tank space to support staging of salt solution adequate to feed the SCIX at system capacity
- Sustain sludge vitrification in the DWPF
- Remove the TPB laden waste from Tank 48 so this tank is available to support DWPF feed batch preparation, tank removal from service, and salt feed batch preparation; treat and destroy the TPB in the waste
- Minimize the quantity of radionuclides (curies) dispositioned in the SDF, keeping the total curies at or below the amount identified in the *SRS LW Strategy*[8] and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*
- Support continued nuclear material stabilization of legacy materials in H-Canyon through at least 2019.

The following generalized priorities are used to establish the sequencing of waste removal and disposition from the Liquid Radioactive Waste tanks:

1. Remove waste from tanks with a leakage history, while safely managing the total waste inventory and
   - Maintaining contingency transfer space per the Tank Farm Authorization Basis (AB)
   - Controlling tank chemistry, including radionuclide and fissile material inventory
   - Ensuring blending of processed waste to meet SWPF, DWPF, and SPF Waste Acceptance Criteria (WAC)
   - Enabling continued operation of the evaporators as necessary to process waste streams
   - Maintaining sufficient space in the Tank Farms to allow continued DWPF operation, providing for recycle receipt space and sludge batch preparation
2. Support removal from service of Type I, II, and IV tanks to meet currently approved FFA commitments
3. Provide tank space to support staging of salt solution adequate to feed salt solution to SWPF at full capacity
4. Support continued nuclear material stabilization in H-Canyon
5. Ensure that the curies dispositioned to the SDF are at or below the amount identified in the *SRS LW Strategy* and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*.

There is currently a premium on processing and storage space in the SRS radioactive liquid waste tanks. To enable continuation of risk reduction initiatives encompassed by the goals above, this *Plan* follows a processing strategy providing the tank space required to support meeting, or minimizing impacts to meeting, programmatic objectives. During the period prior to startup of SWPF in 2014, near-term retrieval, treatment, and disposal of salt waste are required. This is performed using operation of the ARP/MCU facilities and the installation and operation of the SCIX process. Operation of these salt treatment processes frees up working space in the 2F, 2H, and 3H Evaporators' concentrate receipt tanks (Tanks 25, 38, and 37, respectively). This provides support for near-term handling of waste streams generated from early-year tank removals from service, DWPF sludge batch preparation, DWPF recycle handling, and H-Canyon processing.

These initiatives and the assumed SWPF startup in 2014 provide tank space to minimize impacts to the programmatic objectives.

2.3 ***Risk Assessment***

A comprehensive identification and analysis of technical risks and opportunities associated with the LW program are documented within the *PBS-SR-0014, Radioactive Liquid Tank Waste Stabilization and Disposition, Risk and Opportunity Management Plan*[10] (ROMP). It identifies individual technical and programmatic risks and presents the strategies for handling risks and opportunities in the near-term and outyears.

3. Planning Bases

Dates, volumes, and chemical or radiological composition information contained in this *Plan* are planning approximations only. Specific flowsheets guide actual execution of individual processing steps. The activities described are summary-level activities, some of which have not yet been fully defined. The sequence of activities reflects the best judgment of the planners. Full scope, schedule, and funding development are found in individual project execution strategies. Once scope, cost and schedule baselines are approved, a modification of this *Plan* may be required.

3.1 *Funding*

Progress toward the ultimate goal of immobilizing all the LW at SRS is highly dependent on available funding. This *Plan* was developed assuming the funding required to achieve the planned project and operations activities at the levels specified in the *SRR Contract Performance Baseline*[11] will be available. It supports justification for requesting necessary funding profiles.

With any reduction from full funding, activities that ensure safe storage of waste claim first priority. Funding above that required for safe storage enables risk reduction activities, i.e., waste removal, treatment — including immobilization — and removal from service, as described in this *Plan*.

3.2 *Regulatory Drivers*

Numerous laws, constraints, and commitments influence LW System planning. Described below are requirements that most directly affect LW system planning.

South Carolina Environmental Laws

Under the South Carolina Pollution Control Act, S. C. Code Ann. §§ 48-1-10 *et seq*., the South Carolina Department of Health and Environmental Control (SCDHEC) is the delegated authority for air pollution control and water pollution control. The State has empowered SCDHEC to adopt standards for protection of water and air quality, and to issue permits for pollutant discharges. Further, SCDHEC is authorized to administer both the federal Clean Water Act and the Clean Air Act. Under South Carolina's Hazardous Waste Management Act, S. C. Code Ann. §§ 44-56-10 *et seq*., SCDHEC is granted the authority to manage hazardous wastes. With minor modifications, SCDHEC has promulgated the federal Resource Conservation and Recovery Act (RCRA) requirements, including essentially the same numbering system. The South Carolina Solid Waste Policy and Management Act, S. C. Code Ann. §§ 44-96-10 *et seq*., provides standards for the management of most solid wastes in the state. For example, SCDHEC issued to DOE-SR permits such as the Solid Waste Class 3 Landfill Permit for SDF. This landfill permit contains conditions for the acceptable disposal of non-hazardous waste in the SDF. This permit also contains potential stipulated fines and other penalties in the event defined LW facilities fail to meet other conditions of this permit within prescribed periods subject to certain limited exceptions. Other principal permits required to operate LW facilities pursuant to the state's environmental laws include:

- SCDHEC Bureau of Water:
  - industrial wastewater treatment facility permits (e.g., Tank Farms, DWPF, Effluent Treatment Facility [ETF], and the SPF)
  - National Pollutant Discharge Elimination System (NPDES) permit (H-16 Outfall discharges from ETF)
- SCDHEC Bureau of Air Quality:
  - Air Quality Control permit (one Site-wide Air Permit including the LW facilities).

Site Treatment Plan

The STP[5] for SRS describes the development of treatment capacities and technologies for mixed wastes, and provides guidance on establishing treatment technologies for newly identified mixed wastes. The STP allows DOE, regulatory agencies, the States, and other stakeholders to efficiently plan mixed waste treatment and disposal by considering waste volumes and treatment capacities on a national scale. The STP identifies vitrification in DWPF as the preferred treatment option for appropriate SRS liquid high-level radioactive waste streams. SRS has committed that:

> *"Upon the beginning of full operations, DWPF will maintain canister production sufficient to meet the commitment for the removal of the backlogged and currently generated waste inventory by 2028."*

The commitment for the removal of the waste by 2028 encompasses the BWRE and heel removal scope of this *Plan*. Final cleaning, deactivation, and removal from service of storage and processing facilities are subsequent to the satisfaction of this commitment.

Federal Facility Agreement

The Environmental Protection Agency (EPA), DOE, and SCDHEC executed the SRS FFA[4] on January 15, 1993 that became effective August 16, 1993. It provides standards for secondary containment, requirements for responding to leaks, and provisions for the removal from service of leaking or unsuitable LW storage tanks. Tanks that are scheduled to be removed from service may continue to be used, but must adhere to a schedule for removal from service and the applicable requirements contained in the Tank Farms' industrial wastewater treatment facility permit. An agreement between DOE, SCDHEC, and EPA, *Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18*[12], was made in November 2007. This agreement modified the FFA by providing for the submission of Waste Determination documentation for F- and H-Tank Farms and included end dates for BWRE and the operational closure of each old style tank. It commits SRS to remove from service the last old style tank no later than 2022.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to assess the potential environmental impacts of proposed actions. Seven existing NEPA documents and their associated records of decision directly affect the LW System and support the operating scenario described in this *Plan*:

- DWPF Supplemental Environmental Impact Statement (SEIS) (DOE/EIS-0082-S)
- Final Waste Management Programmatic Environmental Impact Statement (EIS) (DOE/EIS-0200)
- SRS Waste Management Final EIS (DOE/EIS-0217)
- Interim Management of Nuclear Materials EIS (DOE/EIS-0220)
- SRS High-Level Waste Tank Closure Final EIS (DOE/EIS-0303)
- Environmental Assessment (EA) for the Closure of the High Level Waste Tanks in F- and H Areas at SRS (DOE/EA-1164)
- SRS Salt Processing Alternatives Final SEIS (DOE/EIS-0082-S2).

Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005

The *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* (NDAA) Section 3116 (NDAA §3116) concerns determinations by the Secretary, in consultation with the Nuclear Regulatory Commission (NRC), that certain radioactive waste from reprocessing is not high-level waste and may be disposed of in South Carolina pursuant to a State-approved closure plan or State-issued permit. For salt waste, DOE contemplates removing targeted fission products and actinides using a variety of technologies and combining the removed fission products and actinides with the metals being vitrified in DWPF. NDAA §3116 governs solidifying the remaining low-activity salt stream into saltstone for the purpose of disposal in the SDF. For closure activities, NDAA §3116 governs the Waste Determinations for the Tank Farms that demonstrate that the tanks and ancillary equipment (evaporators, diversion boxes, etc.) at the time of closure can be managed as non-high level waste.

3.3 *Revisions*

The significant updates from the previous version of this *Plan,* the *Liquid Waste System Plan, Revision 15* (Rev 15)[9], include:

- **Salt Processing**:
  - **SWPF Processing:** SWPF operations initiation delayed to July 2014 from May 2013
  - **SCIX Processing**: SRR's proposal of a new salt process to supplement SWPF processing
  - **Next Generation Extractant:**
    - deploy next generation extractant to MCU to improve decontamination factor and to inform SWPF
    - deploy next generation extractant to SWPF to increase processing rate to a nominal 7.2 Mgal/year from 6.0 Mgal/yr
  - **DDA-solely Processing:** no further DDA-solely processing is planned
  - **Salt Storage**: Tank 25 was recovered as the 2F Evaporator concentrate receipt tank, having the salt successfully removed and prepared for salt processing
- **Tank Storage Space**
  - **Tank 48**: Tank 48 return-to-service was revised to October 2016 from December 2014

— **Tank 50**: Tank 50 will be available for HLW service in February 2010; however, this *Plan* projects Tank 50 utilization as the feed tank for the SPF for its entire life.

3.4 *Key Milestones*

Key Milestones are those major dates that are required to remove waste from storage, process it into glass or saltstone, and close the LW facilities. These milestones are compared to Revision 15 of this *Plan*.

Table 3-1 — *Key Milestones*

Key Milestone	Revision 15	this *Plan*
Date last LW facility closed	2032	2026
Date when BWRE complete for Type I, II, and IV tanks	Mar 2016	Nov 2016
Date when all Type I, II, and IV tanks are removed from service	Jun 2018	Sep 2018
DWPF processing complete	2031	2025
Total number of canisters produced	7,235	7,557
– *Salt only canisters produced*	*250*	*0*
GWSB #3 Required	Jul 2015	Sep 2015
Initiate ARP/MCU Processing	Apr 2008 (actual)	Apr 2008 (actual)
– *Deploy next generation extractant at MCU*	*n/a*	*Jan 2012*
Initiate SCIX Processing	n/a	Oct 2013
Initiate SWPF Processing	May 2013	Jul 2014
– *Salt Solution Processed via DDA-solely*	*2.8 Mgal*	*2.8 Mgal (Actual)*
– *Salt Solution Processed via ARP/MCU*	*5.2 Mgal*	*5.4 Mgal*
– *Salt Solution Processed via SCIX*	*n/a*	*26.8 Mgal*
– *Salt Solution Processed via SWPF*	*89 Mgal*	*61 Mgal*
Total Salt Solution Processed	***97 Mgal***	***96 Mgal***
Number of SDU	40	41
Salt Processing Complete	2030	2024
Tank 42 Available as Sludge Blend Tank	Oct 2011	Oct 2011
Tank 50 equipped for HLW service (if needed)	Oct 2011	Feb 2012
Tank 48 Available as Salt Blend Tank	Jan 2015	Oct 2016
Tank 28 Available as Salt Blend Tank	n/a	Oct 2015
Tank 35 Available as Salt Blend Tank	Mar 2014	Oct 2013
2F Evaporator shut down	Nov 2016	Jun 2021
2H Evaporator shut down	Sep 2013	Jan 2023
3H Evaporator shut down	Sep 2027	Sep 2020
SWPF facility removed from service	2031	2025
DWPF facility removed from service	2031	2026
SPF facility removed from service	2032	2026

4. Planning Summary and Results

This section summarizes the key attributes of this *Plan*. Detailed discussion on risks and associated mitigation strategies are included in other documents such as the ROMP and individual implementation project risk assessments.

In addition, this *Plan* is predicated on receiving adequate funding to achieve the required project and operations activities. Failure to obtain adequate funding will have a commensurate impact on the programmatic objectives.

This section summarizes the *Plan*, based on the key assumptions and bases. Tabular results of the lifecycle, on a year-by-year basis, or graphical results of the lifecycle are included in:

- *Appendix A — Bulk Waste Removal Efforts & Removal from Service*
- *Appendix B — Salt Solution Processing*
- *Appendix C — Sludge Processing*
- *Appendix D — Canister Storage*
- *Appendix E — Tank Farm Influents and Effluents*
- *Appendix F — Remaining Tank Inventory*
- *Appendix G — LW System Plan — Rev 16 Summary.*

4.1 *Waste Removal and Tank Closure*

4.1.1 Waste Removal and Tank Cleaning

The first step in the disposition of sludge and salt waste is BWRE. Sludge is sent to one of two feed preparation tanks ensuring sludge waste is continuously available for treatment at DWPF. Salt is dissolved, removed, and staged for treatment at ARP/MCU, SCIX, or SWPF.

Bulk Waste Removal Efforts

This *Plan* assumes utilization of the Waste on Wheels (WOW) concept, which requires no new infrastructure. Portable and temporary equipment meet tank infrastructure needs. Additional purchased pumps and WOW equipment perform accelerated BWRE operations concurrently in both Tank Farms. The primary components of the WOW system are:

- Long-lasting reusable submersible mixer pumps (SMP)
- A portable field operating station containing pump drives and controls
- A portable substation to provide 480-, 240- and 120-volt power to the WOW equipment
- Disposable carbon steel transfer pumps.

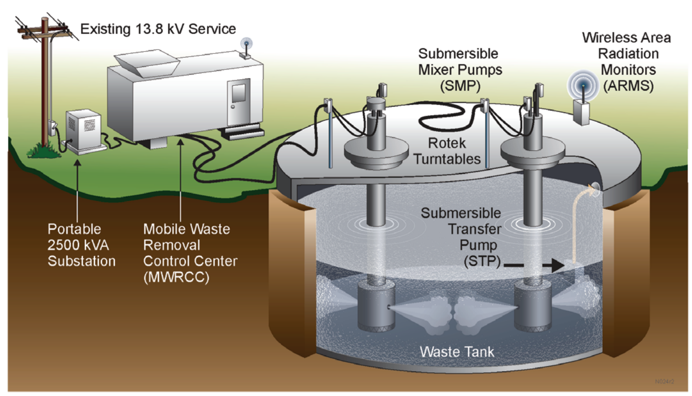


Figure 4–1 — *WOW Deployment for BWRE*

WOW equipment is deployed at the tank as a field operating station, providing temporary power and control for BWRE equipment. When BWRE is completed on one tank, the WOW equipment is reconfigured to support waste removal on the next tank. Pumps are sized to fit through 24-inch openings allowing a high degree of flexibility to locate the pumps in optimal configurations within the waste tanks. Most are supported from the bottom of the tank, minimizing steel superstructures and tank-top loading. Product lubricated bearings and motor cooling eliminate the need for bearing and seal water supply. These pumps have exterior fittings and fixtures so that the pumps can be quickly decontaminated, removed, and reinstalled in the next tank with minimal radiation exposure to personnel. Disposable transfer pumps are used to transfer the waste to a receipt or hub tank using existing underground transfer lines and diversion boxes. If the transfer system is degraded or non-existent, above-grade hose-in-hose technology is deployed, rather than investing in costly repairs. Temporary shielding is supplied as necessary to reduce exposure to personnel.

Sludge Removal

Sludge removal operations are typically conducted with three mixing pumps with provision for a fourth pump if needed. Sufficient liquid is added to the tank to suspend sludge solids; existing supernatant or DWPF recycle material is used instead of Inhibited Water (IW), when feasible, to minimize introduction of new liquids into the system. Operation of the mixing pumps suspends the solids, which are then transferred as a slurry from the tank. This operation is repeated, periodically lowering the mixer pumps, until the remaining contents of the tank can no longer be effectively removed by this method.

Sludge batches are configured to remove sludge from Type I, II, and IV tanks first and to balance the sludge batch composition of Plutonium Uranium Reduction Extraction (PUREX) process and the modified PUREX process in H-Canyon (HM) sludges (see §7.1 for a description of these sludge types). Tank 13, a Type II tank in H-Tank Farm (HTF), will be used to store and transfer sludge from other tanks, as necessary, until Tank 13 heel removal is performed in 2015.

Salt Removal

Salt waste removal is accomplished using a modified density gradient process followed by mechanical agitation. A well is mined through the saltcake down to the tank bottom. An off-the-shelf, disposable transfer pump is installed at the bottom of the well, along with instruments to monitor waste density, to pump the interstitial liquid out of the tank until the well is dry. Water is added to dissolve the salt, and as the density increases, the saturated solution migrates to the bottom of the well where it is pumped out. The initial process involves no moving parts in the tank except the

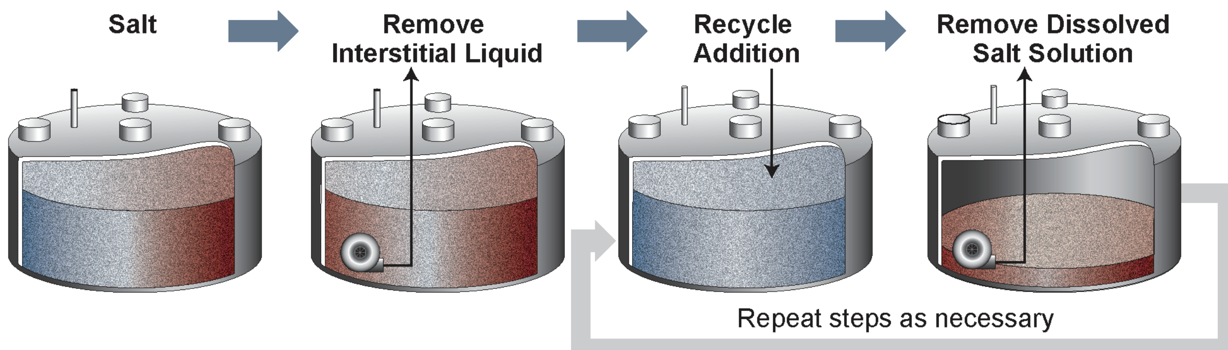


Figure 4–2 — *Modified Density Gradient Salt Removal*

transfer pump. When available, DWPF recycle is used to dissolve salt, conserving Type III tank space by minimizing additions of new material and reducing the load on the evaporator system. The dissolved salt solution is prepared as close to saturation as possible prior to pumping out the tank. As salt dissolution progresses and the soluble fraction is pumped from the tank, the insoluble materials dispersed throughout the salt matrix blankets the underlying salt and the dissolution rate decreases significantly. SMPs, powered and controlled with WOW equipment, suspend and remove insoluble solids at the end of the dissolution step, similar to sludge removal.

Heel Removal

Heel removal is performed after BWRE has removed all of the material that can be removed with the technologies discussed above. It consists of Mechanical Heel Removal and Chemical Cleaning. In general mechanical heel removal is done prior to chemical cleaning, and is discussed below in some detail. However, depending on tank conditions, it may be more effective to perform chemical cleaning prior to mechanical heel removal or to perform some mechanical heel removal, some chemical heel removal, back and forth to provide removal to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical.

Mechanical Heel Removal

For mechanical heel removal, this *Plan* assumes vigorous mixing continues, using SMPs, until less than 5,000 gallons of material remain. More aggressive methods, such as targeted hydro-lancing of sludge mounds, remotely operated robotic crawlers, etc., may be employed for difficult heels.

Chemical Cleaning

Chemical cleaning is performed when it is determined that mechanical heel removal has not removed the waste to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical. This *Plan* assumes that, prior to 2013, Type I or II tanks will be chemically cleaned via bulk oxalic acid (OA) washing after waste removal is completed and that either Enhanced Chemical Cleaning (ECC) or bulk OA is used for tanks after 2013.

In bulk OA cleaning, OA is added to remaining solids in the tank to the minimum liquid level required to enable mixer pump operation. The contents of the tank are agitated for a short period and then transferred to a receipt tank for neutralization. This process is repeated three to four times, as necessary, to remain within the Tank Farm space constraints for receipt of the neutralized waste stream.

Enhanced Chemical Cleaning

Beginning in 2013, this *Plan* assumes the implementation of the Enhanced Chemical Cleaning (ECC) process for Type I, II, and III/IIIA tanks. Type IV tanks, which contain no cooling coils, are assumed to be cleaned to an acceptable level using mechanical cleaning technologies. Using an AREVA patented technology, insoluble sludge and salt solids will be dissolved and redeposited in a Type III/IIIA waste tank resulting in a fraction of the spent liquid currently used for bulk chemical cleaning. This process employs dilute OA to dissolve residual waste, removing it along with insoluble material to clean vessels. A proprietary process using ozone destroys oxalates and spent acid, reducing liquid volume. This process operates in small batch configuration until no more waste can be effectively removed by this process. There are instances in which bulk OA may be used after 2013.

Tanks with Documented Leak Sites

Several Type I, II, and IV tanks have documented leak sites. All Type IV tanks having documented leak sites have been removed from service; however, waste removal operations on some of the Type I and II tanks could potentially reactivate old leak sites and potentially create new leak sites in those tanks. Contingency equipment and procedures will be utilized to contain leakage, transfer the waste to a Type III/IIIA tank, and minimize the potential for release to the environment. Specific plans will avoid liquid levels above known leak sites, when feasible, and focused monitoring will be employed where these levels cannot be avoided.

Annulus Cleaning

Some Type I and II tanks have waste in the annulus space, the majority of which is a soluble form of salt appearing as dried nodules on tank walls at leak sites and at the bottom of the annulus pan. These tanks will be inspected to determine if Annulus Cleaning is required. Before declaring the tank ready for grouting (for those tanks requiring annulus cleaning), this waste will be removed from the annulus to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical by dissolving the salt deposits with IW and transferring the solution out of the annulus. A remotely operated wall crawler is used to rinse salt nodules from the tank walls to the floor where the solution can be collected and transferred out. For Tank 16, a Type II tank, where materials are not readily dissolved or difficult to remove, remotely operated equipment may be deployed to mechanically remove the waste and transfer it out of the annulus.

4.1.2 Tank Closure

Type I, II, and IV tanks are planned for grouting in accordance with a formal agreement between the DOE, Region IV of the EPA, and SCDHEC as expressed in the SRS currently approved FFA. The 24 SRS Type I, II, and IV tanks must be removed from service per the currently approved FFA schedule. Two of these tanks in F-Tank Farm (FTF), Tank 17 and Tank 20, were grouted in 1997.

Operational closure consists of those actions following waste removal that bring liquid radioactive waste tanks and associated facilities to a state of readiness for final closure of the Tank Farms complex. The process involves:

- Developing tank-specific regulatory documents
- Isolating the tank from all operating systems in the surrounding Tank Farm (e.g., electrical, instruments, steam, air, water, waste transfer lines, and tank ventilation systems)
- Grouting of the tank primary, remaining equipment, annulus, and cooling coils
- Capping all tank risers.

A 24-month closure process is planned for the first tanks to account for sampling and characterization, initial drafting of closure documents, first-time review process, annulus and coil closure, and a 4-month grout period. The experience gained on Tanks 5, 6, 18, and 19 should allow compressing the closure process to approximately 18 months for the next tanks (Tanks 4, 7, 8, 11, 12, 15, and 16). Further refinement of sampling and characterization techniques and review and response cycles are expected to accelerate the tank closure process for the remaining tanks.

Sampling and Characterization

When cleaning using the above methods is complete, an analysis is performed to ensure that the material in the tank has been removed to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical. Before declaring a tank ready for grouting, however, the tank and annulus are inspected, the residual volume is determined, and the residual is sampled in accordance to a sample plan. Laboratory analysis of the samples yields concentrations of radiological and non-radiological constituents in the remaining material. Concentration and volume data are used to characterize the residual material to produce radiological and non-radiological inventories for the Closure Module (CM). Tank-specific closure documents are prepared to demonstrate compliance with State and DOE regulatory requirements as well as NDAA §3116.

Tank Isolation

Tank isolation is the physical process of isolating transfer lines and services from the tank and removing the tank from service. Tank isolation includes cutting and capping or blanking mechanical system components (transfer lines, water piping, air piping/tubing, steam piping, etc.) and disconnecting electrical power to all components on the tank. After tank isolation, flammability and inhalation dose calculations are completed to allow the tank to be placed in Removed from Service (RFS) Mode[13]. Temporary power skids provide services for grout placement (including ventilation, lighting, and cameras). They also provide a portable ventilation system to replace the permanent system so that each tank is completely isolated from the Tank Farm during grouting operations.

Closure Documentation Development

An area-specific WD approach ensures the NDAA §3116 tank closure process is implemented as efficiently as possible. Performance Assessments (PA) and NDAA §3116 Basis Documents are generated for each Tank Farm—one for FTF and one for HTF. The NDAA §3116 Basis Documents will include the waste tanks as well as ancillary structures located within the boundary of the respective Tank Farm. An area-specific General Closure Plan is developed for each of the Tank Farms for approval by SCDHEC.

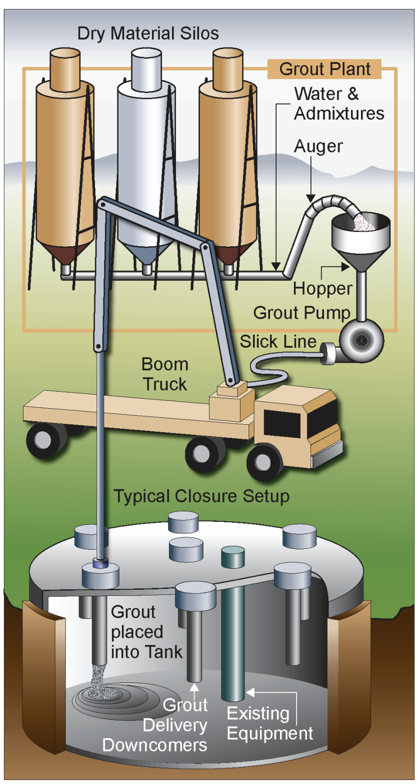


Figure 4–3 — *Tank Grouting Setup*

DOE Order 435.1-1 mandates a Tier 1 Closure Plan and associated Tier 2 Closure Plans. The Tier 1 plan is area-specific and provides the bases and process for moving forward with tank grouting. This document is approved at the DOE-Headquarters level. The Tier 2 documents are tank-specific, follow the approved criteria established in the Tier 1 document, and are locally approved by DOE-SR.

Development of a tank specific CM, per the State-approved area-specific General Closure Plans, follows completion of tank cleaning activities. It describes the waste removal and cleaning activities performed and documents the end state. Final characterization data supports the performance of Special Analysis, the process used to determine if final residual inventories continue to support the conclusions of the PA.

Grout Selection and Manufacture

A reducing grout provides long-term chemical durability and minimizes leaching of residual waste over time. The reducing grout fills each tank, is self-leveling, and encapsulates the equipment remaining inside the tank. A strong grout cap is applied on top for intruder prevention in tanks that do not have a thick concrete roof. The properties of the reducing grout may be such that it can serve as this strong grout cap.

Grouting activities include AB changes, field modifications, grout plant mobilization, and grout installment.

Grout Placement

Grout fill operations; including site preparation, grout plant set up, installation of grout delivery lines, pumper truck placement, and grout equipment placement; are established around the tanks (see Figure 4–3). Fill progress is monitored using an in-tank video.

A sequence for tanks with an annulus will be developed so that all voids are filled and the structural integrity of the tank is maintained, overcoming the problems in filling a Type I, II, and III tank with grout. Generally, grouting the annulus and primary tank in alternating steps provides structural support for the tank wall.

Cooling Coil Grouting

For tanks with cooling coils, the cooling coils are grouted with a technique to pressure grout the cooling coils. In those tanks where the cooling coils have broken, alternative techniques will be developed to minimize voids in the grout matrix.

Riser Grouting and Capping

The final step in the tank grouting operation, after filling the tank, is encapsulating the risers. Using forms, grout encapsulates the risers thus providing a final barrier to in-leakage and intrusion. The final grouted tank configuration is an integral monolith free of voids and ensuring long-lasting protection of human health and the environment (see Figure 4–4).

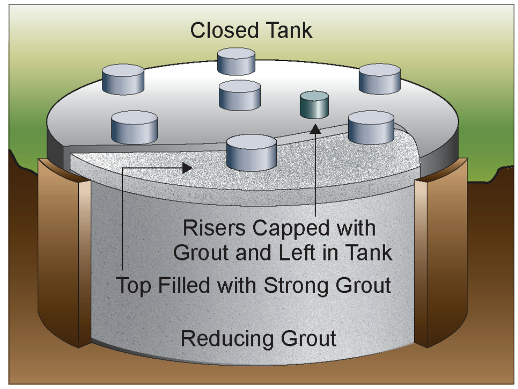


Figure 4–4 — *Grouted Tank*

4.2 Disposition of Sludge Waste

The basic steps for sludge processing are:

1. Sludge removal from tanks
2. Blending and washing of sludge
3. Sludge feeding to the DWPF
4. Vitrification in DWPF.

Sludge processing is paced by the capabilities of the sludge washing and the DWPF processing facilities and by tank storage space to prepare sludge batches. Sludge batch planning uses the estimated mass and composition of sludge and known processing capabilities to optimize processing sequences. Sub-tier plans document the modeling, guide the sequence of waste removal, and support a more detailed level of planning. They are revised as new information becomes available or when significant updates in the overall waste removal strategy are made. The specific input to this *Plan* from sludge batch planning is summarized in *Sludge Batch Plan – 2010 in Support of System Plan R-16* [14].

Differences in sludge batch sequencing, total number canisters produced, and batch end dates between *Sludge Batch Plan – 2010 in Support of System Plan R-16* and *Sludge Batch Plan – 2009 in Support of System Plan R-15* [15] are mainly driven by the following:

- Sludge Batch (SB) 7B is planned, utilizing remaining sludge in Tanks 4, 7, and 12
- The estimated sludge mass in Tanks 4, 7, and 12 has been updated to reflect recent waste removal for SB7 preparation
- This *Plan* assumes the use of low temperature aluminum dissolution for SB11 through 16. Most of Tank 13 and some Tank 15 sludge are no longer targeted for aluminum dissolution due to a shortage of leachate storage space
- The projected canister pour rate and waste loadings are lower (@325 canisters/yr) until the SWPF tie-in, DWPF melter replacement, and process improvements outage is complete on August 1, 2014. After this outage, the projected canister pour rate will be 400 canisters per year
- In addition to SB7, three other sludge batches are modeled to include enough washing to remove sodium oxalate solids that originate from bulk OA chemical cleaning operations
- Receipt of the Fluidized Bed Steam Reformer (FBSR) product stream (see § 4.4.5) into sludge preparation Tanks 51 and 42 is included
- Receipt of spent monosodium titanate (MST) resin from the SCIX process into sludge preparation Tanks 51 and 42 is included
- Receipt of ground spent crystalline silicotitanate (CST) resin from the SCIX process into sludge feed Tank 40 is included.

Sludge Feed Preparation

This *Plan* adjusts Tank Farm operations to ensure sufficient feed availability for the retrofitted DWPF melter (described below). Use of a second sludge tank (Tank 42) as a DWPF feed preparation tank (see Figure 4-5) doubles the feed availability for the DWPF operation. This *Plan* also forecasts that DWPF feed will contain 16 weight percent (wt%) solids, reducing evaporation load on the DWPF processing systems.

An in-tank rotary microfiltration system in Tanks 42 and 51 will eliminate reliance on gravity settling and enables continuous sludge washing. This accelerated batch preparation enables improved glass formulation efforts achieving optimized waste loading in the glass.

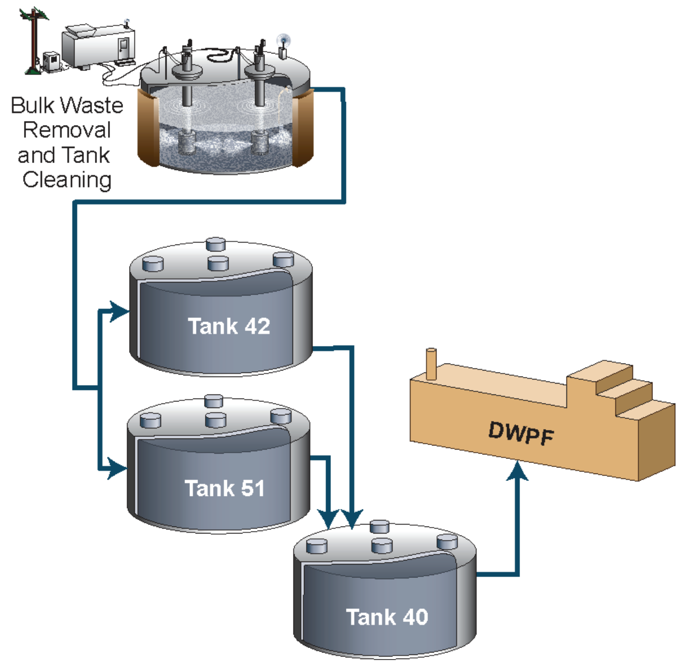


Figure 4-5 — *Sludge Feed Preparation*

Sludge Washing

Sodium and other soluble salts in DWPF feed are reduced through sludge washing. Sludge washing has historically been performed by adding water to the sludge batch, mixing with slurry pumps, securing the pumps to allow gravity settling of washed solids, and decanting the sodium-rich supernate to an evaporator system for concentration. This cycle is repeated until the desired sodium molarity, typically 1 M Na, is reached. Some types of sludge settle slowly, extending wash cycles. Sludge settling typically constitutes 60% of batch preparation time. The total number of washes performed and volume of wash water used is minimized to conserve waste tank space. Sludge batch size and wash volumes are also limited by the hydrogen generation rate associated with radiolysis of water. Tank contents are mixed on a periodic frequency to release hydrogen retained within the sludge layer, resulting in a limited window within operating constraints for gravity settling.

Accelerated Sludge Washing

To overcome washing limitations and enable accelerated DWPF vitrification, two sludge feed preparation cycle time reduction strategies will be implemented to ensure continuous, increased DWPF feed availability:

- A second sludge feed preparation tank (Tank 42) begins service in 2013 to double feed preparation capacity. This includes new slurry pumps using improved bearing design to provide several thousand hours of reliable mixing. Dedicated variable frequency drives enable increased mixing in both sludge batch preparation tanks.
- In-tank rotary microfiltration will be installed in Tanks 42 (planned for deployment in October 2013) and 51 (planned for deployment in October 2014), eliminating reliance on gravity settling and enabling continuous sludge washing.

The rotary microfilter (RMF) is a compact filtration system using membrane filters mounted on rotating disks (see Figure 4-6). Its flux advantage (over static membrane filters) results from high shear and centrifugal force acting on membrane boundary layers, greatly reduces fouling, and increases fluid flow. The RMF's feed flow rate is decoupled from feed pressure, allowing more control over driving force pressure and independent control of shear applied to the filter cake. It uses 11-inch diameter disks operating at 1,170 rpm. Feed fluid enters the filter housing and flows across the membrane surface, while permeate flows through and exits through the hollow shaft. Concentrated slurry is pumped from the filter housing. A filter module with pump is installed in a sludge feed preparation tank riser. Extensive static filter element testing demonstrated RMF's advantages including:

- less plugging
- higher utility
- higher throughput.

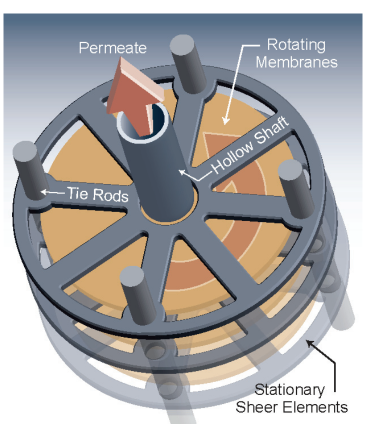


Figure 4-6 — *Rotary Microfilter*

Advantages of the RMF include:

- provides more efficient sodium removal
- uses 40% less wash water
- reduces batch preparation cycle time

- enables larger sludge batches that facilitate accelerated waste removal and tank removal from service
- reduces load on current evaporators
- conserves receipt tank salt storage space.

4.2.1 DWPF Operations

Washed sludge is transferred to the DWPF facility where it is combined with the high-level waste streams from salt processing (discussed below) for vitrification into glass canisters and stored in a GWSB pending disposition.

Historically, melter performance has been the limiting factor for DWPF throughput. The DWPF melter (without bubblers) has produced an average of 215 canisters/year for the past ten years. Tank Farm sludge waste feed preparation and DWPF feed preparation systems have been analyzed to be capable of supporting a canister production capability of 250 and 325 canisters/year, respectively. All other DWPF plant systems have been analyzed to be capable of supporting the DWPF original design production capability in excess of 400 canisters/year.

Two-step Production Improvement Approach

This *Plan* implements a two-step glass production rate improvement program. *First*, retrofitting the melter with bubblers and upgrading Tank Farm sludge waste feed preparation capacity increased the DWPF production rate to 325 canisters per year in FY2011. *Second*, enhancing the feed preparation system and implementing operation improvement initiatives during the SWPF tie-in outage is expected to achieve a nominal production rate of 400 canisters per year. This two-step improvement approach provides flexibility and a cost-effective balance between plant production and improvements.

In the first step, the current DWPF melter was retrofitted in September 2010 with four bubbler systems to increase the average production capacity of the melter to 400 canisters/year. The melter off-gas system was also optimized to support higher glass throughput and reduce DWPF recycle water, however, further enhancements are required to enable the rest of the plant to achieve 400 canisters/year.

The second step of DWPF production capacity improvement program addresses streamlining the DWPF feed preparation system. Four process improvements are planned to streamline the DWPF feed preparation system:

- Implementation of an alternate reductant
- Processing of cesium strip effluent in the slurry mix evaporator (SME)
- Addition of dry process frit to the SME
- Minimization of water from canister decontamination frit stream to the SME.

This step reduces recycle water generation by 1,250 kgal/yr:

- 250 kgal/yr by using dry process frit
- 400 kgal/yr by replacing steam with air as the motive fluid in one Steam Atomized Scrubber (SAS)
- 1.5 kgal/canister × 400 canisters/yr = 600 kgal/yr by routing decon frit water to ETF.

The DWPF production rate (over the last ten years) has averaged 215 canisters per year with 4,000 lbs of glass per canister. The two-step canister production rate improvement initiative establishes a higher nominal DWPF canister production capability of 400 canisters/year. Future estimated canister production, by year is shown in Table 4-1 — *Planned DWPF Production Rates*. The canister rates assume two one-week outages every year to allow for routine planned maintenance.

Table 4-1 — *Planned DWPF Production Rates*

FY	Nominal Rate *(Canisters/yr)*	Outage *(Months)*	Total DWPF Canisters poured *(Canisters)*
FY11	325		311
FY12	325		311
FY13	325		312
FY14	325	4 [a]	229
FY15	400		383
FY16	400		385
FY17	400		383
FY18	400		383

FY	Nominal Rate *(Canisters/yr)*	Outage *(Months)*	Total DWPF Canisters poured *(Canisters)*
FY19	400		384
FY20	400	4 [b]	267
FY21	400		383
FY22	400		383
FY23	400 [c]		277 + 55 (sludge heels)
FY24	(sludge heels) [c]		125 (sludge heels)

[a] Four-Month outage in 2014 to accommodate transition to SWPF-DWPF coupled operations — assumes no canister production rate impact from coupled SWPF-DWPF operations. Outage includes DWPF production capacity improvement program and melter change out. Production capacity improvement program allows an additional increase in the nominal canister production rate.

[b] Four-month melter outage is assumed every six years during sludge processing. Actual melter change-out is determined by melter performance.

[c] Lower production rate assumed for dilute heel processing beginning in late 2023.

Failed Equipment Storage Vaults and Melter Storage Boxes

Failed equipment storage vaults (FESVs) and Melter Storage Boxes (MSBs) are repetitive projects required to sustain ongoing DWPF operation by providing interim storage of failed DWPF melters. The original DWPF design has two vaults contained within one construction unit. Each FESV is designed to store one failed melter inside an MSB.

Melter 1 was placed in FESV #2 in December 2002. Melter 1 (inside MSB #1) had a relatively low radiation field and was placed in the northernmost vault since the next vault pair to be constructed would be adjacent to FESV #2.

FESV #1 remains available for use with Melter 2. Construction of MSB #2 was completed in October 2008. MSB #2 is currently stored in FESV #1 awaiting use during the Melter 2 replacement outage currently forecasted in this *Plan* to occur in 2014.

Space has been reserved for construction of up to 10 FESVs, if needed.

Under the current planning basis, the need date for FESV #3 and #4 will be triggered by the failure of Melter 3. Melter 3 is currently scheduled to be placed into service in July 2014. Based upon this strategy, FESVs #3 and #4 construction should be completed and available for service by January 2014 (approximately six months prior to the planned installation of Melter 3). Likewise, MSB #3 should be constructed and available to receive Melter 3 by January 2014.

The need dates for FESV #3 and #4 and successive pairs of vaults will be evaluated on an ongoing basis.

Currently, the FESV 200-ton gantry crane is designed to interface only with an MSB that is designed primarily to contain failed melters. The placement of other large failed DWPF equipment (which do not have disposal paths) in FESVs has been considered but the complete engineered system to move large contaminated equipment from the 221-S canyon to the FESV has not been designed or constructed. Alternative methods for disposal of large contaminated equipment from DWPF (not including melters) are being evaluated.

4.3 *Disposition of Salt Wastes*

As highlighted in the Introduction, this *Plan* includes the use of a series of salt treatment processes over the life of the program, including ARP/MCU, SCIX, and SWPF. *Appendix B — Salt Solution Processing* reflects the breakdown of the volumes treated from each of the processes by year. Using the input assumptions for this *Plan*, approximately 97 Mgal of salt solution from the Tank Farms are planned for processing over the life of the program; 3.8 Mgal was processed by the end of FY10. SWPF processes the majority of this salt solution waste. As a result, the salt solution processed after SWPF reaches its nominal capacity is approximately 7.2 Mgal/yr (actual anticipated throughput varies with respect to DWPF outages, with an average of 6.8 Mgal/yr). Coupled with the SCIX throughput of 2.5 Mgal/yr, 9.7 Mgal/yr is the total planned salt processing capacity.

4.3.1 Actinide Removal Process / Modular CSSX Unit

The ARP/MCU process reduces the activity of the waste stream going to SDF, albeit at a lower rate than the future SWPF. The Decontaminated Salt Solution (DSS) stream, the low-level waste stream, is disposed of in the SDF as LLW grout. The higher activity strip effluent (SE) stream is eventually processed by vitrification in DWPF.

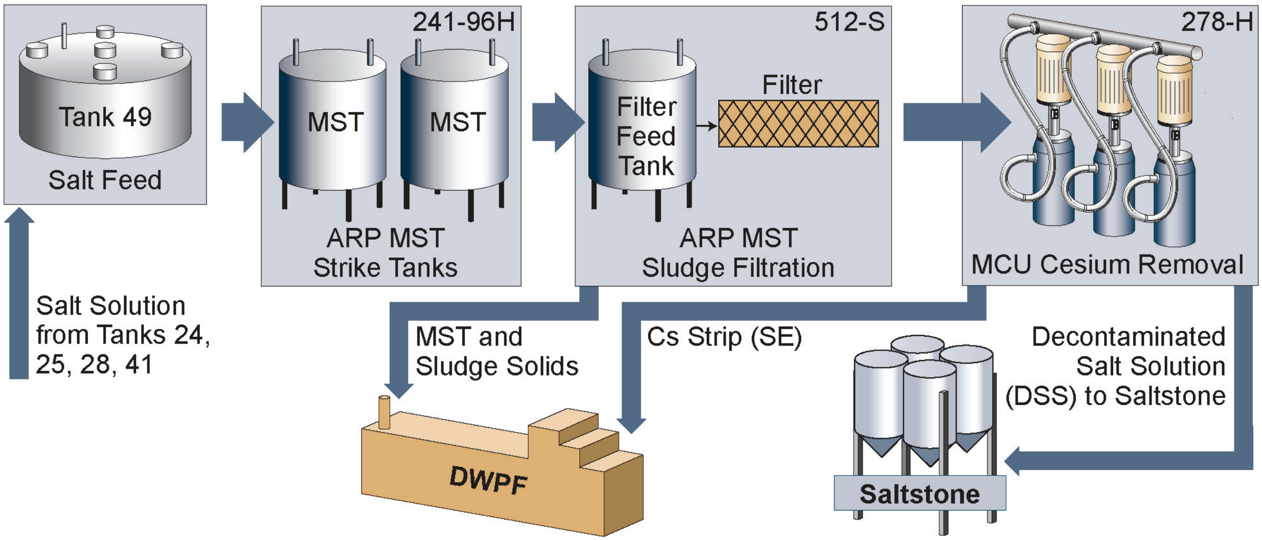


Figure 4-7 — *Actinide Removal Process / Modular Caustic Side Solvent Extraction Unit*

ARP/MCU, having begun operation in April 2008, processes salt solutions until permanent shutdown for SWPF transfer line tie-ins. ARP/MCU will not operate during DWPF major outage periods (e.g., melter replacement outages) due to the close coupling of the two facilities. Table 4-2 below gives the composition of the salt batches for ARP/MCU.

Table 4-2 — *ARP/MCU Salt Batch Composition*

Batch	Source Tanks	Nominal Batch Volume (kgal)
ARP/MCU B3	Tank 25 salt solution stored in Tank 23, 2H concentrated liquor stored in Tank 24, and DWPF recycle from Tank 21	1,040
ARP/MCU B4	Tank 25/41 salt solution stored in Tank 23, 2H concentrated liquor, and DWPF recycle in Tank 24	1,040
ARP/MCU B5	Tank 41 salt solution from Tank 23, SB 5 & 6 LTAD stored in Tank 8, and DWPF recycle for adjustment.	1,030
ARP/MCU B6	Tank 41 salt solution from Tank 23, SB 5 & 6 LTAD stored in Tank 8, and DWPF recycle for adjustment.	1,030
ARP/MCU B7	Tank 41 salt solution from Tank 23, SB 5 & 6 LTAD stored in Tank 8, and DWPF recycle for adjustment.	1,030

The next generation extractant is planned for deployment at MCU in early FY12 to provide operating experience and improved decontamination in MCU and to inform SWPF.

4.3.2 Small Column Ion Exchange

The SCIX Program will provide additional salt processing capability utilizing an Ion Exchange Column (IXC) to accelerate salt processing and tank grouting. In this *Plan* SCIX operates in parallel with ARP/MCU or SWPF. It will consist of one feed pump, four RMF, two IXC units, and one Spent Resin Disposal (SRD) unit installed in risers in Tank 41. An additional 2.5 M gal/year salt solution treatment capacity above the SWPF capacity of 7.2 Mgal/year is planned.

The process utilizes a non-elutable ion exchange media, crystalline silicotitanate (CST), for use in the IXC to remove Cs-137 from the salt solution. CST can only be loaded with Cs-137 one time. Once loaded, the spent media must be removed and the IXC replenished with fresh resin. Spent CST will be sluiced to the SRD to reduce the particle size. The ground CST, laden with Cs-137, is then transferred to a sludge batch for ultimate disposal at DWPF. The CST is assumed to require replacement once every two weeks, based on operating 24 hours a day, seven days per week. Table 4-3 below gives the composition of the salt batches for SCIX.

Table 4-3 — *SCIX Salt Batch Composition*

Batch	Source Tanks	Nominal Batch Volume (kgal)
SCIX B1	Tank 37 supernate and salt solution stored in Tank 35 and SB5 & SB6 LTAD stored in Tank 8	1,040
SCIX B2	Tank 35 heel and Tank 28 interstitial liquid (IL) and direct salt dissolution	1,040
SCIX B3	Tank 28 direct salt dissolution to Tank 35	890
SCIX B4	Tank 28 salt direct salt dissolution to Tank 35 and Tank 24 supernate	890
SCIX B5	Tank 28 salt direct salt dissolution to Tank 35 and Tank 24 supernate	890
SCIX B6	Tank 28 salt direct salt dissolution to Tank 35 and Tank 3 IL	890
SCIX B7	Tank 3 direct salt dissolution to Tank 35 and Tank 30 supernate	890
SCIX B8	Tank 3 & Tank 30 direct salt dissolution to Tank 35 and Tank 29 supernate, IL, and salt dissolution	890
SCIX B9	Tank 2 direct salt dissolution to Tank 35 and Tank 39 supernate	890
SCIX B10	Tank 9 direct salt dissolution to Tank 35 and Tank 39 supernate	890
SCIX B11	Tank 1 direct salt dissolution into Tank 48 and Tank 33 supernate	890
SCIX B12	Tank 29 direct salt dissolution into Tank 48 and Tanks 42, 13, & 33 supernate stored in Tank 24	890
SCIX B13	Tank 29 direct salt dissolution into Tank 48 and Tank 32 supernate (3H system liquor)	890
SCIX B14	Tank 47 direct salt dissolution into Tank 48 and Tank 24 supernate	890
SCIX B15	Tank 47 direct salt dissolution into Tank 48 and Tank 1 salt solution stored in Tank 30	890
SCIX B16	Tank 31 supernate, IL, and direct salt dissolution into Tank 48	890
SCIX B17	Tank 31 direct salt dissolution into Tank 48 and Tank 1 salt solution stored in Tank 30	890
SCIX B18	Tank 31 direct salt dissolution into Tank 48 and Tank 44 supernate	890
SCIX B19	Tank 44 direct salt dissolution into Tank 48 and Tank 45 supernate	890
SCIX B20	Tank 45 direct salt dissolution into Tank 48 Tank 27 supernate	890
SCIX B21	Tank 46 supernate and Tank 44 salt solution stored in Tank 32	890
SCIX B22	Tank 46 supernate and Tank 44 salt solution stored in Tank 32	890
SCIX B23	Tank 27 supernate and direct salt dissolution into Tank 48	890
SCIX B24	Tank 45 direct salt dissolution into Tank 48 and Tank 46 supernate	890
SCIX B25	Tank 27 & Tank 46 direct salt dissolution into Tank 48 and Tank 25 supernate	890
SCIX B26	Tank 46 direct salt dissolution into Tank 48 and Tank 25 supernate	890
SCIX B27	Tank 25 IL and Tank 36 & Tank 37 direct salt dissolution	890
SCIX B28	Tank 37 & Tank 25 direct salt dissolution into Tank 48	890
SCIX B29	Tank 36 salt solution stored in Tank 39	890
SCIX B30	Tank 38 direct salt dissolution into Tank 43	890
SCIX B31	Tank 38 direct salt dissolution into Tank 43	890
SCIX B32	Tank 38 direct salt dissolution into Tank 43	890

4.3.3 Salt Waste Processing Facility

SWPF is assumed to begin operation in July 2014. For the first 12 months, the SWPF processing rate is assumed to be 4.5 Mgal/yr of salt solution. After 12 months, this *Plan* assumes a new extractant is introduced allowing the nominal processing rate to increase to 7.2 Mgal/yr. The 7.2 Mgal/yr nominal processing rate is based on:

- 9.4 Mgal/yr maximum hydraulic rate adjusted
- 20% increase due to an alternate cesium extractant to be introduced after the first year
- 85% contactor efficiency
- 75% availability

$$[9.4 \text{ Mgal/yr}] \times [1.2] \times [0.85] \times [0.75] = 7.2 \text{ Mgal/yr}$$

However, because of the close coupling between SWPF and DWPF, SWPF must shut down for each DWPF melter replacement outage, with assumed four-month outages approximately every six years. The actual anticipated throughput, necessarily varying because of DWPF outages, averages 6.8 Mgal/yr.

The SWPF processing rate is based on an assumed 100% availability for the Tank Farm feed as well as DWPF and Saltstone receipt of the SWPF discharge streams. Availability of tank space to prepare salt solution batches may impact the ability to achieve full capacity SWPF operations, especially in the first few years of operation.

Table 4-4 below gives the composition of the salt batches for SWPF.

Table 4-4 — *SWPF Batch Composition*

Batch	Source Tanks	Nominal Batch Volume (kgal)
SWPF B1	Remainder of ARP/MCU B7 in Tank 49 and Tank 41 salt solution stored in Tank 23	1,250
SWPF B2	Tank 28 direct salt dissolution to Tank 21 and Tank 24 supernate	1,200
SWPF B3	Tank 41 salt solution left in Tank 23 and Tank 10 IL/ direct salt dissolution to Tank 23	1,200
SWPF B4	Tank 28 direct salt dissolution to Tank 21, Tank 26 supernate (2F liquor), and SB11 LTAD leachate from Tank 42	1,200
SWPF B5	Tank 3 direct salt dissolution to Tank 23, Tank 30, and Tank 26 supernate	1,200
SWPF B6	Tank 3 and Tank 28 direct salt dissolution to Tank 21 and Tank 26 supernate	1,200
SWPF B7	Tank 30 supernate, IL, and direct salt dissolution to Tank 23 and Tank 26 supernate	1,200
SWPF B8	Tank 3 direct salt dissolution to Tank 28 and Tank 2 IL and direct salt dissolution to Tank 28	1,200
SWPF B9	Tank 30 salt solution, Tank 29 direct salt dissolution to Tank 30, and SB10 LTAD leachate from Tank 51	1,200
SWPF B10	Tank 2 direct salt dissolution to Tank 28 and Tank 37 supernate	1,200
SWPF B11	Tank 29 direct salt dissolution to Tank 30 and Tank 9 supernate and IL and Tank 39 supernate	1,200
SWPF B12	Tank 9 direct salt dissolution to Tank 28 and Tank 1 supernate and IL	1,200
SWPF B13	Tank 9 direct salt dissolution to Tank 35 and Tank 24 supernate	1,200
SWPF B14	Tank 29 direct salt dissolution to Tank 28 and Tank 33 supernate	1,200
SWPF B15	Tank 33 supernate, IL, and direct salt dissolution to Tank 35 and SB13 LTAD from Tank 42	1,200
SWPF B16	Tank 33 direct salt dissolution to Tank 28 and Tank 24 supernate (contained Tank 13 supernate and Tank 3 salt solution)	1,200
SWPF B17	Tank 29 direct salt dissolution to Tank 35 and Tank 32 supernate	1,200
SWPF B18	Tank 47 direct salt dissolution to Tank 28 and Tank 24 supernate (contained Tank 3 salt solution)	1,200
SWPF B19	Tank 47 direct salt dissolution to Tank 35 and Tank 24 supernate (contained Tank 3 salt solution)	1,200
SWPF B20	Tank 47 direct salt dissolution to Tank 28 and Tank 33 supernate, IL, and direct salt dissolution to Tank 28	1,200
SWPF B21	Tank 29 direct salt dissolution to Tank 35 and SB14 LTAD from Tank 51	1,200
SWPF B22	Tank 47 direct salt dissolution to Tank 28 and Tank 34 supernate	1,200
SWPF B23	Tank 29 & Tank 47 direct salt dissolution to Tank 35 and Tank 30 supernate (contained Tank 1 salt solution)	1,200
SWPF B24	Tank 47 direct salt dissolution to Tank 28 and Tank 34 supernate/IL	1,200
SWPF B25	Tank 31 direct salt dissolution to Tank 35 and Tank 30 supernate	1,200
SWPF B26	Tank 31 direct salt dissolution to Tank 28 and SB15 LTAD from Tank 42	1,200
SWPF B27	Tank 31 direct salt dissolution to Tank 35 and Tank 44 supernate	1,200
SWPF B28	Tank 31 direct salt dissolution to Tank 28 and Tank 44 supernate /IL	1,200
SWPF B29	Tank 31 &Tank 44 IL and Tank 34 & Tank 31 direct salt dissolution to Tank 35	1,200
SWPF B30	Tank 44 direct salt dissolution to Tank 28 and Tank 45 supernate /IL	1,200
SWPF B31	Tank 45 IL and direct salt dissolution to Tank 35	1,200
SWPF B32	Tank 45 IL and direct salt dissolution to Tank 28 and SB16 LTAD from Tank 51	1,200
SWPF B33	Tank 45 direct salt dissolution to Tank 35 and Tank 27 IL	1,200

Batch	Source Tanks	Nominal Batch Volume (kgal)
SWPF B34	Tank 44 salt solution stored in Tank 32	1,200
SWPF B35	Tank 45 direct salt dissolution to Tank 35	1,200
SWPF B36	Tank 27 direct salt dissolution to Tank 28 and Tank 36 supernate	1,200
SWPF B37	Tank 27 direct salt dissolution to Tank 35 and Tank 36 supernate	1,200
SWPF B38	Tank 27 direct salt dissolution to Tank 28 and Tank 36 IL	1,200
SWPF B39	Tank 27 direct salt dissolution to Tank 35 and Tank 36 IL	1,200
SWPF B40	Tank 46 direct salt dissolution to Tank 28 and Tank 25 supernate	1,200
SWPF B41	Tank 46 direct salt dissolution to Tank 35 and Tank 25 supernate	1,200
SWPF B42	Tank 36 direct salt dissolution to Tank 28 and Tank 25 supernate	1,200
SWPF B43	Tank 36 direct salt dissolution to Tank 35 and Tank 25 supernate	1,200
SWPF B44	Tank 37 direct salt dissolution to Tank 28 and Tank 25 IL and direct salt dissolution to Tank 28	1,200
SWPF B45	Tank 25 direct salt dissolution to Tank 35	1,200
SWPF B46	Tank 37 direct salt dissolution to Tank 28	1,200
SWPF B47	Tank 37 salt solution stored in Tank 42	1,200
SWPF B48	Tank 25 salt solution stored in Tank 51	1,200
SWPF B49	Tank 37 salt solution stored in Tank 42 and Tank 25 salt solution stored in Tank 51	1,200
SWPF B50	Tank 38 direct salt dissolution to Tank 28, Tank 36 salt solution (stored in Tank 39), and Tank 42 supernate (Tank 37 salt solution)	1,200

4.3.4 Saltstone Operations

The current active SDU (Vault 4) is approximately 200 feet wide, by 600 feet in length, by 26 feet in height. Future SDUs will consist of two cells nominally 150 feet diameter by 22 feet high. After accounting for interior obstructions (support columns, drainwater collection systems, etc.) and the requirement for a 2-foot cold cap, the nominal useable volume of a cell is 2,600 kgal. Recent operating experience has resulted in approximately 1.76 gallons of grout being produced for each gallon of DSS feed, thus yielding a nominal cell capacity of approximately 1,500 kgal of DSS.

Operations using ARP/MCU waste can be processed at rates as high at 120 kgal/week into an individual cell. This is based on experience in the facility with Isopar® concentrations low enough that ventilation and temperature controls are not required. With higher Isopar® concentrations, two cells are required to process at this rate. Saltstone currently assumes that DSS resulting from the SWPF treatment process will contain Isopar® levels below that required for ventilation or temperature controls. Disposal cells will require ventilation and temperature control additions if Isopar® levels are higher than assumed. However, sufficient cells will be available to process at the required rates even if the Isopar® levels require these controls.

To demonstrate the capability to operate at production rates required to support SWPF, during ARP/MCU processing SPF will shut down, accumulate feed in Tank 50, and process at a ~350 kgal/wk rate until the feed is depleted.

4.4 *Base Operations*

4.4.1 Supporting Nuclear Material Stabilization

A continuing portion of the mission of the Tank Farms, especially HTF, is safe receipt, storage, and disposition of waste yet to be received from H-Canyon and HB-Line. This *Plan* supports nuclear material stabilization in H-Canyon through 2019 (with shutdown flows through 2022) per the *H-Area Liquid Waste Forecast Through 2019*[16].

Tank 39 will continue to be used for H-Canyon receipt at least through 2022 to support shutdown flows from H-Canyon. This is one reason the 2F Evaporator System will continue to operate and that salt must be successfully removed from Tank 37 to allow continued 3H Evaporator operation. Thus, this *Plan* relies on Tank Farm evaporators to operate at reasonable attainment. An unanticipated extended outage of either the 2F or 3H Evaporator Systems could delay the preparation of a DWPF sludge batch, delay tank removals from service, and impact H-Canyon operation.

This *Plan* assumes waste volumes from H-Canyon transferred to Tank 39 per the *H-Area Liquid Waste Forecast Through 2019*[16]. Some plutonium bearing waste by-passes Tank 39 and is inserted into a DWPF sludge batch "just-in-time" via receipt into the sludge processing tanks (Tank 51 or Tank 42) or the DWPF feed tank (Tank 40) as the alternative disposition path. Plutonium discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings and continuing to comply with canister fissile material concentration limits. Additionally, LLW is transferred from H-Canyon into Tank 50 for direct disposal in SPF.

4.4.2 2H Evaporator System

Reliable operation of the 2H Evaporator System is needed prior to SWPF startup to ensure that DWPF recycle, the largest stream received by the Tank Farm, can be managed. The DWPF recycle rate will remain between 1.5 and 1.9 Mgal/yr prior to SWPF operations. The rate depends on canister production rate and SAS operation as well as DWPF Recycle reduction initiatives. The rate could increase to as high as 3.2 Mgal/yr after the startup of SWPF because of extra water in the strip effluent stream and MST slurry and because the higher Cs-137 concentrations will require the operation of two SAS in the DWPF melter offgas system. Currently, only one SAS is operated. Although DWPF recycle can be evaporated only in the 2H Evaporator System due to chemical incompatibility with other waste streams, it may be beneficially reused for salt solution molarity adjustment, salt dissolution, heel removal, etc. This minimizes the utilization of the 2H Evaporator.

4.4.3 DWPF Recycle Handling

As described in Section 4.4.2 — *2H Evaporator System*, DWPF recycle is the largest influent stream received by the Tank Farm. In this *Plan*, disposition of the recycle stream is handled through evaporation in the 2H Evaporator System and through the beneficial reuse of the low sodium molarity (less than 1.0 molar sodium) recycle stream for dissolution of salt and adjustment of salt solution feed for salt processing. LW system modeling forecasts that the current life cycle processing outlined in this *Plan* can adequately handle the DWPF recycle stream through 2025. DWPF Recycle will be supplemented by IW, as required, for salt dissolution and adjustment.

4.4.4 Transfer Line Infrastructure

Although efforts will continue to be made to keep transfers between tanks to a minimum, executing this *Plan* requires more frequent transfers than have historically occurred in the Tank Farm, especially after the startup of SWPF, when large volumes of salt solution will be delivered to the facility. Because of the greatly increased pace of transfers after the startup of SWPF, short downtimes due to unexpected conditions requiring repair will be more difficult to accommodate without impact because the idle time of transfer lines will be reduced.

New infrastructure is required to accomplish transfers to support SWPF, while also continuing activities that have been historically performed, such as waste removal and evaporation. Discoveries of unexpected conditions in existing transfer systems could impact the installation of new transfer lines and equipment.

The transfers in this *Plan* are generally based on the known current infrastructure and modifications planned in the SWPF transfer line tie-ins and in projects for new facilities. The actions described can be executed as long as the planned modifications are made and significant failures of key transfer equipment do not occur or can be mitigated quickly enough to allow activities to proceed as planned. The American Recovery and Reinvestment Act (ARRA) has accelerated several of the needed infrastructure upgrades which, upon completion, will appreciably reduce the risk of failure of the infrastructure required to achieve the goals of this *Plan*. This *Plan*, however, does not attempt to explain all the modifications needed or the failure of specific pieces of transfer equipment.

4.4.5 Tank 48 Return to Service

This *Plan* assumes the waste containing TPB in Tank 48 is dispositioned using a Fluidized Bed Steam Reformer (FBSR) to destroy the organic content and convert the remaining inorganic constituents to a soluble solid form. The solids will then be dissolved in water and the resulting product will be transferred to a Tank Farm receipt tank for eventual treatment. The treated stream, after decomposition, will still contain Cs-137 and other radionuclides, but the organic concentration will be low enough for mixing with other Tank Farm wastes.

The Tank 48 return-to-service date of October 2016 reflects the realization of a previously identified risk (ROMP Risk ID #184) and is consistent with the Tank 48 Alternative Treatment Technology selection process Independent Technical Review (ITR) conclusions. This return-to-service date allows Tank 48 to be used as a salt batch blend tank beginning in February 2017. Prior to Tank 48 return-to-service, SWPF is fully supported utilizing Tanks 28 and 21 as salt batch blend tanks. Once Tank 48 is returned to service, Tank 21 is available for removal from service.

4.4.6 Tank 50 Equipping for HLW Service

Tank 50 will be configured to be able to initiate HLW service by February 2012. Final conversion will occur when required to meet lifecycle objectives. This *Plan* projects the continued use of Tank 50 as the SDF feed tank (LLW) throughout the life cycle.

4.4.7 Managing Type III Tank Space

Type III tank space is essential to all the processes described in this *Plan*: evaporation, DWPF sludge batch preparation, salt processing, tank removal from service, etc. Limited waste storage space exists in Type III/IIIA tanks in both FTF and HTF. There is a risk that a leak in a primary tank or other adverse event could occur that might impair execution of this *Plan.*

In the 2F and 3H Evaporator Systems, space is needed for evaporator concentrate receipt to support periodic salt dissolutions and storage of high-hydroxide waste that does not precipitate into salt. This "boiled-down" liquid is commonly referred to as liquor and removing the liquor from an evaporator system is referred to as deliquoring. Evaporator effectiveness is diminished when the concentrate receipt tank salt level is 330″ or greater — at this point, the evaporator system is said to be "salt bound." Salt removal from the 3H Evaporator concentrate receipt tank, Tank 37, is planned for early FY11 to reduce the salt level. Tank 25 replaced Tank 47 as the 2F Evaporator concentrate receipt tank in early 2010.

In addition, this *Plan* was structured in such a way as to provide contingency when allowable in order to provide the best opportunity for success. Even so, risk exists pertaining to availability of Type III tank space, specifically tied to the start-up of the SWPF. If the start-up of SWPF is delayed, the 2F Evaporator System will have to be employed to wash Sludge Batch 8. This would consume the remaining available salt space in the 2F Evaporator concentrate receipt tank, and space could not be reclaimed until start-up of SWPF. Thus, it would hinder acceleration of tank removals from service, canister production rate at the DWPF, or H-Canyon support.

This *Plan*, as did Revision 15 of the *Plan*, utilizes Type I, II, and IV tanks to store supernate generated by sludge preparation. Tanks 8 and 11 store aluminum-laden supernate from the aluminum dissolution of Sludge Batches 5 and 6. Tank 24 is planned for storage of Tank 13 supernate to enable sludge removal from Tank 13.

4.5 *Glass Waste Canister Storage*

The canisters of vitrified HLW glass produced by DWPF are stored on-site in dedicated interim storage buildings called Glass Waste Storage Buildings (GWSB). A Shielded Canister Transporter moves one canister at a time from the Vitrification Building to a GWSB. The schedule for filling the GWSBs is found in *Appendix D — Canister Storage.*

GWSB #1 consists of a below-grade seismically qualified concrete vault containing support frames for vertical storage of 2,262 standard canisters. Eight of these positions have been abandoned due to construction defects and three contain archived non-radioactive glass filled canisters. As of September 30, 2010, 2,244 standard positions are in use storing radioactive canisters, the remaining 7 being contingency positions for placement of canisters if GWSB #2 is temporarily unavailable.

GWSB #2, with a similar design to GWSB #1, has 2,340 standard storage locations. The first radioactive canister was placed in GWSB #2 on July 10, 2006. One archived non-radioactive canister has been placed in GWSB #2. As of September 30, 2010, GWSB #2 stored 736 canisters. The total storage capacity of GWSB #1 and #2 for standard radioactive storage is 4,590.

A third GWSB, similar in design to GWSB #2, must be ready to store canisters in 2015. The size of the building will be determined during design.

The schedule for shipment of the canisters from SRS is not included in this *Plan*.

4.6 *Closure Sequence for the Liquid Waste System*

This *Plan* describes a sequence of events to facilitate an orderly and reasonable shutdown and closure of the various facilities used to treat and disposition the waste. A previous section described activities required for removal from service of tanks and associated equipment in the Tank Farms. The Liquid Waste facilities outside the Tank Farm — DWPF, SWPF, ARP/MCU, SPF, SDF, and associated ancillary equipment — will also require removal from service. Projection of shutdown and cleaning of the facilities to the point where they will generate no more liquid effluents is required for modeling the end of this *Plan*. Future plans will project Dismantlement and Decommissioning (D&D) requirements for full closure of processing facilities. A detailed definition of the closure of the processing facilities is premature for this *Plan*.

To the extent practical, removal from service of tanks and facilities occurs in groups to minimize operating and removal from service costs for each group. The priority (but not necessarily the sequence) for shutdowns as modeled is:

1. Type I, II, and IV tanks
2. F-Area waste tanks, the 2F Evaporator, and ancillary equipment (and including 1F Evaporator and the concentrate transfer system)
3. H-Area West Hill waste tanks, the 3H Evaporator, and ancillary equipment (including 1H Evaporator)
4. H-Area East Hill waste tanks, the 2H Evaporator, and ancillary equipment (including any remaining ARP/MCU equipment)
5. Major remaining processing facilities (e.g., DWPF, SWPF, SDF/SPF, etc.).
6. ETF is not addressed in this plan as it process streams from facilities outside the scope of this plan (e.g. Mixed Oxide Facility, etc.)

The key elements of the systematic closure sequence for shutting down and closing the LW System are summarized in Table 4-5.

Table 4-5 — *Closure Activities*

FY16–19	- Waste removal is complete from all Type I, II, and IV tanks - All Type I, II, and IV tanks are closed in compliance with the currently approved FFA removal from service commitments - H-Canyon processing influents cease
FY20–23	- 2F Evaporator shutdown - 3H Evaporator shutdown - H-Canyon shutdown flow influents cease - 2H Evaporator shutdown - Maintenance Facility (299-H) receipts diverted directly to DWPF
FY24	- FTF waste removal is completed and the FTF (including the 2F Evaporator that had previously shutdown in FY21) begins its shutdown and subsequent removal from service activities, including final F-Area Tanks - SWPF shutdown - HTF waste removal is complete and the HTF (including the 2H and 3HEvaporator) begins its shutdown and subsequent removal from service activities - SWPF cleaned by flushing with water and chemicals initiated
FY25	- SWPF flushing is complete - DWPF Shutdown
FY26	- Grouting is complete on the last FTF tank - Grouting is complete on the last HTF tank - DWPF cleaned by flushing with water and chemicals - SPF cleaned by flushing with water and chemicals

The schedule for shipment of the canisters from SRS is not included in this *Plan*.

5. Alternative Analyses

5.1 *2015 SWPF Startup*

Summary

In this Alternative Analysis, SWPF operations are delayed to September 2015 from July 2014.

Discussion

A fourteen-month delay in the start-up of SWPF operations would directly impact those processes that depend on expeditious treatment and disposal of salt waste:

- The immediate results would be a delay in the salt removal campaigns for Tanks 1, 2, and 3 in FTF and Tanks 9 and 10 in HTF. While this results in a day-for-day slip in waste removal and removal from service of these tanks, the tanks would still be able to meet the FFA commitments for removal from service. The fourteen-month delay in the start of SWPF operations would result in a fourteen-month delay in removal from service of these tanks.
- Less DWPF recycle is used for salt dissolution or molarity adjustment. The salt feed to SWPF (7.2 Mgal/year) is almost twice the salt feed to ARP/MCU and SCIX (2 Mgal/year + 2.5 Mgal/year). As less salt feed is produced, less DWPF recycle can be beneficially reused. Tanks 22 and 23 removals from service could be delayed to support receipt of the recycle until the start-up of SWPF.
- Delays in salt removal also delays waste removal on Type III tanks, specifically, evaporator concentrate receipt tanks. This decreases the functionality of the evaporators impacting future sludge batches preparation capability. The result would potentially be decreased canister production.

DOE received concurrence from SCDHEC for the continued operations of the Modular Caustic-Side Solvent Extraction Unit until September 30, 2011, with continued operation after that date to be submitted “with the SWPR startup date extension request.” However, this Plan assumes continued extension until ARP/MCU is shutdown for SWPF tie-ins. The total curies disposed at Saltstone during interim salt processing, using the ARP/MCU process, would remain below the 200,000 curies projected in the *SRS LW Strategy*[8] and the 300,000 curies discussed in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*. Mitigation of the impact of the SWPF delay, however, would be limited. The additional million gallons of tank space could allow salt removal from one of the FFA removal from service tanks or could be used to increase sludge preparation, somewhat mitigating the DWPF production impact. A priority decision on the type of material to be processed through ARP/MCU would dictate which of the impacts would be diminished.

Were the SWPF start-up delayed as described herein, the sequence of salt and sludge removal and tank removals from service should be reconfigured to minimize the impacts as much as possible. Since the sequence of activities described in this *Plan* are progressing apace, the earlier the notification of a delay in SWPF, the greater the potential for mitigation of the impacts.

5.2 *Start Operations of a Second SCIX Unit in October 2013*

Summary

Recognizing the importance of salt waste processing as the critical path to completion of the SRS Liquid Waste mission and to mitigate impacts associated with startup of SWPF beyond its early startup date, EM has identified and is pursuing several strategies which, taken collectively, fully mitigate SWPF startup impacts and accelerate mission completion by 6 years, savings $3.25 billion. These initiatives are described elsewhere in this *Plan* and include:

- Rotary Microfiltration and Small Column Ion Exchange
- ARP/MCU Operational Improvements
- Next Generation Extractant Deployment and Demonstration at MCU

DOE is committed to maintaining priority on timely completion of the SWPF project. DOE closely monitors the progress of the SWPF construction project and frequently updates the estimate for cost and schedule at completion. Any movement of the projected startup date to later into the approved baseline completion range will be detected early (i.e. several years prior to projected startup). The SRS Supplemental Salt Initiative includes the option for additional mitigation through deployment of a second SCIX unit (coupled with continued ARP/MCU operation with next generation extractant demonstration) should any movement of the projected SWPF startup date be detected. This

Plan includes an alternate analysis providing for the installation of a second SCIX unit to further supplement salt processing should the projected SWPF startup date be later than July 31, 2014, as assumed in this *Plan*. Two SCIX units and continued operation of ARP/MCU would provide a total salt processing capacity approximately equivalent to SWPF. Providing salt processing capacity equivalent to SWPF would be required to maintain tank closures generally on the schedule predicted by this *Plan*.

Discussion

Alternatives were considered for the installation of a second SCIX unit including:

- Install a second SCIX unit in an existing Type III tank. The following Type III tanks suitable for the installation of SCIX unit 2 would require adjustments in their currently planned service:
  - Tanks 29, 31, 36, 37, and 38 would require accelerated salt removal.
  - Tank 39 is the H-Canyon receipt tank.
  - Tank 50 is the DSS feed tank for SPF.
  - Tanks 30, 32, 38, and 43 are evaporator feed or concentrate receipt tanks.
  - Tanks 40, 42, and 51 are sludge preparation and feed tanks.
  - Tanks 35, 41, 48, and 49 are salt processing or blend tanks.

  If projected SWPF startup is delayed beyond July 2014, a second SCIX unit could be located in one of the tanks currently planned to store feed for SWPF Operations. Obviously, if SWPF startup is delayed, the need for such feed storage is deferred. Equipping Tank 49 with a SCIX unit would provide the needed additional salt processing capability to maintain program progress until SWPF startup. Just prior to SWPF startup, Tank 49 would be converted back to support feed supply to SWPF. Whether such a decision is prudent is dependent upon several factors such as availability of needed funds and the length of the projected delay in SWPF startup.
- Install a second SCIX unit alongside the first SCIX unit in Tank 41. This alternative would be technically feasible; however, the capacity of these two SCIX units would be limited to approximately 3.4 Mgal/yr as compared with a capacity of 2.5 Mgal/yr for a single SCIX unit. Approximately 30 days of the nominal 90-day SCIX batch cycle are for: transferring the salt batch to Tank 41, MST strike, sampling, ion exchange column changeouts, and removal of the solids to the sludge-processing tank. The remaining 60 days are required for filtering the salt solution and transferring through the ion exchange column. A second SCIX unit in Tank 41 would halve the 60 days of processing time, but would not affect the other activities. This limited combined capacity would not be sufficient to fully mitigate impacts to Type I, II, or IV tanks removal from service; but it would serve to mitigate lifecycle impacts of the SWPF startup delay.
- Alternatively, a Type I or IV tank, that meets permit, Federal Facility Agreement, and DOE requirements for this use case, could be used for installation of a second SCIX unit as an interim measure. In this scenario, the second SCIX unit would operate at the nominal capacity of 2.5 Mgal/year. The beneficial reuse of this tank would obviously defer its closure beyond the accelerated projection of this plan, but still well ahead of the FFA commitment.

Addition of a second SCIX unit into the LW system could introduce more sludge to be processed at DWPF, increasing the total canisters to be produced by ~ 200. This assumes two SCIX units processing 3.4 Mgal/ yr of salt, which increases the can count by 550 as compared to an increase of only 350 with a single SCIX. This increase could be deemed acceptable to maintain accelerated tank closure progress and to prevent protracted delay in the critical path for salt waste treatment. Alternatively, consideration could be given to use of an elutable resin for the second SCIX unit, thereby minimizing any additional sludge volume load on DWPF.

5.3 *Additional Plutonium Disposition*

Summary

This *Plan* includes the following sensitivity cases for Pu disposition in sludge batches at various concentrations in glass:

- disposition of 2.5 metric tons (t) at 897 g/m^3
- disposition of additional Pu at 2,500 g/m^3
- disposition of additional Pu at 5,400 g/m^3.

Discussion

This *Plan* allows receipt of additional fissile materials from H-Canyon to the extent allowable without negatively impacting the planned Sludge Oxide Loading (SOL). Table 5-1 below provides the quantity of additional fissile material that can be added to each batch without impacting the planned waste loading or exceeding the fissile material concentration limit of 897 g/m^3.

Table 5-1 — *Additional Fissile Mass*

Sludge Batch	SOL (wt%)	Additional fissile mass which could be added to a sludge batch and maintain the canister fissile concentration below 897 g/m^3 (kg)*
SB7	36	51
SB7B	36	41
SB8	36/40	193
SB9	40	200
SB10	40	198
SB11	40	169
SB12	40	110
SB13	40	46
SB14	40	49
SB15	40	63
SB16	40	87
SB17	40	118
Total additional Pu added:		**1,361 kg**

*The amount shown only takes into account the concentration limit; DWPF nuclear criticality constraints are not factored in.

Case 1 (Table 5-2) displays a scenario where 2,500 kg of additional fissile material from H-Canyon supplements the ~1,148 kg of fissile material currently in the waste tanks, bringing the total fissile material mass to be vitrified to ~3,648 kg. The volume of a DWPF canister is 0.6745 m^3. At a concentration of 897 g/m^3, this equates to 605 grams of fissile material per canister or over 9,400 canisters remaining to be poured (approximately 2,000 more than the Revision 16 Base Case). In this case, 2.5 t of additional fissile is distributed equally among the future batches. It reduces the 40 wt% SOL, as the additional fissile material is evenly distributed and must remain less than 897 g/m^3.

The addition of 2,000 canisters extends the operation of DWPF, and the feed tanks associated with feeding sludge, through the end of 2028 with a total in excess of 9,400 canisters. The storage capacity in the three GWSBs could be exceeded by over 2,000 canisters — the equivalent of an additional GWSB.

This case extends DWPF operations, varying only in impacts to Tank Farm and H-Canyon operations. Table 5-2 assumes that discards from H Canyon begin with 51 kg in Sludge Batch 7 and are increased in subsequent batches until a maximum of 227 kg per batch is reached. This alternative impacts the removal from service dates for all compliant tanks that contain sludge and would likely delay removal from service of the last old-style tank past 2022.

Table 5-2 — *Case 1: 2,500 kg of additional Pu @ 897 g/m³*

	SOL wt%	No. of Cans	Canisters /year	Fissile Mass per Batch in HLW Tanks	Additional Fissile Mass From H-Canyon (kg)*	Total Fissile Mass per Sludge Batch	Total Canisters @ 897 g/m³	Sludge Batch End Date	Waste Loading to meet 897 g/m³
SB6	36	290	325				290	Jun 2011	36
SB7	36	305	325	100	51	151	250	Mar 2012	44
SB7B	36	176	325	66	227	293	484	Dec 2013	13
Melter #2 Replacement + SWPF Tie-in + Process Improvements								Jul 2014	
SB8	36/40	442	325/400	74	227	301	498	Jul 2015	34
SB9	40	410	400	48	227	275	455	Sep 2016	36
SB10	40	391	400	39	227	266	440	Nov 2017	36
SB11	40	397	400	71	227	298	493	Feb 2019	32
SB12	40	356	400	105	227	332	549	Jul 2020	26
Melter #3 Replacement								Nov 2020	
SB13	40	340	400	160	217	377	623	Jun 2022	22
SB14	40	347	400	161	217	378	625	Jan 2024	22
SB15	40	320	400	131	217	348	575	Jul 2025	22
SB16	40	319	400	106	217	323	534	Dec 2026	24
Melter #4 Replacement								Mar 2027	
SB17	40	337	400	86	219	305	504	Jul 2028	27
Total for SB 6-17	**4,430**			**1,148**	**2,500**	**3,648**	**6,319**		
						Canisters in SB 1A-5	*2,948*		
						Canisters in heel	*180*		
						Total Canisters Lifecycle	**9,447**		

* Additional Fissile mass shown here is what could be brought in from the canyon at Pu concentration of 897 gm/m^3 in glass. The amount shown only takes into account the concentration limit; DWPF nuclear criticality constraints are not factored in.

Case 2 (Table 5-3) displays a scenario that assumes Pu at a concentration of 2,500 g/m^3 in the glass and no change in the SOL wt% for the future batches. This option allows addition of 5,500 kg of fissile material, maintains the canister count, and does not change the waste loading. It shortens the life cycle by approximately 5 years when compared to Case 1. One advantage of this option is that it allows almost 5.5 t of additional fissile material for processing into glass (almost double to Case 1) and still maintains the same life cycle duration as suggested in this *Plan*.

Table 5-3 — *Case 2: 5,500 kg of additional Pu @ 2,500 g/m^3*

	SOL wt%	No. of Cans	Canisters /year	Fissile Mass per Batch in HLW Tanks	Additional Fissile Mass From H-Canyon (kg)*	Total Fissile Mass per Sludge Batch	Total Canisters @ 2,500 g/m^3	End Date	Waste Loading to meet 2,500 g/m^3
SB6	36	290	325				290	Jul 2011	36
SB7	36	305	325	100	51	151	304	Jul 2012	36
SB7B	36	176	325	66	232	297	176	Feb 2013	36
Melter #2 Replacement + SWPF Tie-in + Process Improvements								Jul 2014	
SB8	36/40	442	325/400	74	671	745	442	Oct 2014	38
SB9	40	410	400	48	643	691	410	Nov 2015	40
SB10	40	391	400	39	620	659	391	Nov 2016	40
SB11	40	397	400	71	598	669	397	Nov 2017	40
SB12	40	356	400	105	495	600	356	Oct 2018	40
SB13	40	340	400	160	413	573	340	Sep 2019	40
SB14	40	347	400	161	424	585	347	Nov 2020	40
Melter #3 Replacement								Sep 2020	
SB15	40	320	400	131	409	540	320	Oct 2021	40
SB16	40	319	400	106	432	538	319	Jul 2022	40
SB17	40	337	400	86	482	568	337	Jun 2023	40
Total for SB 6-17		**4,430**		**1,148**	**5,471**	**6,618**	**4,429**		
						Canisters in SB 1A-5	*2,948*		
						Canisters in heel	*180*		
						Total Canisters Lifecycle	**7,557**		

* Additional Fissile mass shown here is what could be brought in from the canyon at Pu concentration of 2,500 gm/m^3 in glass. The amount shown only takes into account the concentration limit; DWPF nuclear criticality constraints are not factored in.

Case 3 (Table 5-4) displays a scenario that assumes Pu at a concentration of 5,400 g/m^3 in the glass and no change in the SOL wt% for the future batches. This option allows addition of 13,000 kg of fissile material, maintains the canister count, and does not change the waste loading. It also shortens the life cycle by almost approximately 5 years when compared to Case 1. One advantage of this option is that it allows almost 13 t of additional fissile material for processing into glass and still maintains the same life cycle duration as suggested in this *Plan***.**

Table 5-4 — *Case 3: 13,000 kg of additional Pu @ 5400 g/m^3*

	SOL wt%	No. of Cans	Canisters /year	Fissile Mass per Batch in HLW Tanks	Additional Fissile Mass From H-Canyon (kg)*	Total Fissile Mass per Sludge Batch	Total Canisters @ 5,400 g/m^3	End Date	Waste Loading to meet 5,400 g/m^3
SB6	36	290	325				290	Jul 2011	36
SB7	36	305	325	100	51	151	304	Jul 2012	36
SB7B	36	176	325	66	577	643	176	Feb 2013	36
Melter #2 Replacement + SWPF Tie-in + Process Improvements								Jul 2014	
SB8	36/40	442	325/400	74	1,536	1610	442	Oct 2014	38
SB9	40	410	400	48	1,445	1493	410	Nov 2015	40
SB10	40	391	400	39	1,385	1424	391	Nov 2016	40
SB11	40	397	400	71	1,375	1446	397	Nov 2017	40
SB12	40	356	400	105	1,192	1297	356	Oct 2018	40
SB13	40	340	400	160	1,078	1238	340	Sep 2019	40
SB14	40	347	400	161	1,102	1264	347	Nov 2020	40
Melter #3 Replacement								Sep 2020	
SB15	40	320	400	131	1,035	1166	320	Oct 2021	40
SB16	40	319	400	106	1,056	1162	319	Jul 2022	40
SB17	40	337	400	86	1,142	1227	337	Jun 2023	40
Total for SB 6-17	**4,430**			**1,148**	**12,973**	**14,121**	**4,429**		
						Canisters in SB 1A-5	*2,948*		
						Canisters in heel	*180*		
						Total Canisters Lifecycle	**7,557**		

* Additional Fissile mass shown here is what could be brought in from the canyon at Pu concentration of 5,400 gm/m^3 in glass. The amount shown only takes into account the concentration limit; DWPF nuclear criticality constraints are not factored in.

6. Description of Assumptions and Bases

The major assumptions and planning bases are the results of an agreement between SRR[17] and DOE[18]. They address the planning period to the end of the program.

6.1 *Funding*

This *Plan* was developed assuming the funding required to achieve the planned project and operations activities will be available. This *Plan* may be used to provide justification for obtaining the necessary funding profiles.

6.2 *Regulatory Drivers*

The following regulatory requirements drive the development of the System Plan through the end of the program.

- **Federal Facility Agreement (FFA)** – Commits the Department to grout the Type I, II, and IV tanks (Tanks 1–24) no later than 2022. The specific schedule for the Type I, II, and IV tanks is per the *Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18*[12] which is the schedule for the currently approved FFA.
- **Site Treatment Plan (STP)** – "Upon the beginning of full operations, DWPF will maintain canister production sufficient to meet the commitment for the removal of the backlogged and currently generated waste inventory by 2028." This is satisfied by removing waste (including heels) from all Type III tanks by 2028; Types I, II, and IV having had all waste removed in compliance with the FFA above.

6.3 *Waste Removal and Tank Removal from Service Program*

The following technical assumptions were used as input to the modeling of this *Plan*:

Waste Removal

- Types I, II, and IV tanks (Tanks 1–24)
  - Waste Removal and Tank Removal from Service commitments are per the FFA
    - Salt will be removed on a schedule to support the SWPF startup date
    - After the completion of bulk waste removal efforts in a specific tank, additional contaminated liquids may be reintroduced after completion of bulk waste removal efforts upon approval by SCDHEC and EPA
    - Isolation and grouting of a tank is the condition that satisfies the FFA requirement for tank closure
- Type III and IIIA (Tanks 25–51)
  - Commitment for completion of waste removal (bulk waste and heel) from all Type III/IIIA tanks is per the STP

  Note: Tanks are not required to be isolated and grouted to meet the STP
- Waste removal and cleaning activities could include mechanical, chemical, and water washing operations
- After the initial BWRE campaign in a sludge tank, a ~3 to 6″ heel (10–20 kgal) of waste remains.
- After the initial BWRE campaign in a salt tank, ~ 2 to 3 feet (90–130 kgal depending on the type of tank) of insoluble/low solubility material waste (heel) remains
- Two Phases of Waste Heel Removal are available for use:
  - Mechanical Cleaning uses mechanical agitation
    - Assumed to take 12 months of operation unless otherwise stated
      - Heel solids volume reduced to less than 5 kgal
  - Chemical Cleaning uses OA or advanced/specialized mechanical or chemical technology
    - Assumed to take 6 months of operation unless otherwise stated
  - Following chemical cleaning in Tank 7, mechanical cleaning will be performed to remove insoluble solids resulting in a Tank Farm volume impact of ~150 kgal/tank
  - After Tanks 7, 11, 12, and 15, future tanks using ECC result in Tank Farm waste volume impact of ~100 kgal/tank with an additional 150 kgal/tank of water to flush the tank.
  - For some tanks with high waste turnover , e.g. Tank 8, mechanical cleaning is not required; however, flushing could be required prior to chemical cleaning
  - For some tanks mechanical cleaning may remove waste to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical (e.g. Tanks 21, 22, 23, and 24). For those tanks chemical cleaning will not be performed.
  - Testing during the heel removal phase will inform the decision to do mechanical or chemical cleaning.

— Tank cleaning is complete for Tanks 5 and 6.

Annulus Cleaning

- All tanks that have experienced leaks will undergo sampling and analysis to determine the necessity for annulus cleaning. The volume used for annulus cleaning depends on the extent of waste present.

Tank Removal from Service

- A 24-month removal from service process is planned for the first five tanks to account for sampling and characterization, initial drafting of documents, first-time review process, annulus and coil removal from service, and a 4-month grout period. The experience gained on Tanks 5, 6, 18, 19, and 16 will allow compression of the removal from service schedule to 18 months for the next four tanks (Tanks 7, 8, 11, and 12). Further refinement of sampling and characterization techniques and review and response cycles will accelerate the tank removal from service schedule to 12 months for the remaining tanks.
- Overall tank closure priority will support area closure in the following order, as feasible:
  1. F-Tank Farm
  2. H-Tank Farm West Hill
  3. H-Tank Farm East Hill

Regulatory Approvals

- Two Secretarial Waste Determinations (F-Tank Farm and H-Tank Farm) will be issued pursuant to NDAA §3116 to determine whether the provisions of NDAA §3116(a) are met such that the tank and ancillary equipment residuals are not high level waste.
- SCDHEC reviews and approves tank removals from service using a process that will be documented in the respective General Closure Plan.
- DOE will approve any necessary waste determination documents (e.g. amendments) to support this *Plan*
- DOE will maintain NEPA documentation necessary to support this *Plan*.

6.4 *DWPF Production*

Canister production and sludge batch need dates are projected by the *Sludge Batch Plan*[14]

- DWPF will produce canisters at maximum throughput for the duration of the program (based on achievable melt rate, planned outages, and waste loading for sludge being processed). DWPF near-term canister production is based on revised sludge mass values.
- In general, assumes 4-month melter replacement outage approximately every 72 months of melter operation (i.e., DWPF operates 68 months out of every 72 months). The next DWPF melter outage to replace Melter 2 is planned concurrent with the SWPF tie-in outage (April 2014–July 2014)
- A four-month DWPF outage will allow:
  — Melter #3 will replace Melter #2
  — DWPF feed preparation modifications
    – yields a 400 canister per year production rate
    – enables a SOL of 40 wt%
  — Recycle reduction modifications
    – Reduces the recycle amount by ~1.25 Mgal/yr from the forecast of ~3.2 Mgal/yr after SWPF startup (as predicted by the algorithm used in versions of the LW System Plan prior to Rev. 15)
  — SWPF tie-ins
- Discrete Canister Production Rate[i]:
  — Sludge batch planning is performed to recommend the sequencing and timing of future sludge batches. Based on modeling of sludge batches, *Appendix C — Sludge Processing* sums the canister production expectations, assuming the following nominal canister production rates:
    – 325 Discrete canisters/yr at 36 wt% SOL for Sludge Batches 6–7 due to improvements in melter technology with the addition of bubblers
    – 400 Discrete canister/yr at 40 wt% SOL upon implementation of feed preparation modifications except where SOL is limited by fissile material concentration (planned during the SWPF tie-in outage).
- DWPF recycle is beneficially reused

[i] *"Discrete canisters" refers to actual canisters (sometimes referred to as cans) that occupy a storage location in the Glass Waste Storage Building.*

- A third GWSB, similar in design to GWSB #2 will be required with the need date determined by modeling
- Shipment of canisters off-site for final disposition is not in the scope of this Plan.
- DWPF canisters will maintain a fissile material concentration limit of 897 g/m^3 of glass[19]. Sludge batch preparation will supply feed for the DWPF to ensure the canisters remain within this requirement
- Pu discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings while continuing to comply with the canister fissile material concentration limits.

6.5 Salt Program

ARP/MCU

- ARP/MCU processing rates:
  - For modeling purposes, ARP/MCU processes salt feed at a rate of 15 kgal/wk to 40 kgal/wk
    - ARP/MCU will not operate during any DWPF melter replacement outages
    - ARP/MCU will cease operations six months prior to SWPF start-up to allow for SWPF tie-ins
    - ARP/MCU will not return to operation after SWPF startup
  - MCU decontamination factor for Cs-137 is 200
- For each gallon processed, ~1.3 gallons of DSS is sent to SPF
- A next-generation cesium extractant will be introduced during ARP/MCU Salt Batch #4
  - Implementation of the next generation cesium extractant will require a three month outage
  - Processing will be 15 kgal/week for three months after implementation of the next generation cesium extractant, 30 kgal/week for the following three months and then 40 kgal/week for the remainder of Salt Batch #4
  - The ARP strike function will relocate to building 512-S from 241-96H during the next generation extractant outage to allow 241-96H to be used for the Tank 48 FBSR process
- The ARP/MCU facilities will permanently shutdown sufficiently in advance of the startup of SWPF allowing for SWPF tie-ins and modifications to Tank 49. This assumes:
- DOE and SCDHEC will approve operation of ARP/MCU facilities to align with a SCDHEC approved delay in SWPF startup
- Any ARP/MCU facility upgrades required to maintain the ARP/MCU operating rate for its extended life will be provided
  - the total volume of waste may be increased from the present NDAA §3116 Basis
  - ARP/MCU facilities operate within the curie estimates of the present NDAA §3116 Basis

SCIX

- SCIX Processing of salt waste begins October 2013 at 2.5 Mgal/year (nominal rate)
- The average DSS stream resulting from the SCIX process will be equivalent to the DSS stream produced from the SWPF process and consistent with the NDAA §3116 WD for Salt Waste Disposal at SRS.
- Annual processing throughput:
  - 2.5 Mgal/yr processing rate
  - The 2.5 Mgal per year is based on 100% availability for the Tank Farm feed as well as DWPF and SPF/DSS Tank receipt of SWPF discharge streams. The yearly throughput varies when adjusted for the assumed 4-month duration melter replacement outage every six years and other planned outages
    - ~40 kgal will be sent to DWPF per year
    - ~2,500 kgal of DSS will be sent to SPF per year
- Tank Farm feed preparation infrastructure modifications are completed to support SCIX processing rates. Major modifications include:
  - H-Tank Farm blend tanks readiness for salt solution preparation (Tank 35 currently proposed)
  - Tank 41 readiness as SCIX processing tank
  - Mixing capabilities
  - Enhanced transfer capabilities
  - Dedicated transfer routes provided to feed tank

SWPF

- SWPF becomes operational July 31, 2014 and SCDHEC approves the modification of the SWPF's permitted startup from September 2011 to July 31, 2014
  - SWPF tie-ins will require a four-month outage of DWPF operations and a 2 month outage of SPF operations

- Annual processing throughput (*Long Term Processing Capacity at SWPF – Inputs to System Plan*[20])
  - Initial year: 4.5 Mgal/yr processing rate
  - Subsequent years: 7.2 Mgal/yr nominal processing rate (actual anticipated throughput varies with respect to DWPF outages with an average of 6.8 Mgal/yr)
    - Processing rate determined as follows:

$$[9.4\,\text{Mgal/yr}]\times[1.2]\times[0.85]\times[0.75]=7.2\,\text{Mgal/yr}$$

      9.4 Mgal per year based on maximum hydraulic rate
      1.2 – 20 % increase due to the assumed introduction of a next-generation extractant after start-up
      0.85 – estimated reduction due to hydraulic limits of the V-10 contactor
      0.75 – availability
    - The 7.2 Mgal per year is based on 100% availability for the Tank Farm feed as well as DWPF and SPF/DSS Tank receipt of SWPF discharge streams. The yearly throughput varies when adjusted for the assumed 4-month duration melter replacement outage every six years and other planned outages
    - ~600 kgal (nominal rate) of SE will be sent to DWPF per year
    - ~156 kgal (nominal rate) of MST solids/sludge will be sent to DWPF per year
    - Next generation extractant has minimal impact on DWPF operations
    - Next generation extractant has minimal impact on SPF operations
  - The SWPF feed chemistry is per SWPF Feed Specification Radionuclide Limits of the SWPF *Waste Acceptance Criteria*[21] including:
    - the initial one million gallons of feed to SWPF will be (at 6.44 M Na):
      - ≤ 1.0 Ci/gal
    - all batches are planned to be at 6.44 M Na
    - additional blending may be required to meet other feed criteria, such as:
      - OH > 2 M
        - Caustic (50% NaOH) additions are planned during salt dissolution and batch preparation, as needed to meet the minimum 2 M OH requirements
      - Al < 0.25 M
      - Si < 842 mg/L
- Tank Farm feed preparation infrastructure modifications are completed to support SWPF processing rates. Major modifications include:
  - H-Tank Farm Blend tanks readiness for salt solution preparation
  - F-Tank Farm Blend tanks readiness for salt solution preparation
  - Tank 49 readiness as SWPF feed tank
  - Mixing capabilities
  - Enhanced transfer capabilities
  - Dedicated transfer routes provided to feed tank

Tank 48 Return to Service

- Material dispositioned by organic destruction using the fluidized bed steam reforming treatment technology. Completion of treatment is October 2016
- The material in Tank 48 will be fully treated by sending 350 kgal to the treatment unit.
- The Tank 48 heel will have an acceptable quantity of potassium tetraphenylborate (KTPB) for mixing with other Tank Farm waste and dispositioning to downstream facilities (i.e., SWPF and associated transfer facilities)
- Tank 48 waste will be processed at a rate of 184 kgal per year. This is based on seven days per week, 24 hours per day at a utilization factor of 75% (25% downtime allows for 10% duty cycle — defined as the minimum time the FBSR treatment unit is required to be operable — and 15% limitations due to weather, emergent facility issues, etc.).
- The coal fraction of the FBSR product will be dispositioned via vitrification during its two-year operation. Two sludge batches are available to receive the stream into the sludge feed tanks, Tanks 42 and 51. Tank 39 may be utilized if additional receipt space is required[22]. The projected nominal coal contribution to the total organic carbon in the melter feed is not expected to impact melter throughput, melter flammability, or REDOX equilibrium.

6.6 Saltstone Production

SPF is capable of processing at a rate that supports other waste treatment operations as follows:

- During ARP/MCU operations:
  - ~120 kgal/wk of feed (including DSS) maximum rate
  - ~95 kgal/wk of feed (including DSS) average, accounting for outages, cold caps, etc.
  - May require operation of more than one cell and the use of "cold caps" to meet radiological control requirements
  - Prior to SWPF operation, SPF will demonstrate the capacity to operate at the maximum rate of ~350 kgal/week. During the demonstration period, SPF will experience extended periods of downtime to allow sufficient volume of DSS to accumulate in Tank 50. Subsequently, SPF will operate for short sprints, ramping up to ~350 kgal/week, and then shut down for extended periods as the DSS volume accumulates again.
- During SWPF and SCIX operation:
  - ~350 kgal/wk of feed (including DSS) maximum rate
  - ~215 kgal/wk of feed (including DSS) annual average rate
  - SPF and SDF will support SWPF processing rates
  - Based on:
    - nominal SWPF rate of 7.2 Mgal/yr x 1.269 gal of DSS/gal of salt solution feed x 75% attainment = 6.8 Mgal/yr
    - nominal SCIX rate of 3.3 Mgal/yr x 1.0 gal of DSS/gal of salt solution feed x 75% attainment = 2.5 Mgal/yr
  - Additional operational time (i.e., multiple shifts, additional operating days each week, etc.) and adequate SDU receipt space to match production stream from SWPF is planned
  - Modifications will provide sufficient contingency storage capacity to minimize impacts to SWPF, SCIX, MCU, or ETF due to SPF or SDF outages
- Since neither ARP/MCU nor SWPF process during melter replacement outages, SPF is not planned to operate other than to run off any backlog material that may be in the feed tanks
- Two SDUs, Vault 1 and 4, are in service. Vault 1 will receive no additional saltstone grout; Vault 4 has five cells available to receive grout. Future SDUs will have two disposal cells with 1.4 Mgal feed capacity. SDU fill sequence will be Vault 4, SDU 2 (cells 2a, 2b), SDU 3 (cells 3a, 3b), SDU 5 (cells 5a, 5b), SDU 6 (cells 6a, 6b), SDU 7 (cells 7a, 7b) … etc.
  - Each gallon of feed, when added to the cement, flyash, and slag, makes 1.76 gallons of grout. Each disposal cell, starting with SDU 2, is estimated to contain ~2,600 kgal of grout. Therefore, each cell holds ~1,500 kgal of feed solution; each SDU holds ~ 3,000 kgal of feed solution.

6.7 Base Operations

Evaporation

The primary influents into the Tank Farms are DWPF recycle and H-Canyon receipts. In addition, sludge batch preparation produces a large internal stream of spent washwater. In order to continue to maintain space in the Tank Farms to support these missions, these streams must be evaporated. There is one evaporator in F-Area and two in H-Area.

DWPF recycle has a high concentration of silica due to the vitrification process. When this stream is mixed with high aluminum streams from PUREX and HM canyon processing, there is a potential for forming sodium aluminosilicate. Experience has shown that sodium aluminosilicate can co-precipitate sodium diuranate in the evaporator, causing a potential criticality concern. In order to prevent the potential for criticality, a feed qualification program is in place to minimize the formation of a sodium aluminosilicate scale in the 2F and 3H Evaporators and to prevent accumulation of enriched uranium in the 2H Evaporator. It is assumed that scale may accumulate in the 2H Evaporator, but uranium enrichments and masses will be well below criticality concerns.

- The 2H Evaporator System is used to evaporate DWPF recycle. The 2F and 3H Evaporators are used to process streams that will not produce scale, i.e., canyon wastes and sludge batch decants. The evaporator system feed and concentrate receipt tanks configuration is:
  - 3H: Feed – Tank 32; Receipt – Tank 30 transitioning to Tank 37 in 2011
  - 2H: Feed – Tank 43; Receipt – Tank 38
  - 2F: Feed – Tank 26; Receipt – Tank 25

- Evaporator Capacity – The following evaporator utilities and capacity were assumed based on historical experience.

Table 6-1 — *Evaporator Utilities*

Evaporator	Utility	Space Gain Capacity
2F	50%	150 kgal/mo
2H	50%	150 kgal/mo
3H	50% [a]	200 kgal/mo

[a] 50% utility is assumed when operating. Due to periodic salt dissolutions and feed availability, average percentage of operating time is lower (<30%).

- The 2F Evaporator is assumed to be shut down in 2021.
- The 2H Evaporator is assumed to be placed in standby in 2024.
- The 3H Evaporator is assumed to be shut down in 2021.

General Assumptions

- A minor influent is the 299-H Maintenance Facility. The influents mainly consist of a dilute nitric acid stream, decontamination solutions, and steam condensate. These waste streams are collected from decontaminating equipment and collected in the 299-H pump tank, neutralized and sent to Tank 39. Beginning in 2023, these receipts are assumed to be redirected to allow for Tank 39 Waste Removal.
- Tank Farm infrastructure maintained to support SWPF, DWPF, and SPF processing rates and tank closure schedules.

Separations Canyon Operations

- Sufficient tank space volume is available to support the projected receipt HLW into Tank 39 from H-Canyon operations through 2019 with provision for shutdown flows through 2022. This is not inclusive of Unirradiated Uranium Materials (UUM) dispositioned in SPF or direct discards of Pu or neptunium materials to the DWPF feed system
- Source of streams is based on *H-Area Liquid Waste Forecast Through 2019*[16] adjusted to meet the volumes stated above
- Shutdown flows for H-Canyon are assumed from FY20–FY22 and are as outlined in *H-Canyon Liquid Waste Generation Forecast for H-Tank Farm Transfer*[23].
- Low level streams sent directly to Tank 50 and Pu streams sent directly to a sludge batch are not included in the volumes stated above
- Additional material sent directly to sludge batches increases total DWPF canister count by as much as 100 canisters (these additional canisters are included in the 7,557 forecast canisters of this *Plan*):
  - Fissile isotope concentration of SRS HLW canisters will be maintained at or below 897 g/m^3
  - Pu discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings while continuing to comply with canister fissile material concentration limits.

Effluent Treatment Facility

- ETF is assumed to receive an average of 11 Mgal/yr:
  - LW Evaporators: 5 Mgal/yr
  - Savannah River Nuclear Solutions (SRNS) Facilities: 6 Mgal/yr
    Note: the Agreement between Savannah River Nuclear Solutions, LLC and Savannah River Remediation for Liquid Waste Receipt Services provides that the total maximum allocation for waste generated from SRNS facilities including H-Canyon, F-Canyon, the Waste Solidification Building, Mixed Oxide Facility, and miscellaneous smaller contributors is 15 Mgal/yr.

Dismantlement and Decommissioning

  - LW Areas transferred to D&D on an Area-by-Area basis upon closure of their included facilities.

7. System Description

7.1 *History*

The LW System is the integrated series of facilities at SRS that safely manage the existing waste inventory and disposition waste stored in the tanks into a final glass or grout form. This system includes facilities for storage, evaporation, waste removal, pre-treatment, vitrification, and disposal.

Since it became operational in 1951, SRS, a 300-square-mile DOE Complex located in the State of South Carolina, has produced nuclear material for national defense, research, medical, and space programs. The separation of fissionable nuclear material from irradiated targets and fuels resulted in the generation of large quantities of radioactive waste that are currently stored onsite in large underground waste storage tanks. As of June 2010, approximately 37 Mgal[24] of radioactive waste are currently stored at SRS. Most of the tank waste inventory is a complex mixture of chemical and radioactive waste generated during the acid-side separation of special nuclear materials and enriched uranium from irradiated targets and spent fuel using the Plutonium Uranium Reduction Extraction (PUREX) process in F-Canyon and the modified PUREX process in H-Canyon (HM process). Waste generated from the recovery of Pu-238 in H-Canyon for the production of heat sources for space missions is also included. The waste was converted to an alkaline solution; metal oxides settled as sludge and supernate was evaporated to form saltcake.

The variability in both nuclide and chemical content is because waste streams from the 1st cycle (high heat) and 2nd cycle (low heat) extractions from each Canyon were stored in separate tanks to better manage waste heat generation. When these streams were neutralized with caustic, the resulting precipitate settled into four characteristic sludges presently found in the tanks where they were originally deposited. The soluble portions of the 1st and 2nd cycle waste were similarly partitioned but have and continue to undergo blending in the course of waste transfer and staging of salt waste for evaporative concentration to supernate and saltcake. Historically, fresh waste receipts were segregated into four general categories in the SRS Tank Farms: PUREX high activity waste, PUREX low activity waste, HM high activity wastes and HM low activity wastes. Because of this segregation, settled sludge solids contained in tanks that received fresh waste are readily identified as one of these four categories. Fission product concentrations are about three orders of magnitude higher in both PUREX and HM high-activity waste sludges than the corresponding low-activity waste sludges.

Because of differences in the PUREX and HM processes, the chemical compositions of principal sludge components (iron, aluminum, uranium, manganese, nickel, and mercury) also vary over a broad range between these sludges. Combining and blending salt solutions has tended to reduce soluble waste into blended PUREX salt and concentrate and HM salt and concentrate, rather than maintaining four distinct salt compositions. Continued blending and evaporation of the salt solution deposits crystallized salts with overlying and interstitial concentrated salt solution in salt tanks located in both Tank Farms. More recently, with transfers of sludge slurries to sludge washing tanks, removal of saltcakes for tank removal from service, receipts of DWPF recycle, and space limitations restricting full evaporator operations, salt solutions have been transferred between the two Tank Farms. Intermingling of PUREX and HM salt waste will continue until processing in the SWPF can begin.

Continued long-term storage of these radioactive wastes poses a potential environmental risk. Therefore, since 1996, DOE and its contractor have been removing waste from tanks, pre-treating it, vitrifying it, and pouring the vitrified waste into canisters for long-term disposal in a permanent canister storage location (see *Figure 7-2 — Process Flowsheet*). As of September 30, 2010, DWPF had produced 2,987 vitrified waste canisters.

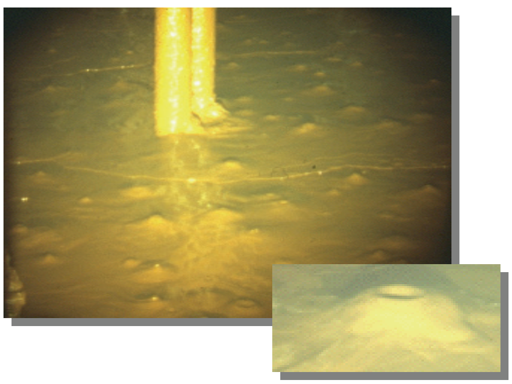
7.2 *Tank Storage*

SRS has 51 underground waste storage tanks, all of which were placed into operation between 1954 and 1986. There are four types of waste tanks — Types I through IV. Type III tanks are the newest tanks, placed into operation between 1969 and 1986. There are 27 Type III tanks. Type I tanks are the oldest tanks, constructed in 1952 through 1953. Type II waste tanks were constructed in 1955 through 1956. There are eight Type IV tanks, constructed in 1958 through 1962. Two of these Type IV tanks, Tanks 17 and 20 in F-Tank Farm, have been isolated, removed from service, and grouted. Twelve tanks without full secondary containment have a history of leakage[25]. Sufficient waste has been removed from these tanks such that there are currently no active leak sites. The first tank, Tank 1F, lacking full secondary containment, began receiving waste in 1954. This tank is still in service.

Approximately 37.1 Mgal of radioactive waste, containing 235 million curies (MCi)[24] of radioactivity, are currently stored in 49 active waste storage tanks located in two separate locations, H-Tank Farm (29 tanks) and F-Tank Farm (20 tanks). This waste is a complex mixture of insoluble metal hydroxide solids, commonly referred to as sludge, and soluble salt supernate. The supernate volume is reduced by evaporation, which also concentrates the soluble salts to their solubility limit. The resultant solution crystallizes as salts. The resulting crystalline solids are commonly referred to as saltcake. The saltcake and supernate combined are referred to as salt waste (34.2 Mgal).

Tanks under construction. Note tank size relative to construction workers. Later, dirt is backfilled around the tanks to provide shielding.

The sludge component of the radioactive waste represents approximately 2.9 Mgal (8% of total) of waste but contains approximately 169 MCi (48% of total). The salt waste makes up the remaining 34.2 Mgal (92% of total) of waste and contains approximately 183 MCi (52% of total). Of that salt waste, the supernate accounts for 18.4 Mgal and 171 MCi and saltcake accounts for the remaining 15.8 Mgal and 12 MCi[24]. The sludge contains the majority of the long-lived (half-life > 30 years) radionuclides (e.g., actinides) and strontium. The sludge is currently being stabilized in DWPF through a vitrification process that immobilizes the waste in a borosilicate glass matrix.



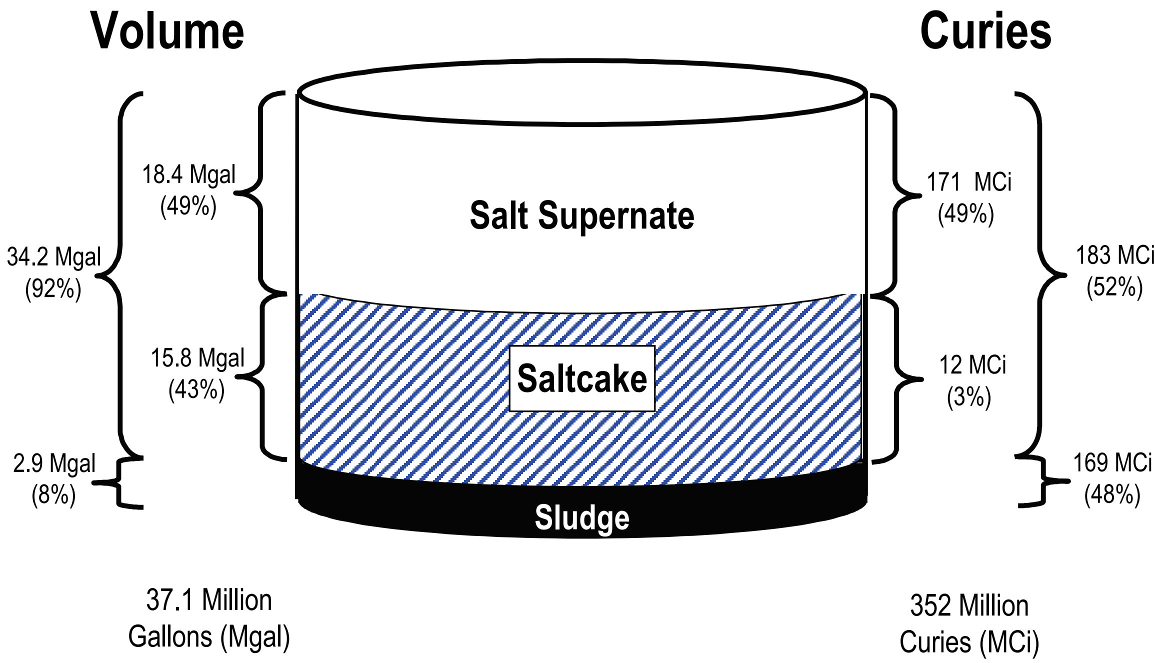
Sludge consists of insoluble solids that settle to the bottom of a tank. Note the offgas bubbles, including hydrogen generated from radiolysis.

Radioactive waste volumes and radioactivity inventories reported herein are based on the Waste Characterization System (WCS) database, which includes the chemical and radionuclide inventories on a tank-by-tank basis. WCS is a dynamic database frequently updated with new data from ongoing operations such as decanting and concentrating of free supernate via evaporators, preparation of sludge batches for DWPF feed, waste transfers between tanks, waste sample analyses, and influent receipts such as H-Canyon waste and DWPF recycle.

Salt waste is dissolved in the liquid portion of the waste. It can be in normal solution as Supernate (top picture) or, after evaporation, as salt cake (bottom picture) or concentrated supernate. The pipes in all the pictures are cooling coils.

Well over 95%[24] of the salt waste radioactivity is short-lived (half-life ≤ 30 years) Cs-137 and its daughter product, Ba-137m, along with lower levels of actinide contamination. Depending on the particular waste stream (e.g., canyon waste, DWPF recycle waste), the cesium concentration may vary. The precipitation of salts following evaporation can also change the cesium concentration. The concentration of cesium is significantly lower than non-radioactive salts in the waste, such as sodium nitrate and nitrite, therefore, the cesium does not reach its solubility limit and only a small fraction precipitates[26]. As a result, the cesium concentration in the saltcake is much lower than that in the liquid supernate and interstitial liquid fraction of the salt waste.

Figure 7-1 — *Waste Tank Composite Inventory (As of June 30, 2010)*



7.3 *Waste Tank Space Management*

To make better use of available tank storage capacity, incoming liquid waste is evaporated to reduce its volume. This is important because most of the SRS Type III waste storage tanks are already at or near full capacity. Since 1951, the Tank Farms have received over 150 Mgal of liquid waste, of which over 110 Mgal have been evaporated, leaving approximately 37.1 Mgal in the storage tanks. Projected available tank space is carefully tracked to ensure that the Tank Farms do not become "water logged," a term meaning that so much of the usable Type III tank space has been filled that normal operations and waste removal and processing operations cannot continue. A portion of tank space must be reserved as contingency space should a new tank leak occur. Waste receipts and transfers are normal Tank Farm activities as the Tank Farms receive new or "fresh" waste from the H-Canyon stabilization program, liquid waste from DWPF processing (typically referred to as "DWPF recycle"), and wash water from sludge washing. The Tank Farms also make routine transfers to and from waste tanks and evaporators. Since initiation of interim salt waste treatment (DAA and ARP/MCU), the working capacity of the Tank Farms has been maintained. Three evaporator systems are currently operating at SRS — the 2H, 3H, and 2F systems.

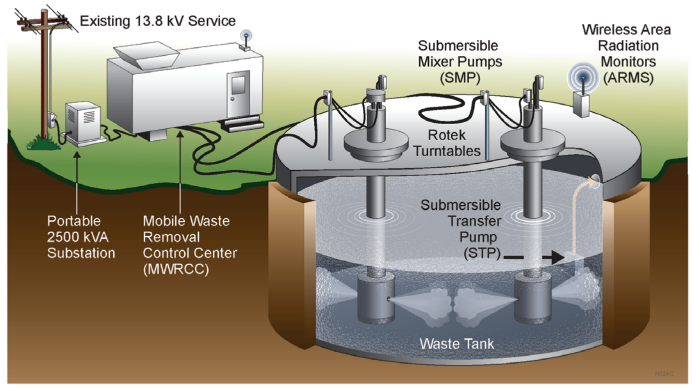
7.4 *Waste Removal from Tanks*

The first step in the disposition of sludge and salt waste is BWRE. Sludge is sent to one of two feed preparation tanks ensuring sludge waste is continuously available for treatment at DWPF. Salt is dissolved, removed, and staged for treatment at ARP/MCU, SCIX, or SWPF.

To reduce the two-to-four year period required for installation of substantial structural steel and large mixing and transfer pumps — with their attendant infrastructure — required for BWRE, a Waste on Wheels (WOW) innovation was developed. The WOW concept requires no new infrastructure. Portable and temporary equipment meet tank infrastructure needs. Additional purchased pumps and WOW equipment perform accelerated BWRE operations concurrently in both Tank Farms. The primary components of the WOW system are:

- Long-lasting reusable SMPs
- A portable field operating station containing pump drives and controls
- A portable substation to provide 480-, 240- and 120-volt power to the WOW equipment
- Disposable carbon steel transfer pumps.

WOW equipment is deployed at the tank as a field operating station, providing temporary power and control for BWRE equipment. When BWRE is completed on one tank, the WOW equipment is reconfigured to support waste removal on the next tank. Pumps are sized to fit through 24-inch openings allowing a high degree of flexibility to locate the pumps in optimal configurations within the waste tanks. Most are supported from the bottom of the tank, minimizing steel superstructures and tank-top loading. Product lubricated bearings and motor cooling eliminate the need for bearing and seal water supply. These pumps have exterior fittings and fixtures so that the pumps can be quickly decontaminated, removed, and reinstalled in the next tank with minimal radiation exposure to personnel. Disposable transfer pumps are used to transfer the waste to a receipt or hub tank using existing underground transfer lines and diversion boxes. If the transfer system is degraded or non-existent, above-grade hose-in-hose technology is deployed, rather than investing in costly repairs. Temporary shielding is supplied as necessary to reduce exposure to personnel.



WOW Deployment for BWRE

7.5 *Safe Disposal of the Waste*

The goal is to convert all of the waste into one of two final waste forms: Glass, which will contain 99% of the radioactivity, and Saltstone grout, which will contain most of the volume. Each of the waste types at SRS needs to be treated to accomplish disposal in these two waste forms. The sludge must be washed to remove non-radioactive salts that would interfere with glass production. The washed sludge can then be sent to DWPF for vitrification. The salt must be treated to separate the bulk of the radionuclides from the non-radioactive salts in the waste. Starting in 2014, this separation will be accomplished in SWPF. However, until the startup of SWPF, SCIX, and ARP/MCU will be used to accomplish this separation.

7.6 *Salt Processing*

This *Plan* uses five different processes to treat salt:

- **Deliquification, Dissolution, and Adjustment** (DDA) –**D**eliquification (i.e., extracting the interstitial liquid) is an effective decontamination process because the primary radionuclide in salt is Cs-137, which is highly soluble. To accomplish the process, the salt was first deliquified by draining and pumping. The deliquified salt was **D**issolved by adding water and pumping out the salt solution. The resulting salt solution was aggregated with other Tank Farm waste to **A**djust batch chemistry for processing at SPF. For salt that was in Tank 41 as of June 9, 2003, which was relatively low in radioactive content, treatment using solely DDA (DDA-solely) was sufficient to meets the SPF WAC. Tank 41 has since received additional salt dissolution from Tank 25 and there is no longer any qualified feed for the DDA-solely process. No further use of DDA-solely is anticipated.
- **Actinide Removal Process** (ARP) – For salt in selected tanks (e.g., Tank 25), even though extraction of the interstitial liquid reduces Cs-137 and soluble actinide concentrations, the Cs-137 or actinide concentrations of the resulting salt are too high to meet the SPF WAC. Salt from these tanks first will be sent to ARP. In ARP, MST is added to the waste as a finely divided solid. Actinides are sorbed on the MST and then filtered out of the liquid to produce a low-level waste stream that is sent to MCU. The MST, containing the actinides, is sent to DWPF.
- **Modular CSSX Unit** (MCU) – For tanks with salt that is too high in activity for deliquification to sufficiently reduce Cs-137 concentrations, the salt in these tanks must be further treated to reduce the concentration of Cs-137 using the CSSX process. So that some of these wastes can be treated before SWPF startup, an MCU was built. Salt to be processed will first be processed through ARP and then through the MCU. MCU has a dual purpose:
  - demonstrating the CSSX flowsheet
  - treating salt waste to enable accelerated closure of Type I, II, and IV tanks and uninterrupted vitrification of HLW at DWPF.

  MCU will also demonstrate the efficacy of the next general extractant planned for deployment in SWPF.

- **Small Column Ion Exchange** (SCIX) – This process utilizes a non-elutable ion exchange media, crystalline silicotitanate (CST), for use in an ion exchange column (IXC) to remove Cs-137 from the salt solution. Ground CST, laden with Cs-137, is then transferred to a sludge batch for ultimate disposal at DWPF. The DSS stream is dispositioned at SPF. The MST solids are transferred to a sludge batch preparation tank for ultimate disposal at DWPF.
- **Salt Waste Processing Facility** (SWPF) – This is the full-scale CSSX process. The facility incorporates both the ARP and CSSX process in a full-scale shielded facility capable of handling salt with high levels of radioactivity. Facility startup of SWPF is assumed to be in 2014.

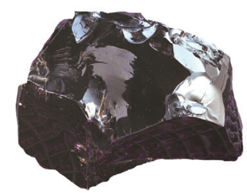
7.7 *Sludge Processing*

Sludge is washed to reduce the amount of non-radioactive soluble salts remaining in the sludge slurry. During sludge processing, large volumes of wash water are generated and must be volume-reduced by evaporation or beneficially reused. Over the life of the waste removal program, the sludge currently stored in tanks at SRS will be blended into separate sludge batches to be processed and fed to DWPF for vitrification.

7.8 *DWPF Vitrification*

Canisters being received (prior to being filled with radioactive glass)

Final processing for the washed sludge and salt waste occurs at DWPF. This waste includes MST/sludge from ARP or SWPF, the cesium strip effluent from MCU or SWPF, and the washed sludge slurry. In a complex sequence of carefully controlled chemical reactions, this waste is blended with glass frit and melted to vitrify it into a borosilicate glass form. The resulting molten glass is poured into stainless steel canisters. As the filled canisters cool, the molten glass solidifies, immobilizing the radioactive waste within the glass structure. After the canisters have cooled, they are first sealed with a temporary plug, the external surfaces are decontaminated to meet United States Department of Transportation requirements, and the canister is then permanently sealed. The canisters are then ready to be stored on an interim basis on-site in the GWSB. A low-level recycle waste stream from DWPF is returned to the Tank Farms. DWPF has been operational since 1996.



Sample of Vitrified Radioactive Glass

7.9 *Saltstone Disposition*

View of the Saltstone Facility

The Saltstone Facility, located in Z-Area, consists of two facility segments: the Saltstone Production Facility (SPF) and the Saltstone Disposal Facility (SDF). SPF is permitted as a wastewater treatment facility per SCDHEC regulations. SPF receives and treats the salt solution to produce grout by mixing the LLW liquid stream with cementitious materials (cement, flyash, and slag). A slurry of the components is pumped into the SDUs, located in SDF, where the Saltstone grout solidifies into a monolithic, non-hazardous, solid LLW form. SDF is permitted as an Industrial Solid Waste Landfill site.

The facility will contain many large concrete SDUs. Each of the SDUs will be filled with solid Saltstone grout. The grout itself provides primary containment of the waste, and the walls, floor, and roof of the SDUs provide secondary containment.

Approximately 15 feet of overburden were removed to prepare and level the site for SDU construction. All SDUs will be built at or slightly below the grade level that exists after the overburden and leveling operations are complete. The bottom of the Saltstone grout monoliths will be at least five feet above the historic high water table beneath the Z-Area site, thus avoiding disposal of waste in a zone of water table fluctuation. Run-on and runoff controls are installed to minimize site erosion during the operational period.

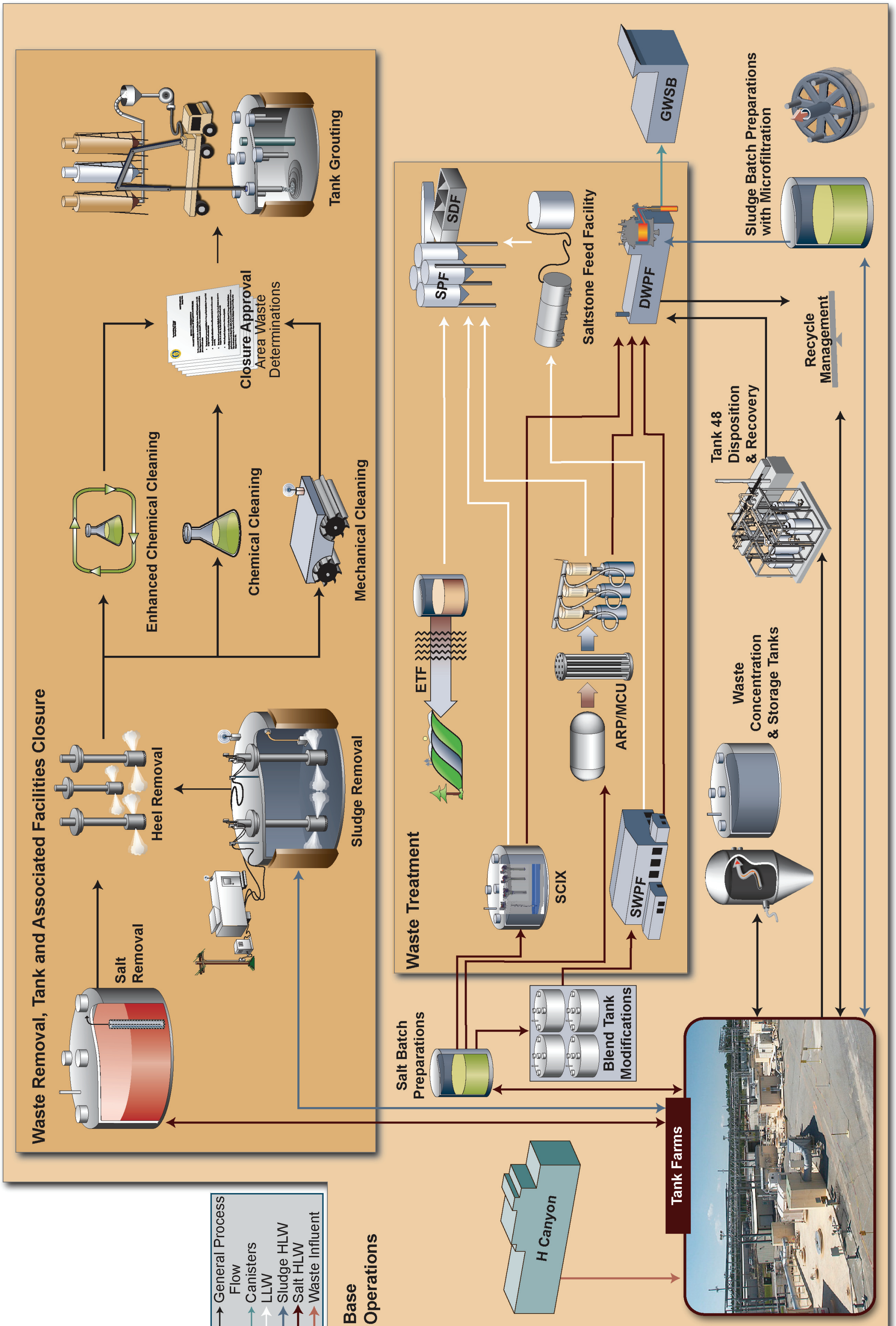
The current active SDU (Vault 4) is approximately 200 feet wide, by 600 feet in length, by 26 feet in height, divided into twelve cells. The other current SDU (Vault 1) is approximately 100 feet wide, by 600 feet in length, by 25 feet in height, divided into six cells.

Future SDUs are planned to be two cells nominally 150 feet diameter by 22 feet high each and will be designed in compliance with provisions contained in the Consent Order of Dismissal in Natural Resources Defense Council, et al. v. South Carolina Department of Health and Environmental Controls, et al. (South Carolina Administrative Law Court, August 7, 2007). This design is used commercially for storage of water. After accounting for interior obstructions (support columns, drainwater collection systems, etc.) and the requirement for a 2-foot cold cap, the nominal useable volume of a cell is 2,600 kgal. Recent operating experience has resulted in approximately 1.76 gallons of grout being produced for each gallon of DSS feed, yielding a nominal cell capacity of approximately 1,500 kgal of DSS.

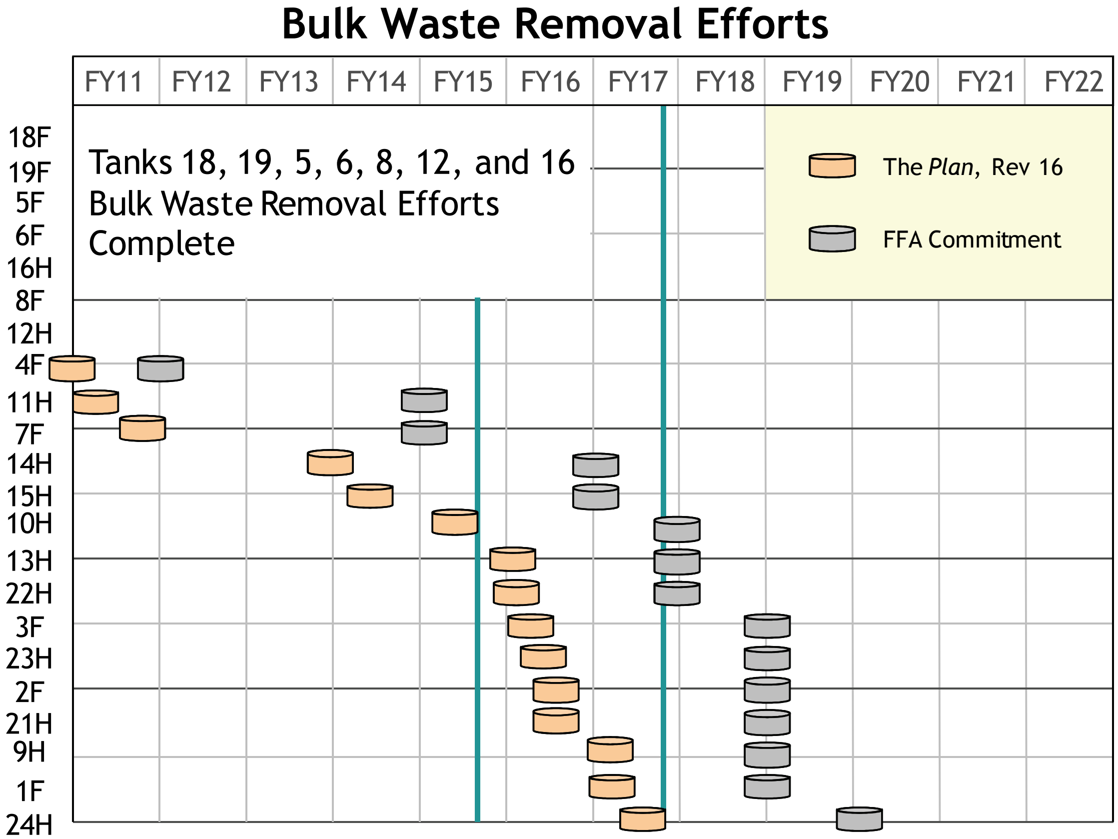
Closure operations will begin near the end of the active disposal period in the SDF, i.e., after most or all of the SDUs have been constructed and filled. Backfill of native soil will be placed around the SDUs. The present closure concept includes two moisture barriers consisting of clay/gravel drainage systems along with backfill layers and a shallow-rooted bamboo vegetative cover.

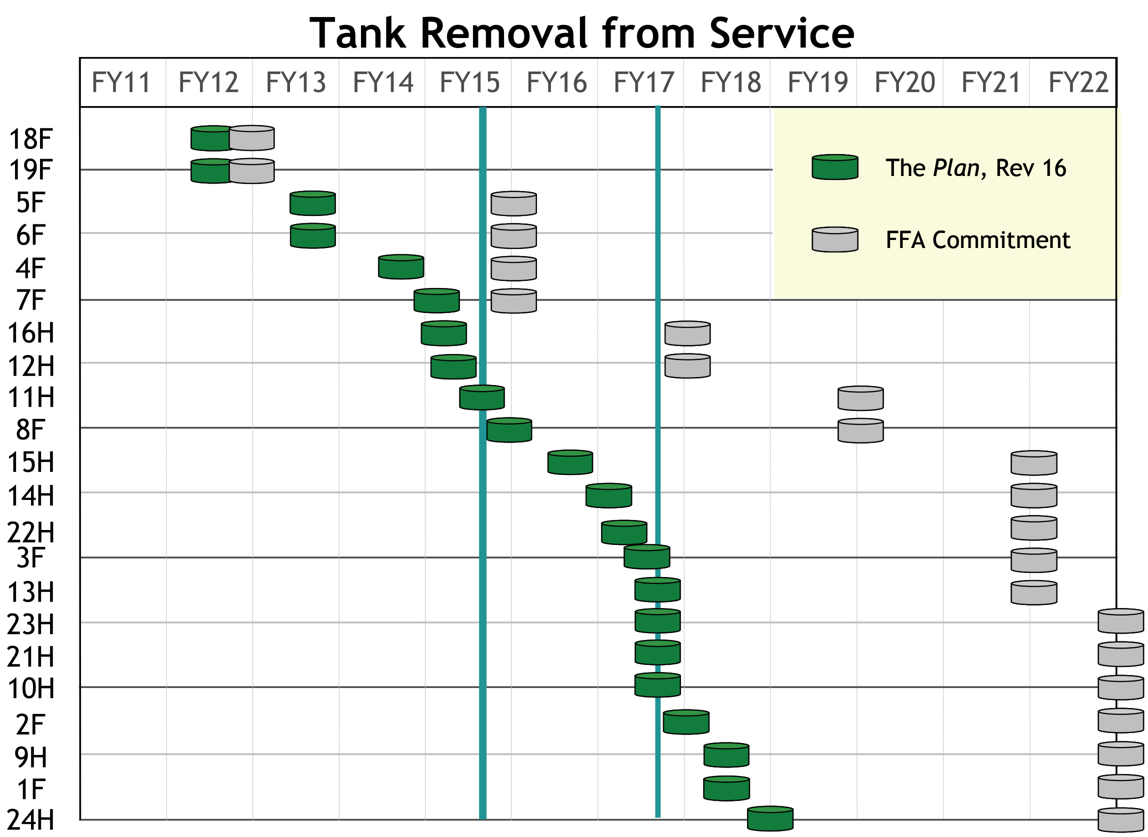
Construction of the SDF and the first two SDUs was completed between February 1986 and July 1988. The SDF started radioactive operations June 12, 1990. Future SDUs will be constructed on a “just-in-time” basis in coordination with salt processing production rates.

Figure 7-2 — *Process Flowsheet*



Appendix A — *Bulk Waste Removal Efforts & Removal from Service*





Appendix B — *Salt Solution Processing*

End of Fiscal Year	Salt Solution via DDA-solely (kgal)	Salt Solution via ARP/MCU (kgal)	Salt Solution via SCIX (kgal)	Salt Solution via SWPF (kgal) [a]	Total Salt Solution from Tank Farms (kgal) [b]	DSS Stream to SPF (kgal)	UUM Stream to SPF (kgal) [c]	ETF Stream to SPF (kgal)	Total Feed Stream to SPF (kgal)	SDU Numbers [d]
Total as of end of FY10	2,800	990			3,790					
FY11		1,345			1,345	1,707	128	120	1,955	4
FY12		905			905	1,148	18	120	1,286	4-2
FY13		1,765			1,765	2,240	18	120	2,378	2
FY14		485	2,520	750	3,755	4,087	18	120	4,225	2- 5
FY15			2,520	4,950	7,470	8,802	18	120	8,940	3 - 9
FY16			2,520	7,200	9,720	11,657	18	120	11,795	8 -13
FY17			2,520	7,200	9,720	11,657	18	120	11,795	12-17
FY18			2,520	7,200	9,720	11,657	18	120	11,795	16-21
FY19			2,520	7,200	9,720	11,657	18	120	11,795	20-25
FY20			2,520	4,800	7,320	8,611	18	120	8,749	24-29
FY21			2,520	7,200	9,720	11,657	18	120	11,795	28-33
FY22			2,520	7,200	9,720	11,657	18	120	11,795	32-37
FY23			2,520	7,200	9,720	11,657		50	11,707	36-41
FY24			1,680		1,680	1,680		40	1,720	40 & 41
FY25								10	10	40 & 41
Total	**2,800**	**5,490**	**26,880**	**60,900**	**96,070**	**109,873**	**326**	**1,540**	**111,739**	

[a] SWPF throughput in several years is impacted by assumed DWPF melter replacement outages in those years

[b] *Total Salt Solution from Tank Farms* is a total of all LLW sent directly from the Tank Farm and all salt solution treated via the DDA-solely, ARP/MCU, SCIX, and SWPF processes.

[c] Low Level Waste receipts to Tank 50 are assumed as outlined in *H-Area Liquid Waste Forecast Through 2019*[16].

[d]
- Vault 1 and 4 are in service. Vault 1 will not receive additional grout; Vault 4 has five cells available to receive grout. Future SDUs will have (2) cells with 1.5 Mgal feed capacity. SDU # fill sequence to be 4, 2 (cells 2a, 2b), 3 and 5 (cells 3a, 3b, 5a, & 5b), 6 and 7 (cells 6a, 6b, 7a, & 7b) … etc.
- Beginning with SDU 3 and 5, the SDUs with be installed and filled in pairs. This allows for multiple filling of cells to meet ventilation requirements to manage organics in the feed stream, when necessary.
- Each gallon of feed, when added to the cement, flyash, and slag, makes 1.76 gallons of grout. Each cell is estimated to contain ~2,600 kgal of grout. Therefore, each cell holds ~1,500 kgal of feed solution (each SDU holds ~3,000 kgal of feed solution).
- Bleed water recycling consumes 5% of the vault space, reducing the available space for feed solution

Note: Dates, volumes, and chemical or radiological composition information are planning approximations only.

Appendix C — *Sludge Processing*

Sludge Batch	Prep Tank	Source Tanks [a]	Projected SOL (weight %)	Canister Production Rates (Cans/Year)	Actual Cans @ Projected SOL	Date Batch Finished @ Projected SOL[b]
		Current through September 30, 2010:			2,986	
SB6 (LTAD)	51	4, 7, 12	36	325	252	Jul 2011
SB7A	51	4, 7, 12	36	325	304	Jul 2012
SB7B	51	4, 7, 12	36	325	176	Feb 2013
SB8	51	4, 7, 13	36	325	364	Mar 2014
DWPF melter Replacement+DWPF Process Modifications+SWPF Tie-in Outage						Jul 2014
SB8 (Remaining)	51	4, 7, 13	40	400	78	Oct 2014
SB9 (First RMF Batch in TK 42)	42	11,12,13, MST,CST in Tk40	40	400	410	Nov 2015
SB10 (First RMF Batch in 51)	51	13,15,FBSR,MST,CST in Tk40	40	400	391	Nov 2016
SB11 (LTAD)	42	13,14,15,26,FBSR,MST,CST in TK 40	40	400	397	Nov 2017
SB12 (LTAD)	51	13,14,15,21,26,33,35, MST,CST in Tk40	40	400	356	Oct 2018
SB13 (LTAD)	42	22,33,35,39,MST,CST in Tk40	40	400	340	Sep 2019
SB14 (LTAD)	51	23,32,33,39,MST,CST in Tk40	40	400	280	May 2020
DWPF Melter Replacement						Sep 2020
SB14 (LTAD) (Remaining)	51	23,32,33,39,MST,CST in Tk40	40	400	67	Nov 2020
SB15 (LTAD)	42	32,33,39,47,MST,CST in Tk40	40	400	320	Oct 2021
SB16 (LTAD)	51	32,33,39,47,MST,CST in Tk40	40	400	319	Jul 2022
SB17	42	32,34,43, MST, CST in Tk40	40	400	337	Jun 2023
Accounting for the Heels[c]				180	180	Jun 2024
Total Canisters					**7,557**	

[a] The indicated tanks are the sources of the major components of each sludge batch, not necessarily the sludge location just prior to receipt for sludge washing. Tanks 7 and 13, for example, are also used to stage sludge that is removed from other tanks.

[b] Dates are approximate and represent when Tank 40 gets to a 40″ heel. Actual dates depend on canister production rates.

[c] Lower production rate assumed for dilute heel processing

Note: Dates, volumes, and chemical or radiological composition information are planning approximations only.

Appendix D — *Canister Storage*

End of Fiscal Year	SRS Cans Produced		SRS Cans in GWSB #1 (2,251 capacity)[a]		SRS Cans in GWSB #2 (2,339 capacity)[b]		SRS Cans in GWSB #3 (capacity TBD)[c]	
	Yearly	Cum.	Added	Cum.	Added	Cum.	Added	Cum.
FY96	64	64	64	64				
FY97	169	233	169	233				
FY98	250	483	250	483				
FY99	236	719	236	719				
FY00	231	950	231	950				
FY01	227	1,177	227	1,177				
FY02	160	1,337	160	1,337				
FY03	115	1,452	115	1,452				
FY04	260	1,712	260	1,712				
FY05	257	1,969	257	1,969				
FY06	245	2,214	244	2,213	1	1		
FY07	160	2,374	28	2,241	132	133		
FY08	225	2,599		2,241	225	358		
FY09	196	2,795		2,241	196	554		
FY10	191	2,986	3	2,244	182	736		
FY11	311	3,297		2,244	311	1,047		
FY12	311	3,608		2,244	311	1,358		
FY13	312	3,920		2,244	312	1,670		
FY14	229	4,149		2,244	229	1,899		
FY15	383	4,532		2,244	383	2,282		
FY16	385	4,917		2,244	57	2,339	328	328
FY17	383	5,300		2,244		2,339	383	711
FY18	383	5,683		2,244		2,339	383	1,094
FY19	384	6,067		2,244		2,339	384	1,478
FY20	267	6,334		2,244		2,339	267	1,745
FY21	383	6,717		2,244		2,339	383	2,128
FY22	383	7,100		2,244		2,339	383	2,511
FY23	332	7,432		2,244		2,339	332	2,843
FY24	125	7,557		2,244		2,339	131	2,974
FY25		7,557		2,244		2,339	[d]	2,974

Numbers in italics are actuals — through FY10. FY11 and on are forecast based on modeling assumptions

[a] GWSB #1 filling began in May 1996. Of 2,262 standard canister storage locations, 8 are unusable and 3 store non-radioactive archive canisters yielding a usable storage capacity of 2,251 standard canisters; 10 are contingency positions for placement of canisters if GWSB #2 is temporarily unavailable. It reached its maximum capacity in FY07.

[b] GWSB #2 was built with 2,340 standard storage locations. One archived non-radioactive canister is stored in GWSB #2 yielding a usable storage capacity of 2,339 standard canisters. GWSB #2 received its first radioactive canister in June 2006. It is expected to reach maximum capacity in FY16.

[c] This *Plan* assumes the construction of a third GWSB to be available by the end of FY15. GWSB #3 is assumed to be designed and built to similar specification as GWSB #2 with the necessary capacity to store the remaining canisters forecast in this *Plan.*

[d] Typically, five to ten canisters are in the vitirification building pending transfer to a GWSB. All cans will be transferred to a GWSB before the DWPF is cleaned and flushed.

Note: Dates, volumes, and chemical or radiological composition information are planning approximations only.

Appendix E — *Tank Farm Influents and Effluents*

End of Fiscal Year	Influents (kgal): H-Canyon[a] HLW	Influents (kgal): H-Canyon[a] UUM	Influents (kgal): H-Canyon[a] Pu[b]	Influents (kgal): DWPF Recycle[c]	Influents (kgal): 299-H	Influents (kgal): ETF	Effluents (kgal): Salt Solution[j]	Effluents (kgal): Sludge to DWPF	Total Inventory[k]
FY11	190	128	17	2,561	6	120	1,955	168	**35,308**
FY12	348	18	27	2,433	6	120	1,286	175	**34,768**
FY13	364	18	33	2,809	12	120	2,378	196	**34,232**
FY14	348	18	33	932	12	120	4,225	134	**33,608**
FY15	348	18	34	2,029	12	120	8,940	273	**30,686**
FY16	364	18	51	2,432	12	120	11,795	267	**28,212**
FY17	348	18	16	2,377	12	120	11,795	263	**25,126**
FY18	364	18	-	2,337	12	120	11,795	261	**22,022**
FY19	348	18	2	2,348	12	120	11,795	249	**18,236**
FY20	399	-	-	1,990	12	120	8,749	152	**15,909**
FY21	321			2,174	12	120	11,795	233	**13,029**
FY22	165			2,264	12	120	11,795	261	**9,312**
FY23	-			2,256	d	50	11,707	239	**4,849**
FY24				1,243		40	1,720	73	**23**
FY25						10	10		**-**

[a] H-Canyon receipts are based on *H-Area Liquid Waste Forecast Through 2019*[16]. Shutdown flows for H-Canyon are assumed from FY20–FY22 and are as outlined in *H-Canyon Liquid Waste Generation Forecast For H-Tank Farm Transfer*[23]. HLW is the main component of H-Canyon waste and is received into Tank 39. UUM consists of unirradiated uranium material and concentrate from the General Purpose H-Canyon (GP) Evaporator that is received in Tank 50. Pu consist of Pu-bearing waste that is received directly into a sludge batch, either in the sludge preparation tanks (Tanks 51 and 42) or the DWPF feed tank (Tank 40).

[b] Pu discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings while continuing to comply with the canister fissile material concentration limits.

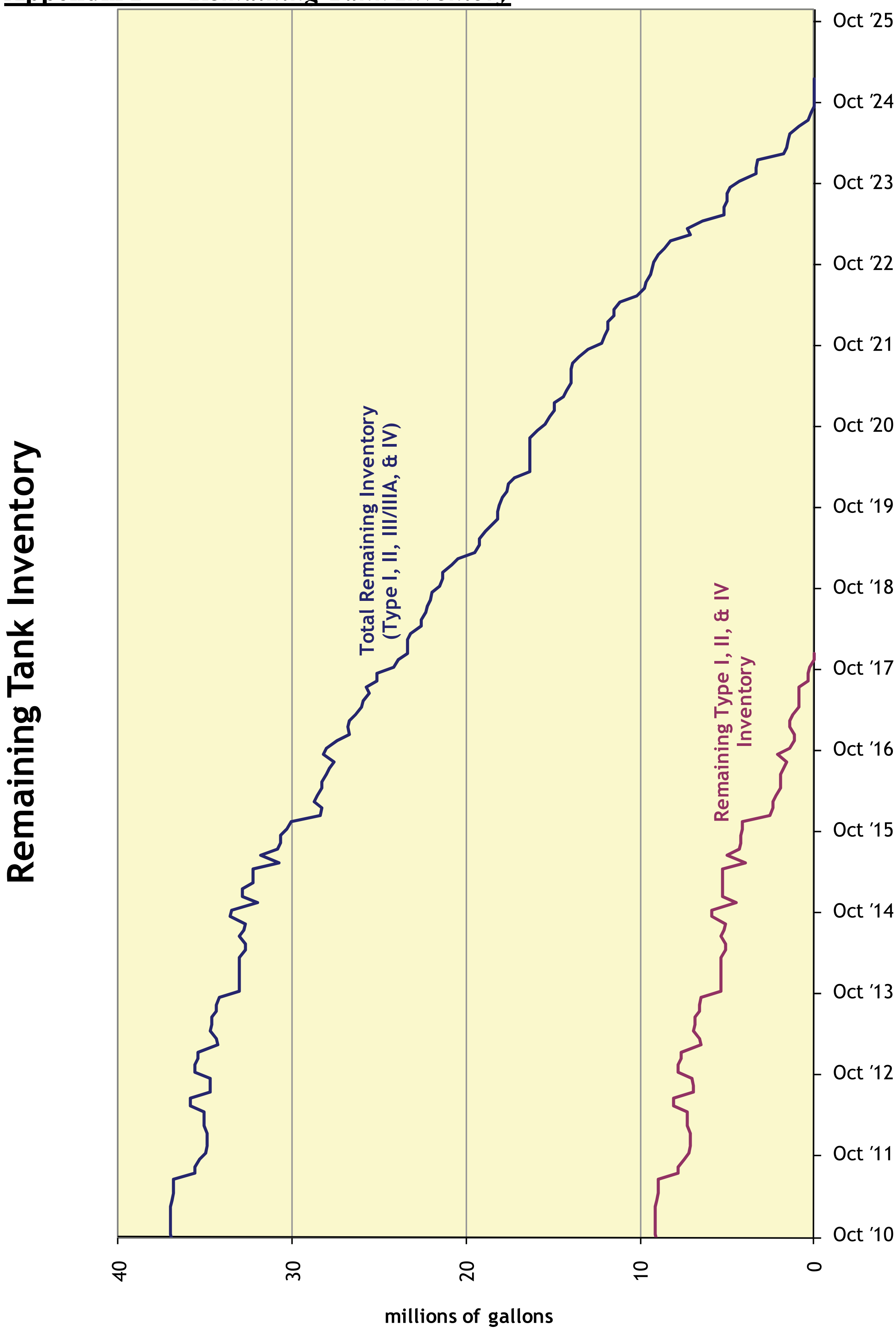
[c] DWPF Recycle receipts reflect modifications made in the DWPF to reduce recycle. Additionally, DWPF recycle is used to minimize inhibited water addition required for salt dissolution and molarity adjustments within the Tank Farms.

[d] Maintenance Facility (299-H) receipts mainly consists of a dilute Nitric Acid Stream, decon solutions and steam condensate. These waste streams are collected from decontaminating equipment and collected in their pump tank, neutralized and sent to Tank 39. They are assumed to be redirected beginning in FY23 in order to complete Tank 39 heel removal.

[k] Volumes are not additive after accounting for jet dilution, expansion of sludge during sludge slurrying operations (sludge becomes less dense), and other volume changes during the processing of waste. During a transfer, steam eductor jets are used to transfer liquid waste from tank to tank. Volume from the transfer steam accounts for 4% of the mass being transferred for intra-area transfers and 6% for inter-area lines. Mixing waste forms of different compositions are not mathematically additive. For example, noticeable space recovery can be achieved when a light solution (such as DWPF recycle water) is mixed with concentrated supernate. Also, the dissolution of “dry salt” (i.e. salt with interstitial liquid removed) tends to recover space. Years with large amounts of salt dissolution reflect this anomaly.

Note: Dates, volumes, and chemical or radiological composition information are planning approximations only.

Appendix F — *Remaining Tank Inventory*



Appendix G — *LW System Plan — Rev 16 Summary*

(see attached foldout chart)

Appendix H — *Acronyms*

AB Tank Farm **Authorization Basis**
ARRA **American Recovery and Reinvestment Act**
ARP **Actinide Removal Process** – planned process that will remove actinides and Strontium-90 (Sr-90), both soluble and insoluble, from Tank Farm salt solution using MST and filtration
BWRE **Bulk Waste Removal Efforts**
Ci/gal Curies per gallon
CM **Closure Module**
CSSX **Caustic Side Solvent Extraction** – process for removing cesium from a caustic (alkaline) solution. The process is a liquid-liquid extraction process using a crown ether. SRS plans to use this process to remove Cesium-137 (Cs-137) from salt wastes.
CST **crystalline silicotitanate**
D&D **Dismantlement and Decommissioning**
DDA **Deliquification, Dissolution, and Adjustment**
DOE **Department of Energy**
DOE-SR The **DOE Savannah River** Operations Office
DNFSB **Defense Nuclear Facility Safety Board**
DSS **Decontaminated Salt Solution** – the decontaminated stream from any of the salt processes – DDA, ARP/MCU, or SWPF
DWPF **Defense Waste Processing Facility** – SRS facility in which LW is vitrified (turned into glass)
EA **Environmental Assessment**
ECC **Enhanced Chemical Cleaning**
EIS **Environmental Impact Statement**
EPA **Environmental Protection Agency**
ETF **Effluent Treatment Facility –** SRS facility for treating contaminated wastewaters from F & H Areas
FFA **Federal Facility Agreement** – tri-party agreement between DOE, SCDHEC, and EPA concerning closure of waste sites. The currently-approved FFA contains commitment dates for closing specific LW tanks
FBSR **Fluidized Bed Steam Reformer**
FESV **Failed Equipment Storage Vault**
FTF **F-Tank Farm**
GP **General Purpose** Evaporator – an H-Canyon process that transfers waste to HTF
GWSB **Glass Waste Storage Building** – SRS facilities with a below-ground concrete vault for storing glass-filled HLW canisters
HLW **High Level Waste**
HM **H Modified** – the modified PUREX process in H-Canyon for separation of special nuclear materials and enriched uranium from irradiated targets
HTF **H-Tank Farm**
IL **Interstitial Liquid**
IPABS **Integrated Planning, Accountability, & Budgeting System**
ITR **Independent Technical Review**
IW **Inhibited Water** – well water to which small quantities of sodium hydroxide and sodium nitrite have been added to prevent corrosion of carbon steel waste tanks
IXC **Ion Exchange Column**
kgal **thousand gallons**
KTPB potassium **t**etra**p**henyl**b**orate
LTAD **Low Temperature Aluminum Dissolution**
LLW **Low Level Waste**
LW **Liquid** (Radioactive) **Waste** – broad term that includes the liquid wastes from the canyons, HLW for vitrification in DWPF, LLW for disposition at SDF, and LLW wastes for treatment at ETF
MCi **Million Curies**
MCU **Modular CSSX Unit** – small-scale modular unit that removes cesium from supernate using a CSSX process similar to SWPF
Mgal **million gallons**
MSB **Melter Storage Box**
MST **monosodium titanate**
NDAA Ronald W. Reagan **National Defense Authorization Act** for Fiscal Year 2005, Public Law 108-375
NDAA §3116 **Section 3116** – Defense Site Acceleration Completion — of the **NDAA**
NEPA **National Environmental Policy Act**
NPDES **National Pollution Discharge Elimination Systems**
NRC **Nuclear Regulatory Commission**
OA **Oxalic Acid**
PA **Performance Assessment**
PEP **Project Execution Plan**
PMP **Performance Management Plan**
PUREX **Plutonium Uranium Reduction Extraction**
RCRA **Resource Conservation and Recovery Act**
RFS **Removed from Service**
RMF **Rotary Microfilter**
ROMP **Risk** and **Opportunity Management Plan**

SAS	**Steam Atomized Scrubber**
SB	**Sludge Batch**
SCDHEC	**South Carolina Department of Health and Environmental Control** – state agency that regulates hazardous wastes at SRS
SCIX	**Small Column Ion Exchange**
SDF	**Saltstone Disposal Facility** – SRS facility containing Saltstone Disposal Units
SDU	**Saltstone Disposal Units** – Disposal Units that receive wet grout from SPF, where it cures into a solid, non-hazardous Saltstone
SE	**Strip Effluent**
SEIS	**Supplemental Environmental Impact Statement**
SME	**Slurry Mix Evaporator**
SMP	**Submersible Mixer Pump**
SOL	**Sludge Oxide Loading**
SPF	**Saltstone Production Facility** – SRS facility that mixes decontaminated salt solution and other low-level wastes with dry materials to form a grout that is pumped to SDF
SRD	**Spent Resin Disposal**
SRNS	**Savannah River Nuclear Solutions**
SRR	**Savannah River Remediation** LLC
SRS	**Savannah River Site**
STP	**Site Treatment Plan**
SWPF	**Salt Waste Processing Facility** – planned facility that will remove Cs-137 from Tank Farm salt solutions by the CSSX process and Sr-90 and actinides by treatment with MST and filtration
TBD	**to be determined**
TPB	**t**etra**p**henyl**b**orate
UUM	**Unirradiated Uranium Material**
WAC	**Waste Acceptance Criteria**
WCS	**Waste Characterization System** – system for estimating the inventories of radionuclides and chemicals in SRS Tank Farm tanks using a combination of process knowledge and samples
WD	**Waste Determination**
WOW	**Waste on Wheels**

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