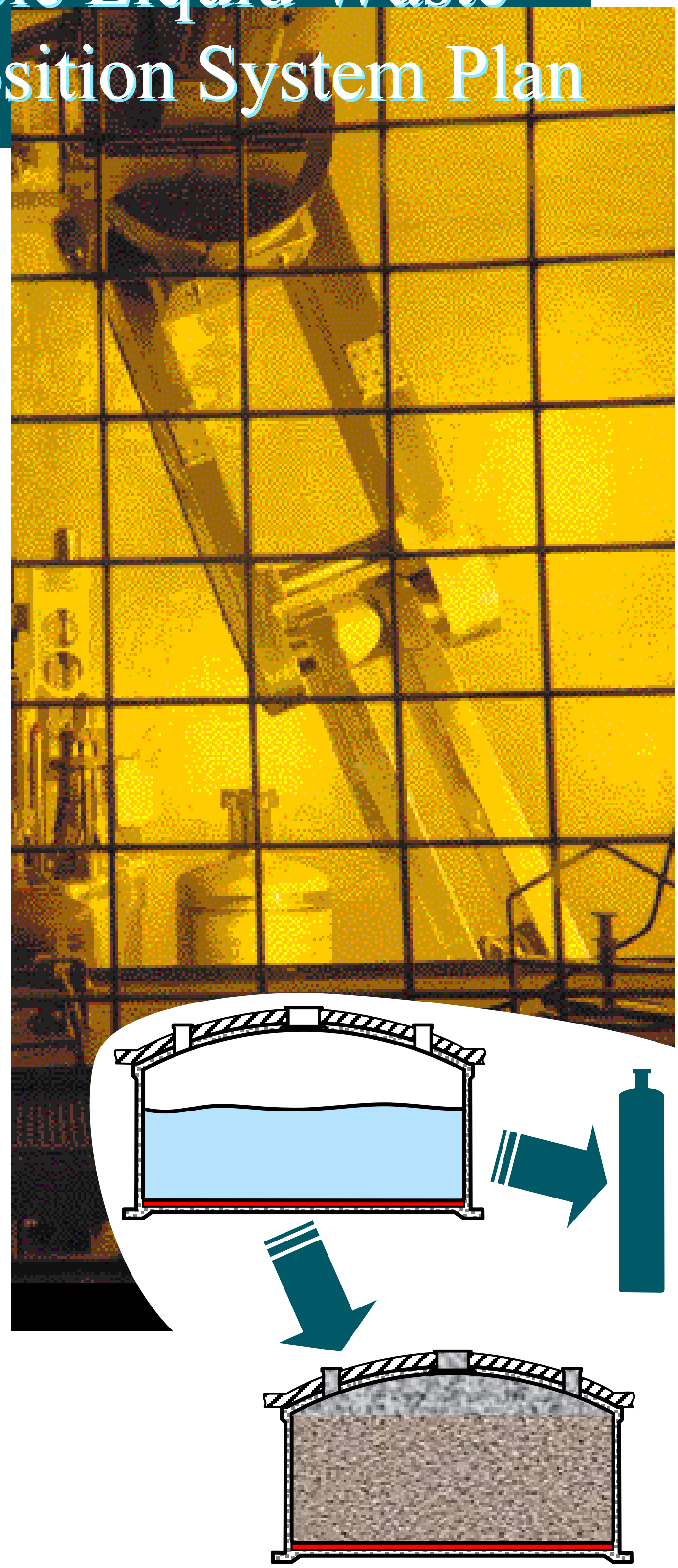
LWO-PIT-2007-00062

Life-cycle Liquid Waste Disposition System Plan

Savannah River Site Liquid Waste Planning Process

An Integrated System at the Savannah River Site



REVISION 14

October 2007

LWO-PIT-2007-00062
REVISION: 14
October 18, 2007

KEYWORDS: Tank Farm, Salt Program,
DWPF, Liquid Waste,
ETP, Sludge Washing,
Waste Solidification, MCU
ARP, CSSX, SWPF

RETENTION: PERMANENT

CLASSIFICATION: U

Does not contain UCNI
10/18/07
DC/RO

Life-cycle Liquid Waste Disposition System Plan

Liquid Waste Planning Process

D. P. Chew, 766-H
M. J. Mahoney, 766-H
J. R. Vitali, 766-H

Approvals:

10/18/07
L. D. Olson
Executive Vice President, Liquid Waste Operations

10/18/07
V. G. Dickert
Director, Site Regulatory Integration & Planning

10/18/07
T. J. Spears
Assistant Manager for Waste Disposition Project

Washington Savannah River Company
Liquid Waste Operations Division
Aiken, SC 29808

Prepared for U.S. Department of Energy under Contract No. DE-AC09-96SR18500 Modification No. M161

Authors

October 18, 2007

D. P. Chew, Liquid Waste Planning – System Integration and Planning

J. R. Vitali, Liquid Waste Planning – System Integration and Planning

M. J. Mahoney, Manager, Liquid Waste Planning – System Integration, and Planning

Reviews

S. A. Thomas, Manager, LW Regulatory Integration & Planning

L. K. Sonnenberg, Manager, LWO Business Management

Table of Contents

1. EXECUTIVE SUMMARY 1
PURPOSE 2
GOALS 2
REVISIONS 3
RESULTS OF THE PLAN 4
2. INTRODUCTION 6
2.1 GOALS 6
2.2 PLANNING IMPROVEMENTS SINCE REVISION 13 8
2.3 RISK MANAGEMENT 8
3. PLANNING BASES 9
3.1 REFERENCE DATE 9
3.2 FUNDING 9
3.3 REGULATORY DRIVERS 9
3.4 REVISIONS 10
3.5 KEY MILESTONES 12
4. KEY PLANNING BASES INPUTS AND ASSUMPTIONS 14
5. PLANNING SUMMARY AND RESULTS 16
5.1 PROCESSING SALT 16
5.1.1 Salt Volume to be Processed 16
5.1.2 DDA 17
5.1.3 ARP/MCU 17
5.1.4 SWPF 18
5.2 TANK 48 RESTORATION TO SERVICE 18
5.3 TANK 50 RESTORATION TO SERVICE 18
5.4 DISPOSITION OF SALT WASTES AT SPF AND SDF 18
5.4.1 Processing DDA at SPF and SDF 19
5.4.2 Modifications to Prepare Vaults for Waste Containing Isopar® 20
5.5 DISPOSITION OF SLUDGE WASTE 20
5.5.1 Sludge Mass Forecast 20
5.5.2 Balancing Salt and Sludge Vitrification 22
5.6 CONTINUING TANK FARM OPERATIONS 23
5.6.1 Supporting Nuclear Material Stabilization 23
5.6.2 2H Evaporator System 23
5.6.3 DWPF Recycle Handling 24
5.6.4 Managing Type III Tank Space 24
5.6.5 Tank 25 Availability 25
5.6.6 Transfer Line Infrastructure 26
5.7 TANK CLOSURE 26
5.7.1 Requirements for Closure of LW Tanks 27
5.8 GLASS WASTE CANISTER STORAGE AND SHIPPING 27
5.9 CLOSURE SEQUENCE FOR THE LIQUID WASTE SYSTEM 28
6. PROCESS SIMULATION TOOLS 30
7. OPPORTUNITIES 31
7.1 INCREASE MAXIMUM ANNUAL SWPF PROCESSING RATE 31
7.2 INCREASE DWPF RATE 31
7.3 RECOVERY OF UNIRRADIATED URANIUM MATERIAL AND OTHER SPECIAL MATERIALS IN H-CANYON 31
7.4 IMPROVE WASTE REMOVAL AND TANK CLEANING TECHNIQUES 31
7.5 LLW OFFSITE TREATMENT 32
8. DESCRIPTION OF ASSUMPTIONS AND BASES 33
8.1 FUNDING 33
8.2 TANK FARM 33

8.3 SALT PROGRAM 35
8.4 SPF PRODUCTION 36
8.5 DWPF PRODUCTION 36
8.6 CANYON OPERATIONS 38
8.7 WASTE REMOVAL AND TANK CLOSURE PROGRAM 38
8.8 REGULATORY APPROVALS 39

9. SYSTEM DESCRIPTION 40

9.1 HISTORY 40
9.2 TANK STORAGE 40
9.3 WASTE TANK SPACE MANAGEMENT 42
9.4 WASTE REMOVAL FROM TANKS 42
9.5 SAFE DISPOSAL OF THE WASTE 43
9.6 SALT PROCESSING 43
9.7 SLUDGE PROCESSING 44
9.8 DWPF VITRIFICATION 44
9.9 SALTSTONE DISPOSITION 44

APPENDIX A — TANK FARM VOLUME BALANCE 48

APPENDIX B — SALT SOLUTION PROCESSING 50

APPENDIX C — SLUDGE PROCESSING 52

APPENDIX D — CANISTER STORAGE 53

APPENDIX E — CURRENTLY-APPROVED FFA WASTE REMOVAL PLAN & SCHEDULE 54

APPENDIX F — USABLE TYPE III TANK SPACE 55

APPENDIX G — REMAINING TANK INVENTORY 56

APPENDIX H — EVAPORATOR SYSTEM LEVELS (THROUGH FY14) 57

APPENDIX I — ACRONYMS 58

REFERENCES 60

Index of Tables

Table 1-1 — Results of the *Plan* 4
Table 3-1 — Key Milestones 12
Table 5-1 — Saltstone Vault Need Dates 19
Table 5-2 — Sludge Mass Comparison 22
Table 5-3 — Closure Activities 29
Table 8-1 — Evaporator Utilities 33
Table 8-2 — Historical Evaporator Utilities 33
Table 8-3 — Evaporator Feed Rates 34
Table 8-4 — DWPF Production Rates 37

Index of Figures

Figure 5–1 — Forecast Type III Tank Inventory vs. Available Type III Capacity 25
Figure 9–1 — Waste Tank Composite Inventory (As of August 14, 2007) 42
Figure 9–2 — Process Flowsheet 46

1. Executive Summary

Delays in issuing the Modified Industrial Solid Waste Landfill Permit for the Saltstone Disposal Facility (SDF), legal challenges to that Modified Permit, and process improvements and operational issues, resulted in a sixteen-month delay (to November 2007 from July 2006) in the initiation of interim salt processing. Additionally, the startup of the Salt Waste Processing Facility (SWPF) is assumed to have a twelve-month delay (to September 2012[i] from September 2011). These delays impact the ability to meet the goals of the Liquid Waste (LW) system. This *Plan* was developed using integrated system modeling, with input data, assumptions, and conditions as of August 2007. The dates and other assumptions reflected in this plan may evolve due to a number of factors[ii], and updates will be included in future revisions to this *Plan*. A summary of the main programmatic attributes of this *Plan* includes:

- Mitigation of the impacts to tank closures in order to meet the FY10–FY12 *Federal Facility Agreement* (currently-approved FFA)[1] commitments (Tanks 4–6, 8, and 16). Additionally, this *Plan* accomplishes the currently-approved FFA commitment to close all old-style tanks by FY22. However, some of the currently-approved FFA tank closure commitments for FY14–FY15 are delayed from twenty to thirty-one months (Tanks 10, 11, 14, and 15), and some of the currently-approved FFA commitments for FY19–FY20 are delayed up to twelve months (Tanks 1–3). This results from the assumed 12-month delay in SWPF startup, which causes delays in salt removal from the LW system and the inability to reclaim Type III Tank space to store sludge from old-style tanks scheduled for closure.
- The *Site Treatment Plan* (STP)[2] regulatory commitment to complete treatment of all waste in the Tank Farms by 2028 is forecast to be missed by two years, primarily due to the assumed 12-month delay in the startup of SWPF.
- Defense Waste Processing Facility (DWPF) sludge batch preparation has become just-in-time, reducing contingency for accommodating emergent technical or facility issues without impacting DWPF operations.
- Tanks 48 and 50 are recovered for higher activity waste service, providing valuable Type III tank space prior to SWPF startup.
- H-Canyon processing plans are supported through 2019 with shutdown flows continuing through 2022. Several initiatives, planned by H-Canyon to minimize high-level waste (HLW) streams received by the Tank Farm, are included in this plan to conserve valuable Tank Farm tank space between now and the startup of SWPF
- Feed is available for the Actinide Removal Process/Modular Caustic Side Solvent Extraction (CSSX) Unit (ARP/MCU) facilities to initiate processing by March 2008.
- Beginning with Sludge Batch 7 or 8, aluminum dissolution mitigates the impact of increased sludge mass estimates.[iii]

---

[i] September 2012 is the early start date for completion of construction and start of SWPF operations. This *Life-cycle Liquid Waste Disposition System Plan* is based on the September 2012 early start date for SWPF. Construction could be completed and the SWPF could begin hot operations in November 2013, based on an External Independent Review and including a 60-month contingency.

[ii] These factors include: ongoing dispute resolution under the *Federal Facility Agreement for the Savannah River Site* (FFA) concerning modification of the FFA operational closure dates for Tanks 18F and 19F; potential modification of the FFA dates for other tanks; revision of the projected date for the start of operations of the SWPF, including additional schedule contingency; and integration into this *Plan* of the Department's intended revised approach to issue fewer Secretarial Determinations (one for F Area and one for H Area), pursuant to section 3116(a) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, so as to avoid duplication, facilitate tank closure, and more comprehensively consider cumulative effects.

[iii] Prior to any DOE decision to send low-level waste from aluminum dissolution processing to the SDF, DOE will confirm that such an approach is in conformity with the Secretary's *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*, the Modified Permit for the Savannah River Z-Area Saltstone Disposal Facility, 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).

Purpose

The purpose of the *Life-cycle Liquid Waste Disposition System Plan* (LLWD — hereinafter referred to as "this *Plan*") is to integrate and document the activities required to disposition and close Radioactive Liquid Tank Waste (LW) tanks and facilities at the Department of Energy (DOE) Savannah River Site (SRS). It establishes a planning basis for waste processing in the LW System through the end of the program mission. Its development is a joint effort between the Department of Energy, Savannah River Operations Office (DOE-SR) and Washington Savannah River Co. (WSRC). Life-cycle program planning for PBS-SR-0014 (Radioactive Liquid Tank Waste Stabilization and Disposition) will use this *Plan* as the scope and schedule basis.

Modeling for this *Plan* used the initial conditions (e.g., tank waste volumes, characterization, etc.) as of the beginning of August 2007. This *Plan* assumes full funding of the estimated costs to accomplish the required project and operations activities. It supports justification for requesting necessary funding profiles. This *Plan* assumes the reader has a familiarity with the systems and processes discussed. Section 9 — *System Description* is an overview of the LW System.

This *Plan* documents the operating strategy of the LW System at SRS to receive, store, treat, and dispose of over 36 million gallons of existing LW and any future generated waste and to close the associated tanks and facilities. This waste is stored in 49 underground tanks. To date, thirteen revisions of the *Plan* have been issued, each giving an updated status of the LW operating strategy at the time of issue.

Additionally, this fourteenth revision (Revision 14) of the *Plan*:

- Provides one of the inputs for financial submissions to the complex-wide Integrated Planning, Accountability, & Budgeting System (IPABS)
- Provides a basis for updating the *Savannah River Site Environmental Management Program Project Execution Plan* (PEP)[3]
- Summarizes the scope and schedule baselines with their associated assumptions and plans for the Risk and Opportunity management process per DOE Order 413.3A
- Forecasts compliance with the currently-approved *Federal Facility Agreement* (FFA)[1] Waste Removal Plan and Schedule and the *Site Treatment Plan* (STP)[2].

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 closure regulatory milestones in the currently-approved FFA, as may be modified in accordance with the 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*[4], the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[5], and future waste determination (WD) and bases documents for F- and H-Areas.
- Comply with applicable permits and consent orders, including the Modified Permit for the Savannah River Site (SRS) Z Area Saltstone Disposal Facility (permit No. 025500-1603) and the Consent Order of Dismissal in <u>Natural Resources Defense Council, et al. v. South Carolina Department of Health and Environmental Control, et al.</u> (South Carolina Administrative Law Court, August 7, 2007).
- Provide tank space to support staging of salt solution adequate to feed the SWPF at system capacity.
- Sustain sludge vitrification in the DWPF.
- Remove the tetraphenylborate (TPB) laden waste from Tank 48 and recover Tank 50 so these tanks are available to support DWPF feed batch preparation, tank closures, and SWPF 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 that identified in the *Savannah River Site – Liquid Waste Disposition Processing Strategy*[6] (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.
- Mitigate the impact of the revised sludge-mass forecast using aluminum dissolution.

There is currently a critical shortage of 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 minimize impacts to meeting, programmatic objectives. During the period prior to startup of SWPF in late 2012, three main tank-space initiatives are required to support programmatic objectives.

First, limited near-term retrieval, treatment, and disposal of salt waste is required. This is performed using the Deliquification, Dissolution, and Adjustment (DDA) process alone (for Tank 41 as of June 9, 2003) and operation of the ARP/MCU facilities. Operation of these salt treatment processes frees up critical working space in the 2F and 3H Evaporators' concentrate receipt tanks (i.e., Tank 25 and Tank 37, respectively). This is necessary to support near-term handling of influent streams from early-year tank closures, DWPF sludge batch preparation and recycle handling, and H-Canyon processing. Any reduction in the amount of material processed through the DDA process or in the amount of material removed from Tank 25 in the interim salt processing period has significant adverse impact on achieving programmatic objectives.

Second, it is imperative to return Tanks 48 and 50 (each a 1.3-million gallon [Mgal] newer-style tank) to general higher-activity waste service. Tank 48 is planned for recovery in 2012 after treatment of the TPB-containing waste. Tank 50 is also planned for recovery in 2012. Prior to the recovery of Tank 50, modifications are required to provide for decoupling the salt processing facilities' Decontaminated Salt Solution (DSS) feed from the Saltstone Processing Facility (SPF). Recovery of these two tanks is necessary to adequately store and prepare salt solution to feed SWPF at maximum capacity.

Third, initiatives to reduce or eliminate Tank Farm influent streams are being considered to deal with DWPF recycle and several H-Canyon streams. In particular, H-Canyon is pursuing waste minimization initiatives to reduce or re-direct H-Canyon influents to optimize Tank Farm space, e.g., segregation of Low-Level Waste (LLW) streams for disposition at SPF, re-sequencing of HLW streams to avoid high pinch-point periods, and sending qualified HLW streams directly to the DWPF feed system.

These initiatives and the assumed SWPF startup in 2012 provide critical tank space to minimize impacts to the programmatic objectives.

Revisions

The significant processing milestones of the last full publication of the *High Level Waste System Plan Revision 13 (U)*[7] were superseded by the Performance Management Plan (PMP) in the *PMP Supplement to the HLW System Plan Rev 13* (PMP–Rev 13)[8]. Further, since the publication of PMP–Rev 13, significant revision to the LW program impacted major planning assumptions in the areas of salt processing, sludge processing, and tank closure. The *2006 Savannah River Site Environmental Management Program Project Execution Plan* (2006 PEP)[3] documents revisions through early 2006 and incorporates them into the LW planning baseline. This *Plan* incorporates updates since early 2006. The major assumption updates in this *Plan* with respect to the 2006 PEP include:

- **Salt Processing**:
  - **Near-term Salt Waste Processing:** The 2006 PEP assumed that salt processing (in particular DDA processing) could be initiated in July 2006 after the receipt of a modified Industrial Solid Waste Landfill Permit from the South Carolina Department of Health and Environmental Control (SCDHEC). This did not occur as scheduled due to permit delays. In addition, the permit was further impacted in March 2007 when requests for a Contested Case Hearing concerning the modified Industrial Solid Waste Landfill Permit were filed before the Administrative Law Court of South Carolina (ALC-SC). In recognition of those requests for a Contested Case Hearing, disposal of DDA-processed waste was suspended. On August 7, 2007, an agreement, formalized in a Consent Order of Dismissal by the ALC-SC, allowed DOE to resume disposal of salt waste treated by interim processing. Thus, this *Plan* assumes that DDA waste processing resumes in November 2007 after completion of SPF processing modifications.
  - **ARP/MCU Processing**: Initiation of ARP/MCU processing was delayed to March 2008 from October 2007 as assumed by the 2006 PEP.
  - **Salt Storage**: Additional salt storage space is required due to the delay of salt removal and processing via DDA and ARP/MCU. Recent operating experience enabled consideration of Tanks 44 and 47 as concentrate receipt tanks for the 2F Evaporator. This enables the 2F Evaporator to handle limited campaigns, mainly associated with tank closure and mechanical and chemical cleaning streams. This

prolongs the ability of the 2F Evaporator to process salt-laden waste before requiring Tank 25 salt removal and conversion to the 2F Evaporator concentrate receipt tank.
- **SWPF Startup Date:** The startup date of the SWPF is assumed to have been delayed to September 2012 from September 2011.

- **Tank Storage Space**
  - **Tank 48**: Tank 48 return-to-service was delayed to September 2012 from January 2010. This is a realization of a previously identified schedule risk and is consistent with the Tank 48 Alternative Treatment Technology (to destroy organic materials) selection process Independent Technical Review (ITR) conclusions.
  - **Tank 50**: Tank 50 will be converted from LLW service to SWPF feed batch preparation service. This will require modifications to provide for decoupling the salt processing facilities' DSS feed from the SPF. This *Plan* assumes a May 2012 return to service date versus the January 2010 date assumed in the 2006 PEP.
- **Sludge Mass Processing**: Recent studies have indicated an increase in the forecast mass of sludge remaining as compared to the 2006 PEP. Without mitigating strategies, this could result in an increase in a forecast DWPF total canister count to as much as 8,900 canisters from the ~5,900 assumed in the 2006 PEP. However, mitigating strategies such as performing aluminum dissolution for sludge mass reduction and incorporating DWPF melter technology improvements, which are incorporated into this *Plan*, should reduce the total number of canisters. Therefore, the nominal canister projection for this *Plan is* ~6,300 (including the estimated 100 cans added from the proposed Plutonium Vitrification [PUV] program).

Results of the Plan

Table 1-1 — *Results of the Plan* describes the major results with respect to the latest published baseline — the 2006 PEP. A description of these results follows.

Table 1-1 — Results of the *Plan*

Parameter	2006 PEP	This *Plan*
Tank space provided to feed SWPF at full capacity	Yes	Yes
Radionuclides (curies) dispositioned in SDF meet *SRS LW Strategy*	Yes	Yes
Sludge vitrification at DWPF sustained	Yes	Yes
Nuclear material stabilization in H-Canyon supported	Yes	Yes
All yearly tank closure currently-approved FFA commitments met	Yes	No
Final FY2022 currently-approved FFA commitment met	Yes	Yes
FY 2028 STP commitment met	Yes	No
Date when waste removal complete from all tanks	FY24	FY30
Total number of canisters produced	~5,900	~6,300 [a]
Begin shipping canisters to Federal Repository	FY15	FY17
Facility (Canister Shipping) deactivation complete	FY28	FY32

[a] See Section 5.5.1 –*Sludge Mass Forecast* for a discussion of the possible range of total canisters

- **Salt Processing**: This *Plan* maintains the tank space required to provide feed for SWPF to maintain full capacity operations. However, the 6 Mgal/yr SWPF nominal processing rate (5.5 Mgal/yr average) is inadequate to meet the 2028 STP waste removal commitment.
- **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 disposed of at SDF.
- **Vitrification of Sludge at DWPF**: This *Plan* provides for the continued vitrification of sludge at DWPF that enables all stored and forecast sludge to be processed by FY30. Incorporating the revised sludge estimates from recent studies results in a total projected canister production of ~6,300 canisters over the life of the program. The ~6,300 canisters include ~100 additional canisters resulting from the proposed PUV process. This *Plan* also incorporates sludge mass reduction (i.e., aluminum dissolution on high aluminum sludge batches) and the implementation of alternative technology initiatives to mitigate the life-cycle impact of increased sludge mass. Without implementation of sludge mass reduction initiatives and sludge processing improvement initiatives, the total canister count was calculated to be as high as ~8,900 canisters with an end-of-program date forecast in FY35 or later.

- **Supporting Nuclear Material Stabilization**: Sufficient Tank Farm space exists to support the receipt of 440,000 gallons (440 kgal) from March 2007 through September 2009 and 300 kgal/yr through the end of operations in FY19 and for shutdown flows through 2022.
- **Tank Closure — Currently-Approved FFA Commitments:**
  - — Delays in issuing the Modified Industrial Solid Waste Landfill Permit required for SDF operation, legal obligations to that Modified Permit, and process improvements and operational issues have delayed the start of salt processing. In addition, the startup of SWPF is assumed to have been delayed to September 2012 from September 2011. These delays resulted in a proposed re-sequencing of waste removal and tank closures. Some tank closure commitments through FY20 were impacted.
  - — **Tank 25 Availability:** The use of Tank 25 as the 2F Evaporator concentrate receipt tank is necessary to meet the processing objectives associated with DWPF feed batch preparation, tank closure, and long-term H-Canyon operations. The delay in Tank 25 availability, due to the delay in resumption of DDA processing, reduces the capacity to process heel removal washwater. To mitigate this delay, the *Plan* assumes the use of additional 2F Evaporator concentrate receipt tanks (Tanks 44 and 47) to process specific waste campaigns resulting from Tanks 5 and 6 closure activities
- **Waste Treatment — STP Commitment**: The delays in initiation of DDA and ARP/MCU and the assumed 12-month delay in the start-up of SWPF reduce our ability to remove and treat the waste during the STP commitment time frame. The completion of removal of the backlogged and currently generated waste inventory is delayed to 2030 from 2028.
- **Canister Storage and Shipping**: This *Plan* assumes a third Glass Waste Storage Building (GWSB), consistent with the 2006 PEP. It assumes Federal Repository shipments occur during FY17-FY30, with GWSB and Canister Shipping Facilities closures planned for FY32.
- **Closure Sequence for the LW System**: Previous plans focused on the implementation of salt processing and did not address the details of the closure of the LW system. This *Plan* reflects the development of a proposed sequence of events that facilitate an orderly and reasonable shutdown and closure of the LW system used to treat and disposition the waste.

2. Introduction

This fourteenth 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 LLW fraction in concrete vaults; vitrifying the higher activity waste; and storing the vitrified waste until permanent disposition at a Federal Repository. 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 9 — *System Description* is an overview of the LW System.

The Tank Farms have received more than 140 million gallons of waste from 1954 to the present. Reducing the volumes of waste through evaporation and vitrification of waste, the Tank Farms currently store over 36 million gallons of waste. Containing approximately 400 million curies of radioactivity, this waste will be dispositioned for over 20 years. As of August 14, 2007, DWPF had produced 2,358 vitrified waste canisters. All volumes and total curies reported as current inventory in the Tank Farms are as of August 14, 2007, and account for any changes of volume or curies in the Tank Farms since Revision 13 of the System Plan and the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*.

Additionally, this *Plan*:

- Provides one of the bases for financial submissions to the complex-wide IPABS.
- Provides a basis for updating the PEP.
- Summarizes the scope and schedule baselines with their associated assumptions and plans for the Risk and Opportunity management process per DOE Order 413.3A.
- Forecasts compliance with the currently-approved *Federal Facility Agreement* (FFA)[1] Waste Removal Plan and Schedule and the *Site Treatment Plan* (STP)[2].

Successful and timely salt waste removal and disposal is integral to efforts by SRS to proceed with all aspects of tank cleanup and closure, extending well beyond disposal of the solidified low-activity salt waste streams themselves. This is for not only the obvious reason that the salt waste must be removed and treated before the tanks may be closed, but, less obviously, because disposal of the salt waste will enable SRS to continue, without interruption, to remove and stabilize 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. Thus, executing this *Plan*, which calls for removal and disposal of low-activity salt waste through DDA and ARP/MCU, is critical in order to relieve this tank space shortage and assure that vitrification of the high-activity fraction will be able to continue uninterrupted.

In addition, operating DDA and 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 will allow DOE to complete cleanup and closure 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 *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 closure regulatory milestones in the currently-approved FFA, as may be modified in accordance with the 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 Saltstone Disposal Facility (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).

- Provide tank space to support staging of salt solution adequate to feed the SWPF at system capacity.
- Sustain sludge vitrification in the DWPF.
- Remove the TPB laden waste from Tank 48 and recover Tank 50 so these tanks are available to support DWPF feed batch preparation, tank closures, and SWPF 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 that identified in the *Savannah River Site – Liquid Waste Disposition Processing Strategy*[6] (*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.
- Mitigate the impact of the revised sludge-mass forecast using aluminum dissolution.

Due to the delays in salt processing and other key initiatives (e.g., Tank 48, Tank 50, etc.) described in this *Plan*, meeting the high-priority tank closure commitments, especially for FY10–FY15, is put at a higher risk. A summary of the impacts is described in Section 5— *Planning Summary and Results*.

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

- 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
  - 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
    - Sludge batch preparation.
- Support closure of old-style tanks to meet currently-approved FFA commitments as may be modified in accordance with the FFA.
- Provide tank space to support staging of salt solution adequate to feed salt solution to SWPF at full capacity.
- Support continued nuclear material stabilization in H-Canyon.
- Ensure that the curies dispositioned to the SDF meet the *SRS LW Strategy* and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*.

There is currently a critical shortage of 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 minimize impacts to meeting, programmatic objectives. During the period prior to startup of SWPF in late 2012, three main tank-space initiatives are required to support programmatic objectives.

First, limited near-term retrieval, treatment, and disposal of salt waste is required. This is performed using the DDA process alone (for Tank 41 as of June 9, 2003) and operation of the ARP/MCU facilities. Operation of these salt treatment processes frees up critical working space in the 2F and 3H Evaporators' concentrate receipt tanks (i.e., Tank 25 and Tank 37, respectively). This is necessary to support near-term handling of influent streams from early-year tank closures, DWPF sludge batch preparation and recycle handling, and H-Canyon processing. Any reduction in the amount of material processed through the DDA process or in the amount of material removed from Tank 25 in the interim salt processing period has significant adverse impact on achieving programmatic objectives.

Second, it is imperative to return Tanks 48 and 50 (each a 1.3-million gallon [Mgal] newer-style tank) to general higher-activity waste service. Tank 48 is planned for recovery in 2012 after treatment of the TPB-containing waste. Tank 50 is also planned for recovery in 2012. Prior to the recovery of Tank 50, modifications are required to provide for decoupling the salt processing facilities' DSS feed from the SPF. Recovery of these two tanks is necessary to adequately store and prepare salt solution to feed SWPF at maximum capacity.

Third, initiatives to reduce or eliminate Tank Farm influent streams are being considered to deal with DWPF recycle and several H-Canyon streams. In particular, H-Canyon is pursuing waste minimization initiatives to reduce or re-direct H-Canyon influents to optimize Tank Farm space, e.g., segregation of LLW streams for disposition at SPF, re-sequencing of HLW streams to avoid high pinch-point periods, and sending qualified HLW streams directly to the DWPF feed system.

These initiatives and the assumed SWPF startup in 2012 provide critical tank space to minimize impacts to the programmatic objectives.

2.2 *Planning Improvements since Revision 13*

One goal of the planning process is continuous improvement of the *Plan* to better serve the needs of the user. Revision 14 of the *Plan* incorporates the results from several improvements in the planning process implemented since the publication of Revision 13:

- **Systems Integrated Management Plan** (SIMP): The *Systems Integrated Management Plan*[9], published in July 2006, provides an overview of the planning process. Instead of incorporating the forecasting efforts in one all-encompassing plan, the SIMP describes the use of multi-tier documents that address the short, medium, and long-range needs of the LW system. This results in a family of complementary documents that describe the activities through the end of the program and closure of the facilities. This family of documents includes:
  - this *Life-cycle Liquid Waste Disposition System Plan*, an overall comprehensive strategy for disposition of the Liquid Waste stored in F-Tank Farm (FTF) and H-Tank Farm (HTF) (previously known as the *High Level Waste System Plan*[7]) and closure of those facilities
  - various proposed sub-tier program plans that describe specific parts of the system in greater detail
  - the *FY06-FY12 Liquid Waste Disposition Processing Plan* [10](DPP), an overall comprehensive strategy for disposition of the Liquid Waste that describes the next five to seven years of operations in greater detail
  - the twelve month *LW System Plan - Transfer Strategy*[11].
- **Modeling Improvements:** A rewrite of the primary tank farm modeling tool, SpaceMan, more realistically simulates tank farm activities with additional modules for major processing facilities (*i.e.*, ARP/MCU, DDA, SWPF, etc.). SpaceMan Plus™ replaces SpaceMan II™ (used in Revision 13 of the *Plan*) and SpaceMan™ (used in Revisions 11 and 12 of the *Plan*).

2.3 *Risk Management*

A complete discussion of documented project, operational, and programmatic risks and the risk reduction handling strategies associated with the risks is contained in the Liquid Waste Operations (LWO) Risk Management Plan (RMP), *PBS-SR-0014 Radioactive Liquid Tank Waste Stabilization and Disposition (U) Risk Management Plan*[12].

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 *Reference Date*

The reference date for the mathematical modeling (SpaceMan Plus™ and GlassMaker) of this *Plan* is July 31, 2007. Schedules, milestones, and operational plans were current as of that date.

3.2 *Funding*

Progress toward the ultimate goal of immobilizing all the LW at SRS is highly dependent on available funding. With a reduction in 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 closure, as described in this *Plan*.

This *Plan* assumes full funding of the estimated costs to accomplish the required project and operations activities. It supports justification for requesting necessary funding profiles.

3.3 *Regulatory Drivers*

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

South Carolina Pollution Control Act (S.C. Code Ann. §§ 48-1-10* et seq.*)

SCDHEC is the delegated authority for hazardous waste management (Resource Conservation & Recovery Act of 1976 [RCRA]), air pollution control, and water pollution control. The State has empowered SCDHEC to adopt standards for water and air, and to issue permits for such discharges. Further, under the Pollution Control Act (PCA), SCDHEC is authorized to administer both the federal Clean Water Act and the Clean Air Act, as well as to implement and enforce the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, aka SuperFund). For example, SCDHEC issued to DOE-SR permits such as the Industrial Solid Waste 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 LWO facilities fail to meet other conditions of this permit within prescribed periods of time subject to certain limited exceptions. Other principal permits required to operate LWO facilities pursuant to the state's PCA include:

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

Site Treatment Plan

The *Site Treatment Plan*[2] (STP) 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. This 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 waste removal and heel removal scope of this *Plan*. Final cleaning, deactivation, and closure of storage and processing facilities are subsequent to the satisfaction of this commitment.

Currently-Approved Federal Facility Agreement

DOE, the Environmental Protection Agency (EPA), and the SCDHEC executed the SRS currently-approved FFA[1] on January 15, 1993. The currently-approved FFA, which became effective August 16, 1993, 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 closure. A revised "F/H Area HLW Removal Plan and Schedule (WRP&S)" was submitted to EPA and SCDHEC on March 7, 2002, and updated on April 8, 2002. This revision to the schedule provides end dates for the operational closure of each non-compliant tank and commits SRS to remove from service and close the last non-compliant tank no later than FY22. The WRP&S also provides for the possibility that certain Type I tanks may be used to store concentrated supernate after the completion of waste removal. The current schedule (Revision 2) was submitted to EPA and SCDHEC on July 23, 2004, and approved on September 6, 2004. Refer to *Appendix E — Currently-Approved FFA Waste Removal Plan & Schedule* to see the approved schedule.

National Environmental Policy Act (NEPA)

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 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 (NDAA)

The *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* (NDAA) Section 3116 (§3116) concerns, among other things, determinations by the Secretary, in consultation with the NRC, that certain radioactive waste from reprocessing is not high-level waste and may be disposed of in South Carolina. For salt waste, DOE contemplates removing 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 in vaults at the SDF. For closure activities, NDAA §3116 governs the disposal of residual waste in situ as part of the overall closure of the tank and ancillary equipment (evaporators, diversion boxes, etc.).

3.4 *Revisions*

Significant revisions have occurred to the LW program since the publication of PMP–Rev 13. These revisions have impacted major planning assumptions in the areas of salt processing, sludge processing and tank closure. Revisions through early 2006 were incorporated into the LW planning baseline as documented in the *2006 SRS Environmental Management Program Project Execution Plan* (2006 PEP)[3]. Additional updates since early 2006 have been incorporated into this *Plan*. The major revisions from the PMP–Rev 13 and the 2006 PEP are

- **§3116 Salt Disposition**: Since PMP–Rev 13 was issued in 2002, major revisions in salt processing planning assumption changes were made. The PMP–Rev 13 assumed processing of approximately one third of the salt waste via a low curie process, one third using an ARP, and the remaining third using the SWPF. The plan was not executed because a number of stakeholder groups, including SCDHEC and the

South Carolina Governor's Nuclear Advisory Council (GNAC), expressed concern that the plan would leave significant quantities of radionuclides in the State of South Carolina from the low curie and ARP processes[13]. Additionally, litigation relative to the DOE order concerning radioactive waste management affected the plan. The NDAA §3116 clarified DOE's authority to dispose of certain waste from reprocessing in South Carolina, among other things. The Secretary of Energy, in consultation with the Nuclear Regulatory Commission (NRC), issued the *Section 3116 Waste Determination for Salt Waste Disposal at the Savannah River Site*[4]. As was assumed in the 2006 PEP planning baseline, this *Plan* assumes processing the majority of the salt waste via the SWPF. To enable continuation of risk reduction activities (i.e., sustaining sludge vitrification in DWPF and closing old-style tanks), limited near-term retrieval, treatment, and disposal of salt waste is required at the SDF prior to the availability of the SWPF. The near-term salt waste disposal methods are DDA and ARP/MCU operations. The source of this near-term salt waste and the resultant approximate curies dispositioned in the SDF vaults is outlined in the *SRS LW Strategy*. This strategy is consistent with performance objectives of DOE and the Common Goals and Values, jointly developed by DOE, SCDHEC, and the GNAC. The revised salt processing strategy in this *Plan* results in fewer curies dispositioned at SDF compared to the PMP–Rev 13.

- **Salt Processing**:
  - **SWPF Startup Date:** The 2006 PEP SWPF startup date was delayed to September 2011 from the PMP–Rev 13 assumed date of August 2009. This *Plan* assumes the start-up date is delayed to September 2012.
  - **Near-term Salt Waste Processing:** The 2006 PEP assumed that near-term salt processing could be initiated in July 2006 after the receipt of a Modified Industrial Solid Waste Landfill Permit from SCDHEC. This did not occur as scheduled. The modified Industrial Solid Waste Landfill Permit was eventually received on February 26, 2007, and disposal of DDA-processed DSS, originating from Tank 41, was initiated on March 2, 2007. However, requests for a Contested Case Hearing concerning the modified Industrial Solid Waste Landfill Permit were filed before the ALC-SC. In recognition of those requests for a Contested Case Hearing, disposal of DDA-processed waste was suspended. On August 7, 2007, an agreement, formalized in a Consent Order of Dismissal by the ALC-SC, allows DOE to resume interim salt waste processing. Thus, this *Plan* assumes that DDA waste processing resumes in November 2007 after completion of SPF processing modifications.
  - **ARP/MCU Processing**: Initiation of ARP/MCU processing was delayed to March 2008 from October 2007 as assumed by the 2006 PEP.
  - **Salt Storage**: Additional salt storage space is required due to the delay of salt removal and processing via DDA and ARP/MCU. Recent operating experience enabled consideration of Tanks 44 and 47 as concentrate receipt tanks for the 2F Evaporator. This enables the 2F Evaporator to handle limited campaigns, mainly associated with tank closure and mechanical and chemical cleaning streams. This extends the duration that the 2F Evaporator is able to process salt-laden waste before requiring Tank 25 salt removal and conversion to the 2F Evaporator concentrate receipt tank.
- **Tank Storage Space**
  - **Tank 48**: Tank 48 return-to-service was delayed to September 2012. This is a realization of a previously identified schedule risk and is consistent with the Tank 48 Alternative Treatment Technology selection process ITR conclusions. This is a delay with respect to the 2006 PEP (January 2010) and PMP–Rev 13 (2006).
  - **Tank 50**: Tank 50 will be converted from LLW service to SWPF feed batch preparation service. This will require modifications to provide for decoupling the salt processing facilities' DSS feed from the SPF. This *Plan* assumes a May 2012 return to service date versus the January 2010 date assumed in the 2006 PEP.
- **Sludge Mass Processing**: The recent analysis of the total mass of sludge in the waste tanks increased the amount of sludge anticipated (see Section 5.5.1 — *Sludge Mass Forecast*). The upper estimate of the total number of canisters (were no sludge-processing improvements made) is ~8,900 canisters as compared to ~5,900 canisters in the 2006 PEP and ~5,100 in PMP–Rev 13. Without mitigating strategies, this could extend the life of the LW program to FY35. However, the implementation of aluminum dissolution in 2012, when tank space is available to support the process, should reduce the mass of sludge processed at DWPF. In addition, technology development at DWPF is assumed to increase the waste loading in the canisters starting in 2015. The canister count is thus reduced to ~6,200 canisters. The proposed incorporation of plutonium cans in DWPF canisters via the proposed PUV increases the canister count by approximately 100 to ~6,300 total forecast canisters. The implementation of these technologies enables the processing of all stored and forecasted sludge by FY30. Further acceleration of sludge processing without a

corresponding improvement in salt processing rate could result in the production of salt-only canisters, which are undesirable due to the uncertainties associated with qualifying salt-only canisters

- **§3116**: The PMP–Rev 13 predated the legal challenges and enactment of §3116 of the NDAA. For closure activities, §3116 governs the disposition of residual tank waste in the waste tanks as part of the overall closure of the tank. Two planned future §3116 determinations, one each for the F- and H- Tank Farms, will concern the disposition of wastes in South Carolina and are required for closure of the tanks and ancillary equipment. The 2006 PEP and this *Plan* assume an increased duration from the last waste removal to the closure (grouting) of a tank to 24 months.
- **Waste Treatment — STP Commitment**: The delays in initiation of DDA and ARP/MCU and the assumed 12-month delay in the start-up of SWPF reduce DOE's ability to remove and treat the waste during the STP commitment time frame. The completion of removal of the backlogged and currently generated waste inventory is delayed to 2030 from 2028.
- **SDF Vault Configuration**: The 2006 PEP and this *Plan* reflect the design upgrade of the existing SDF Vault 4, increasing curie loading capacity to 0.2 Ci/gal ^{137}Cs, from 0.05 Ci/gal ^{137}Cs (PMP–Rev 13) while meeting Class C requirements for LLW. This accommodates the increased curie concentration of DDA material. For all future vaults to be constructed, the PMP–Rev 13 assumes a rectangular 12-cell (1 Mgal/cell salt solution capacity) vault design with a permanent roof. The 2006 PEP and this *Plan* assume future vaults use two cells, with each cell holding the equivalent of 1.5 Mgal of salt solution in order to meet revised technical requirements. The SDF vaults will be designed in accordance with applicable provisions in 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).
- **Canister Storage and Shipping**: The PMP–Rev 13 assumes two GWSBs are sufficient for interim storage of DWPF canisters pending disposition in a Federal Repository. It projects shipping canisters to the Federal Repository starting in FY10 and continuing to FY20. The 2006 PEP recognizes the delay in the planned startup of the Federal Repository and provides for three GWSBs with shipping occurring from FY17–FY30. This *Plan* assumes the construction of a third GWSB, consistent with the 2006 PEP. Canister shipping to the Federal Repository is assumed to begin in FY17, consistent with announced plans to initiate repository operations in 2017. Assuming a gradually increasing shipping rate in the initial years, about 14 years will be needed to ship all SRS DWPF canisters to the Federal Repository. The last canister is shipped in FY30; facility closure of the Canister Shipping Facility is planned for FY32.
- **Major Facility Closure**: The PMP–Rev 13 and the 2006 PEP focus on the implementation of salt processing and do not address the details of the closure of the Liquid Waste system. This *Plan* uses a more detailed analysis of the facility closure sequence with respect to influent and effluent streams to the Tank Farm to provide improved modeling of the final activities required for facility closure.

3.5 *Key Milestones*

Key Milestones are those major dates that are required to remove waste from storage, process it into glass or saltstone grout, and close the LW facilities. These milestones are compared to the PMP–Rev 13 and the 2006 PEP.

Table 3-1 — Key Milestones

Key Milestone	PMP–Rev 13	2006 PEP	this *Plan*
Total Number of Canisters Produced	~5,100	~5,900	~6,300[a]
GWSB #2 Available	FY06	Jun 2006	Jul 2006 (actual)
GWSB #3 Available	n/a	Sep 2015	Sep 2019
Salt Processing			
Initiate DDA Processing	FY03	Jul 2006	Nov 2007
Initiate ARP/MCU Processing	FY03[b]	Aug 2007	Mar 2008[c]
Initiate SWPF Processing	Sep 2009	Sep 2011	Sep 2012
Salt Solution Processed via DDA only	28.4 Mgal	2.6 Mgal	2.6 Mgal
Salt Solution Processed via ARP/MCU	27.8 Mgal [b]	5.9 Mgal	4.3 Mgal
Salt Solution Processed via SWPF	28.5 Mgal	76.2 Mgal [d]	90.3 Mgal
Total Salt Solution Processed	**84.7 Mgal**	**84.7 Mgal [d]**	**97.2 Mgal [e]**

Key Milestone	PMP–Rev 13	2006 PEP	this *Plan*
Key Risk Reduction Dates			
Date when all non-compliant Tanks are closed	FY15	FY22	FY22
Key Space Management Activities			
Tank 42 Available as Sludge Staging Tank	n/a	Jan 2010	Jun 2012
Tank 50 Available as Salt Staging Tank	FY02	Jan 2010	May 2012
Tank 48 Available as Salt Staging Tank	FY06	Jan 2010	Sep 2012
Tank 41 Available as Salt Staging Tank	n/a	Nov 2006	Apr 2008
Alternate Recycle Handling Implemented	FY13	TBD [f]	FY18
Repository Activities			
Start shipping canisters to the Federal Repository	FY10	FY15	FY17
Complete shipping canisters to Federal Repository	FY20	FY26	FY30
Facility Deactivation Complete	FY20	FY26	FY32

[a] Additional canisters are based on updated sludge mass studies (see Section 5.5.1 – *Sludge Mass Forecast*). The modeling for this *Plan* assumes ~6,300 canisters, including the proposed PUV canisters; successful implementation of sludge mass reduction initiatives; and successful implementation of DWPF technology initiatives. This figure does not take into account additional canisters attributed to future H-Canyon operation nor additional oxalates resulting from chemical cleaning associated with tank closures. This figure will be adjusted when actual compositions of these future waste streams are known.

[b] The PMP–Rev 13 assumes that processing of salt solution through ARP is completed without an MCU facility to reduce the Cs-137 concentrations.

[c] ARP/MCU processing initiation is impacted by process improvements and permitting and litigation delays.

[d] The total salt resulting from extended H-Canyon operations (to FY13 from FY09) and DWPF recycle calculations (see Section 5.1.1 – *Salt Volume to be Processed*) was assumed for the DPP but was not modeled to the end of the program. For planning purposes, the same total salt solution volume used for the PMP–Rev 13 was assumed for the 2006 PEP.

[e] The ~97 Mgal of salt solution processed over the life of the program is 12 Mgal more than the ~84 Mgal predicted in PMP–Rev 13 and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*. The projected increase in salt solution to be processed is attributed to planned extension of canyon operations, sludge mass, and DWPF recycle as discussed in Section 5.1.1 — *Salt Volume to be Processed*. Prior to any final DOE decision to dispose of this additional 12 Mgal of low-level salt waste in SDF, DOE will confirm that the total curies to be disposed of in SDF will not exceed the total curies discussed in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* and is in conformance with the Secretary's *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*.

[f] The 2006 PEP was updated through early 2006, including results of DPP[10]. The DPP does not model through the end of the program, and thus a date associated with an alternate recycle handling strategy is not identified therein.

4. Key Planning Bases Inputs and Assumptions

The following major assumptions and planning bases are the results of an agreement between WSRC[14] and DOE[15]. They address the planning period to the end of the program. Note that these are input assumptions and are not completely achieved by this *Plan*. Specifically, while meeting the FY22 currently-approved FFA commitment to close all old-style tanks, further delays with respect to the specific tank schedules have been unavoidable due to the delay of the Modified Industrial Solid Waste Landfill Permit and process improvements. Detailed assumptions are described in Section 8 — *Description of Assumptions and Bases*.

Regulatory Drivers – Regulatory requirements, including the FFA, drive the development of the LLWD System Plan through the end of the program.

- **Federal Facility Agreement (currently-approved FFA)** – Commits the Department to remove from service and close the last non-compliant tank (Tanks 1–24) no later than FY22
- **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."[2] 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 currently-approved FFA above.

Major Assumptions and Input Bases – The following are major assumptions and planning basis inputs for the development of the LLWD System Plan through the end of the program.

- **Salt Processing**
  - — Interim salt processing initiates in November 2007 after completion of modifications at the SPF.
  - — Radiological operations (integrated test runs) for the ARP/MCU facilities are initiated by September 2007 *(completed)*.
  - — Feed is made available for the ARP/MCU facilities as soon as practical without adversely impacting the system goals with a goal of March 2008.
  - — The ARP/MCU processing goals are
    - – 2.0 gallons per minute (average rate) processing for initial year of operation
    - – 3.0 gallons per minute (average rate) processing for subsequent years.
  - — The ARP facility is not anticipated to operate after the startup of SWPF; MCU will not operate after startup of SWPF.
  - — The SWPF becomes operational September 2012.
  - — The SWPF annual processing goals are
    - – 3.75 million gallons (nominal rate) of salt solution processed in the initial year of operation
    - – 6.0 million gallons (nominal rate) of salt solution processed per year beginning in the second year of operation
      - actual anticipated throughput varies with respect to DWPF melter outages, with an average SWPF processing rate of 5.5 million gallons per year.
  - — Capacity is available to provide contingency for potential SPF/SDF planned and unplanned outages associated with the close coupling with SWPF, MCU, and ETP.
  - — Tank 48 waste treatment is complete and the tank is available for general waste service by September 2012.
  - — Tank 50 is available for general waste service with higher levels of radioactivity by May 2012.

- **Sludge Processing**
  - — Updated sludge mass estimates are used for sludge batch planning.
  - — Target waste is removed from all Type III tanks by 2028 (STP) or earlier with emphasis on minimizing total canisters produced. This will require implementation of alternative technology initiatives to mitigate life-cycle impact of increased sludge mass. Emphasis areas include
    - – sludge mass reduction (i.e., aluminum dissolution)
      - Aluminum dissolution availability tied to Tank 50 (or Tank 48 if it is available first) recovery for general waste service
      - Low temperature aluminum dissolution assumed for Sludge Batch 5 with the aluminum-rich supernate stored in Tank 11
    - – sludge processing rate improvements
      - Increased sludge processing rate corresponds to available Tank Farm space (or implementation of new technology) to build sludge feed batches at an increased rate.

- Balance sludge processing rates with salt processing rates to end in the same time period (i.e., avoid salt-only canister production).
- Prior to Tank Farm space availability, just-in-time sludge batching is performed.
- Four-month melter replacement outage every 48 months continues through the life of the program.
- Proposed PUV process will operate from FY13–FY19 resulting in approximately 100 additional canisters (~16 canisters per year) from the displacement of tank farm sludge by the vitrified Pu cans. This is assumed to have no impact on the DWPF melter production rate.

- **Tank Closures**
  - Tank-specific closure process is completed expeditiously and includes
    - Contractor completion of the initial tank-specific activities
    - Characterization of residual source terms
    - SCDHEC approved closure plans
    - The grout contract placed, at risk, before SCDHEC approves closure of the tank
    - Actual grouting of the tank.

    Note: Operational closure of Tanks 18, 19, 5 and 6 could be delayed. A new technology to enhance the tank cleaning effectiveness and a new F Area Performance Assessment (PA) contribute to this delay.
  - Old-Style Tanks (Types I, II and IV — Tanks 1–24)
    - Tank closure commitments from the currently-approved FFA are high priority.
    - Targeted to meet or improve currently-approved FFA FY22 date for all old-style tanks
      - currently-approved FFA operational closure defined as waste removed and residuals are isolated and grouted
  - New-Style Tanks (Type IIIs — Tanks 25–51)
    - Target for waste removed from all Type III tanks by 2028 to meet STP
      - Note: Tanks not required to be isolated and grouted
  - Prioritize tanks to facilitate closings in groups, as feasible
  - Reducing the overall closure schedule for the Liquid Waste facilities is a high priority.
  - Proposed overall tank closure priority will support area closure in the following order, as feasible:
    - F-Tank Farm
    - H-Tank Farm West Hill
    - H-Tank Farm East Hill.

- **Tank Farm Operations**
  - The maximum amount of saltcake will be removed from Tank 25 (ideally to the 150" level) prior to SWPF startup to ensure 2F evaporator support for Tank Closures, SWPF feed preparation, sludge washing, and H-Canyon.
  - Sufficient tank space volume is available to support the receipt of 440 kgal[iv] from H-Canyon operations from March 2007 to September 2009. After that, the Tank Farms can support an average of 300 kgal per year from H-Canyon operations.
  - Realistic but challenging project and transfer schedules will be utilized.

- **Federal Repository Availability**
  - Federal Repository is available starting in FY17.
  - Rate of canister shipments is assumed to be as follows:
    - FY17 130 canisters
    - FY18 250 canisters
    - FY19 and subsequent years 500 canisters per year.

[iv] This value is an adjusted receipt volume based on emergent modeling information and H-Canyon expected waste generation through FY09.

5. 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 RMP and individual implementation project risk assessments.

Interim salt processing delays and the assumed 12-month delay in SWPF start-up resulted in impacts to several of the LW system objectives. While the impacts to some objectives were mitigated, complete mitigation of some of the higher-priority objectives was not technically feasible. In summary, this *Plan* meets the programmatic objectives with the exception of the following impacts:

- The current tank closure milestones from the currently-approved FFA:
  - The tank closure dates for the four tanks (Tanks 10, 11, 14, and 15) are being re-negotiated; the currently-approved FFA FY14–FY15 dates will be missed by twenty to thirty-one months. This primarily results from delays in the removal of salt from the LW system and the inability to reclaim Type III Tank space to store sludge to facilitate closure of old-style tanks.
  - The tank closure dates from the three F-Area salt tanks (Tanks 1–3) are being re-negotiated; the currently-approved FFA FY19–FY20 dates will be missed by three to twelve months. This primarily results from delays in the removal of salt from the LW system.
- DWPF sludge batch preparation has become just-in-time, allowing for less contingency to accommodate emergent technical or facility issues in the system without impacting DWPF operations.
- DDA DSS originating from Tank 41 and concentrated DWPF recycle from the 2H Evaporator must be temporarily stored in a tank in HTF with space reclaimed via interim salt processing.

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 results of the modeling, 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 — Tank Farm Volume Balance*
- *Appendix B — Salt Solution Processing*
- *Appendix C — Sludge Processing*
- *Appendix D — Canister Storage*
- *Appendix F — Usable Type III Tank Space*
- *Appendix G — Remaining Tank Inventory*
- *Appendix H — Evaporator System Levels (through FY14).*

5.1 *Processing Salt*

As highlighted in the Introduction, this *Plan* includes the use of a series of salt treatment processes over the life of the program, including DDA, ARP/MCU, 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 will be processed over the life of the program. SWPF processes the vast majority of this salt solution waste. As a result, the salt solution processed after SWPF reaches its nominal capacity (in FY14) is approximately 6 Mgal/yr (actual anticipated throughput varies with respect to DWPF outages, with an average of 5.5 Mgal/yr).

5.1.1 Salt Volume to be Processed

The ~97 Mgal of salt solution processed over the life of the program is 12 Mgal more than the 85 Mgal predicted in PMP–Rev 13. Prior to any final DOE decision to dispose of this additional 12 Mgal of low-level salt waste in SDF, DOE will confirm that the total curies to be disposed of in SDF will not exceed the total curies discussed in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* and are in conformance with the Secretary's *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*. While the 2006 PEP recognizes some increase in the total volume, detailed modeling was not done to quantify the increase. The projected increase in salt solution to be processed over the life of the LW Program can be attributed to the following main assumption revisions since the development of PMP–Rev 13.

- Planned Extension of Canyon Operations: Whereas PMP–Rev 13 assumes cessation of waste transfers from F- and H-Canyons to the Tank Farms by FY09, this *Plan* assumes H-Canyon production continues through FY19 with receipts of shutdown flow through FY22. The additional waste received over this extension period results in an increase in salt solution that must be processed.

- Sludge Mass: As the washing of sludge removes salt entrained in the sludge, increases in estimated sludge mass result in a similar increase in the amount of salt removed to meet DWPF feed specification requirements.
- DWPF recycle: The total DWPF recycle receipts by the Tank Farm have increased in correlation with the longer DWPF and SWPF operating lives driven primarily by the increase in estimated sludge mass and additional canyon production.

5.1.2 DDA

Tank 41 salt waste is the only waste processed through DDA alone, having been chosen to minimize the curies dispositioned in the SDF while meeting other processing goals. Tank 41 was selected because it was one of the Type III tanks that had the lowest activity supernate waste, did not contain large volumes of sludge, and was not being used for an operational function vital to Tank Farm processes (such as evaporator systems or sludge batch preparation). These criteria are pertinent because

- Type III tanks meet current EPA requirements for full secondary containment and leak detection and are the only tanks approved for use in further processing;
- Low supernate activity minimizes the activity being sent to SDF;
- Sludge carry-over into SDF precludes tanks with large volumes of sludge, also minimizing the activity being sent to SDF;
- Tanks performing vital functions are needed to carry out the plan of safely disposing of the wastes.

5.1.3 ARP/MCU

The ARP/MCU process reduces the activity of the waste stream going to SDF, albeit at a lower rate than the subsequent SWPF. The DSS stream, the low-level waste stream, is disposed of in the SDF after the addition of a grout matrix in the SPF. The higher activity stream is eventually processed by vitrification in DWPF.

ARP/MCU begins operation in March 2008 and processes salt solutions through the startup of SWPF. A salt waste feed processing rate of 2 gpm is assumed for approximately the first year of operations and 3 gpm for subsequent years except during feed batch preparation and qualification. ARP/MCU will not operate during DWPF major outage periods (e.g., melter replacement outages) due to the close coupling of the two facilities. Construction of the ARP facilities is complete and the facilities are transitioning through start-up testing and cold chemical processing runs.

MCU is a fast-track project with minimal contingency. Thus, problems in start-up testing and cold chemical processing runs have a risk of delaying the startup or reducing the throughput. In addition, MCU design basis is a three-year operating life within a five-year processing window. Since the equipment is designed for contact maintenance, maintenance, if required, may pose considerable personnel exposure concerns and be time-consuming and costly. Maintenance should be minimal because of the short time the process will be operated and a robust design. This *Plan* assumes that ARP/MCU will operate for approximately 40 months during the 4-year period between its startup and shutdown for SWPF tie-ins. Based on actual timing of DWPF melter outages and batch qualifications, if the ARP/MCU operating life is increased, an evaluation will need to be performed to determine any impacts that occur as a result of the extended operating life, although neither the quantities nor curies processed with interim processing will be increased.

Before ARP/MCU can be operated, modifications are required at DWPF, Tank 50, SPF, and SDF so that these processes can accommodate carryover of Isopar®-L™[v], the main solvent used in MCU. The modifications are safety related engineered features involving temperature controls and associated interlocks. The modifications required at SPF and SDF are described in more detail in Section *5.4 — Disposition of Salt Wastes at SPF and SDF.*

---

[v] Isopar®-L™ is not characteristically hazardous or a RCRA listed waste and will not be present in the Saltstone grout matrix in sufficient quantities to make the waste form ignitable or to create other RCRA concerns.

5.1.4 SWPF

SWPF is assumed to begin operation in September 2012. For the first 12 months, the SWPF processing rate is assumed to be 3.75 Mgal/yr of salt solution. After 12 months, the nominal processing rate is increased to 6 Mgal/yr. The 6 Mgal/yr nominal processing rate is based on a 9.4 Mgal/yr. maximum hydraulic rate adjusted for 85% contactor efficiency and 75% availability ([9.4 Mgal/yr.] x [0.85] x [0.75] = 6 Mgal/yr.). However, because of the close coupling between SWPF and DWPF, SWPF must shut down for each DWPF melter replacement outage, and assumed four-month outages approximately every four years. The actual anticipated throughput, then, varies with respect to DWPF melter outages with an average of 5.5 Mgal/yr.

The SWPF processing rate is based on an assumed 100% availability for the Tank Farm feed as well as DWPF and Saltstone/DSS Tank 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.

5.2 *Tank 48 Restoration to Service*

This *Plan* assumes the waste containing TPB in Tank 48 is dispositioned using a selected alternative treatment technology 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 through SWPF or vitrification in DWPF[16]. 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 or disposition at DWPF. This *Plan* assumes the product stream will go to the 2H Evaporator system.

The Tank 48 restoration-to-service date of September 2012 reflects the realization of a previously identified risk and is consistent with the Tank 48 Alternative Treatment Technology selection process ITR conclusions. There is a risk that delays in the procurement process or additional technology selection reviews could further impact these dates and delay the availability of Tank 48 for other uses.

5.3 *Tank 50 Restoration to Service*

Tank 50 currently holds LLW intended for feed to SPF. It then serves to feed the SPF. The feed function that Tank 50 currently provides will be reconfigured when modifications are completed to decouple the DSS stream from SPF. Upon availability, Tank 50 modifications will allow for the receipt and processing of higher activity sources. Tank 50, as currently configured, can receive only low-level wastes.

This *Plan* assumes completion of modifications to decouple DSS streams from SPF in May 2012. These modifications are necessary to provide adequate contingency for potential SPF/SDF planned and unplanned outages associated with the close coupling of the salt processes and SPF. Currently, and through ARP/MCU operations, this function is supported using Tank 50. However, there is a necessity to return Tank 50 to general higher-activity waste service to meet the programmatic objectives outlined in this *Plan*. A delay in decoupling modifications would directly result in a delay in the return to general higher-activity waste service of Tank 50. This would affect the storage and preparation of salt solution to feed SWPF at maximum capacity, which would impact the ability to adequately complete waste removal and heel removal activities, which are required to support currently-approved FFA tank closure commitments and the STP waste removal commitment. In addition, a delay in the return to general higher-activity waste service of Tank 50 would result in a delay in the ability to use Tank 42 to support aluminum dissolution beginning with Sludge Batch 8 preparation. This would increase the total number of canisters produced over the life of the program.

5.4 *Disposition of Salt Wastes at SPF and SDF*

The DSS will be sent to the SPF and SDF for treatment and ultimate disposal, as described in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*. Executing this *Plan* requires that SPF and SDF can receive decontaminated salt solution and resulting grout at the radionuclide concentrations and processing rates assumed.

5.4.1 Processing DDA at SPF and SDF

The maximum allowable grout temperature at SDF during the processing of DDA DSS is 85°C assuming that there is no Isopar® containing waste mixed with these streams. Therefore, the pour strategy for filling the cells must be planned so that the maximum grout temperature in each cell remains below this limit. During the processing of material that has a low Cs-137 concentration, there is no restriction on the number of cells that can have exposed grout made from the salt solution feed.

As the DDA DSS will have concentrations as high as 0.2 Ci/gal Cs-137, eight cells (cells B, D, E, F, H, J, K and L) of Vault 4 were modified to allow SDF to accept grout made from this waste. Due to the higher Cs-137 concentration, it is expected that only one cell (100-feet by 100-feet surface area) with grout from 0.2 Ci/gal wastes can be exposed at a time because the “skyshine” from two cells could exceed exposure limits to surrounding facility personnel. The vault walls are shielded sufficiently to control radiation below exposure limits. However, radiation shining vertically through the minimally shielded roof of the vault will reflect off air and water vapor resulting in a phenomenon known as skyshine. If Cs-137 concentrations are too high, skyshine will cause radiation rates at ground level surrounding the vaults to exceed exposure limits. Plans are to pour grout to a cell for a period of time, then pour a “clean cap,” a layer of non-radioactive grout that will reduce radiation shining through the roof of that cell, and then to begin pouring grout in another cell. Heat transfer calculations indicate that operating in this manner will allow SPF to receive salt solution from DDA at a rate of 83 kgal/week in Vault 4. (The rate can potentially be increased by performing additional clean caps, but this uses up vault space with non-radioactive material.). The next generation cells, cells 2A and 2B, are expected to be able to accept grout with the higher Cs-137 concentration at 100 kgal/week with one exposed cell, although there are presently no plans to use these cells for this purpose.

The vault need dates for this *Plan* are shown in *Table 5-1 — Saltstone Vault Need Dates* and in *Appendix B — Salt Solution Processing.*

Table 5-1 — Saltstone Vault Need Dates

Vault	Feed Stream to SPF: By vault (kgal)	Feed Stream to SPF: Cumulative (kgal)	Need Date
4	8,000	8,000	Currently Available
2[a]	3,000	11,000	Feb 2012
3	3,000	14,000	Jun 2013
5	3,000	17,000	Dec 2013
6	3,000	20,000	Sep 2014
7	3,000	23,000	Sep 2015
8	3,000	26,000	Feb 2016
9	3,000	29,000	Jul 2016
10	3,000	32,000	Dec 2016
11	3,000	35,000	May 2017
12	3,000	38,000	Oct 2017
13	3,000	41,000	Mar 2018
14	3,000	44,000	Jul 2018
15	3,000	47,000	Dec 2018
16	3,000	50,000	May 2019
17	3,000	53,000	Feb 2020
18	3,000	56,000	Jul 2020
19	3,000	59,000	Dec 2020
20	3,000	62,000	Apr 2021
21	3,000	65,000	Sep 2021
22	3,000	68,000	Feb 2022
23	3,000	71,000	Jul 2022
24	3,000	74,000	Dec 2022
25	3,000	77,000	Apr 2023
26	3,000	80,000	Jan 2024
27	3,000	83,000	Jun 2024

Vault	Feed Stream to SPF		Need Date
	By vault (kgal)	Cumulative (kgal)	
28	3,000	86,000	Nov 2024
29	3,000	89,000	Apr 2025
30	3,000	92,000	Sep 2025
31	3,000	95,000	Jan 2026
32	3,000	98,000	Jun 2026
33	3,000	101,000	Nov 2026
34	3,000	104,000	Apr 2027
35	3,000	107,000	Mar 2028
36	3,000	110,000	Jan 2029

[a] After Vault #4, each vault will consist of two cells

5.4.2 Modifications to Prepare Vaults for Waste Containing Isopar®

The DSS resulting from treatment by MCU and SWPF will contain Isopar® requiring temperature control to mitigate the hazard of organic emissions while pouring grout in Vault 4. Vault 4 temperature control modifications allow introduction of grout containing trace amounts of Isopar®. This *Plan* assumes SPF can receive Isopar® containing waste at 60 kgal/week as long as the mixed salt solution is less than 0.1 Ci/gal Cs-137. This rate is based on being able to process into two cells with no clean cap installed and processing at a rate of 30 kgal/week per cell.

DSS resulting from the SWPF treatment process will also contain trace amounts of Isopar® similar to the MCU process. Therefore, future cells will also require a method to ensure this waste can be safely dispositioned. This *Plan* also assumes that when SWPF begins operation, SDF can leave enough cells uncapped to process SWPF DSS at system rates. (The SWPF DSS is low enough in Cs-137 concentrations that a large number of cells can be left uncapped without exceeding exposure limits from skyshine.)

5.5 *Disposition of Sludge Waste*

For sludge processing, this *Plan* intends to maintain adequate sludge feed availability for continued DWPF operations. 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.

Producing canisters at the nominal rate (i.e., 186 discrete canisters/yr at 34 wt%–38 wt%) requires that sludge feed batches are washed in time for each new batch to be ready when sludge in the previous batch has been made into glass. This washing schedule requires maintaining enough tank space to support continued evaporator operations to receive and evaporate decants from sludge washing in a timely manner. This objective ensures that canister production is not interrupted. This *Plan* assumes implementation of alternative technology initiatives to increase the nominal rate to 200 discrete canisters/yr at 50 wt%.

Sludge processing is constrained 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 constraints 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 Washing and DWPF Sludge Batch Processing Inputs and Assumptions in Support of Life Cycle Plan-2007*[17].

5.5.1 Sludge Mass Forecast

The Waste Characterization System (WCS) was developed to support criticality control in the waste tanks by estimating the composition and mass of liquid waste, focusing on radioactive materials and non-radioactive materials affecting criticality control. While providing a conservative estimate of mass of materials required for safe storage, it does not accurately assess the mass of materials that have no impact on criticality control. This caused a discrepancy between the WCS prediction of sludge mass and the sludge mass experienced in the first several sludge batches vitrified at DWPF.

Previous versions of the *HLW System Plan* (e.g., revisions 9 through 13) used the WCS to forecast that approximately 6,000 canisters would be produced over the life of the LW System. However, it was recognized that the predicted weight percent solids in settled sludge in the waste tanks was subject to revision (*HLW System Plan*, Rev 13[7], Section 4.5 — Key HLW Processing Parameter Uncertainties). Revision 13 of the *HLW System Plan* notes that better characterization of the weight percent of solids in the waste would be developed using analyses of tank waste samples and the empirical processing data from Sludge Batches 1A, 1B, and 2. The PMP–Rev 13 relies on the *HLW System Plan, Rev 13* sludge mass forecast but recognizes undefined technology improvements in DWPF. It was assumed that these improvements would yield higher sludge oxide loading (SOL) reducing the forecast to 5,100 canisters.

The initial *Sludge Batch Plan[18]* (SBP-R0) issued in 2005 provides the recommended sludge batch sequence, timing, and estimate of canisters to be produced. SBP-R0 includes preliminary results from the sludge batch characterization studies specifically relating to Tanks 4 and 11. It estimates 5,900 total canisters with new canisters having an SOL of 38% and a production rate of 250 canisters/yr through 2008, and 230 canisters/yr thereafter. The 2006 PEP incorporates this increase in the forecasted number of glass canisters.

Several studies were conducted to better predict the quantity of sludge in the Tank Farms based on tank waste samples and empirical processing data from sludge batches vitrified to date. The first study, *SRS DWPF Sludge Feed Mass – Predicted vs. Measured*[19], quantified the magnitude of the disparity between WCS predictions and measured sludge mass for Sludge Batches 1A through 4. A second evaluation, *Estimating the Sludge Mass Remaining in SRS Waste Tanks after the Processing of Sludge Batch 4*[20], performed a statistical analysis of the correlation between the WCS forecast and empirical experience for the first five sludge batches. A third study, *SRS Characterization Model Using Dial-Up Factors*[21], analyzed sludge type, canyon processes, year of operation, existing sludge sample data, and the observed sludge batch masses. It recommended a series of “dial-up” factors be applied to the WCS predictions for future planning of the mass and composition of sludge.

The first revision of the *Sludge Batch Plan[22]* (SBP-R1), issued in July 2006, incorporates the recommendations of these studies. SBP-R1 evaluates two cases: the baseline case, which forecasts vitrification of 7,900 canisters ending in 2035, and an aluminum dissolution case, which forecasts vitrification of 6,900 canisters ending in 2028. The plan includes the assumption of a constant 38 wt% SOL and 250 canisters/yr for DWPF processing of high iron sludge batches and 34% SOL and 186 canisters/yr for high-aluminum sludge batches. Tank sequencing was arranged to ensure currently-approved FFA commitment dates were met and sludge batches were blended to limit the aluminum/iron (Al/Fe) ratio to acceptable DWPF limits.

The second revision of the *Sludge Batch Plan*[23] (SBP-R2) provides updated forecasts with enhanced aluminum dissolution assumptions and assumed additional DWPF melter technology improvements to further improve SOL. In addition, plutonium vitrification is proposed to begin operation in FY13, resulting in approximately 100 additional canisters from the displacement of LW by the Pu material. The results of SBP-R2 as presented in this *Plan* reduce the canisters count to ~6,300 (including the additional canisters from the proposed PUV campaign) from ~7,900 with canister production complete in 2028.

A third revision of the *Sludge Batch Plan*[24] (SBP-R3) will provide updated forecasts with Low Temperature aluminum dissolution (LT Al Diss) to be performed for Sludge Batch #5, enhanced aluminum dissolution to be implemented for Sludge Batch #8 onwards, and assumed additional melter technology improvements to further increase SOL. The results of SBP-R3 will have the same range of canister count as SBP-R2. SBP-R3 estimates canister production completion by 2030.

Table 5-2 — Sludge Mass Comparison provides a comparison summary of sludge mass comparison for PMP–Rev 13 through this *Plan*.

Table 5-2 — Sludge Mass Comparison

	PMP Supplement to HLW Sys Plan–Rev 13	**2006 PEP, (SBP-R0 – 2005)**	**SBP-R1 (2006)**	**this *Plan* (SBP-R3 – 2007)**
Projected Canister Count	5,100	5,900	7,900 (6,900 – 8,900)[a]	6,300 (6,100 – 7,900)[b]
Projected Program End Date	FY19	FY24	FY35	FY30 (includes heel processing)
Notes:	● Makes several updates in sludge batch sequencing with respect to the assumptions in Revision 13 of the HLW System Plan. The objective was to accelerate sludge processing by increasing waste loading. ● Sludge from the high-risk F-tank farm tanks is also moved up to accelerate closure of F area tanks.	● Incorporates most recent data on sludge batches processed since PMP–Rev 13. In addition, also incorporates information from sludge batch preparation activities for the following tanks: – Tank 11 sample analysis showed higher sludge mass. – Tank 4 sludge sounding resulted in higher sludge mass.	● Incorporates results of detailed evaluation by a Sludge Mass Task Team resulting in a higher sludge mass projection for remainder of sludge mass to be processed through the end of the program. ● Incorporates processing rate impacts from projected higher Al in the sludge into sludge batch planning. Sludge mass reduction initiatives evaluated but not assumed.	● Incorporated flowsheet for aluminum dissolution process to be carried out in Tank 42 in H-area. This includes detailed modeling of the waste removal, blending, aluminum treatment and washing that would be required. ● Assumed sludge process and technology enhancements to significantly increase the amount of waste in a glass canister and the number of canisters that could be produced per year. [c] ● Incorporated Low Temperature Aluminum Dissolution (LT Al Diss) process to be executed for Sludge Batch #5

[a] Sludge Batch Plan, R-1, incorporates sludge mass estimate recommendations and performs the modeling. This plan's baseline case forecasts vitrification of ~7,900 canisters ending in 2035 without aluminum dissolution. This plan outlines a range of canisters from ~6,900 canisters (assuming successful implementation of aluminum dissolution) to ~8,900 canisters (assuming a lower SOL than the baseline case).

[b] Sludge Batch Plan, R-2, provides updated forecasts based on updated sludge mass estimates with enhanced aluminum dissolution assumptions and additional technical enhancements to further improve SOL. The modeling for this plan assumes ~6,300 canisters including proposed PUV canisters. This plan outlines a range of canisters from ~6,100 canisters (based on the statistical analysis, *Estimating the Sludge Mass Remaining in SRS Waste Tanks after Processing of Sludge Batch 4*[20]) to ~7,900 canisters (based on the baseline case with no implementation of sludge mass reduction initiatives and no technology improvements).

[c] Though the production rate could be increased to 250 canisters/yr through the implementation of melter technology enhancements, this *Plan* assumes a top rate of 200 canisters/yr in order to balance sludge and salt processing. Therefore, if improvements could be made to salt processing throughput, the sludge processing rate could be increased to match it up to the 250 canister/yr rate.

5.5.2 Balancing Salt and Sludge Vitrification

Alternative technologies and sludge mass reduction initiatives are anticipated to reduce the total number of canisters produced at DWPF. Reduction of total canisters produced is a high priority due to the life-cycle cost of canister production, on-site storage, and shipping and emplacement in a federal repository. However, the DWPF canister production rate must be controlled to ensure salt and sludge processing operations finish at the same time, eliminating the need for production of salt-only canisters. The increase in the amount of salt processed results in the possibility of salt-only canister production. However, expeditious incorporation of alternative DWPF technology and sludge mass reduction initiatives enable greater flexibility. The production of salt-only canisters is undesirable due to uncertainties associated with qualifying salt-only canisters for a Federal Repository. In addition, Tank Farm space is not available until ~FY20 to support higher canister production rates.

Though implementation of the alternative DWPF technologies is currently assumed to result in an eleven-month DWPF (and associated SWPF) outage, the resulting projected 3.5 year program life-cycle reduction (~700 DWPF canisters) more than offsets the outage impact.

5.6 *Continuing Tank Farm Operations*

5.6.1 Supporting Nuclear Material Stabilization

This *Plan* supports nuclear material stabilization in H-Canyon through at least 2019 (with shutdown flows through 2022). Earlier plans assumed nuclear material stabilization would be completed in 2013 or earlier with only minimal shutdown flows received after that.

Tank 39 will continue to be dedicated for canyon receipt at least through 2022 to support shutdown flows from H-Canyon. This is one of the reasons the 2F Evaporator System will continue to operate (see Section 5.6.5 — *Tank 25 Availability*) and salt must be successfully removed from Tank 37 to allow continued 3H Evaporator operation. Thus, this *Plan* relies heavily on aging 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 closures, and impact H-Canyon operation. To mitigate this risk, H-Canyon has initiated or proposed the following waste minimization initiatives:

- Sequence H-Canyon Area planned materials to minimize near-term impacts to Tank Farm HLW inventory capacities. This dictates that Special Nuclear Material (unirradiated, low level waste) processing has priority over Spent Nuclear Fuel material (irradiated, high level waste) processing.
- Develop near-term waste minimization alternatives to reduce the volume of waste generated, including the amounts of salts and moles of acid requiring disposition.
- Eliminate High Level Waste transfers to H-Tank Farm by developing alternative disposition paths (i.e. directly to DWPF sludge batch prep and/or feed tanks).
- Eliminate Low Level Waste transfers by developing potential alternative strategies for disposition directly to off-site, out-of-state vendors.

Due to salt build-up in the evaporator systems, space must be optimized for H-Canyon receipts until after salt has been removed from Tank 25 and the 2F Evaporator System has been restarted (see Section 5.6.5 *Tank 25 Availability*). Therefore, receipt capacity exists to support 440 kgal of H-Canyon receipts between March 2007 and September 2009. For planning purposes, this *Plan* assumes that waste volumes do not exceed 300 kgal per year after September 2009. The source of the H-Canyon receipts is based on the *H-Area Liquid Waste Forecast Through 2019*[25] adjusted to meet the 300 kgal per year volume. Note that even if no Canyon waste was being received into the Tank Farm, the ability to meet other programmatic objectives requires optimization of tank space in the evaporator systems.

5.6.2 2H Evaporator System

Reliable operation of the 2H Evaporator System is needed to ensure that DWPF recycle, the largest stream received by the Tank Farm, can be managed. An extended 2H evaporator outage, such as occurred in 2000 because of sodium aluminosilicate formation, could cause a shutdown of the DWPF. In FY06, a planned outage to remove sodium aluminosilicate deposits using nitric acid lasted approximately three months. This outage temporarily reduced the available space for receiving DWPF recycle. At the end of the outage, there was only enough space to provide for another two weeks of DWPF operation. Work is ongoing to minimize the extent of these outages.

The DWPF recycle rate is between 1.5 and 1.9 Mgal/yr during sludge-only operations (the rate depends on canister production rate and Steam Atomized Scrubbers [SAS] operation). The rate is expected to increase to as high as 2.6 Mgal/yr after the startup of SWPF because of extra water in the strip effluent stream and monosodium titanate (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.

DWPF recycle that is not used for salt solution molarity adjustment needs to be evaporated and can be evaporated only in the 2H Evaporator System due to chemical incompatibility with other waste streams. Experience has shown that silica in the DWPF recycle combines with aluminum compounds in other wastes to form sodium aluminosilicate deposits that plug lines and concentrate uranium, preventing operation of the evaporator and creating a potential criticality hazard. To eliminate the criticality hazard, uranium enrichment in the 2H Evaporator System is limited to levels that prevent a criticality even if significant sodium aluminosilicate deposits form, unlike the other two evaporator systems, which are controlled to limit the possibility of deposits. In addition, to prevent plugging and extended outages, aluminum-bearing wastes (most other Tank Farm wastes) are excluded from the 2H Evaporator System. The only other major waste that might be sent to the 2H Evaporator System is the product associated with the disposition of the organics found in Tank 48. It is assumed that this stream can be handled by the 2H Evaporator System.

The possibility of evaporating the DWPF recycle in the 3H Evaporator System has been considered. However, the uranium in this system is enriched, and the enrichment would need to be reduced so that the DWPF recycle could be introduced without the risk of a criticality. Lowering the enrichment in the system would be challenging because the sludge and salt in the system contain enriched uranium. Thus, any plan for transitioning the 3H Evaporator System to evaporating the DWPF recycle would need to address these issues.

5.6.3 DWPF Recycle Handling

As described in Section 5.6.2 — *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 use of the low sodium molarity (less than 1.0 molar sodium) recycle stream for 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 the FY17 timeframe. Starting in FY18 the DWPF, recycle stream to the Tank Farm must be significantly reduced or eliminated to allow the timely closure of Tanks 21–24 (non-compliant Type IV tanks) to support meeting currently-approved FFA commitments. Note that DWPF recycle is currently received into Tanks 21/22 for staging prior to transfer to the 2H Evaporator System or to a salt solution preparation blend tank.

Based upon processing assumptions, modeling reflects that an average of 1.5 Mgal/yr of DWPF recycle will be sent to the 2H Evaporator System between FY08 and FY17. The 2H Evaporator is assumed to operate at a 50% utility during this period. For comparison purposes, the average space gain for the 2H Evaporator System over the last six fiscal years (FY02–FY07) has been 1.6 Mgal/yr at an average utility of 56%. A significant quantity of DWPF recycle is also planned to be used for salt solution molarity adjustment. Modeling shows that the DWPF recycle stream is adequately handled by the combination of evaporation in the 2H Evaporator and utilization as salt solution molarity adjustment material.

Based on the projected processing strategy for handling DWPF recycle in this *Plan* and given the large amount of project activity planned through FY12 in support of the initiation of salt processing at full capacity, this *Plan* assumes that an alternative DWPF recycle handling strategy is implemented in the FY18 timeframe. Post-FY18, this *Plan* assumes that DWPF recycle will not be received into the Tank Farm. Although the elimination of the DWPF recycle stream to the Tank Farm would be beneficial in reducing the risk of operating the Liquid Waste System, in the near term greater risk reduction is gained by concentrating efforts on start up of SWPF at high capacity and projects to make Type III Tanks 48 and 50 available for higher-activity waste service.

Numerous factors may influence the preferred timing of an alternative DWPF recycle handling initiative. For example, 2H Evaporator performance following the recent acid cleaning campaign (June 2007) should be monitored closely to see if forecasted space recovery is achieved. Any delays or reductions in pre-SWPF salt processing would impact the volume of DWPF recycle handled through use for sodium molarity adjustment. Emergent tank or transfer line integrity issues may impact the planned receipt, storage and disposition of the DWPF recycle stream. For these reasons, process development work should continue on contingency DWPF recycle handling initiatives such as the potential use of an additive to inhibit sodium aluminosilicate formation and potential treatment by an offsite, out-of-state facility, subject to compliance with applicable regulatory and other legal requirements. The need and timing for additional recycle waste handling capability will be periodically re-evaluated with each future revision of the DPP and this *Plan*.

5.6.4 Managing Type III Tank Space

A critical shortage of waste storage space exists in Type III/IIIA compliant tanks in both F- and H-Tank Farms. There is a risk that a leak in a primary tank or other adverse event could occur that would prevent execution of this *Plan.*

Type III tank space is essential to all the processes described herein: evaporation, DWPF sludge batch preparation, all of the salt processes, tank closures, etc.

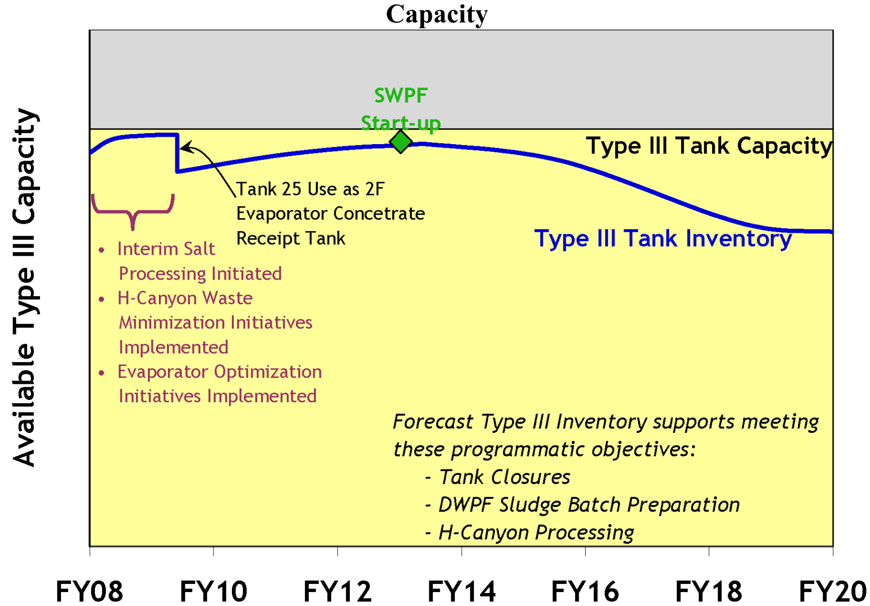
The lack of space is especially critical in the 2F and 3H Evaporator Systems. Space is needed for evaporator concentrate receipt, to support periodic salt dissolutions, and storage of high-hydroxide waste that does not precipitate into salt. This "boiled-down" liquid is commonly referred to as liquor, and removing the liquor from an evaporator system is referred to as deliquoring. Evaporator operations are severely impacted when the concentrate receipt tank has a salt level greater than 300". The evaporator can no longer be effectively operated when the concentrate receipt tank level is 330" or greater — at this point, the evaporator system is "salt bound." The only long-term viable concentrate receipt tank for the 3H System is Tank 37. In October 2005, about 175 kgal of saltcake (about 50") was removed from Tank 37. During this salt removal campaign, the average salt level in Tank 37 dropped from about 337" to about 282". Subsequent processing since that time has already resulted in a current Tank 37 salt level of 314". The 2F concentrate receipt tank, Tank 27, contains ~330" of saltcake, which is already limiting the 2F Evaporator system operations. Since the transfer of H-Canyon waste to the 2F Evaporator, and upon completion of transfers of supernate from Tank 7 to support Tank 5 and Tank 6 heel removal, it is estimated that the salt level in Tank 27 will severely impact sustainable operations. Based on the experience gained in operating the 3H Evaporator system under similar salt bound conditions, WSRC has determined that former 2F concentrate receipt tanks, Tanks 44 and 47, can be utilized similar to Tank 37 to gain Type III tank space prior to the salt removal campaign in Tank 25 for its return to 2F Evaporator concentrate receipt service.

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. In doing so, a great deal of risk exists pertaining to availability of Type III tank space, specifically tied to the start-up of the SWPF. Under current planning, additional salt space is created in the 3H Evaporator System through the processing of salt at the SWPF. This salt space is necessary to support washing of Sludge Batch 8 utilizing the 3H Evaporator (see *Appendix H — Evaporator System Levels (through FY14)*). 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 (see *Appendix H — Evaporator System Levels (through FY14)*, and space could not be reclaimed until start-up of SWPF. Thus, it would be exceptionally difficult to accelerate any tank closures, support an accelerated canister production rate at the DWPF, or support continued operations of H-Canyon.

5.6.5 <u>Tank 25 Availability</u>

The use of Tank 25, a compliant Type III tank, as the 2F Evaporator concentrate receipt tank is necessary to successfully meet the processing objectives associated with DWPF feed batch preparation, tank closure, and H-Canyon operations (see *Figure 5–1 — Forecast Type III Tank Inventory vs. Available Type III Capacity*[vi]). With delays in the availability of Tank 25 associated with the November 2007 start of salt processing, additional 2F Evaporator concentrate receipt tanks (Tanks 44 and 47) must be used to support closure of two old-style tanks to meet the FY10 currently-approved FFA commitments. This is due to the inability to evaporate wash water added to the Tank Farms during heel removal operations prior to closing tanks to support the currently-approved FFA closure schedule. Tanks 44 and 47 were previously used as 2F Evaporator

Figure 5–1 — Forecast Type III Tank Inventory vs. Available Type III Capacity



[vi] Although a series of salt waste transfers is made over a nine-month period, credit for Tank 25 availability to support evaporator operation is not assumed until the last transfer is completed in February 2009.

concentrate receipt tanks and were considered to be "salt bound" (salt level greater than 300") as described in Section 5.6.4 — *Managing Type III Tank Space*. However, due to operational experience gained in running both the 3H and 2F evaporator systems under similar conditions, this *Plan* assumes that limited campaigns can be processed by the 2F Evaporator using Tanks 47 and 44 at higher salt levels under certain feed conditions. Operating the evaporators under salt bound conditions (along with waste minimization efforts described in Section 5.6.1 — *Supporting Nuclear Material Stabilization*) is not optimal, but it does allow the Type III tank space inventory to be available to execute this plan until the startup of SWPF.

5.6.6 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. The Tank Farm transfer line infrastructure is aging and subject to leaks, failures of equipment and instrumentation, pluggage, and other problems. Because of the greatly increased pace of transfers after the startup of SWPF, short downtimes due to unexpected conditions will be more difficult to accommodate without impact because the idle time of transfer lines will be reduced.

In addition, this *Plan* requires transfers that cannot be made with the current infrastructure, e.g., transfers to support SWPF. New infrastructure must be constructed to accomplish these new activities while also continuing activities that have been historically performed, such as waste removal and evaporation. Discoveries of unexpected conditions in existing transfer systems, such as leaks, 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 Waste Transfer Line (WTL) Project 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, such as leaks, do not occur or can be mitigated quickly enough to allow activities to proceed as planned. This *Plan* does not attempt to explain all the modifications needed or the specific risks of failure of certain pieces of transfer equipment.

5.7 *Tank Closure*

The currently-approved FFA establishes the regulatory framework for the operation, new construction, and eventual closure of the LW tank systems. The sequence and schedule for planned heel removal and tank closures in this *Plan* support closure of the total number of non-compliant tanks by the 2022 currently-approved FFA commitments. However, some individual tank currently-approved FFA commitments are missed by as much as 31 months. Sludge batch processing and salt waste processing support tank closures within tank farm space constraints and processing facility availability as identified in this *Plan*.

This *Plan* assumes the tank closure process is completed expeditiously and includes:

- Contractor completion of the initial tank-specific activities
- Characterization of residual source terms
- SCDHEC approved closure plans
- The grout contract placed, at risk, before SCDHEC approves closure of the tank
- Actual grouting of the tank.

Note: Operational closure of Tanks 18, 19, 5 and 6 could be delayed. A new technology to enhance the tank cleaning effectiveness and a new F Area Performance Assessment contribute to this delay.

While meeting this schedule is very challenging, especially when a number of tanks are being closed simultaneously, it will minimize impacts to the currently-approved FFA commitment dates. Furthermore, it is anticipated that DOE will continue to pursue the early exchange of technical information between DOE, NRC, SCDHEC, and EPA to support DOE's performance assessments for F- and H-Areas. However, given the complexity and amount of information required for the closure documents, the number of agencies involved and the detailed reviews required, and the first-time nature of implementing the multiple regulatory requirements for a SRS tank farm, there is risk that the closure process could be extended. Waste removal was performed on Tanks 18 and 19 and they were considered ready to close. However, new technologies using mid-to-high-pressure eductor devices mounted on modified crawler system platforms are currently being demonstrated, evaluated, and tested. LWO is actively investigating deployment of this new technology, which may allow removal of waste from Tanks 18 and 19 to a greater extent than the technologies available when waste removal was stopped due to diminishing returns in 2003 and 2001, respectively. Closure of these tanks will have to be integrated with other planned activities.

This *Plan* assumes that salt waste disposal does not resume until November 2007 and assumes that SWPF startup is delayed until September 2012. These assumptions result in some delayed tank closures because storage space is not available to support tank cleaning in time to meet some currently-approved FFA dates, in particular, tanks required for FY13 –FY15 currently-approved FFA commitments. While some tank-specific currently-approved FFA closure commitments are not met due to the delay in salt waste disposal, all old-style tanks are closed by the currently-approved FFA commitment of 2022.

The major activities required for closure of each waste tank include
- the waste removal phase
- the heel removal phase
- those tanks that are used in waste processing (e.g., SWPF or DWPF feed tank)
- those tanks that are used as evaporator support tanks
- those tanks that are used to support waste removal from other tanks
- characterization of residual source terms
- SCDHEC approved closure plans
- grouting

5.7.1 Requirements for Closure of LW Tanks

Non-compliant tanks are planned for closure in accordance with a formal agreement among the DOE, Region IV of the EPA, and SCDHEC as expressed in the SRS currently-approved FFA.

SRS tanks that do not meet secondary containment standards, as established in the currently-approved FFA, must be removed from service per the currently-approved FFA schedule shown in *Appendix E — Currently-Approved FFA Waste Removal Plan & Schedule.* Twenty-four tanks at SRS do not meet secondary containment standards and are scheduled for closure by 2022. Two FTF tanks, Tank 17 and Tank 20 were closed in 1997. The closure of Tanks 18 and 19 is currently in dispute resolution per Section XXXI of the currently-approved FFA. Therefore, the closure dates for both Tanks 18 and 19 will be determined as a part of the dispute resolution process in accordance with the requirements of the currently-approved FFA.

In order to proceed with closing LW tanks, the Secretary of Energy, in consultation with the Nuclear Regulatory Commission, must first determine that the residual waste in the tanks to be closed meets the provisions of §3116(a) of the NDAA and is not high-level waste.

The NDAA §3116 specifies that certain radioactive waste is not high level waste if the Secretary of Energy determines, in consultation with the NRC, that the waste meets the following criteria:
- the waste must not require disposal in a deep geologic repository
- the waste must have had highly radioactive radionuclides removed to the maximum extent practical (MEP)
- the waste meets Class C concentration limits as defined in 10 CFR 61.55 or if the waste exceeds those concentration limits, the waste will be disposed of pursuant to plans developed in consultation with NRC
- the waste must meet the performance objectives of 10 CFR 61 Subpart C
- the waste must be disposed of pursuant to a State-approved closure plan or State-issued permit.

DOE will pursue completion of a single Secretarial WD for each Tank Farm. In addition to the criteria described above for the §3116, SCDHEC requirements for operational closure will be defined in the overall plans for closing FTF and HTF, referred to as the Tank Farm Closure Plans. Typically, the limiting requirement from each Tank Farm Closure Plan is that the estimated impact to the environment from closure of a Tank Farm will not result in exceeding the groundwater concentrations defined in the Safe Drinking Water Act at the point of compliance.

5.8 *Glass Waste Canister Storage and Shipping*

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.

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 August 14, 2007, all 2,251 remaining standard positions are in use storing radioactive canisters. 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 August 14, 2007, GWSB #2 stored 90 canisters. The total storage capacity of GWSB #1 and #2 for standard radioactive storage is 4,590.

This *Plan* assumes construction of a canister shipping facility to support the initiation of canister shipping in FY17 to a Federal Repository at a rate ramping up to 500 canisters/year. To provide sufficient canister storage space prior to canister shipment to the planned Federal Repository, this *Plan* assumes the construction of a third GWSB to be available in FY20 (see *Appendix D — Canister Storage*).

5.9 *Closure Sequence for the Liquid Waste System*

Previous plans focused on the implementation of salt processing and did not address the details of the shutdown and subsequent closure of Liquid Waste facilities outside the Tank Farms. This *Plan* reflects the development of a concept for a sequence of events to facilitate an orderly and reasonable shutdown and closure of the various facilities used to treat and disposition the waste. The previous section described activities required for closure of tanks and associated equipment in the Tank Farms. The Liquid Waste facilities outside the Tank Farm — DWPF, SWPF, ARP/MCU, ETP, SPF, SDF, and associated ancillary equipment — will also require closure. 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.

To the extent practical, closure of tanks and facilities occurs in groups to minimize operating and closure costs for each group. The priority for shutdowns as modeled is:

1. Old-style Tanks
2. F-Area waste tanks, the 2F Evaporator and ancillary equipment
3. H-Area West Hill waste tanks, the 3H Evaporator and ancillary equipment
4. H-Area East Hill waste tanks, the 2H Evaporator and ancillary equipment
5. Major remaining processing facilities (e.g., DWPF, SWPF, ETP, etc.).

Even with the emphasis on closing FTF earlier, space and processing constraints do not support FTF waste removal and tank cleaning completion until FY26 with subsequent closure in FY28. Because of the assumed 12-month delay in the start-up of SWPF, as well as the increase in estimated sludge mass, space is not available within H-Area to store all the waste from F-Area to support final FTF closure earlier than FY28.

It is preferable to close each facility as soon as possible to reduce the cost of operating the system. However, closing facilities will sometimes require operating them in a manner that is outside the current flowsheet. For example, in the FY25–26 period, DWPF processes strip effluent and actinide streams from SWPF. The SWPF, in turn, processes a recycle stream from DWPF. Shut down of both of these facilities will require the development of alternate processing for one or more of these streams.

The assumed steps for shutting down and closing the LW System are detailed in *Table 5-3 — Closure Activities*, which summarizes the key elements of the systematic closure sequence.

Table 5-3 — Closure Activities

FY17–22	- Due to limited remaining Tank Farm space (due to closing Type IV tanks, in particular Tanks 21 and 22, to meet currently-approved FFA commitments), the volume of waste returned in the DWPF recycle stream is curtailed. (FY18) - Waste removal is complete from all old-style (Type I, II, and IV) tanks. (FY20) - H-Canyon influents (shutdown flows) cease (FY22) - All old-style tanks are closed in compliance with the currently-approved FFA closure commitments. (FY22)
FY23–26	- F-Area waste removal is completed and the FTF (including the 2F Evaporator that had previously shutdown in FY14) begins its shutdown and subsequent closure activities, including final F-Area Tanks. (FY26) - Maintenance Facility (299-H) receipts are redirected to SWPF to support closure of Tank 39. (FY26)
FY27–29	- H-Area West Hill waste removal is complete and the H-Area West Hill (including the 3H Evaporator that had previously shutdown in FY20) begins its shutdown and subsequent closure activities. (FY28) - DWPF Feed Tank (Tank 40) processes sludge to DWPF down to a 40" heel. (FY28) - Grouting is complete on final FTF tank (FY28) - H-Area East Hill waste removal is complete on all tanks except the SWPF Feed Tank (Tank 49), two salt solution feed preparation Tanks (Tanks 41 and 48), and the DWPF Feed Tank (Tank 40). (FY29)
FY30	- Grouting is complete on the final H-Area West Hill Tank (FY30) - The SWPF salt solution feed preparation tanks (Tanks 41 and 48) heel removal is complete. (FY30) - The DWPF feed tank (Tank 40) heel is flushed and the stream (including the un-neutralized, un-evaporated oxalic acid heel removal solution) is sent to DWPF. (FY30) - The SWPF feed tank (Tank 49) is flushed and its contents (including any solution necessary to remove its heel) are transferred to SWPF. (FY30) - The DWPF feed tank (Tank 40) waste removal is complete. (FY30) - The SWPF feed tank (Tank 49) waste removal is complete. (FY30) - ETP and Maintenance Facility (299-H) receipts cease & shutdown and subsequent closure activities begin. (FY30) - Final canister is shipped to Federal Repository. (FY30)
FY31–32	- DWPF and SWPF are cleaned by flushing with water and chemicals for one year. (FY31) - Grouting is complete on the final H-Area East Hill tank (FY32) - Canister shipping facility is decommissioned and closed. (FY32)

With the initiation of shipping to the Federal Repository in FY17 and the rate of shipping canisters from SRS to the Federal Repository, 14 years will be needed to ship the ~6,300 canisters from SRS (see *Appendix D — Canister Storage*). Thus, the last canister from SRS is shipped in FY30. The canister shipping facility is the last LW System facility operating at SRS. It should be fully decommissioned and closed by FY32.

6. Process Simulation Tools

Although this *Plan* is a qualitative assessment based on previous modeling activities, it assumes that the tools used for LW process simulations yield reasonable estimates of parameters of interest. This *Plan* is intended for long-term planning and does not contain sufficient detail to guide operation of individual process steps. This *Plan* uses simplifying assumptions for each process of the LW System. Any dates, volumes, and chemical or radiological composition information contained in this *Plan* are planning approximations only. To guide actual execution of individual processing steps in the future, flowsheets will be developed that contain rates, compositions, and schedules, sometimes including possible ranges of each of these parameters.

The suite of software that performs the process simulation includes

- Waste Characterization System (WCS) – a series of spreadsheets that estimate the composition and inventory of a large number of radionuclides and chemicals in the liquid waste tanks.
- Sludge Washing Spreadsheet – a spreadsheet that simulates washes of each sludge batch using sequential material balances.
- GlassMaker – a Visual Basic program that calculates the composition of each sludge batch and determines if the batch meets DWPF quality parameters for acceptability.
- SpaceMan Plus™ – a Visual Basic program that simulates operation of all the processes in the entire LW System. The program accepts inputs from the three programs mentioned above and estimates volumes and compositions in each tank and each process as waste is processed through the system.
- COREsim® – uses discrete-event simulation logic to construct a model and simulate the process. The software analyzes and monitors resource availability to identify process bottlenecks, resource needs, and queuing effects on system performance. COREsim® modeling has been used in selected areas of the LW systems.

7. Opportunities

There are a number of opportunities for potentially improving the schedule or recovering from emergent schedule problems.

7.1 *Increase Maximum Annual SWPF Processing Rate*

The capacity to prepare salt solution for feed to SWPF will be greatly increased by freeing up additional feed preparation tanks (i.e., Tank 50 and Tank 48). Currently, Tank 50 will be returned to service to support SWPF batch preparation in May 2012 (see Section 5.3— *Tank 50 Restoration to Service*). Successful implementation of modifications to decouple DSS from SPF is required to return Tank 50 to service. In addition, Tank 48 is anticipated to be available September 2012 (see Section 5.2— *Tank 48 Restoration to Service*). This requires successful disposition of organics through a selected alternative treatment technology. Because of the availability of these two tanks to support SWPF batch preparation, SWPF is projected to operate at maximum capacity during its first year of operation (maximum capacity during the first year of operation is assumed to be 3.75 Mgal) with an impact being realized only due to a DWPF outage associated with the proposed PUV transition. In addition, feed will be available to support operation of SWPF at maximum capacity in FY14 and beyond (nominal capacity is assumed to be 6.0 Mgal/yr; actual anticipated throughput varies with respect to DWPF melter outages with an average of 5.5 Mgal/yr).

Due to lack of lag storage between SWPF and DWPF for Strip Effluent and MST slurry, SWPF will have an outage whenever DWPF has an outage of more than a few days. This coupling of the two facilities will limit the SWPF processing rate. Planned outages at DWPF are currently projected to inhibit the processing rate at SWPF. This includes a four-month outage approximately every four years for replacement of the DWPF melter, a two-month outage from December 2012 through January 2013 to support the proposed PUV, and an eleven-month outage, from June 2014 to April 2015, to implement alternative melter technologies.

7.2 *Increase DWPF Rate*

For all of the sludge batches that have been prepared for DWPF, sample results of the slurried batches have shown more sludge than predicted by WCS. Future batch quantities have been adjusted to reflect this expected increase. Additionally, the DWPF processing rate for sludge batches that contain significant quantities of aluminum is much slower than for those batches that contain significant quantities of iron. Research to increase the canister production rate with high aluminum wastes could potentially reduce the life-cycle cost of the DWPF, especially if combined with reduction of the aluminum by aluminum dissolution.

7.3 *Recovery of Unirradiated Uranium Material and other Special Materials in H-Canyon*

Waste from H-Canyon processing that can be considered LLW, e.g., unirradiated uranium material (UUM) and pulse reactor material, is disposed of at SDF, consistent with applicable permits. Disposing of the waste at SDF greatly reduces the impact this waste has on LW tank space and prevents this waste from generating DWPF canisters. All future campaigns in H-Canyon are evaluated against the requirements for direct processing to SDF, consistent with applicable permits. Additionally, some waste from special campaigns involving HB-Line and H-Canyon could possibly be added directly to a sludge batch. This direct discard also reduces the impact on LW tank space.

7.4 *Improve Waste Removal and Tank Cleaning Techniques*

Modifications of waste removal and tank cleaning techniques could improve the schedules for this *Plan* or perhaps decrease the cost. Waste removal as currently planned is expensive, takes years, and requires large quantities of water and oxalic acid that must be processed elsewhere in the LW System. In fact, waste removal is one of the drivers for the need to make Tanks 48 and 50 available for other uses and for operation of the 2F and 3H Evaporator Systems.

Improvements that would be beneficial to this *Plan* are techniques that would

- Reduce the amount of water needed
- Reduce the amount of oxalic acid needed
- Speed up the waste removal process
- Reduce the cost of waste removal equipment or operation.

7.5 ***LLW Offsite Treatment***

LWO is currently evaluating the feasibility, subject to compliance with applicable regulatory and other legal requirements, of the potential option of shipping LLW from Tank 23 to an off-site, out-of-state vendor for disposition[vii]. Initial testing confirms that the LLW in Tank 23 is compatible with processes at commercial treatment vendors. Successful implementation of this alternative LLW disposition path would free up valuable tank space in H-Tank Farm enabling continued support of tank closures, sludge batch preparation required for DWPF operations, and H-Canyon missions.

[vii] Tank 23 supernatant is one of the waste streams discussed in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* for use as an adjustment solution. Other sources of adjustment solution that have been discussed in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* exist in sufficient quantity to satisfy processing needs should an alternative disposition path for Tank 23 solution be deemed feasible.

8. Description of Assumptions and Bases

Details on the key assumptions and bases for this *Plan* are outlined below.

8.1 *Funding*

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

8.2 *Tank Farm*

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 there are 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 H Modified (HM) processing in the canyon, 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, which include canyon wastes and sludge batch decants. The evaporator system feed and concentrate receipt tanks are defined as
  - 3H: Feed – Tank 32; Receipt – Tank 30 initially, changing to Tank 37
  - 2H: Feed – Tank 43; Receipt – Tank 38
  - 2F: Feed – Tank 26; Receipt – Tank 27 initially, changing to Tanks 44, 47, and 25 over the next few years.
- Feed Rates – The following evaporator utilities and feed rates were assumed based on operation of the evaporators during the indicated periods. During each of these periods, the indicated evaporator ran continuously and steadily at conditions that were judged favorable for good operation. Thus, the weekly rates shown are the theoretical rates at which the evaporators could operate with continuous good operation.

Table 8-1 — Evaporator Utilities

Evaporator	Assumed Utility
2F	50%
2H	50%
3H	50% [a]

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

Table 8-2 — Historical Evaporator Utilities

Evaporator	FY01	FY02	FY03	FY04	FY05	FY06	Average
2F	50%	65%	51%	46%	51%	40%	51%
2H	0%	59%	67%	58%	54%	44%	56% [b]
3H	30%	30%	43%	27%	12%	18%	27%

[b] 2H Evaporator was shutdown during FY01 for chemical cleaning. The average shown does not include FY01.

Table 8-3 — Evaporator Feed Rates

EVAPORATOR FEED RATE

3H Evaporator		
Period Start	Period End	Feed Rate
6/13/2004	6/15/2004	29.8 gal/min
2/9/2005	2/11/2005	29.6 gal/min
10/15/2005	10/22/2005	25.5 gal/min
	Average Feed Rate	28.3 gal/min
	Average Feed Rate (100%)	309,670 gal/ week
2H Evaporator		
Period Start	Period End	Feed Rate
12/16/2004	12/19/2004	18.5 gal/min
2/17/2005	2/23/2005	17.5 gal/min
11/5/2005	11/19/2005	22.6 gal/min
	Average Feed Rate	19.6 gal/min
	Average Feed Rate (100%)	214,070 gal/ week
2F Evaporator		
Period Start	Period End	Feed Rate
10/22/2004	10/25/2004	19.9 gal/min
1/5/2005	1/12/2005	22.3 gal/min
11/2/2005	11/6/2005	24.5 gal/min
	Average Feed Rate	22.2 gal/min
	Average Feed Rate (100%)	243,530 gal/week

- Tank Inventories and Chemistry – Starting inventories and chemistry for all tanks are taken from the WCS as of August 14, 2007. This was used as the starting point for all tank chemistry with the following exceptions:
  - Sludge masses were updated (increased inert material in the sludge) to coincide with those reported in the *Sludge Batch Plan*[23]. This included updates to the sludge masses in Tanks 4-7, 11-15, 21, 22, 26, 32-35, 39, 42, 43, 47, and 51.
  - Tank 5 – Sludge level was updated to coincide with information reported in *Tank 5 Sludge Volume Estimation after the Second Phase of Bulk Sludge Removal*[26].
  - Tank 13 – Sludge level was updated to coincide with *8/14/07 - August 2007 Curie and Volume Inventory Report* [27] (*Monthly Report*).
  - Tank 15 – Sludge and salt levels were updated to coincide with the *Monthly Report*. Assumed no supernate in Tank 15 to coincide with the *Monthly Report*.
  - Tank 26 – Sludge level was updated to coincide with the *Monthly Report*.
  - Tank 27 – Salt level was updated to reflect the salt mound observed during a Tk27-26 recycle on February 10, 2007.
  - Tank 41 – Salt level was updated to coincide with the *Monthly Report*.
  - Tank 43 – Sludge level was updated to coincide with the *Monthly Report*.
  - Tank 50 – Sludge level was adjusted to reflect a sludge sounding completed January 19, 2006 (sludge level of 1.3"; SW11.1-WTE-7.2, Rev. 22 IPC 5[28]).
  - Tank 51 – Sludge level was updated to coincide with the *Monthly Report.*
  - Tank Leak Sites – Per *SRS High Level Waste Tank Leaksite Information*[29].
- General supernate assumptions:
  - Sodium concentration is adjusted to preserve charge balance.
  - Solution density is determined by concentration, using empirical relationships. Volume of blends is determined by using the density relationships and solving for volume. Therefore, volumes are not additive.
  - Supernate is divided and tracked into two separate parts: free liquid and interstitial liquid. Interstitial liquid is further sub-classified into liquid that is interstitial in salt, drained salt, and sludge. The different fractions are tracked discretely until a process requires them to intermix, such as during salt dissolution or sludge slurrying.

- Supernate (or dissolved salt solution) is evaporated by removing water. Mass is conserved in the calculations. If the evaporated liquor exceeds saturation for a given component, it is precipitated and treated as saltcake in the evaporator bottoms receipt tank.
- Suspended solids settle at a rate consistent with the settling model in *Particle Size and Settling Velocity of Tank 41H Insoluble Solids*[30]. Settling rates are a function of liquid level and specific gravity.
- Jet dilution for transfers is 4% by volume unless there is a reason to use a higher jet dilution (e.g., IAL Transfers).
- The transfer jets and pump heights are from SW11.1-WTE-7.2, Rev. 22 IPC 5[28] unless there are known plans to make revisions.

8.3 *Salt Program*

Resumption of Disposition of Salt Solution to SPF: November 2007

- Assume resumption of disposal of DDA processed waste begins in November 2007, upon completion of SPF modifications.

ARP/MCU

- Full operations March 2008
- Assumes successful implementation of strategy to exit Tank 50 Justification for Continued Operation (JCO) which is required before receipt of the MCU DSS stream into Tank 50
- ARP/MCU processing rates
  - For planning purposes, ARP/MCU batches processed at 2 gpm rate for the initial year of operations (facility “shake-in” period)
  - Subsequent ARP/MCU batches processed at 3 gpm rate (consistent with COREsim® modeling results of ~1,400 kgal/year)
    - Note that ARP/MCU generation rate averages ~30 kgal/week with a maximum rate of 60 kgal/wk.
    - ARP/MCU not operated during DWPF melter replacement outages
    - ARP facility is not anticipated to operate after the startup of SWPF; MCU will not operate after start-up of SWPF.

SWPF Ready for Hot Ops: September 2012

- Annual processing throughput (*Long Term Processing Capacity at SWPF – Inputs to System Plan*[31])
  - Initial year: 3.75 Mgal/yr processing rate
    - Availability of tank space to prepare salt solution batches and the integration with any planned DWPF outages may impact the ability to process the 3.75 Mgal targeted volume during the first 12 months of SWPF operations.
  - Subsequent years: 6.0 Mgal/yr. nominal processing rate (actual anticipated throughput varies with respect to DWPF outages with an average of 5.5 Mgal./yr)
    - Processing rate determined as follows:

$$[9.4\text{Mgal/ yr}]\times[0.85]\times[0.75] = 6\,\text{Mgal/year}$$

      9.4 Mgal per year based on maximum hydraulic rate
      0.85 – estimated reduction due to hydraulic limits of the V-10 contactor
      0.75 – availability
    - The 6 Mgal per year is based on 100% availability for the Tank Farm feed as well as DWPF and Saltstone/DSS Tank receipt of SWPF discharge streams. The yearly throughput varies when adjusted for the assumed 4-month duration melter replacement outage every 4 years and other planned outages
    - Availability of tank space to prepare salt solution batches may impact the ability to achieve full capacity SWPF operations in the first few years of operation.
- Tank Farm feed preparation infrastructure modifications are completed to support SWPF processing rates. Major modifications include:
  - H-Tank Farm East Hill Blend/Hub tanks readiness for salt solution preparation (Tanks 41, 48 and 50 currently proposed)
  - Mixing capabilities
  - Enhanced transfer capabilities
  - Dedicated transfer routes provided to feed tank

- Enrichment control capabilities
- Tank 49 readiness as SWPF feed tank.

  NOTE: Timing of Tanks 41, 48 and 50 availability to support SWPF salt solution preparation may be impacted by intermediate needs of these tanks as described elsewhere in this *Plan*.

Tank 48 Return to Service: September 2012

- Material dispositioned by organic destruction using a selected alternative treatment technology. Initiation of treatment is September 2010.
  - For this planning case, it was assumed the product stream would go to the 2H Evaporator System. This disposition path is more impactive to tank space and is considered to be a conservative assumption.
- The material in Tank 48 can be fully treated by sending 350 kgal to the treatment unit.
- The heel is defined as a concentration of 3 ppm potassium tetraphenylborate (KTPB) which will be an acceptable level 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 selected alternative treatment technology is required to be operable — and 15% limitations due to weather, emergent facility issues, etc.).

Tank 50 Return to Service: May 2012

- Requires successful implementation of planned modifications to decouple DSS stream from SPF.
- Planned modifications must be coordinated to minimize impact to SPF and salt processing operations during the modification outage duration.

8.4 ***SPF Production***

SPF is capable of processing at the following rates:

- During initial DDA Batch after the resumption of disposition in November 2007: ~83 kgal/wk
  - Requires operation of more than one cell and the use of “cold caps” to meet radiological control requirements
- During ARP/MCU processing: ~60 kgal/wk (limited by temperature controls in vault)
- During disposal of subsequent DDA-processed batches from Tank 41 during disposal of ARP/MCU processed waste: ~60 kgal/wk
  - The disposal of DDA batches from Tank 41must be coordinated with ARP/MCU disposal
  - Requires operation of more than one cell and the use of “cold caps” to meet radiological control requirements.
- During SWPF operation: Yearly average of ~150 kgal/wk with a maximum rate of ~195 kgal/wk
  - Based on rate of 6 Mgal/yr x (1.269 gal. of DSS/gal. of salt solution feed)/ 52 weeks per year at 75% attainment. (Note: due to DWPF outages the average rate is 5.5Mgal/yr)
  - Will require additional operational time (i.e., multiple shifts, additional operating days each week, etc.) and adequate vault receipt space to match production stream from SWPF.
- Since neither ARP/MCU nor SWPF process during melter replacement outages, SPF will also not operate other than to run off any backlog material that may be in the feed tanks.

8.5 ***DWPF Production***

Canister production and sludge batch need dates are projected by the *Sludge Batch Plan*[23]. Note that this table includes an interruption in Sludge Batch 6 to account for a proposed PUV outage not considered in the Sludge Batch Plan.

- In general, assumes 4-month melter replacement outage approximately every 48 months of melter operation (i.e., DWPF operates 44 months out of every 48 months). For planning purposes, next DWPF melter outage planned from June 2009–September 2009.
- Discrete Canister Production Rate[viii]:

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

— Sludge batch planning is performed to recommend the sequencing and timing of future sludge batches. Due to melt rate and glass quality constraints, sludge batches that are predicted to be high in aluminum will result in a slower canister production rate with a lower waste loading. Based on modeling of sludge batches, *Appendix C — Sludge Processing* sums the canister production expectations, assuming the following nominal canister production rates:
  - 186 Discrete canisters/yr. with 34 wt% SOL for high aluminum batches (average will be less when accounting for melter replacement and other outages) — this is currently predicted for Sludge Batches 4–6 within this *Plan*'s duration.
  - 186 Discrete canisters/yr. with 38 wt% SOL for high iron batches (after accounting for SWPF salt processing, melter replacement, and other outages)
  - 200 Discrete canister/yr at 50 wt% SOL upon implementation of alternative technology initiatives
  - PUV, proposed for beginning February 2013, will add 16 Discrete canisters/yr (approximately 100 total canisters) to the number of canisters.

A summary of yearly canister production rates for the duration of this *Plan* is shown in Table 8-4 — *DWPF Production Rates*. Note that these are nominal canister production rates and do not reflect actual annual canister production numbers per year. The canister rates reflect an assumed 85% melter utility to allow for routine planned maintenance and canister pour time dependent on melt rate and glass quality constraints.

Table 8-4 — DWPF Production Rates

FY	**Nominal Rate** *(DWPF Discrete Canisters/yr)*	**Outage** *(Months)*	**Discrete Canisters** *(DWPF Canisters)*	**Proposed PUV adder** *(DWPF Canisters)*	**Total DWPF Discrete Canisters poured** *(DWPF Canisters)*
FY07	186	4 [a]	172[b]		172[b]
FY08	197 [c]		197		197
FY09	186	4 [d]	125		125
FY10	186		186		186
FY11	186		186		186
FY12	186	4 [e]	124		124
FY13	186	2 [f]	186	8	194
FY14	186	5 [g]	121	8	129
FY15	200	6 [g]	93	8	101
FY16	200		200	16	216
FY17	200		200	16	216
FY18	200		200	16	216
FY19	200	2 [d]	158	16	174
FY20	200	2 [d]	160	12	172
FY21	200		200		200
FY22	200		200		200
FY23	200	1 [d]	179		179
FY24	200	3 [d]	155		155
FY25	200		200		200
FY26	200		200		200
FY27	200		133		133
FY28	200		200		200
FY29	90 [h]		90		90
FY30	90		90		90

[a] FY07 outages include October 2006–November 2006 (maintenance), April 2007–May 2007 (replace the failed Slurry Mix Evaporator), and September 2007 (Load Center B-3 outage).

[b] The 172 canisters in FY07 was based on modeling beginning at the end of July 2007. Actual canisters produced are anticipated, at the time of this writing, to be approximately 162.

[c] Increased canister production in FY08 is based on early operation experience with Sludge Batch #4 in FY07.

[d] Four-month melter outage is assumed in FY09 and approximately every four years thereafter. Actual melter change-out is determined by melter performance. Note, due to alternative melter technology implementation in FY13, the melter installed in FY09 is assumed to be in service five years.
[e] FY12 outage to accommodate transition to SWPF/DWPF coupled operations at the beginning of FY13. Starting September 2012, assumes no canister production rate impact from coupled SWPF-DWPF operations.
[f] FY13 outage to accommodate transition to proposed PUV operations. Assumes no canister production rate impact from processing of PUV canisters.
[g] FY14–FY15 outage to accommodate technology improvements to improve waste loading.
[h] Lower production rate assumed for dilute heel processing.

8.6 *Canyon Operations*

- Sufficient tank space volume is available to support the receipt of 240 kgal of HLW from H-Canyon operations from March 2007 through September 2008 and another 200 kgal of HLW through September 2009 (this is possible using Tanks 25, 44,and 47 as 2F Evaporator concentrate receipt tanks).
- After September 2009, the Tank Farms can support an average of 300 kgal per year from H-Canyon operations through the time period evaluated by this *Plan*.
- Source of streams is based on *H-Area Liquid Waste Forecast Through 2019*[25] adjusted to meet the volumes stated above.
- Unirradiated uranium material streams sent directly to Tank 50 and plutonium streams sent directly to a sludge batch are not included in the volumes stated above.

8.7 *Waste Removal and Tank Closure Program*

The following technical assumptions were input to the modeling of this plan.

Additional Waste Heel Removal in Tank 19 and Tank 18

- Additional Heel Removal will be performed in FY08.
- Quantities for volume addition are from *Tanks 7, 18, and 19 Quantity Input for Corrosion Control*[32]. The total volume added to complete heel removal in Tank 18 and Tank 19 will be ~151 kgal, divided as follows:
  - ~7 kgal of water will be added for line volume flushes.
  - ~101 kgal of water will be added for heel removal in Tank 19.
  - ~31 kgal of water will be added for heel removal in Tank 18.
  - ~12 kgal of water will be added to lift the mechanical waste removal system from the tank waste and clear the transfer line.
- Additional heel removal streams are sent to Tank 7 for inclusion into Sludge Batch 6.

Waste Removal

- After the initial waste removal campaign in a sludge tank, 10–20 kgal of waste (heel) remains.
- After the initial waste removal campaign in a salt tank, approximately 2–3 feet (approximately 98–127 kgal depending on the type of tank) of insoluble/low solubility material waste (heel) remains.
- Two Phases of Waste Heel Removal are planned for all tanks.
  - Mechanical Cleaning uses mechanical agitation.
    - Assumed to take 12 months of operation unless otherwise stated
      - Heel solids volume reduced to less than 5 kgal.
      - Sludge tank is estimated to use 500 kgal of liquid.
      - Salt tank is estimated to use 800 kgal of liquid.
  - Chemical Cleaning uses oxalic acid (OA) or advanced/specialized mechanical or chemical technology.
    - Assumed to take 6 months of operation unless otherwise stated
  - Tank 4 mechanical and chemical cleaning is assumed to take a total of 8 months.
    - Assumes efficiency from completing Tanks 5 and 6 and reuse of equipment
  - Tank 8 mechanical cleaning is assumed to take a total of 6 months due to low volume of waste in Tank 8 after previous cleaning campaigns.
- For planning purposes, Tanks 4–6 chemical cleaning will be performed per the current OA flowsheet (results in tank farm waste volume impact of ~200 kgal/tank).

- Following chemical cleaning in Tanks 4–6, mechanical cleaning will be performed to remove insoluble solids that will result in a tank farm volume impact of ~150 kgal/tank.
- After Tanks 4–6, future tanks will use an enhanced chemical cleaning technique that results in tank farm waste volume impact of ~100 kgal/tank with an additional 150 kgal/tank of water to flush the tank.

Annulus Cleaning

- All tanks that have experienced leaks will undergo annulus cleaning. The volume used depends on the extent of waste present.
  - Tanks 5, 6, 10, 11, 12, and 15 are assumed to require 6 kgal. Duration is performed within the heel removal time window.
  - Tank 16 annulus cleaning is assumed to require up to 15 kgal for technology demonstration. An additional 100 kgal is assumed for the full cleaning of the annulus and the primary (1,200 gal. solids). Note: The primary of Tank 16 has previously undergone an extensive waste removal and oxalic acid cleaning campaign in the 1970's. Though no additional cleaning of the primary may be required, the volume used makes a waste handling allowance as a conservative assumption.
  - Tank 14 annulus contains 12"–13" of waste and is assumed to require 20 kgal.

Tank Closure

- The duration between the end of tank cleaning and the completion of grouting is assumed to be 24 months.

8.8 *Regulatory Approvals*

- Two Secretarial determinations (F Tank Farm and H Tank Farm) will be issued pursuant to §3116 of the NDAA to determine whether the provisions of §3116(a) are met such that the tank and ancillary equipment residuals are not high level waste.
- SCDHEC reviews and approves tank closures.

9. System Description

9.1 *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. Approximately 36.5 Mgal[27] 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 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 due to the fact that 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 closure, 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 Federal Repository (see *Figure 9–2 — Process Flowsheet*). As of August 14, 2007, DWPF had produced 2,358 vitrified waste canisters. All canisters to date contain sludge-only waste.

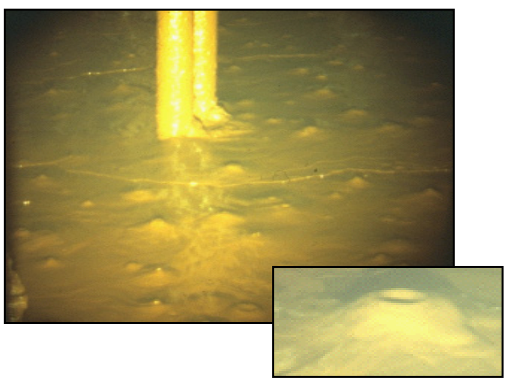
9.2 *Tank Storage*

SRS has a total of 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 a total of 27 Type III tanks. These tanks meet current EPA requirements for full secondary containment and leak detection. The remaining 24 tanks do not have full secondary containment and do not meet EPA requirements for secondary containment. Type I tanks are the oldest tanks, constructed between 1952 and 1953. Type II waste tanks were constructed between 1955 and 1956. There are eight Type IV tanks, constructed between 1958 and 1962. Two of these Type IV tanks, Tanks 17 and 20 in F-Tank Farm, have been isolated, operationally closed, and grouted. Twelve tanks without secondary containment have a history of leakage[29]. Sufficient waste has been removed from these tanks such that there are currently no active leak sites. The first tank, Tank 1F, lacking secondary containment, began receiving waste in 1954. This tank is still in service.

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

Approximately 36.5 Mgal of radioactive waste, containing 397 million curies (MCi)[27] 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 (33.5 Mgal).

The sludge component of the radioactive waste represents approximately 3 Mgal (8% of total) of waste but contains approximately 185 MCi (46% of total). The salt waste makes up the remaining 33.5 Mgal (92% of total) of waste and contains approximately 212 MCi (54% of total). Of that salt waste, the supernate accounts for 16.9 Mgal and 200 MCi and saltcake accounts for the remaining 16.6 Mgal and 12 MCi[27]. The sludge contains the majority of the long-lived (half-life > 30 years) radionuclides (i.e., 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.

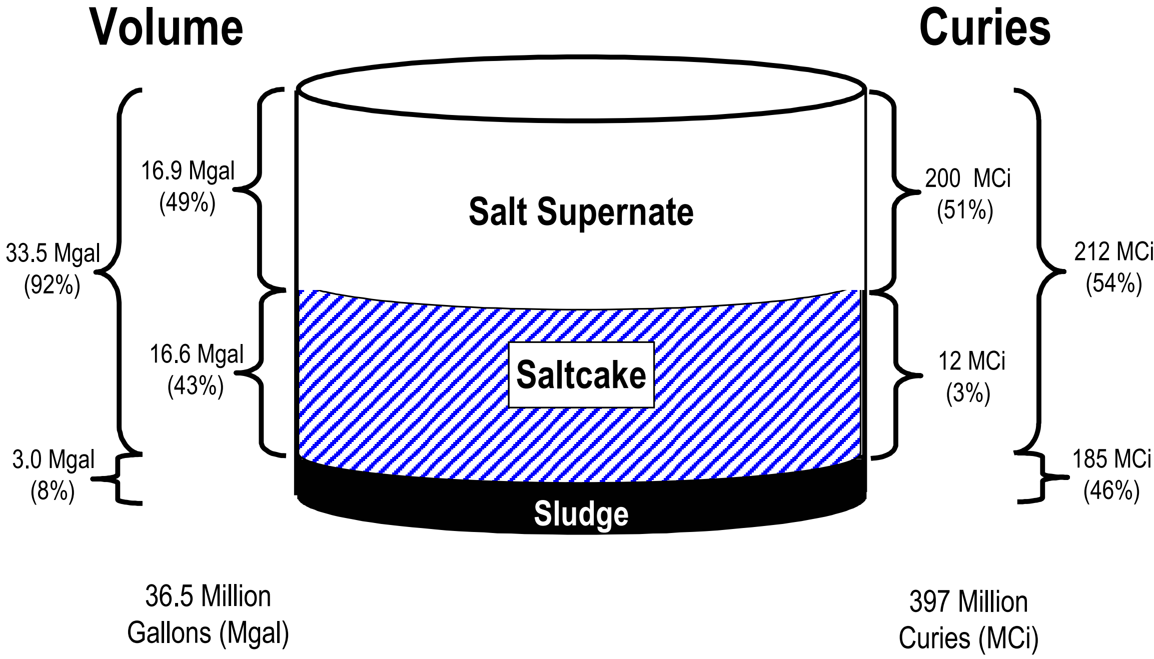
Radioactive waste volumes and radioactivity inventories reported herein are based on the WCS database, which includes the chemical and radionuclide inventories on a tank-by-tank basis. WCS is a dynamic database frequently updated with new data from ongoing operations such as decanting and concentrating 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. Volumes and curies referenced in this evaluation are current as of August 14, 2007.

Well over 95%[27] 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[33]. As a result, the cesium concentration in the saltcake is

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.

much lower than that in the liquid supernate and interstitial liquid fraction of the salt waste.

Figure 9–1 — Waste Tank Composite Inventory (As of August 14, 2007)



9.3 *Waste Tank Space Management*

To make better use of available tank storage capacity, incoming liquid waste is evaporated to reduce its volume. This is critical 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 140 Mgal of liquid waste, of which over 100 Mgal have been evaporated, leaving approximately 36.5 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 compliant 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. Currently, there is very little "fresh" waste that has not had the water evaporated from it to its maximum extent. The working capacity of the Tank Farms has steadily decreased and this trend will continue until salt processing becomes operational or the system becomes water logged. Three evaporator systems are currently operating at SRS - the 2H, 3H, and 2F systems.

9.4 *Waste Removal from Tanks*

During waste removal, inhibited water (IW–water that has been chemically treated to prevent corrosion of the carbon steel waste tanks) is added to the waste tanks and agitated by mixing pumps. If the tank contains salt, IW and agitation, if required, dilute the concentrated salt or re-dissolve the saltcake. If the tank contains sludge, IW and agitation suspend the insoluble sludge particles. In either case, the resulting liquid slurry, which now contains the dissolved salt or suspended sludge, can be pumped out of the tanks and transferred to waste treatment tanks.

Typical Waste Removal equipment includes two to four 45-foot long mixing pumps and one transfer pump or jet. Note the substantial structural steel required to support the loads in the picture above At right is the typical installation of a transfer pump (Tank 8) requiring difficult, high-risk entries into High Level Waste Tanks.

Waste removal is a multi-year process. First, each waste tank must be retrofitted with mixing and transfer pumps, infrastructure to support the pumps, and various service modifications (power, water, air, and/or steam). These retrofits can take between two and four years to complete. Then, the pumps are operated to slurry the waste. Initially, the pumps operate near the top of the liquid and are lowered sequentially to the proper depths as waste is slurried and transferred out of the tanks. Waste removal activities remove the bulk of the waste to prepare the tank for closure.

9.5 ***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 approximately 2012, this separation will be accomplished in SWPF. However, until the startup of SWPF, DDA, and ARP/MCU will be used to accomplish this separation.

9.6 ***Salt Processing***

A final DOE technology selection for salt solution processing was completed and a Record of Decision for the Salt Processing Environmental Impact Statement was issued in October 2001. The Record of Decision designated CSSX as the preferred alternative for separating cesium from the salt waste. The full-scale CSSX facility, the SWPF, is planned to begin operations in 2012.

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

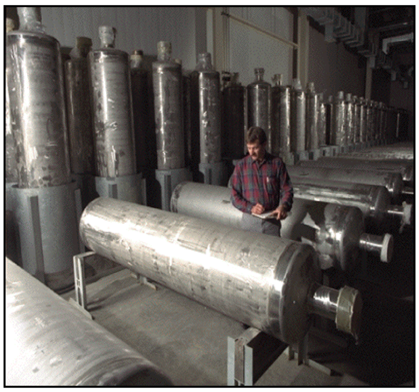
- **Deliquification, Dissolution, and Adjustment** (DDA) – For salt in Tank 41 as of June 9, 2003, that is relatively low in radioactive content, the treatment of deliquification (i.e., extracting the interstitial liquid) is sufficient to produce a salt that meets the SPF WAC. Deliquification is an effective decontamination process because the primary radionuclide in salt is Cs-137, which is highly soluble. To accomplish the process, the salt is first deliquified by draining and pumping. The deliquified salt is dissolved by adding water and pumping out the salt solution. The resulting salt solution is given time to allow additional insoluble solids to settle prior to being sent to the SPF feed tank. If necessary, the salt solution may be aggregated with other Tank Farm waste to adjust batch chemistry for processing at SPF
- **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.
- **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. After approximately 2012, this will be done in a new facility, SWPF. However, so that some of these wastes can be treated before SWPF startup, DOE will build a small-scale modular CSSX unit. Salt to be processed will first be processed through ARP and then through the modular unit. This unit will allow processing of salt waste with higher Cs-137 concentrations at a relatively low rate.

- **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 2012.

9.7 *Sludge Processing*

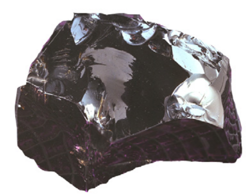
Sludge is "washed" to reduce the amount of non-radioactive soluble salts remaining in the sludge slurry. The processed sludge is called "washed sludge." During sludge processing, large volumes of wash water are generated and must be volume-reduced by evaporation. Over the life of the waste removal program,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

9.8 *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, pending shipment to a Federal Repository for permanent disposal. A low-level recycle waste stream from DWPF is returned to the Tank Farms. DWPF has been fully operational since 1996.



Sample of Vitrified Radioactive Glass

9.9 *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 R.61-67. 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 disposal vaults, 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, as defined by SCDHEC Regulations R61-66 and R.61-107.16.

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

Approximately 15 feet of overburden were removed to prepare and level the site for vault construction. All vaults 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 vault (Vault 4) has the dimensions of approximately 200 feet wide, by 600 feet in length, by 26 feet in height. The vault is divided into 12 cells, with each cell measuring approximately 100 feet by 100 feet. The vault is covered with a sloped, permanent roof that has a minimum thickness of four inches, and a minimum slope of 0.24 inches/foot. The vault walls are approximately 1.5 feet thick, with the base mat having a thickness of two feet. Operationally, the cells of the vault will be filled to a height of approximately 25 feet with Saltstone, and then a layer of uncontaminated grout, with an average thickness of two feet, will be poured to fill in the space between the Saltstone grout and the sloped roof. The other current vault (Vault 1) has the dimensions of approximately 100 feet wide, by 600 feet in length, by 25 feet in height. The vault is divided into six cells, with each cell measuring approximately 100 feet by 100 feet.

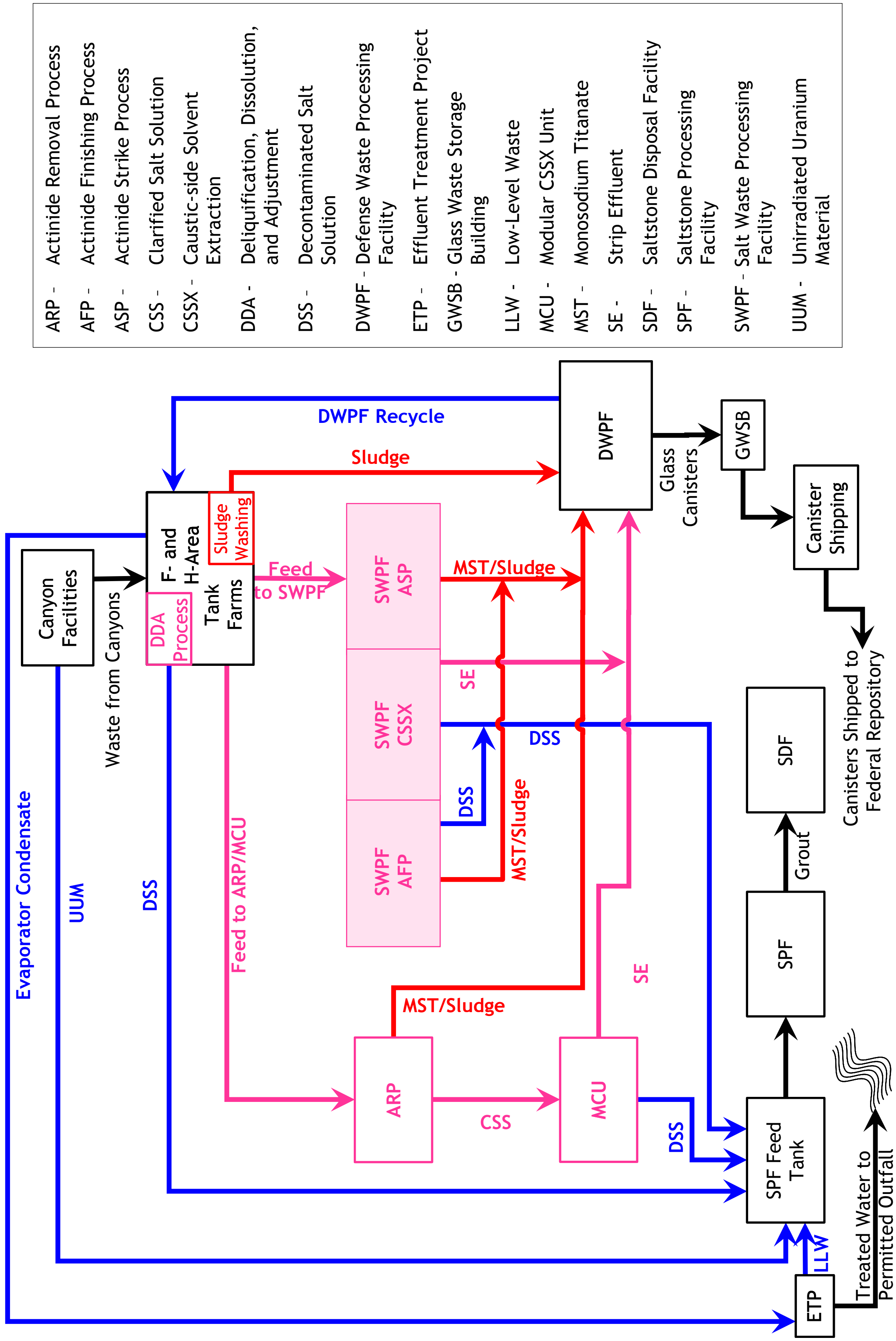
View of a Saltstone Vault

Future vaults are planned to be cylindrical concrete tanks approximately 20 feet high and 150 feet in diameter 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). Tanks of this design are used commercially for storage of water. Each tank will hold approximately 1.5 Mgal of feed solution. One vault will consist of two tanks, so each vault will have a capacity of approximately 3 Mgal of feed solution.

Closure operations will begin near the end of the active disposal period in the SDF, i.e., after most or all of the vaults have been constructed and filled. Backfill of native soil will be placed around the vaults. 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 vaults was completed between February 1986 and July 1988. The SDF started radioactive operations June 12, 1990. Future vaults will be constructed on a “just-in-time” basis in coordination with salt processing production rates.

Figure 9–2 — Process Flowsheet



Appendices

Appendix A — Tank Farm Volume Balance

End of Fiscal Year	Influents (kgal)								Effluents (kgal)						(kgal)	
	Canyons			DWPF			IW/Chem	Total	Space Recovery			Salt	Sludge	Total		Total
	F[b]	H[c]	UUM[c]	Recycle	299-H	ETP	Add[g]	In	2F Evap[h]	2H Evap[i]	3H Evap[j]	Solution[k]	to DWPF	Out	Other[l]	Inventory[m]
FY06															Beginning Volume:	36,517
FY07 [a]	-	103	32	1,340	5	65	-	**1,545**	240	1,770	270	-	183	**2,463**	613	**36,212**
FY08	-	213	81	1,810	12	120	3,150	**5,386**	509	2,710	478	1,640	222	**5,559**	(19)	**36,020**
FY09	-	200	47	1,850	12	120	2,460	**4,689**	2,010	2,190	-	2,330	136	**6,666**	(57)	**33,986**
FY10	-	300	-	1,930	12	120	2,680	**5,042**	1,910	1,700	941	1,140	181	**5,872**	40	**33,196**
FY11	-	300	-	1,930	12	120	836	**3,198**	682	1,930	1,280	1,120	167	**5,179**	37	**31,252**
FY12	-	300	-	1,890	12	90	1,430	**3,722**	258	1,800	-	723	157	**2,938**	(74)	**31,962**
FY13	-	300	-	2,310	12	f	2,800	**5,422**	284	2,070	982	3,130	157	**6,623**	67	**30,828**
FY14	-	290	-	1,540	12		3,080	**4,922**	141	1,960	970	3,630	43	**6,744**	52	**29,058**
FY15	-	306	-	1,160	12		3,070	**4,548**	-	791	1,260	2,500	99	**4,650**	74	**29,030**
FY16	-	290	-	2,590	12		3,780	**6,672**	-	2,470	760	6,000	250	**9,480**	146	**26,368**
FY17	-	306	-	2,600	12		4,680	**7,598**	-	2,480	270	6,000	290	**9,040**	(50)	**24,876**
FY18	-	290	-	d	12		5,630	**5,932**	-	-	728	6,000	288	**7,016**	277	**24,069**
FY19	-	306	-		12		6,700	**7,018**	-	3,010	436	4,880	234	**8,560**	35	**22,562**
FY20	-	399	-		12		4,160	**4,571**	-	2,410	150	5,130	258	**7,948**	156	**19,341**
FY21	-	321	-		12		5,570	**5,903**	-	937	-	6,000	215	**7,152**	(76)	**18,016**
FY22	-	165	-		12		6,180	**6,357**	-	1,040	-	6,000	254	**7,294**	34	**17,113**
FY23	-	-	-		12		4,530	**4,542**	-	824	-	5,380	235	**6,439**	61	**15,277**
FY24	-	-	-		12		4,520	**4,532**	-	1,620	-	4,630	170	**6,420**	169	**13,558**
FY25	-	-	-		12		5,700	**5,712**	-	1,180	-	6,000	240	**7,420**	(225)	**11,625**
FY26	-	-	-		12		5,730	**5,742**	-	2,410	-	6,000	240	**8,650**	(68)	**8,649**
FY27	-	-	-		12		4,100	**4,112**	-	-	-	4,000	160	**4,160**	(207)	**8,394**
FY28	-	-	-		e		2,860	**2,860**	-	-	-	6,000	245	**6,245**	(54)	**4,955**
FY29	-	-	-				3,330	**3,330**	-	-	-	6,000	140	**6,140**	(445)	**1,700**
FY30	-	-	-				1,850	**1,850**	-	-	-	3,010	500	**3,510**	(40)	**-**

a FY07 includes actual values obtained from "LW Morning Reports" between October 1, 2006 and August 15, 2007.

b F-Canyon was shut down in FY05 and is assumed to remain shutdown for the purpose of this *Plan*.

c H-Canyon receipts are based on *H-Area Liquid Waste Forecast Through 2019*[25], adjusted to receive 240 kgal between August 2007 and September 2008, 200 kgal in FY09, and 300 kgal per year from FY10 - FY13. 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*[34]. UUM consists of unirradiated uranium material and concentrate from the General Purpose H-Canyon (GP) Evaporator. Concentrate from the GP Evaporator is sent to Tank 39 beginning in FY09 (after unirradiated uranium material campaign is completed).

d An alternate handling strategy of DWPF recycle is assumed beginning in FY18.

e Maintenance Facility (299-H) receipts are assumed to be redirected to SWPF beginning in FY28 in order to complete Tank 39 heel removal (current receipt tank for Maintenance Facility, 299-H, receipts).

f ETP receipts are assumed to be redirected to SPF (bypassing the Tank Farm) beginning in July 2012 when Tank 50 is returned to service.

g The "IW / Chemical Addition" column includes all additions, including IW used during sludge batch washing activities, salt dissolution activities, and during tank cleaning activities (mechanical and chemical heel removal).

h 2F Evaporator is assumed to be shut down permanently in FY14 after start-up and operation of the SWPF (2F Evaporator final closure is concurrent with H-Tank West Hill shutdown and closure initiating in FY26).

i The 2H Evaporator is assumed to be shut down during a period in FY25 for bulk sludge removal operations from Tank 43 (2H Evaporator Feed Tank). The 2H is assumed to shut down permanently in FY26.

j The 3H Evaporator is assumed to be shut down for periods during FY09, FY12, FY16, and FY17 for periodic salt removal campaigns and for periods during FY17 and FY18 for sludge removal campaigns. The 3H Evaporator is assumed to shut down permanently in FY20 (3H Evaporator final closure is concurrent with H-Tank West Hill shutdown and closure initiating in FY28).

k Due to the shutdown of all evaporator systems by the end of FY26 and the need to continue flushing waste tanks to successfully complete heel removal, salt solution sent to SWPF from FY27 - FY30 may be less than 6.44 M Na. It is assumed that this material will be sent from the Tank Farm to be concentrated prior to being sent to SWPF.

l This column accounts 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.

m FY06 total inventory was obtained from "LW Morning Reports" from September 30, 2006. All other total inventory values were obtained from modeling completed to support this *Plan*.

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

Appendix B — Salt Solution Processing

End of Fiscal Year	Total Salt Solution from Tank Farms (kgal) [a]	Salt Solution via DDA only (kgal)	Salt Solution via ARP/MCU (kgal)	Salt Solution via SWPF (kgal) [b]	DSS Stream to SPF (kgal) [c]	UUM Stream to SPF (kgal) [d]	ETP Stream to SPF (kgal)	Total Feed Stream to SPF (kgal)	Vault Numbers [e]
FY07	0	0	0		820	0	15	250	4
FY08	1,640	1,290	350		1,490	80	120	1,720	4
FY09	2,330	1,300	1,030		1,820	50	120	2,540	4
FY10	1,140	0	1,140		1,410	0	120	1,510	4
FY11	1,120		1,120		1,380		120	1,540	4
FY12	720		720	0	890		120	970	4-2
FY13	3,130		0	3,130	3,840		120	3,850	2-3
FY14	3,630			3,630	4,410		120	4,610	3-6
FY15	2,500			2,500	3,060		120	3,010	6-7
FY16	6,000			6,000	7,210		120	7,300	7-9
FY17	6,000			6,000	7,270		120	7,360	9-11
FY18	6,000			6,000	7,330		120	7,420	11-14
FY19	4,880			4,880	5,980		120	6,220	14-16
FY20	5,130			5,130	6,290		120	6,230	16-18
FY21	6,000			6,000	7,430		120	7,520	18-21
FY22	6,000			6,000	7,380		120	7,470	21-23
FY23	5,380			5,380	6,610		120	6,850	23-25
FY24	4,630			4,630	5,650		120	5,590	25-27
FY25	6,000			6,000	7,370		120	7,450	27-30
FY26	6,000			6,000	7,370		120	7,470	30-32
FY27	4,000			4,000	4,410		120	4,590	32-34
FY28	6,000			6,000	4,840		120	4,990	34-35
FY29	6,000			6,000	1,580		120	1,740	35-36
FY30	3,010			3,010	80		120	220	36
Total	**97,240**	**2,590**	**4,360**	**90,290**	**105,920**	**130**	**2,775**	**108,420**	**36**

[a] *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, ARP/MCU, and SWPF processes.

[b]
- SWPF throughput in several years is impacted by assumed DWPF outages in those years
- Due to the shutdown of all evaporator systems by the end of FY26 and the need to continue flushing waste tanks to successfully complete heel removal, salt solution sent to SWPF from FY27 - FY30 may be less than 6.44 M Na. It is assumed that this material can be accommodated at SWPF.

[c] The FY07 value in the "DSS Stream to Tank 50" column accounts for the ~820 kgal of LLW that exists in Tank 50 at the beginning of FY07.

[d] Unirradiated uranium material receipts to Tank 50 are assumed as outlined in *H-Area Liquid Waste Forecast Through 2019*[25].

[e]
- Vault 1 and 4 are in service. Vault 1 will receive no additional grout; Vault 4 has 8 cells available to receive grout. Future vaults will have (2) cells with 1.5 Mgal feed capacity. Vault # fill sequence to be 4, 2 (cells 2a, 2b), 3 (cells 3a, 3b), 5 (cells 5a, 5b), 6 (cells 6a, 6b), 7 (cells 7a, 7b), … etc.
- Each gallon of feed, when added to the cement, flyash, and slag, makes 1.56 gallons of grout. Each cell is estimated to contain ~2,350 kgal of grout. Therefore, each cell holds ~1,500 kgal of feed solution (each vault holds ~3,000 kgal of feed solution).

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

Appendix C — Sludge Processing

Sludge Batch	Source Tanks [a]	Projected SOL (weight %)	Canister Production Rates (Cans/Year)	Actual Cans @ Projected SOL	Date Batch Finished @ Projected SOL[b]	Sludge Batch Preparation Start Date
Current through August 14, 2007		-	-	2,358		
SB4 (remaining)	11	34	197 [c]	242	Oct 2008	
SB5 (LT Al-Diss)	5,6,11	34 [d]	186	108	May 2009	May 2007
DWPF Melter Outage — Jun 09-Sep 09						
SB5 (LT Al-Diss)	5,6,11	34	186	153	Jul 2010	
SB6	4,12	34	186	279	Jan 2012	Nov 2008
SB7	13	34	186	65	May 2012	Aug 2010
SWPF Tie-in Outage — Jun 2012-Sep 2012						
SB7	13	38 [e]	186	298	May 2014	
Implement Alternative Technology Initiatives — Jun 2014-Apr 2015 [f]						
SB8 (Al-Diss #1)	12,13,4,7,8	50 [g]	200	334	Dec 2016	Feb 2012
SB9 (Al-Diss #2)	11,14,15,13	50	200	261	Apr 2018	May 2014
SB10 (Al-Diss #3)	13,15	50	200	252	Jul 2019	Jan 2017
DWPF Melter Outage — Aug 2019-Nov 2019						
SB11 (Al-Diss #4)	13,32,21,22,23	50	200	249	Feb 2021	Apr 2018
SB12	13,32,21,22,23,26	50	200	250	May 2022	Jul 2019
SB13 (Al-Diss #5)	33,34,47,35	50	200	252	Aug 2023	Mar 2021
DWPF Melter Outage — Aug 2023-Dec 2023						
SB14	33,34,47,35	50	200	254	Mar 2025	Jun 2022
SB15 (Al-Diss #6)	33,34,47,39	50	200	241	Jun 2026	Sep 2023
SB16	33,34,47,43	50	200	186	May 2027	Apr 2025
DWPF Melter Outage — Jun 2027-Sep 2027						
SB17	33,34,47,43	50	200	207	Sep 2028	Jul 2026
Tank 40 Heel (40")	-	30	90 [h]	180	Sep 2030	
Sludge Canister Total				**6,169**		
Proposed PUV Canister Addition [i]				100		
Total Canisters				**6,269**		

[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, 13, and 42, 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 (except SB3 which is driven by the current Tk51-40 transfer date combining SB4 with SB3). Actual dates depend on canister production rates.

[c] Increased canister production rate for SB4 is based on actual operating experience

[d] This plan assumes an SOL of 34 wt% and 186 canisters per year production rates for high-aluminum sludge.

[e] This plan assumes an SOL of 38 wt% and 186 canisters per year production rates for high-iron sludge.

[f] Alternative melter technology is assumed to be deployed in FY14. Melter installed in FY09 assumed to be in service 5 years.

[g] This plan assumes an SOL of 50 wt% and 200 canisters per year beginning in FY15 accounting for alternative technology and sludge mass reduction initiatives. The slower production rate (less than 250 canisters per year) allows for sludge and salt processing to end at the same time, avoiding salt only canister production, while still maximizing waste loading to minimize total number of canisters.

[h] Lower production rate assumed for dilute heel processing

[i] The proposed PUV mission is assumed during FY13 - FY19. This will result in approximately 100 additional canisters from the displacement of LW by the Pu material.

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 (2,339 capacity)[c]			SRS Cans Shipped to Repository		Net Cans Stored At SRS
	Yearly	Cum.	Added	Shipped[d]	Cum.	Added	Shipped[d]	Cum.	Added	Shipped[d]	Cum.	Each Year	Cumulative	
FY96	*64*	*64*	*64*		*64*									*64*
FY97	*169*	*233*	*169*		*233*									*233*
FY98	*250*	*483*	*250*		*483*									*483*
FY99	*236*	*719*	*236*		*719*									*719*
FY00	*231*	*950*	*231*		*950*									*950*
FY01	*227*	*1,177*	*227*		*1,177*									*1,177*
FY02	*160*	*1,337*	*160*		*1,337*									*1,337*
FY03	*115*	*1,452*	*115*		*1,452*									*1,452*
FY04	*260*	*1,712*	*260*		*1,712*									*1,712*
FY05	*257*	*1,969*	*257*		*1,969*									*1,969*
FY06	*245*	*2,214*	*244*		*2,213*	*1*		*1*						*2,214*
FY07	172	2,386	38		2,251	107		108						2,359
FY08	197	2,583			2,251	98		206						2,457
FY09	125	2,708			2,251	186		392						2,643
FY10	186	2,894			2,251	186		578						2,829
FY11	186	3,080			2,251	186		764						3,015
FY12	124	3,204			2,251	124		888						3,139
FY13 [e]	194	3,398			2,251	217		1,105						3,356
FY14	129	3,527			2,251	263		1,368						3,619
FY15	101	3,628			2,251	206		1,574						3,825
FY16	216	3,844			2,251	143		1,717						3,968
FY17	216	4,060		(130)	2,121	206		1,923				130	130	4,044
FY18	216	4,276		(250)	1,871	206		2,129				250	380	4,000
FY19	174	4,450		(500)	1,371	202		2,331				500	880	3,702
FY20	172	4,622		(500)	871	8		2,339	126		126	500	1,380	3,336
FY21	200	4,822		(500)	371			2,339	77		203	500	1,880	2,913
FY22	200	5,022		(371)			(129)	2,210	194		397	500	2,380	2,607
FY23	179	5,201					(500)	1,710	250		647	500	2,880	2,357
FY24	155	5,356					(500)	1,210	250		897	500	3,380	2,107
FY25	200	5,556					(500)	710	167		1,064	500	3,880	1,774
FY26	200	5,756					(500)	210	250		1,314	500	4,380	1,524
FY27	133	5,889					(210)		250	(290)	1,274	500	4,880	1,274
FY28	200	6,089							180	(500)	954	500	5,380	954
FY29	90	6,179								(500)	454	500	5,880	454
FY30	90	6,269								(454)		454	6,334	0

Numbers in italics are actuals — through FY06. FY07 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.

[b] GWSB #2 filling began in June 2006. GWSB #2 is expected to reach maximum capacity in FY20, and will be emptied and available for D&D in FY27.

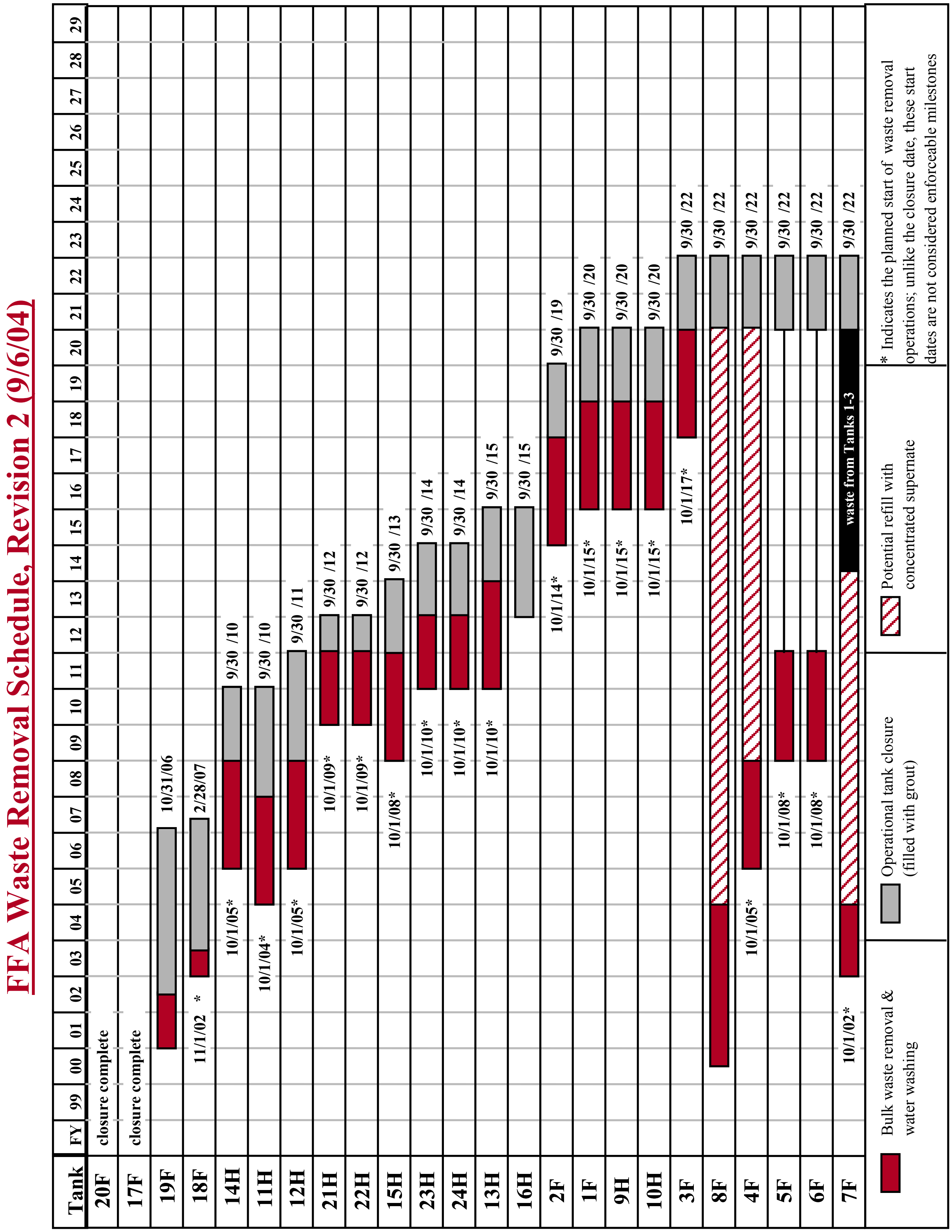
[c] This Plan assumes the construction of a third GWSB to be available in FY20. GWSB #3 is assumed to be designed and built to the same specification as GWSB #2 and is expected to be emptied and available for D&D in FY30.

[d] Shipping of canisters to the Federal Repository begins in FY17. Assuming a gradually increasing shipping rate in the initial years, about 14 years will be needed to ship all SRS DWPF canisters to the Federal Repository.

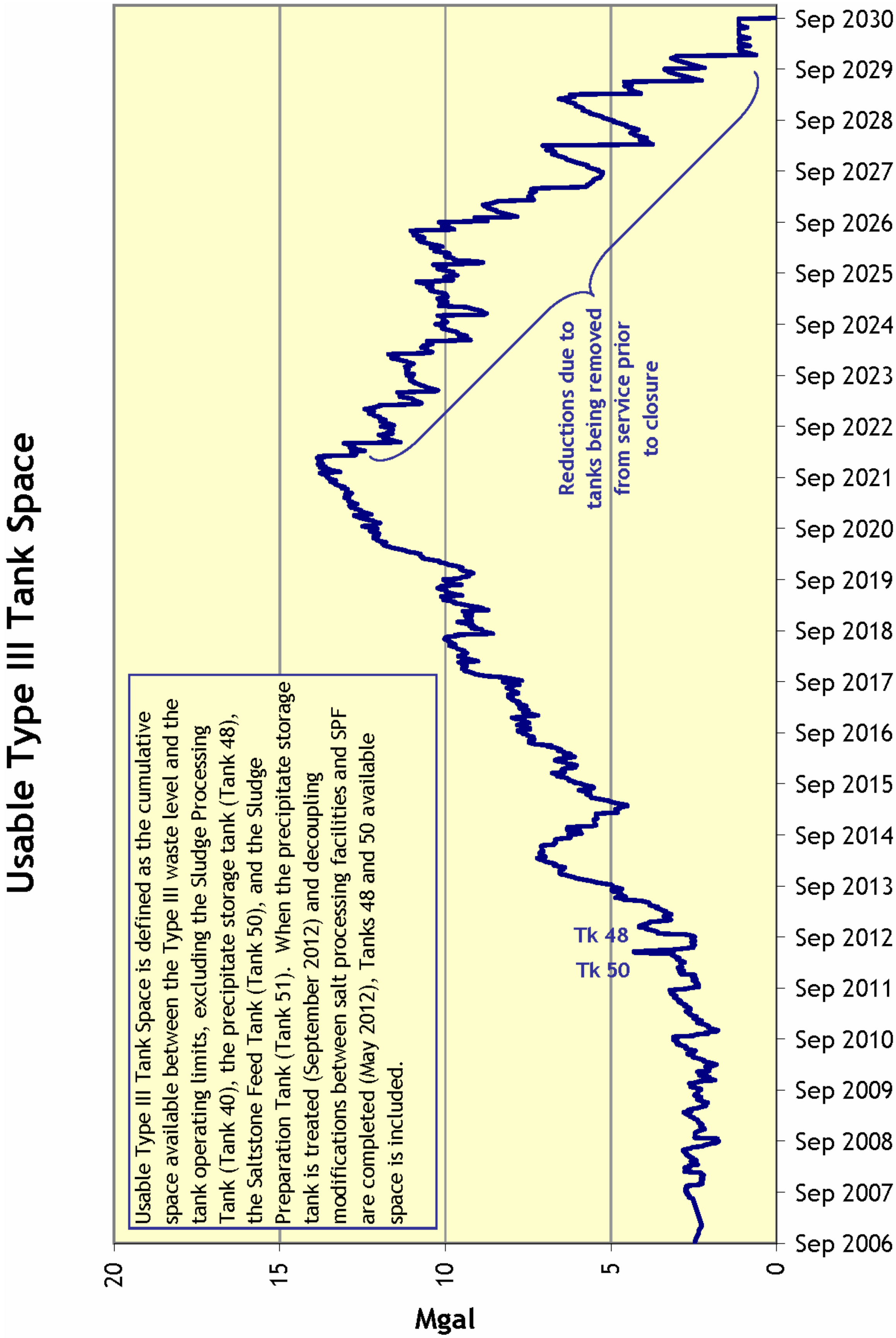
[e] The proposed PUV process is assumed to operate from FY13-FY19 resulting in approximately 100 additional canisters from the displacement of LW by the Pu material. These additional canisters are accounted for in the table above.

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

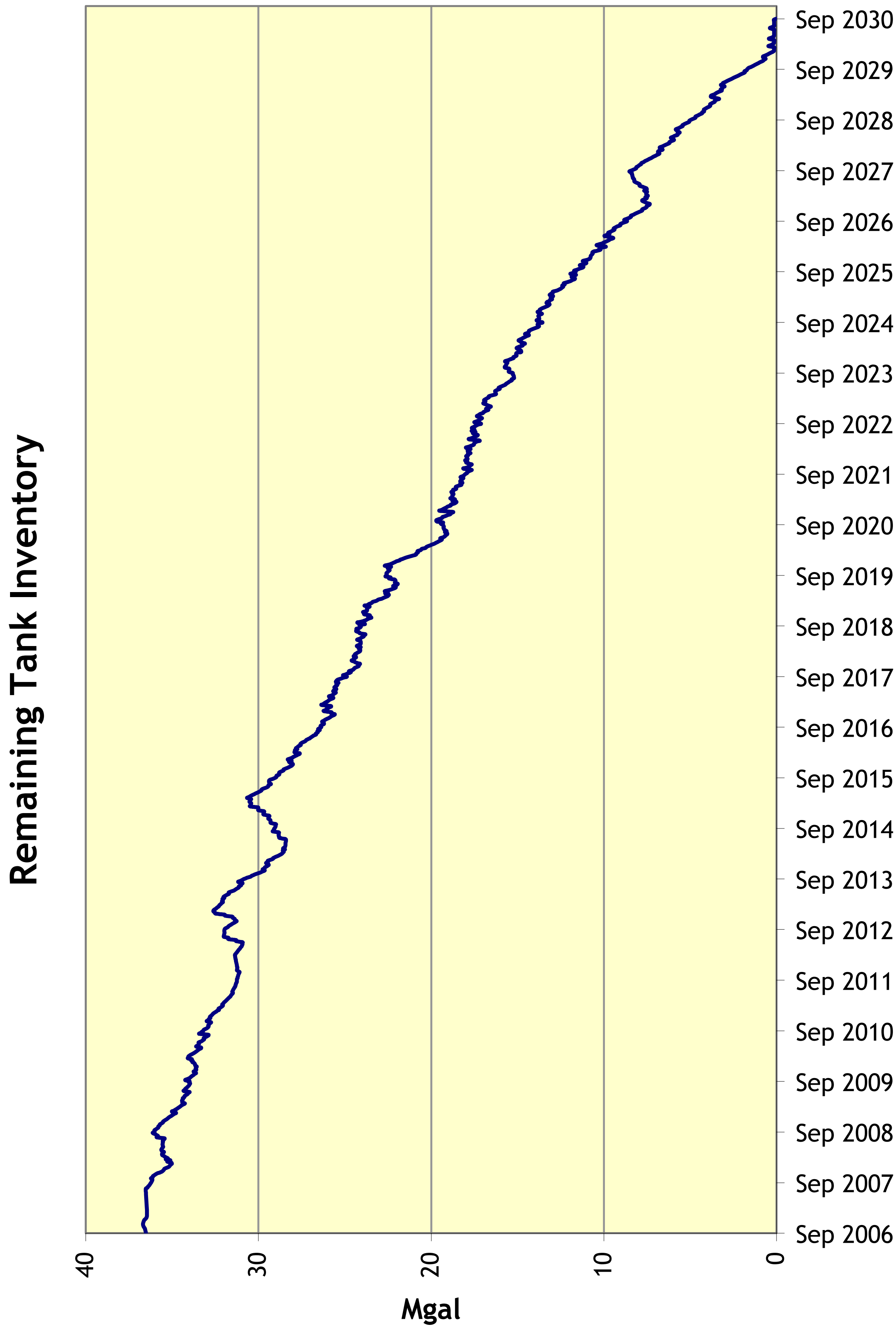
Appendix E — Currently-Approved FFA Waste Removal Plan & Schedule



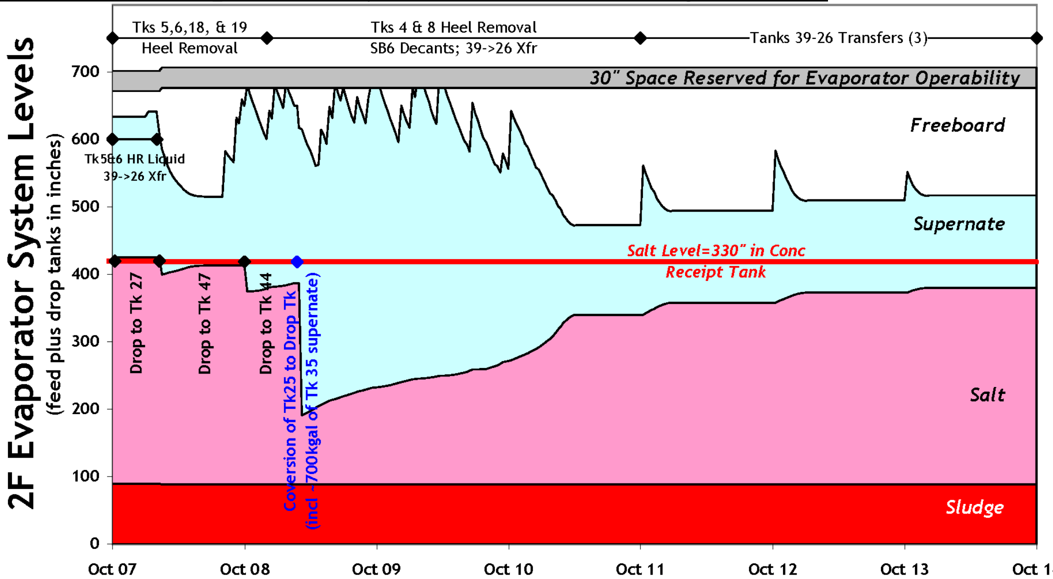
Appendix F — Usable Type III Tank Space

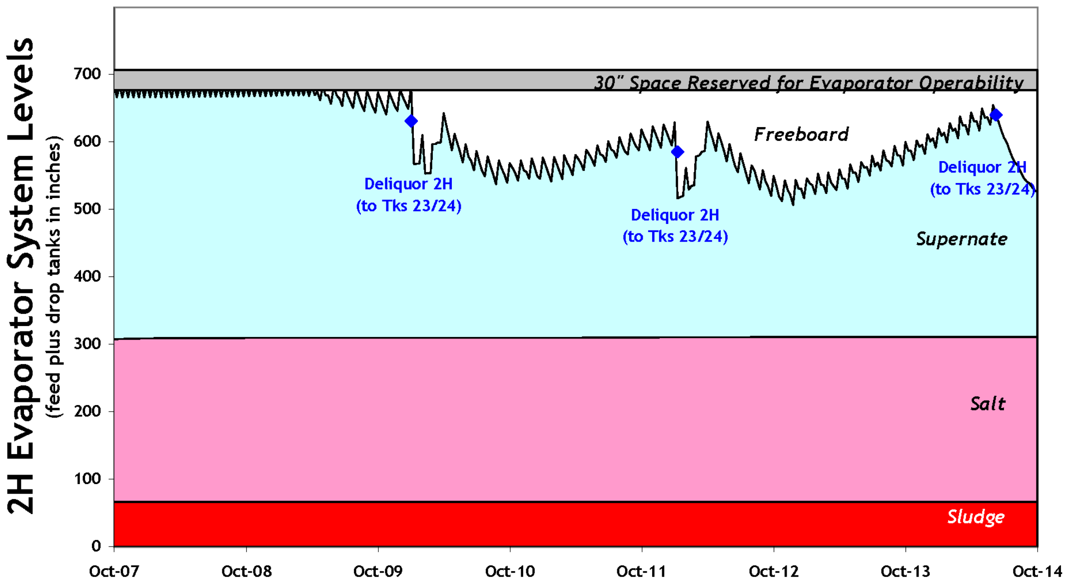


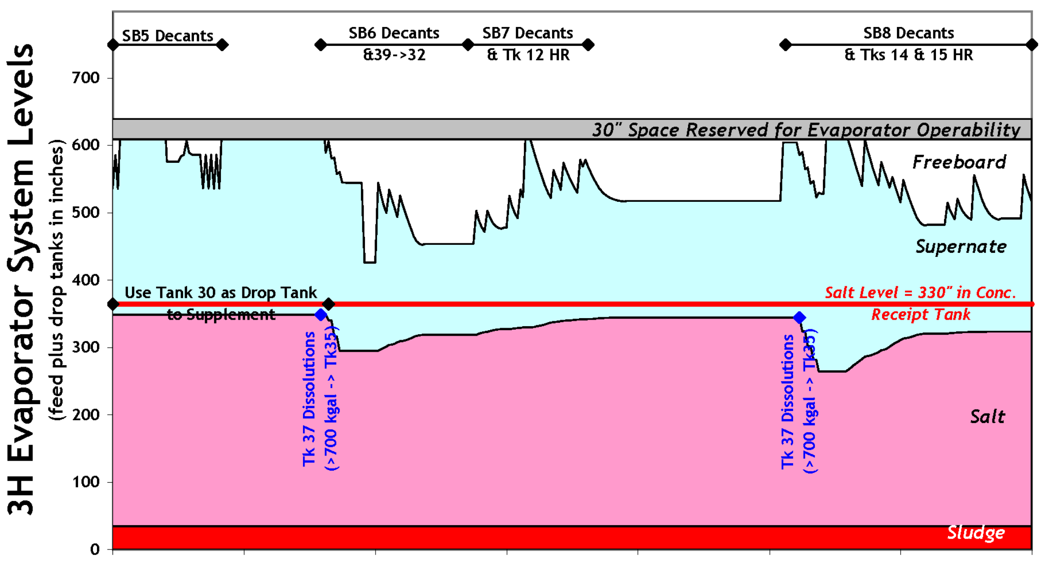
Appendix G — Remaining Tank Inventory



Appendix H — Evaporator System Levels (through FY14)







Appendix I — Acronyms

AB	Tank Farm **Authorization Basis**
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
Al Diss	**Aluminum Dissolution**
ALC-SC	**Administrative Law Court of South Carolina**
CERCLA	**Comprehensive Environmental Response, Compensation, and Liability Act** (aka SuperFund)
Ci/gal	Curies per gallon
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.
D&D	**Dismantlement and Decommissioning**
DDA	**Deliquification, Dissolution, and Adjustment** – process for treating salt that is low in activity by removing the interstitial liquid (deliquification), dissolving the salt that remains, and adjusting the salt concentration to acceptable SPF feed concentrations
DOE	**Department of Energy**
DOE-SR	The **DOE Savannah River** Operations Office
DPP	"*FY07–FY13 Liquid Waste **Disposition Processing Plan***" **Revision 0**– basis for near term planning of Liquid Waste operations in accordance with DOE requirements, commitments, and milestones
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**
EIS	**Environmental Impact Statement**
EPA	**Environmental Protection Agency**
ETP	**Effluent Treatment Project** (formally called 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
FTF	**F-Tank Farm**
gal/yr	**gallons per year**
GNAC	South Carolina **Governor's Nuclear Advisory Council**
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**
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
JCO	**Justification for Continued Operation**
kgal	**thousand gallons**
KTPB	potassium **t**etra**p**henyl**b**orate
LT Al Diss	**Low Temperature Aluminum Dissolution**
LLW	**Low Level Waste**
LLWD	This *Plan* – **Life-cycle Liquid Waste Disposition** System Plan – Similar to the DPP in that it is a comprehensive processing plan for disposition of waste originating from F- and H-Canyon receipts to disposal, either in SDF, treated and release to the environment, or shipped to a Federal Depository. Different from the DPP in that it covers the disposition of all contents for the life of the waste rather than limited to a specific duration.

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 ETP
LWO	**Liquid Waste Operations** – the portion of the WSRC company that manages liquid radioactive waste operations and disposal
MCi	**Million Curies**
MCU	**Modular CSSX Unit** – small-scale modular unit that removes cesium from supernate using a CSSX process similar to SWPF
MEP	**maximum extent practical**
Mgal	**million gallons**
MST	**monosodium titanate**
NDAA	Ronald W. Reagan **National Defense Authorization Act** for Fiscal Year 2005, Public Law 108-375
NEPA	**National Environmental Policy Act**
NPDES	**National Pollution Discharge Elimination Systems**
NRC	**Nuclear Regulatory Commission**
NWPA	**Nuclear Waste Policy Act**
OA	**Oxalic Acid**
PA	**Performance Assessment**
PEP	**Project Execution Plan**
PCA	**Pollution Control Act**
PMP	**Performance Management Plan**
PUV	**Plutonium Vitrification**
RBOF	**Receiving Basin for Off-site Fuel**
RCRA	**Resource Conservation and Recovery Act**
RMP	**Risk Management Plan** – LWO Programmatic Risk Assessment
SAS	**Steam Atomized Scrubbers**
SBP	**Sludge Batch Plan**
SCDHEC	**South Carolina Department of Health and Environmental Control** – state agency that regulates hazardous wastes at SRS
SDF	**Saltstone Disposal Facility** – vaults that receive wet grout from SPF, where it cures into a solid, non-hazardous Saltstone.
§3116	**Section 3116** – Defense Site Acceleration Completion — of the NDAA
SEIS	**Supplemental Environmental Impact Statement**
SIMP	**Systems Integrated Management Plan**
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
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
TPB	**t**etra**p**henyl**b**orate
UUM	**Unirradiated Uranium Material**
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**
WRP&S	F/H Area High Level **Waste Removal Plan and Schedule**
WSRC	**Washington Savannah River Company, LLC**
WTL	**Waste Transfer Lines**

References

[1] WSRC-OS-94-42, Federal Facility Agreement for the Savannah River Site, August 1993

[2] WSRC-TR-94-0608, *Savannah River Site Approved Site Treatment Plan, 2006 Annual Update*, Revision 14, November 2006

[3] Sellers, M.C., OCPM-06-037, *2006 Savannah River Site Environmental Management Program Project Execution Plan (PEP)*, July 2006

[4] Bodman, S.W., DOE-WD-2005-001, *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Revision 0, January 2006

[5] DOE-WD-2005-001, *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Revision 0, January 2006

[6] Thomas, S.A., LWO-PIT-2006-00017, *Savannah River Site – Liquid Waste Disposition Processing Strategy*, Revision 0, September 2006

[7] Caldwell, T.B., *et al.*, HLW-2002-00025, *High Level Waste System Plan Revision 13 (U)*, April 2002

[8] Caldwell, T.B., *et al.*, HLW-2002-00161, *PMP Supplement to HLW System Plan Rev. 13 (U)*, December 2002

[9] Chew, D. P., CBU-PIT-2005-00267, *Systems Integrated Management Plan*, Revision 1, July 2006

[10] d'Entremont, P.D., et al., CBU-PIT-2006-00070, *FY06-FY12 Liquid Waste Disposition Processing Plan*, Revision 0, May 2006

[11] Chew, D.P., LWO-PIT-2007-00003, *LW System Plan - Transfer Strategy*. Revision 5.4, January 2007

[12] Winship, G.C., Y-RAR-G-00022, *PBS-SR-0014C Radioactive Liquid Tank Waste Stabilization and Disposition (U) Risk Management Plan*, Revision 3, August 2007

[13] Rusche, B.C. *Governor's Nuclear Advisory Committee Comments on Accelerated Cleanup Program*, Letter, Ben Rusche, Chairman, to Charles A. Hanse, Assistant Manager for Waste Disposition Project, July 2004

[14] Olson, L.D., LWO-EVP-2007-00024, *Agreement on Key Input Bases and Assumptions for the Life-cycle Liquid Waste Disposition System Plan*, Revision 1, August 2007

[15] Spears, T.J., *Agreement on Key Input Bases and Assumptions for the Life-Cycle Liquid Waste System Plan (Your letter, 8/22/07)*, Revision 0, September 2007

[16] Cederdahl, B.A., LCW-SPT-00100, *Tank 48 Treatment Process Project G-2 Critical Decision 1 (CD-1) Package*, Revision 1, December 2006

[17] Shah, H.B., LWO-PIT-2007-00075, *Sludge Batch Washing and DWPF Sludge Batch Processing Inputs and Assumptions in Support of Life Cycle Plan-2007*, DRAFT

[18] Elder, H.H., *et al.*, CBU-PIT-2005-00144, *Sludge Batch Plan*, Revision 0, September 2005

[19] Elder, H.H. and Hamm, B.A., CBU-PIT-2006-00046, *Savannah River Site DWPF Sludge Feed Mass – Predicted vs. Measured*, Revision 0, March 2006

[20] Edwards, T.B., SRNL-SCS-2006-00021, *Estimating the Sludge Mass Remaining in SRS Waste Tanks after the Processing of Sludge Batch 4*, Revision 0, July 2006

[21] Hamm, B.A. and Elder, H.H., CBU-PIT-2006-00058, *Savannah River Site Sludge Characterization Model Using Dial-Up Factors*, March 2006

[22] Gillam, J.M., *et al.*, CBU-PIT-2005-00144, *Sludge Batch Plan*, Revision 1, July 2006

[23] Gillam, J.M., CBU-PIT-2005-00144, *Sludge Batch Plan*, Revision 2, July 2007

[24] Gillam, J.M., *et al.*, CBU-PIT-2005-00144, *Sludge Batch Plan*, Revision 3, DRAFT

[25] Price, M.R., M&O-MDO-2007-00054, *H-Area Liquid Waste Forecast Through 2019*, Revision 0, January 2007

[26] Daily, D.E., M-ESR-F-00109, *Tank 5 Sludge Volume Estimation after the Second Phase of Bulk Sludge Removal*, Revision 0, December 2005

[27] Le, T.A., LWO-PIT-2007-00072, *8/14/07 - August 2007 Curie and Volume Inventory Report*, Revision 1, August 2007

[28] Matthews, R.T., SW11.1-WTE-7.2, *Transfer Jet/Pump/Waste Downcomer Levels and Adjustments Data Sheet*, Revision 22 IPC 5, Immediate Procedure Change (IPC) 2, February 2007

[29] Waltz, R.S.,Jr., C-ESR-G-00003, *SRS High Level Waste Tank Leaksite Information*, Revision 2, March 2006

[30] Hobbs, D.T., WSRC-TR-95-0249, *Particle Size and Settling Velocity of Tank 41H Insoluble Solids*, May 1995

[31] Suggs, P.C. to Mahoney, M.J., PIT-MISC-0195, email *Long Term Processing Capacity of SWPF-Inputs to System Plan*, July 2006

[32] Hyche, J.P., LWO-CES-2007-00002, *Tanks 7, 18, and 19 Quantity Input for Corrosion Control*, Revision 0, January 2007

[33] Brooke, J. N., Peters, J. F., and K. Stahell, WSRC-TR-99-00358, *Hydrological Methods Can Separate Cesium from Nuclear Waste Saltcake*, 1999.

[34] Jilani, I.A., CBU-HCP-2005-00105, *H-Canyon Liquid Waste Generation Forecast For H-Tank Farm Transfer*, Revision 0, May 2005