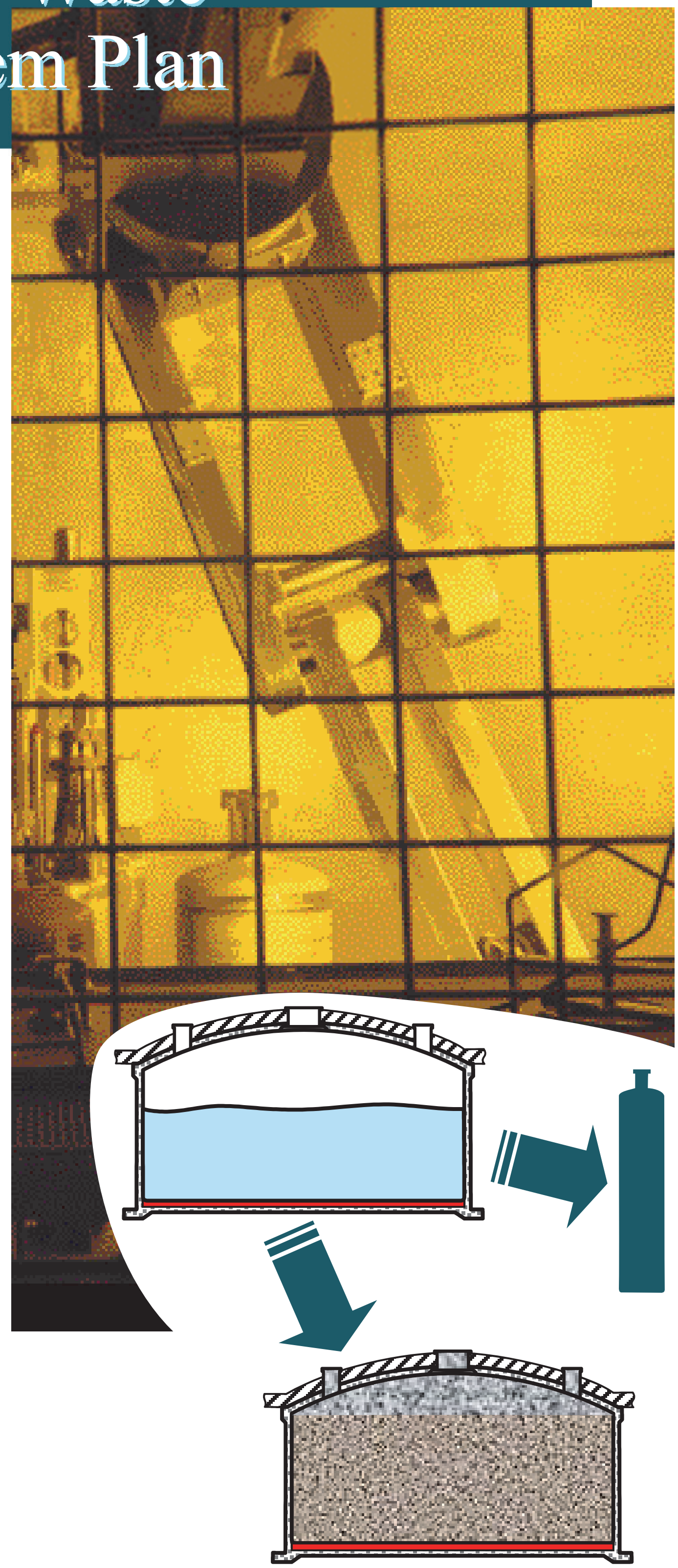
SRR-LWP-2009-00001

# LIQUID Waste System Plan



An Integrated System at the Savannah River Site

Savannah River Site Liquid Waste Planning Process

## REVISION 19

**May 2014**

SRR-LWP-2009-00001
REVISION: 19
May 15, 2014
KEYWORDS: Tank Farm, Salt Program
Saltstone, DWPF, Liquid Waste
SPF, ETF, Sludge Washing
Lifecycle, Waste Solidification
MCU, ARP, CSSX, SWPF

RETENTION: PERMANENT

# Liquid Waste System Plan
# Revision 19

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Prepared for U.S. Department of Energy under Contract No. DE-AC09-09SR22505

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# 1. Executive Summary

Treatment and disposition of salt waste is the critical path to completion of the Savannah River Site (SRS) Liquid Waste (LW) Disposition Program. During the period prior to startup of the Salt Waste Processing Facility (SWPF), salt waste disposition will continue through the Actinide Removal Process (ARP) and Modular Caustic Side Solvent Extraction (CSSX) Unit (MCU) facilities. Deliquification, Dissolution, and Adjustment (DDA) processing was required prior to startup of the ARP/MCU facilities to enable continued tank closure activities, to sustain sludge disposition activities in the Defense Waste Processing Facility (DWPF), and to minimize continued limited use of old-style tanks. During the DDA phase, approximately 2.8 million gallons (Mgal) of dissolved salt solution from Tank 41 and associated adjustment streams were dispositioned. Another 4.1 Mgal of salt waste has been dispositioned through ARP/MCU since startup in April 2008.

The June 2013 Revision 18[1] of the *LW System Plan* included updated inputs and assumptions. Revision 18 recognized challenges from the further delay of SWPF and its concomitant effect on regulatory milestones. Funding guidance for Fiscal Year 2014 (FY14), however, and projections for future years were significantly less than needed to execute the mission as outlined in Revision 18.

This nineteenth revision of the *Liquid Waste System Plan* (hereinafter referred to as the *Plan*), reducing the processing rate of DWPF and ARP/MCU, is predicated on the funding guidance provided in March 2014[2]. The reduced funding levels drove the need for a revised approach. This *Plan* mitigates the effect of these challenges by continuing to resequence the SRS LW Program in a way that integrates the optimum combination of facility operating schedules, supporting infrastructure upgrades, and workforce management actions to enable the completion of as many deliverables as possible under reduced funding. The overarching objective of this *Plan* is to ensure safe storage of the waste and minimize extension of the remaining time at risk associated with legacy high level waste storage in aging tanks.

Also important is timely approval of major scope items (e.g., Saltstone Disposal Unit 6 (SDU-6) and subsequent SDUs, additional Glass Waste Storage, etc.). This *Plan* assumes the availability of these facilities that require multi-year construction projects and approvals well before the need date. Delay in approving these major scope items increases the risk of accomplishment of the goals of this *Plan*.

Safe storage, risk reduction, and provision of necessary facilities are essential precursors to successful closure of waste tanks.

***Purpose***

The purpose of this *Plan* is to integrate and document the activities required to disposition the existing and future High Level Waste (HLW) and to remove from service radioactive LW tanks and facilities at the Department of Energy (DOE) at SRS. It records a planning basis for waste processing in the LW System through the end of the program mission. Development of this *Plan* is a joint effort between DOE-Savannah River (DOE-SR) and Savannah River Remediation LLC (SRR).

This *Plan* satisfies the contract deliverable described in Contract № DE-AC09-09SR22505; Part III — List of Documents, Exhibits, and Other Attachments; Section J — List of Attachments; Appendix M — Deliverables; Item № 1 — *Liquid Waste System Plan*.[3]

This nineteenth revision (Revision 19) of the *Plan*:

- Provides one of the inputs to development of financial submissions to the complex-wide Integrated Planning, Accountability, & Budgeting System (IPABS)
- Provides a technical basis for LW Contract and Contract Performance Baseline changes.

***Common Goals & Values***

The overarching principles which govern strategic planning and execution of the SRS Liquid Waste Disposition Program are summarized in the seven "Common Goals and Values" that were agreed upon by key stakeholders almost a decade ago. These remain the guiding goals and values for program execution and planning:

1. Reduce operational risk and the risk of leaks to the environment by removing waste from tanks, and closing the tanks.
2. Remove actinides from waste expeditiously since their impact on the environment is the most significant if a leak occurs.

3. Maximize amount of waste ready for disposal in deep geologic repository. Make significant effort to ensure maximum amount of long lived radionuclides are disposed in a deep geologic repository.
4. Remove as much cesium as practical from salt waste and dispose in parallel with vitrified sludge.
5. Dispose of cesium as soon as practical to avoid having cesium only waste when sludge vitrification is complete.
6. Limit disposal of radioactive waste onsite at SRS so that residual radioactivity is as low as reasonably achievable.
7. Ensure DOE's strategy and plans are subject to public involvement and acceptance.

***Goals***

The goals of previous revisions of this *Plan,* through Revision 17, have always been to meet *Federal Facility Agreement* (FFA)[4] and *Site Treatment Plan* (STP)[5] regulatory commitments. However, with the delays of SWPF beyond October 2014, as demonstrated in Revision 17, the following regulatory commitments have been adversely affected:

- Meet tank bulk waste removal efforts (BWRE) regulatory milestones in the currently-approved FFA
- Meet tank removal-from-service regulatory milestones in the currently-approved FFA
- Meet the waste treatment goals identified in the STP.

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

- Continue storing liquid radioactive wastes in a safe and environmentally sound manner
- Optimize program life cycle cost and schedule to minimize extension of the remaining time-at-risk associated with legacy high level waste storage in aging tanks
- Conduct operations consistent with the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[6], the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7], the *Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site*[8], the *Basis for Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site*[9], and future Waste Determination (WD) and Basis documents for H-Tank Farm
- Comply with applicable permits and consent orders, including the Modified Class 3 Landfill Permit for the SRS Z-Area Saltstone Disposal Facility (SDF) (permit ID 025500-1603) and State-approved area-specific General Closure Plans
- Provide tank space to support staging of salt solution adequate to feed ARP/MCU and SWPF per the inputs and assumptions
- Sustain sludge vitrification in the DWPF
- Minimize the quantity of radionuclides (as measured in curies) dispositioned in the SDF, keeping the total curies at or below the amount identified in *Savannah River Site – Liquid Waste Disposition Processing Strategy*[10] (SRS LW Strategy), as amended by letter from the South Carolina Department of Health and Environmental Control (SCDHEC) to DOE-SR[11] and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7]
- Support continued nuclear material stabilization of legacy materials in H-Canyon.

To enable continuation of risk reduction initiatives encompassed by the goals above, this *Plan* follows a processing strategy to provide the tank space required to support meeting, or minimizing impacts to meeting, programmatic objectives. During the period prior to startup of SWPF in 2018, near-term retrieval, treatment, and disposal of salt waste are required. The ARP/MCU facilities provide this treatment. Operation of these salt treatment processes frees up working space in the 2H and 3H Evaporators' concentrate receipt tanks (Tanks 38, 30, and 37). This provides support for near-term handling of waste streams generated from early-year tank removals from service, DWPF sludge batch preparation, DWPF recycle handling, and H-Canyon processing.

***Revisions***

The significant updates from the previous version of this *Plan,* the *Liquid Waste System Plan, Revision 18* (Rev 18)[1], include:

- Modifications required due to near-term funding limitation:
  - Delays in tank removal from service that are beyond FFA commitments for BWRE and operational closure (i.e., removal from service) commitments
- **Salt Processing**:
  - **SCIX Processing**: Suspend implementation of Small Column Ion Exchange (SCIX) due to lack of funding
  - **ARP/MCU Processing**: Reduced maximum ARP/MCU rate to 2 Mgal/yr from 4.7 Mgal/yr (due to limited SDU space prior to SDU-6 availability, then limited by availability of Glass Waste Storage locations)

- **Sludge Processing**
  - — The nominal canister rate prior to SWPF startup reduced to 165 from 275 (due to limited available Glass Waste Storage locations and ability to afford Sludge BWRE) with the objective of pouring the minimum number of canisters needed to support planned salt processing rates

***Results of the Plan***

Table 1-1 — *Results of the Plan* describes the major results as compared to Revision 18 of the *Plan*:

**Table 1-1 — *Results of the* Plan**

| Parameter | Revision 18 | This *Plan* |
|---|---|---|
| Date last LW facility turned over to D&D | 2034 | 2042 |
| All bulk waste removal currently-approved FFA commitments met | No | No |
| All yearly tank removal from service currently-approved FFA commitments met | No | No |
| Final FY2022 currently-approved FFA commitment met | No | No |
| Final Type I, II, and IV tanks complete operational closure | 2028 | 2032 |
| Complete bulk sludge treatment | 2026 | 2030 |
| Complete bulk salt treatment | 2028 | 2033 |
| Complete heel treatment | 2032 | 2039 |
| SCIX for supplemental salt waste treatment | Yes | No |
| Next generation extractant for increased SWPF throughput | Yes | Yes |
| Maximum canister waste loading | 40 wt% | 40 wt% |
| Nominal annual canister throughput rate | 275 | 275 |
| Total number of canisters produced | 7,824 | 8,582 |
| Total number of cesium-only canisters produced | 0 | 0 |
| Radionuclides (curies) dispositioned in SDF within the amended *SRS LW Strategy* | Yes | Yes |
| Radionuclides (curies) dispositioned in SDF within NDAA §3116 | Yes | Yes |
| Total number of SDUs | 12 | 13 |

- **SWPF Processing**: This *Plan* provides limited SWPF operations in the early years. After the first year, SWPF production is limited by blend tank availability, DWPF capability, SDU capacity, etc. Full capacity (9 Mgal/yr rate) is forecast to begin in FY25
- **Radionuclides Dispositioned in SDF**: This *Plan* is consistent with *SRS LW Strategy* as amended by letter from the SCDHEC to DOE-SR[11] and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7] concerning the total curies dispositioned at SDF
- **Vitrification of Sludge at DWPF**: This *Plan* reflects:
  - — reduced Low Temperature Aluminum Dissolution (LTAD) for some of the material in Tank 13 \
  - — lower waste loadings
  - — completion of sludge processing three years ahead of salt processing requires cans using sludge simulant. These will not be cesium-only as they continue to contain sludge heel waste
- **Supporting Nuclear Material Stabilization**: Tank Farm space exists to support limited receipt of projected H-Canyon waste through during FY14, FY15, and FY16. Beginning in FY17, Tank Farms will fully support H-Canyon receipts, assumed to be 300 thousand gallons (kgal) per year through the end of H-Canyon operations and shutdown flows. This *Plan* accommodates receipt of additional H-Canyon waste in Tank 50 or directly to sludge batches
- **Canister Storage**: This *Plan* limits DWPF production so as to delay completely filling Glass Waste Storage Building (GWSB) #2 until 2019. This assumes supplemental canister storage will become available in December 2018. Shipment of canisters from SRS is not included in this *Plan* since a repository has not been identified to date
- **SDU**: SDU-1 and SDU-4 are rectangular multi-cell units; no further contaminated grout is forecast for emplacement in these units. SDU-2, SDU-3, and SDU-5 (the current operating units) are dual cylindrical cell units with ~2.3 Mgal grout capacity (~1.3 Mgal Decontaminated Salt Solution or DSS) per cell. SDU-6 through SDU-13 are single cylindrical cell units with ~30 Mgal grout capacity (~17 Mgal DSS). One additional SDU is required due to the elimination of SCIX.

# 2. Introduction

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

The Tank Farms have received over 150 million gallons of waste from 1954 to the present. Having reduced the volume of waste via evaporation and dispositioned waste via vitrification and saltstone, the Tank Farms currently store approximately 37 million gallons of waste containing approximately 287 million curies of radioactivity. As of December 31, 2013, DWPF had produced 3,754 vitrified waste canisters. All volumes and curies reported as current inventory in the Tank Farms are as of December 31, 2013 and account for any changes of volume or curies in the Tank Farms since Revision 18 of the *Plan* and the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*.

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

Operating ARP/MCU as described in this *Plan* will enable continued stabilization of DOE Complex legacy nuclear materials. It will also increase the likelihood of feeding SWPF per the inputs and assumptions, which would not be possible without these treatment processes. Use of ARP/MCU allows DOE to complete cleanup and removal from service of the tanks years earlier than would otherwise be the case, which, in turn, will reduce the time during which the tanks — including several that do not have full secondary containment and some of which that have known history of leak sites — continue to store liquid radioactive waste.

The use of ARP/MCU and operation of DWPF has allowed BWRE to be completed for Tanks 4, 5, 6, 7, 8, 11, and 12. Additionally, salt dissolution from Tanks 25 and 37, enabling continued evaporation operations, would not have been feasible without the use of ARP/MCU. Elimination of most of the high-risk, mobile waste from the Type I and II tanks would not have been possible without the aggressive pursuit of salt processing, pending SWPF startup.

## 2.1 *Common Goals & Values*

The overarching principles which govern strategic planning and execution of the SRS Liquid Waste Disposition Program are summarized well in the seven "Common Goals and Values" that were agreed upon by key stakeholders almost a decade ago. These remain the guiding goals and values for program execution and planning:

1. **Reduce operational risk and the risk of leaks to the environment by removing waste from tanks, and closing the tanks**
   - Curie Workoff from ~550 million curies (MCi) in 1995 to 287 MCi in 2013 (~52 MCi in glass, 0.4 MCi in grout, and the remainder due to radioactive decay).
   - Of the 14 SRS tanks with leakage history (all old-style tanks):
     - 4 are operationally closed and grouted (Tanks 5, 6, 19, and 20)
     - 2 were cleaned (Tanks 12 and 16)
     - 4 contain essentially dry waste, with little or no free liquid supernate (Tanks 1, 9, 14, and 15)
     - 4 contain liquid supernate at a level below known leak sites (Tanks 4, 10, 11, and 13)
   - Of the 24 SRS old-style tanks:
     - 6 are grouted and operationally closed (Tanks 5, 6, 17, 18, 19, and 20)
     - 6 have had bulk waste removal efforts completed (Tanks 4, 7, 8, 11, 12, and 16)
   - Approximately 65% of old-style tank space is currently empty or grouted and approximately 17% of new-style tank space is empty.

2. **Remove actinides from waste expeditiously since they impact on the environment most significantly if a leak occurs.**
   - Actinides and other high activity components are being immobilized in glass as a top priority
   - To date, 3,754 canisters of waste (~44 % of the projected lifecycle total) have been vitrified
   - Canister waste loading has been raised from the originally planned ~28% to the current waste loading of ~36% and is planned to be maximized further to ~40%
   - In August 2013, DWPF set a production record of 40 canisters produced in a single month.
3. **Maximize amount of waste ready for disposal in deep geologic repository. Make significant effort to ensure maximum amount of long lived radionuclides are disposed in a deep geologic repository.**
   - To date, over 99% of the curies immobilized have been placed in glass in preparation for disposal in a deep geologic repository
   - Less than 1% of treated curies have been immobilized in grout
   - At mission completion, over 99% of treated curies are projected to have been immobilized in glass.
4. **Remove as much cesium as practical from salt waste and dispose in parallel with vitrified sludge.**
   - Only 15% of the volume of salt waste originally projected to be treated via DDA- only was actually treated with that process; the remainder will have been treated through processes with higher cesium removal efficiency
   - Extraction of cesium from salt waste through ARP/MCU began in 2008 and to date has been ~10 times more efficient than the original projection;
   - The cesium-laden MCU Strip Effluent (SE) stream is vitrified with sludge and disposed in canisters
   - Deployment of Next Generation Solvent (NGS) at MCU is projected to further improve cesium removal efficiency.
5. **Dispose of cesium as soon as practical to avoid having cesium only waste when sludge vitrification is complete.**
   - To date, 6.9 million gallons (Mgals) of salt waste (~6% of the projected lifecycle total) have been treated and disposed
   - Allocation of available resources is focused on maintaining the pace of risk reduction through waste treatment and immobilization
   - The contribution of ARP/MCU will be enhanced and maximized by deploying NGS to increase cesium removal efficiency
   - With the disposition of MST sludge from salt processing and sludge heel processing, no cesium only canisters will be produced.
6. **Limit disposal of radioactive waste onsite at SRS so that residual radioactivity is as low as reasonably achievable.**
   - Formal Performance Assessments of low level waste disposal and operational closure of tanks, coupled with cost to benefit evaluations prior to cessation of tank waste removal activities, support that any residual future impacts from onsite waste disposal are well within the requirements of all applicable federal and state laws and regulations and are as low as reasonably achievable
   - Based on operational experience, over 95% of the radioactive inventory in a tank has been removed after bulk waste removal and heel dilution; over 99% of the radioactive inventory has been removed after final cleaning
   - At mission completion, over 99% of treated curies are projected to be immobilized in glass and packaged for offsite disposal in a deep geologic repository
   - The originally agreed upon projection for onsite emplacement in engineered disposal units from liquid waste treatment and disposition was 3 MCi (2.5 MCi from DDA-only; 0.3 MCi from ARP/MCU; and 0.2 MCi from SWPF). That agreement was reduced to 0.8 MCi in August 2011[11] based on progress as of 2011.
7. **Ensure DOE's strategy and plans are subject to public involvement and acceptance.**
   - The formal processes for evaluation, determination, and execution of all tank waste removal, disposal, and operational closure fully involves SCDHEC, the Environmental Protection Agency (EPA), and the Nuclear Regulatory Commission (NRC)
   - Various formal hold points exist in these processes for public involvement and comment
   - All SRS Liquid Waste Disposition activities fall within the purview of the Defense Nuclear Facilities Safety Board (DNFSB) oversight, and DNFSB periodically issues publically accessible reports of their evaluations and conducts periodic meetings to receive public input regarding their activities
   - The SRS Citizen's Advisory Board receives routine updates in a public venue regarding all SRS Liquid Waste Disposition activities

- Annual updates to this *Plan* are provided to all regulatory and oversight entities and made available for public review
- Quarterly updates of radiological inventory additions to SDUs are posted to a publically accessible website
- SRR monthly and annual reports of progress towards disposition of SRS Liquid Waste are available to the public.

## 2.2 Goals

The overarching priorities for development of this *Plan* are:

1. Continued Safe Storage of liquid waste in tanks and vitrified canisters in storage
2. Maximize Risk Reduction through Waste Disposition
3. Tank Cleaning and Grouting.

***Development of Priorities for this Plan***

The overarching priorities are expressed through specific goals related to the various parts of the LW system. As documented in Revision 17 of this *Plan*, startup of SWPF by October 2014 was necessary to achieve compliance with all regulatory requirements. The current forecast availability of SWPF, however, adversely affects the following regulatory commitments:

- Meet tank bulk waste removal efforts regulatory milestones in the currently-approved FFA
- Meet tank removal-from-service regulatory milestones in the currently-approved FFA
- Meet the waste treatment goals identified in the STP.

In addition, projected funding in Revision 19 is insufficient to perform all activities desired for maximum performance of the Liquid Waste scope. A review of the prioritization methodology presented in Revision 18 confirmed its advisability for use in this revision. Given the limited funding and the SWPF forecast, prioritization criteria have been applied to guide allocation of the funding to the activities that provide the best value to DOE. A full discussion of the implications of these two options is found in Appendix I — *Priority Analysis (from Revision 18 of the* Plan).

Briefly, two sets of prioritization criteria were evaluated:

Option A (Closure Acceleration Priority)

1. Safe Storage
2. Tank Cleaning & Grouting
3. Hazard Elimination & Risk Reduction

Option B (Risk Reduction Priority)

1. Safe Storage
2. Hazard Elimination & Risk Reduction
3. Tank Cleaning & Grouting

Option A prefers funding final cleaning and grouting, maximizing compliance with near term regulatory requirements, over activities that maintain waste processing rates. Option B prioritizes activities that maintain optimal sludge and salt processing over cleaning and grouting activities. It bears repeating that focusing on tank closure in the near term ultimately delays closure of the last old-style tank. Additionally, a consequence of focusing on near term closures is the significant increase in unstabilized curies remaining in the waste tanks longer. The significant real benefit of maximized risk reduction far outweighs the limited perceived benefit of near term closures.

***Goals for this Plan***

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

- Continue storing liquid radioactive wastes in a safe and environmentally sound manner
- Optimize program life cycle cost and schedule to minimize extension of the remaining time at risk associated with legacy high level waste storage in aging tanks
- Conduct operations consistent with the *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[6], the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7], the *Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site*[8], the *Basis for Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site*[9], and future WD and Basis documents for H-Tank Farm
- Satisfy applicable permits and consent orders, including the Modified Class 3 Landfill Permit for the SRS Z-Area SDF (permit ID 025500-1603) and State-approved area-specific General Closure Plans

- Provide tank space to support staging of salt solution adequate to feed ARP/MCU and the SWPF per the inputs and assumptions
- Sustain sludge vitrification in the DWPF
- Minimize the quantity of radionuclides (as measured in curies) dispositioned in the SDF, keeping the total curies at or below the amount identified in the *SRS LW* Strategy[10] as amended by letter from the SCDHEC to DOE-SR[11] and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7]
- Support continued nuclear material stabilization of legacy materials in H-Canyon.

The following generalized priorities guide the sequencing of waste removal and disposition from the Liquid Radioactive Waste tanks:

1. Remove waste from tanks with a leakage history, while safely managing the total waste inventory
2. Ensure the curies dispositioned to the SDF are at or below the amount identified in the *SRS LW Strategy* as amended by letter from the SCDHEC to DOE-SR and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7]
3. Provide tank space to support staging of salt solution adequate to feed salt solution to ARP/MCU and SWPF per the inputs and assumptions
4. Provide tank space to support staging of sludge adequate to feed DWPF
5. Support removal from service of Type I, II, and IV tanks to meet currently approved FFA commitments
6. Support continued nuclear material stabilization in H-Canyon.

There is currently a premium on processing and storage space in the SRS radioactive liquid waste tanks. To enable continuation of risk reduction initiatives encompassed by the goals above, this *Plan* follows a processing strategy providing the tank space required to meet, or minimizing impacts to meeting, programmatic objectives. During the period prior to startup of SWPF in 2018, near-term retrieval, treatment, and disposal of salt waste are required. The ARP/MCU facilities perform this treatment. Operation of these salt treatment processes frees up working space in the 2H and 3H Evaporators' concentrate receipt tanks (Tanks 38 for 2H, and 30 and 37 for 3H). This provides limited support for near-term handling of waste streams generated from early-year tank removals from service, DWPF sludge batch preparation, DWPF recycle handling, and H-Canyon processing.

These initiatives and the assumed SWPF startup in 2018 provide tank space to minimize impacts to the programmatic objectives. Currently, there are approximately 37 million gallons of liquid waste stored on an interim basis in 43 underground waste storage tanks. Since 1996, the Liquid Waste Program at SRS has been removing waste from tanks, pre-treating it, vitrifying it, and pouring the vitrified waste into canisters for long-term storage and disposal. Through December 2013, 3,754 canisters of waste (containing ~52 million curies) have been vitrified. Canister waste loading has been raised from the originally planned ~28% to the current waste loading of ~36% and is planned to be maximized further to ~40%. The canisters vitrified to date have contained sludge waste and, since April 2008, processed salt waste. These canisters represent ~44% of sludge waste immobilization lifecycle and ~6% of salt waste disposition lifecycle.

Approximately 65% of the old-style tank nominal space is currently empty or grouted and approximately 17% of the new-style tank nominal space is empty. Of the 24 old-style tanks in the SRS Liquid Waste System, six are grouted and operationally closed, two have been cleaned and, pending regulatory approval, are ready to be closed, and four others have had bulk waste removed. Based on operational experience, over 95% of the radioactive inventory in a tank has been removed after bulk waste removal and heel dilution; over 99% of the radioactive inventory has been removed after cleaning.

Space in new-style tanks is used for various operations for waste processing and disposal. Tank space is recovered through evaporator operations, DWPF vitrification, ARP/MCU treatment, and saltstone disposal. This valuable space has been used to: (1) prepare, qualify, and treat sludge waste for disposal; (2) prepare, qualify, treat, and dispose salt waste; (3) retrieve waste from and clean old-style tanks; and (4) support nuclear materials stabilization and disposal through H-Canyon. The Tank Farm space management strategy is based on a set of key assumptions involving projections of DWPF canister production rates, influent stream volumes, Tank Farm evaporator performance, and space gain initiative implementation. The processing of salt and sludge utilizes new-style tank space to retrieve and prepare waste from old-style tanks, and therefore nominal empty space in new-style tanks will increase only after all waste in old-style tanks is processed. Sludge processing through the DWPF removes the highest risk material from the old-style tanks. However, for every 1.0 gallon of sludge processed, 1.3 gallons of salt waste is formed due to sludge washing and DWPF processing operations to return the resulting low hazard salt waste to the Tank Farm. Similarly, salt waste retrieval, preparation, and batching typically require the use of about three gallons of tank space per gallon of salt waste treated. Given these parameters, the "key to reducing the overall risk is processing high-level waste as expeditiously as possible and managing the total tank space efficiently," as recognized by the DNFSB letter dated January 7, 2010[12].

New-style tank space is a currency used to prepare for permanent immobilization and disposition of high level waste in a vitrified waste form and low-level waste in a grouted waste form. The tank space management program maintains sufficient space in the new-style tanks to allow continued DWPF operations. The tank space management program also provides the necessary tank space to support staging of salt solutions to sustain salt waste disposition currently through ARP/MCU and subsequently through SWPF. Of the 27 new-style tanks (with a total volume of 35 million gallons) in the SRS Liquid Waste System:

- 5 (Tanks 38, 41, 43, 49, and 50) are dedicated to salt batching, qualification, and disposition (including DWPF recycle beneficial reuse and the 2H Evaporator)
- 6 (Tanks 29, 30, 32, 37, 40, and 51) are dedicated to sludge batching, qualification, and disposition (including the 3H Evaporator)
- 1 (Tank 39) is dedicated to uninterrupted H-Canyon waste receipts
- 15 (Tanks 25, 26, 27, 28, 31, 33, 34, 35, 36, 42, 44, 45, 46, 47, and 48) are dedicated to safe storage of legacy liquid waste pending retrieval and disposition.

There are currently ~6 Mgals of empty space (~17%) in these new-style tanks:

- 2.4 Mgals is margin as defense-in-depth operational control coupled with Safety Class or Safety Significant (SC/SS) structures, systems, or components (SSC) to facilitate reasonably conservative assurance of more than adequate dilution and ventilation of potentially flammable vapors
- 1.3 Mgals is procedurally-required minimum contingency space for recovery from the unlikely event of a bulk waste leak elsewhere in the system
- 2.3 Mgals is operational “working” space variously used to provide:
  - Additional contingency transfer space as operational excess margin above the procedurally-required minimum
  - Excess margin to preserve salt batch quality and maintain uninterrupted treatment and disposition through ARP/MCU and Saltstone
  - Excess margin to preserve sludge batch quality and maintain uninterrupted immobilization through DWPF
  - Excess margin to preserve uninterrupted support for H-Canyon.

## 2.3 ***Risk Assessment***

The *PBS-SR-0014, Radioactive Liquid Tank Waste Stabilization and Disposition, Risk and Opportunity Management Plan*[13] (ROMP) documents the comprehensive identification and analysis of technical risks and opportunities associated with the LW program. It identifies individual technical and programmatic risks and presents the strategies for handling risks and opportunities in the near-term and outyears.

# 3. Planning Bases

This *Plan* is based on inputs and assumptions provided by DOE[14,15,16]. 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 yet to be fully defined. The sequence of activities reflects the best judgment of the planners. The individual activity execution strategies contain full scope, schedule, and funding development. Upon approval of scope, cost, and schedule baselines modifications of this *Plan* may be required.

## 3.1 *Funding*

Progress toward the ultimate goal of immobilizing all the LW at SRS is highly dependent on available funding. This *Plan* was developed assuming the availability of the funding required as specified in *DE-AC-09SR22505: Savannah River Remediation (SRR) Office of Environmental Management (EM) Interim Fiscal Year (FY) 2014 Expected Funds*[2]. It supports justification for requesting necessary funding profiles. With any reduction from full funding, activities that ensure safe storage of waste claim first priority. Funding above that required for safe storage enables risk reduction activities, i.e., waste removal, treatment — including immobilization — and removal from service, as described in this *Plan*.

## 3.2 *Regulatory Drivers*

Numerous laws, constraints, and commitments influence LW System planning. Described below are requirements most directly affecting LW system planning. This *Plan* assumes the timely acquisition of regulatory approvals.

***South Carolina Environmental Laws***

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

- SCDHEC Bureau of Water:
  - Industrial wastewater treatment facility permits (e.g., Tank Farms, DWPF, ARP/MCU, Effluent Treatment Facility [ETF], and the SPF)
  - National Pollutant Discharge Elimination System (NPDES) permit (H-16 Outfall discharges from ETF)
- SCDHEC Bureau of Air Quality:
  - Part 70 Air Quality Permit (one Site-wide Air Permit including the LW facilities).

***Site Treatment Plan (STP)***

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

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

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

***Federal Facility Agreement (FFA)***

The EPA, DOE, and SCDHEC executed the SRS FFA[4] on January 15, 1993, which became effective August 16, 1993. It provides standards for secondary containment, requirements for responding to leaks, and provisions for the removal from service of leaking or unsuitable LW storage tanks. Tanks scheduled for operational closure may continue to be used, but must adhere to the FFA schedule for operational closure and the applicable requirements contained in the Tank Farms' industrial wastewater treatment facility permit. An agreement between DOE, SCDHEC, and EPA (*Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18*[17] effective in November 2007) modified the FFA by providing for the submission of Waste Determination documentation for F- and H-Tank Farms and including end dates for BWRE and the operational closure of each old style tank. The FFA requires SRS to operationally close the last Type I, II, and IV tank no later than 2022.

***National Environmental Policy Act***

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

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

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

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

## 3.3 *Revisions*

The significant updates from the previous version of this *Plan,* the *Liquid Waste System Plan, Revision 18*[1], include:

- Modifications required due to near-term funding limitation:
  - Delays in tank removal from service that are beyond FFA commitments for BWRE and operational closure commitments
- **Salt Processing**:
  - **SCIX Processing**: Suspend implementation of SCIX (due to lack of funding)
  - **ARP/MCU Processing**: Reduced maximum ARP/MCU rate to 2 Mgal/yr from 4.7 Mgal/yr (due to limited SDU space prior to SDU-6 availability, then limited by availability of Glass Waste Storage locations)
- **Sludge Processing**
  - The nominal canister rate prior to SWPF startup reduced to 165 from 275 (due to limited available Glass Waste Storage locations and ability to afford Sludge BWRE) with the objective of pouring the minimum number of canisters needed to support planned salt processing rates

## 3.4 *Key Milestones*

Key Milestones are those major dates deemed necessary under this *Plan* to remove waste from storage, process it into glass or saltstone, and close the LW facilities. The *LW System Plan, Revision 18* milestones are provided for comparison.

**Table 3-1 — *Key Milestones***

| Key Milestone | Revision 18 | this *Plan* |
|---|---|---|
| Date last LW facility turned over to D&D | 2034 | 2042 |
| BWRE complete for Type I, II, and IV tanks | 2023 | 2028 |
| Final Type I, II, and IV tanks complete operational closure | 2028 | 2032 |
| Complete bulk sludge treatment | 2026 | 2030 |
| Complete bulk salt treatment | 2028 | 2033 |
| Complete heel treatment | 2032 | 2039 |
| Total number of canisters produced | 7,824 | 8,582 |
| Supplemental canister storage required | Dec 2016 | Oct 2018 |
| Initiate ARP/MCU Processing | Apr 2008 (actual) | Apr 2008 (actual) |
| – *Deploy next generation extractant at MCU* | Oct 2013 | Sep 2013 (actual) |
| Initiate SCIX Processing | April 2019 | n/a |
| Initiate SWPF Processing | Oct 2018 | Oct 2018 |
| – *Salt Solution Processed via DDA-solely* | *2.8 Mgal (actual)* | *2.8 Mgal (actual)* |
| – *Salt Solution Processed via ARP/MCU* | *21 Mgal* | *11 Mgal* |
| – *Salt Solution Processed via SCIX* | *24 Mgal* | *n/a* |
| – *Salt Solution Processed via SWPF* | *61 Mgal* | *102 Mgal* |
| Number of SDU *(note SDU-6–SDU-13 are high capacity SDUs)* | 12 | 13 |
| – *SDU 6 available* | *July 2015* | *May 2017* |

- **Canister Storage**: This *Plan* limits DWPF production so as to delay completely filling Glass Waste Storage Building (GWSB) #2 until supplemental canister storage becomes available in 2019
- **SDU**: This *Plan* limits ARP/MCU production so as to delay completely filling SDU-3 and SDU-5 until SDU-6 becomes available. An additional SDU is required due to the cancellation of SCIX. Treatment via SWPF is assumed to produce approximately 1.3 gallons of DSS for each gallon of feed while SCIX was forecast to produce only one gallon of DSS. Processing the 24 Mgal of SCIX via SWPF increased the total DSS processed at SPF by over 6.5 Mgal (12 Mgal of grout).

# 4. Planning Summary and Results

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

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

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

- Appendix A — *Sludge Processing*
- Appendix B — *Canister Storage*
- Appendix C — *Salt Solution Processing*
- Appendix D — *Salt Batch Composition*
- Appendix E — *Tank Farm Influents and Effluents*
- Appendix F — *BWRE & Removal from Service*
- Appendix G — *Remaining Tank Inventory*
- Appendix H — *LW System Plan — Revision 19 Summary*

## 4.1 *Disposition of Sludge Waste*

The basic steps for sludge processing (Figure 4-1) are:

1. Sludge removal from tanks
2. Blending and washing of sludge (in Tank 51)
3. Sludge feeding to the DWPF (from Tank 40)
4. Vitrification in DWPF.

***Sludge processing***

Sludge processing is paced by available canister storage, ability to afford sludge BWRE, and by tank storage space to prepare sludge batches. Sludge batch planning uses the estimated mass and composition of sludge and known processing capabilities to optimize processing sequences. Sub-tier plans document the modeling, guide the sequence of waste removal, and support a more detailed level of planning. These sub-tier plans are revised as new information becomes available or when significant updates in the overall waste removal strategy are made. The specific input to this *Plan* from sludge batch planning is summarized in *Sludge Batch Plan in Support of System Plan Rev. 19*[18].

Differences in sludge batch sequencing, total number canisters produced, and batch end dates between *Sludge Batch Plan in Support of System Plan Rev. 19* and *Sludge Batch Plan in Support of System Plan Rev. 18*[19] are mainly driven by the following:

- This *Plan* assumes the use of LTAD for Sludge Batch (SB) 10 through 13
  - — The remaining Tank 13 sludge is no longer targeted for LTAD
  - — Tank 15 sludge is targeted for LTAD assuming Tank 8 can be used for leachate storage
- This *Plan* assumes 23 total sludge batches
  - — Batches 21–23 are primarily sludge heels, insoluble salt, and oxalates
- The projected canister pour rate is reduced to ~165 canisters per year from 275 prior to SWPF startup.

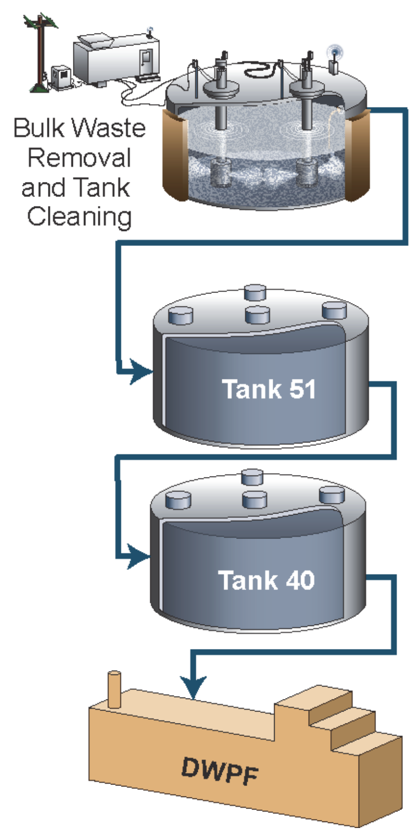



**Figure 4-1 — *Sludge Feed Preparation***

***Sludge Feed Preparation***

This *Plan* uses a single sludge tank (Tank 51) as the sole DWPF feed preparation tank (see Figure 4-1).

***Sludge Washing***

Sodium and other soluble salts (e.g., sulfates, nitrates, nitrites) in DWPF feed are reduced through sludge washing. Sludge washing is performed by adding water to the sludge batch, mixing with slurry pumps, securing the pumps to allow gravity settling of washed solids, and decanting the sodium-rich supernate to an evaporator system for concentration. This cycle is repeated until the desired molarity (e.g., 1.25 M Na) is reached. Some types of sludge settle slowly, extending wash cycles. Sludge settling and washing typically constitutes ~75% of batch preparation time. The total number of washes performed and volume of wash water used are minimized to conserve waste tank space. Sludge batch size and wash volumes are also limited by the hydrogen generation rate associated with radiolysis of water. Tank contents are mixed on a periodic frequency to release hydrogen retained within the sludge layer, resulting in a limited window within operating constraints for gravity settling.

## 4.2 ***DWPF Operations***

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

Historically, melter performance has been the limiting factor for DWPF throughput. The DWPF melter (without bubblers) had produced an average of 215 canisters/yr before melter bubblers were installed. Bubblers installed in September 2010, however, improved the demonstrated melter capacity to a rate of 40 canisters/month (480 canisters/year), resulting in a record 277 canisters poured in FY12. Tank Farm sludge waste feed preparation has been analyzed to be capable of supporting a canister production capability of 275 canisters/year while feed preparation systems internal to DWPF have demonstrated a capacity of greater than 325 canisters/year, e.g., the 337 canisters poured from July 2011 thru June 2012.

Sludge Batch 7B processing challenges were encountered towards the end of FY12 and continued to be experienced during the first part of FY13. The primary challenge was associated with sludge carryover into the vessel vent and recycle collection systems. Mitigation efforts were focused in the following areas:

- **Compliance with Technical Safety Requirement (TSR) Specific Administrative Controls (SAC)**
  - The time consuming laboratory analytical method to determine solids content of recycle material was replaced by implementing a turbidity instrument for solids carryover detection. This effort reduced cycle time by 20 hours per batch
  - The recycle system is maintained under caustic and nitrite inhibited conditions providing additional operational flexibility and improved cycle times
  - Digital Control System (DCS) Software was developed and loaded to increase the ability to both detect the onset of and provide control action to prevent sludge carryover events
  - Process vessel air purge system modifications were performed.
- **Chemical Process Cell Processing with Certainty**
  - An independent team of local (i.e. SRNL & SRR) experts was assembled to review past processing data. The team of experts provided recommendations for both batch processing and carryover prevention
  - DWPF completed a 14 day outage to flush and clean the Process Vessel Vent system in order to restore proper flows to this system following system degradation caused by sludge carryover.

Near-term improvements are complete and historical canister productions rates have once again been demonstrated — a record 40 canisters were poured in August 2013.

***Total Canister Count***

The total canister production increases to 8,582 from 7,824 in Rev 18. This is largely due to the addition of sludge modifier to sludge batches to maintain the production rate of 276 canisters/year after SWPF startup. The rate of 276 canisters/year supports the disposition of the strip effluent volume generated by the 9M gallon/year SWPF processing rate. Table 4-1 provides an estimated breakdown of the impacts to the canister count difference between Rev 18 and this *Plan*.

Beginning as early as Sludge Batch 12, trim chemicals (e.g., iron or depleted uranium) may need to be added to some sludge batches. Similarly, with the completion of bulk sludge processing in 2030 — three years prior to salt processing completion — some cans with minimal radioactive sludge components are produced. The glass canisters generated in the later years of salt waste disposition will contain sludge from heel removal and chemical cleaning of tanks in support of the tank closure program. These cans, however, will require the addition of sludge simulant to make acceptable quality glass.

Disposition of salt waste in canisters requires a sludge component because DWPF is designed to disposition sludge waste, supplemented with salt waste when available. Facility infrastructure; such as pumps, transfer lines, and tank mixers; were designed for a sludge type waste. In this *Plan*, completion of bulk sludge disposition occurs before the end of salt disposition. To counteract the resultant sludge deficit, some quantity of synthetic sludge is added. The synthetic sludge is a mixture of oxides of iron, manganese, nickel, aluminum and other metals. This type of material has been made in the past to support the cold start-up of the DWPF and is also made to support sludge batch qualification studies conducted by SRNL. For this *Plan*, the synthetic sludge is made up as if it was PUREX waste. PUREX waste is high in iron and is needed to offset the high aluminum found in HM waste. The amount of synthetic sludge needed per can, the composition of the synthetic sludge, and the best addition point for the synthetic sludge will be determined before these canisters are produced.

**Table 4-1 — *Difference in Canisters Produced: this* Plan *vs. Rev 18***

| Reasons for Changes in Canisters count | Change in Cans |
|---|---|
| **Rev 18 projected canisters** | **7,824** |
| Increase due to estimated Tk 22 inventory | +289 |
| Decrease due to estimated Tk 13 inventory (pre SB9 basis) | -189 |
| Increase due to estimated Tk 39 inventory and future receipts | +132 |
| Increase due to estimated Tank 51/SB8 inventory | +41 |
| Increase due to addition of sludge modifier | +636 |
| Decrease due to elimination of CST usage (No SCIX) | -117 |
| Increase due to MST usage | +15 |
| Decrease due to 18,000 kg more dissolution with LTAD | -26 |
| Decrease due to more washing (1.25 M from 1.5 M [Na]) | -222 |
| Additional canisters due to miscellaneous changes (e.g., heel processing projections, and compositional changes) | +199 |
| **This *Plan* projected canisters** | **8,582** |

It should be noted that advanced frit formulations and development of a salt-focused flowsheet for DWPF could reduce or eliminate the need for synthetic sludge or sludge modifiers.

***Two-step Production Improvement Approach***

To support higher glass throughput, the DWPF melter was retrofitted with four bubbler systems and the melter off-gas system was optimized in September 2010. The second step of DWPF production capacity improvement program addresses streamlining the DWPF feed preparation system. Several process improvements are planned to streamline the DWPF feed preparation system:

- Implementation of an alternate reductant
- Processing of cesium strip effluent in the slurry mix evaporator (SME)
- Addition of dry process frit to the SME

The feed preparation modifications reduce recycle water generation by using dry process frit:

Reduction of liquid addition in DWPF supports receipt of Strip Effluent (SE) from SWPF. Beneficial reuse of DWPF recycle for waste removal and tank cleaning, in lieu of water additions, supplements recycle reduction and supports maintenance of Tank Farm capacity (see §4.6 below).

The DWPF production rate (prior to the bubbler installation) averaged 215 canisters per year with ~4,000 pounds of glass per canister. The production rate improvement initiatives enable a higher nominal DWPF canister production capability of 275 canisters/year. Relative to previous plans, canister production is limited until sufficient supplemental canister storage is available.

Future estimated canister production, by year is shown in Table 4-2 — *Planned DWPF Production Rates*. The canister rates assume two one-week outages every year to allow for routine planned maintenance and another two week site-wide steam outage each year.

**Table 4-2 — *Planned DWPF Production Rates***

| FY | Nominal Rate *(Canisters/yr)* | Outage *(Months)* | Total DWPF Canisters poured *(Canisters)* |
|---|---|---|---|
| FY14 | 120 | | 120 |
| FY15 | 156 | | 156 |
| FY16 | 204 | 4[a] | 136 |
| FY17 | 168 | | 168 |
| FY18 | 240 | 4[b] | 160 |
| FY19 | 276 | | 276 |
| FY20 | 276 | | 276 |
| FY21 | 276 | | 276 |
| FY22 | 276 | | 276 |
| FY23 | 276 | | 276 |
| FY24 | 276 | 4 [a] | 184 |
| FY25 | 276 | | 276 |
| FY26 | 276 | | 276 |
| FY27 | 276 | | 276 |
| FY28 | 276 | | 276 |
| FY29 | 276 | | 276 |
| FY30 | 276 | | 276 |
| FY31 | 276 | | 276 |
| FY32 | 276 | | 276 |
| FY33 | (sludge heels) | 4 [a] | 81 [c] |
| FY34 | (sludge heels) | | 30 |
| FY35 | (sludge heels) | | 44 |
| FY36 | (sludge heels) | | 44 |
| FY37 | (sludge heels) | | 52 |
| FY38 | (sludge heels) | | 67 |

[a] Four-month melter outage is assumed every eight years during sludge processing. Actual melter change-out is determined by melter performance. This schedule would have a melter change in FY32, the last full year of SWPF production. A one-year extension is provided to support uninterrupted SWPF production

[b] Four-Month outage in 2018 to accommodate transition to SWPF-DWPF coupled operations — assumes no canister production rate impact from coupled SWPF-DWPF operations

[c] Lower production rate assumed after completion of SWPF processing at 9 Mgal/yr for dilute heel processing beginning in 2033.

***Failed Equipment Storage Vaults and Melter Storage Boxes***

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

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

FESV #1 remains available for use with Melter 2. Construction of MSB #2 was completed in October 2008. MSB #2 is currently stored in FESV #1 awaiting use during the Melter 2 replacement outage currently forecast in this *Plan* to occur in 2016. Space has been reserved for construction of up to ten FESVs, if needed.

Under the current planning basis, the need date for FESV #3 and #4 will be triggered by the failure of Melter 3. Melter 3 is currently scheduled to be placed into service in October 2016. Based upon this strategy, FESVs #3 and #4 construction should be completed and available for service by April 2016 (approximately six months prior to the planned installation of Melter 3). Likewise, MSB #3 should be constructed and available to receive Melter 3 by April 2016. The need dates for FESV #3 and #4 and successive pairs of vaults will be evaluated on an ongoing basis.

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

***Glass Waste Canister Storage***

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

GWSB #1 consists of a below-grade seismically qualified concrete vault containing support frames for vertical storage of 2,262 standard canisters. Eight of these positions have been abandoned due to construction defects and three contain archived non-radioactive glass filled canisters. As of December 31, 2012, 2,244 standard positions are in use storing radioactive canisters, the remaining 7 being contingency positions for placement of canisters if GWSB #2 is temporarily unavailable.

GWSB #2, with a similar design to GWSB #1, has 2,340 standard storage locations. The first radioactive canister was placed in GWSB #2 on July 10, 2006. One archived non-radioactive canister is in GWSB #2. As of December 31, 2013, GWSB #2 stored 1,496 canisters. The total storage capacity of GWSB #1 and #2 for standard radioactive storage is 4,590. Note that the 3,740 canisters stored in GWSBs is less than the 3,752 poured due to leak checked canisters stored in the vitrification building pending decontamination and processing.

Additional glass waste storage capacity is planned for availability beginning in FY19. To ensure continued operations, DWPF processing capacity is limited until this supplemental glass waste storage becomes available.

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

## 4.3 *Disposition of Salt Wastes*

As highlighted in the Introduction, this *Plan* includes the use of a series of salt treatment processes over the life of the program, including ARP/MCU and SWPF. *Appendix C — Salt Solution Processing* reflects the breakdown of the volumes treated from each of the processes by year. Using the input assumptions for this *Plan*, over 100 Mgal of salt solution from the Tank Farms are planned for processing over the life of the program; 6.9 Mgal were processed by the end of FY13. If SWPF starts up in October 2018 as assumed, it would processes the majority of this salt solution waste. The nominal capacity of SWPF, after an initial 36-month start-up period is assumed to be approximately 9 Mgal/yr. Salt preparation capability is limited by the number of blend tanks available to prepare salt batches. A single tank is capable of preparing 3Mgal/yr. For the first three years, only a single blend tank will be available. Beginning in FY22, a second tank will be available, enabling a 6 Mgal/yr production rate. Addition of a third blend tank in FY24 yields a 9 Mgal/yr rate beginning in FY24, although 6 Mgal/yr is forecast in FY24 due to a four-month outage for the DWPF melter changeout.

Other factors could limit salt processing capacity:

- SE & MST processing in DWPF at the planned rates. At a DWPF production rate of 275 canisters/year, achieving greater than 7 Mgal/yr of SWPF processing will require reducing the strip effluent and MST volume
- DSS processing in SPF at the planned rates. Funding limitations for ELAWD phase II, along with 24/7 operations limit SPF's ability to process the DSS stream from SWPF.

The specific input to this *Plan* from salt batch planning is summarized in *Salt Batch Plan in Support of System Plan R 19*[20].

### 4.3.1 Actinide Removal Process / Modular CSSX Unit (ARP/MCU)

Salt waste is currently processed through ARP/MCU. A summary of the process is shown in Figure 4-2 — *Schematic of the ARP/MCU Process*. The composition of the salt batches for ARP/MCU is given in Appendix D — *Salt Batch Composition*.

The ARP decontaminates salt solution via adsorption of strontium-90 (Sr-90), actinide radionuclides, and entrained sludge solids in the salt solution onto mono-sodium titanate (MST) followed by filtration or settling. The actinides, Sr-90, and MST laden sludge waste stream are transferred to DWPF for vitrification and the remaining clarified salt solution is transferred to the MCU process. The MCU process extracts Cs from the clarified salt solution using CSSX chemistry. The low Cs-137/low actinide decontaminated salt solution (DSS) is subsequently transferred to Tank 50 for feed to the SPF, and the SE solution of cesium nitrate from the CSSX process is transferred to the DWPF for vitrification.

The ARP/MCU process was constructed and initially permitted for a three-year service period, bridging the crucial period before the startup of the SWPF. With the delay of SWPF, however, ARP/MCU has been enhanced and improved to provide a longer term option for salt disposition. The original goals of the ARP/MCU process were *first* treat salt solution prior to the start of SWPF; and *second* provide operational experience and lessons learned for the SWPF project.

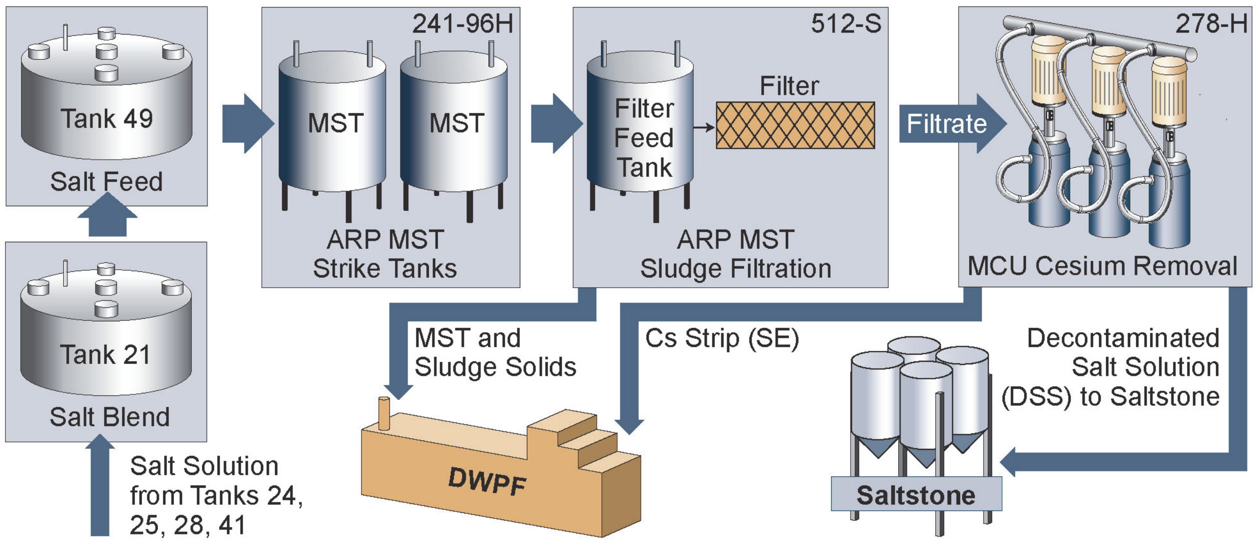



**Figure 4-2 — *Schematic of the ARP/MCU Process***

Actions taken since startup of ARP/MCU have demonstrated an increased processing rate from the original design of 1 million gallons per year to approximately 1.4 million gallons per year. Enhancements and improvements include chemistry adjustments at Tank 49, reduced cycle-times, and redesign and replacement of the secondary filter at 512-S.

Efforts continue to improve equipment reliability, reducing unexpected downtime to improve overall attainment. In addition to equipment and processing upgrades, alternative system planning is being done to more efficiently qualify subsequent salt batches to reduce downtime between batches.

***Improved Decontamination***

In the fourth quarter of FY2013, the original solvent formula was replaced with a next generation solvent (NGS). Operation of ARP/MCU with NGS results in more efficient removal of cesium from the treated salt solution than the original solvent formula. This increased cesium removal efficiency (decontamination factor or DF) allows ARP/MCU to produce a DSS stream with a residual cesium concentration much less than previously achieved. The improved DF will enable continued operation of ARP/MCU while minimizing the curies disposed in the SDF. ARP/MCU will continue to be operated at a nominal 6 gpm until the facility is shut down for SWPF tie-ins.

### 4.3.2 Salt Waste Processing Facility (SWPF)

The SWPF processing rate is based on an assumed 100% availability for the Tank Farm feed as well as DWPF and SPF receipt of the SWPF discharge streams. The SWPF treatment process is planned to produce DSS that meets the SPF Waste Acceptance Criteria (WAC) limit. (Note: the current SDU-6 design is not consistent with the SWPF DSS Isopar® concentration. Resolution will be forthcoming prior to SWPF startup).

The ability to realize full capacity of the SWPF when ready to startup will require:

- Completion of Salt Disposition Initiative (SDI) activities for physical tie-in to SWPF
- Salt dissolution, blending, batching, and qualification at a pace sufficient to provide feed at design rates
- DWPF enhancements and operation sufficient to disposition the SWPF SE stream at design rates (projected to be 275 canisters per year or greater for full SWPF nominal capacity), coupled with additional glass waste storage capacity
- Completion of ELAWD II enhancements and increased staffing at SPF to disposition the SWPF DSS stream at design rates

- Construction of future SDUs to support disposition of grout from SWPF DSS stream processing at design rates
- Construction of future glass waste storage capability to support canister storage for SWPF SE & MST stream processing at design rates

These activities are projected to be only partially complete prior to SWPF startup within the funding profile provided for Revision19 development. Specifically, funding for DWPF enhancements is not available until FY20 with completion of the enhancements in 2022. ELAWD II enhancements and increased staffing at SPF are not funded for completion until FY24. DWPF enhancements, ELAWD II, and increased staffing at SPF are required to support SWPF processing greater than 6 Mgal/year.

As a result, initial SWPF annual throughput is projected to be less than the rated capacity as provided in the inputs and assumptions. The cumulative difference between SWPF capacity and predicted throughput from FY19 to FY24 is more than 18 Mgal, which adds two years to the overall LW program.

In-depth analysis of the factors contributing to the reduced throughput at SWPF identifies multiple components and is a testament to the tightly integrated nature of the LW System. The most significant factors are:

- Lack of sufficient salt batch blend tanks at SWPF startup
- Insufficient utilization of ARP/MCU capacity prior to SWPF startup due to limited SDU space and limited funding
- Inability to afford installation of DWPF Enhancements or ELAWD phase II prior to SWPF startup
- Inability to afford sludge waste removal at a pace sufficient to support canister throughput commensurate with desired salt throughput
- Limited available canister storage locations prior to completion of the GWSP.

SWPF is assumed to begin operation in October 2018. Since feed preparation includes ARP/MCU material not processed as well as feed preparation in both the feed tanks and the blend tanks, for the first 12 months SWPF is forecast to process 4 Mgal of salt solution. After 12 months, this *Plan* assumes the nominal processing rate will be 3 Mgal/yr, pending the availability of an additional blend tank. Beginning in 2022 SWPF is forecast to produce to 6 Mgal/yr for three years. A third blend tank will be available in FY24 allowing an increase in production rate to 9 Mgal/yr. In FY24, however, the 9 Mgal/yr rate will operate for eight months, with a four-month DWPF melter replacement outage requiring a simultaneous SWPF outage for the balance of the year.

Appendix D — *Salt Batch Composition* gives the composition of the salt batches for SWPF.

## 4.4 *Saltstone Operations*

The Saltstone operation consists of two main components. The Saltstone Production Facility (SPF) contains the tanks and equipment necessary to receive decontaminated salt solution and treat and process it into saltstone grout. It is pumped from SPF into the Saltstone Disposal Facility (SDF), consisting of several Saltstone Disposal Units (SDU) for final disposition.

***Saltstone Disposal Facility***

The current active SDUs, SDU-2, SDU-3, and SDU-5 consist of two cells nominally 150 feet diameter by 22 feet high. After accounting for interior obstructions (support columns, drainwater collection systems, etc.) and the requirement for a 2-foot cold cap, the nominal useable volume of a cell is 2,300 kgal. Recent operating experience results in approximately 1.76 gallons of grout being produced for each gallon of DSS feed, thus yielding a nominal cell capacity of approximately 1,300 kgal of DSS. Beginning with SDU-6 through SDU-13, SDUs will consist of a single cell 375 feet in diameter by 43 feet high. The total capacity for these SDUs will be 32 Mgal, which will have a capability, after accounting for cold cap requirements, of dispositioning 30 Mgal of contaminated grout or 17.1 Mgal of DSS. In this *Plan*, SDU-6 is required to begin operations by May 2017.

***Saltstone Production Facility***

SPF receives and treats the salt solution to produce grout by mixing the LLW liquid stream with cementitious materials (cement, flyash, and slag). A slurry of the components is pumped into the SDUs, located in SDF, where the Saltstone grout solidifies into a monolithic, non-hazardous, solid LLW form.

To enable SPF to accommodate the increases in DSS influents from SWPF, streamlining the SPF dry feed preparation system is required for SWPF, which will be accomplished in the second phase of Enhanced Low Activity Waste Disposal (ELAWD). Additionally, to support SWPF processing rates above 6 Mgal/year, SPF operations will be conducted on a 24/7 schedule which will require increased staffing over the current 4/10 schedule.

*ELAWD phase II (SPF Dry Feed Mods)*

Several operations and equipment reliability improvements are required to enhance the operation of SPF feeding SDF:

- **Silo bin discharge** — Rework existing silo bin discharge system to allow silos to operate at full capacity. Implement software changes that will allow air to be pulsed through the silo during downtimes to prevent packing and bridging. Also, install air cannons or equivalent device on silo to address rare cases that bridging may occur
- **Knife Gate valve or equivalent** — Install knife gate valve assembly at each silo to enhance the system's abilities to handle inconsistencies with bulk materials and aid in dry material recipe accuracy
- **Diversion chute** — Install a duct system (diversion chute) which will divert the flow of dry materials to the mixer and send the materials to a holding area for screw feeder operational testing prior to salt waste treatment
- **Screw feeder** — Replace the existing obsolete screw feeder that will allow processing up to 50 tons/hr
- **Weather protection** — Enclose the Premix Feed Bin and Loss-In-Weight hopper to protect the many flexible couplings and joints that are susceptible to water intrusion
- **Flexible couplings** — Upgrade each flexible coupling to provide improved sealing and weather resistance
- **Dust collectors** — Update Silo 2 dust collector to improve simultaneous truck unloading capacity for Silos 1, 2, and 3.

*Saltstone 24/7 Operations*

Operations and equipment reliability improvements are required to enable 24/7 operation of SPF feeding SDF:

- **Lighting upgrades** – Install additional lighting in the Saltstone area to accommodate a 24/7 shift operation at Saltstone and to promote personnel safety and efficiency
- **Lightning protection upgrades** – Install lightning protection throughout the Saltstone facility to minimize process equipment damage during inclement weather and to maximize critical process equipment availability
- **Process air compressor replacement** – Replace outdated process air compressors to support dry feed system operations and serves as a backup supply to the 210-Z instrument air system.

Fabrication and installation of the ELAWD II and hiring of additional staffing for SPF is driven by funding and planned to be performed from FY22 through FY24.

## 4.5 *Waste Removal and Tank Closure*

### 4.5.1 Waste Removal and Tank Cleaning

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

***Bulk Waste Removal Efforts***

This *Plan* includes the Waste on Wheels (WOW) concept, which minimizes new infrastructure (see Figure 4-3). Portable and temporary equipment can meet tank infrastructure needs. Additional purchased pumps and equipment perform accelerated BWRE operations concurrently in both Tank Farms. The primary components of the WOW system are:

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

WOW equipment is deployed at the tank as a field operating station, providing temporary power and control for BWRE equipment. When BWRE is completed on one tank, the WOW equipment is reconfigured to support waste removal on the next tank. Pumps are sized to fit through the 24-inch openings in old style tanks. To the extent that risers are available, pumps are set in optimal configurations within the waste tanks. Product lubricated bearings and motor cooling eliminate the need for bearing and seal water supply. These pumps have exterior fittings and fixtures so the pumps can be decontaminated, minimizing radiation exposure to personnel during relocation to another tank. Disposable transfer pumps transfer the waste to a receipt or hub tank using existing underground transfer lines and diversion boxes. If the transfer system is degraded or non-existent, above-grade hose-in-hose technology is deployed, rather than investing in costly repairs. Temporary shielding is supplied as necessary to minimize exposure to personnel.

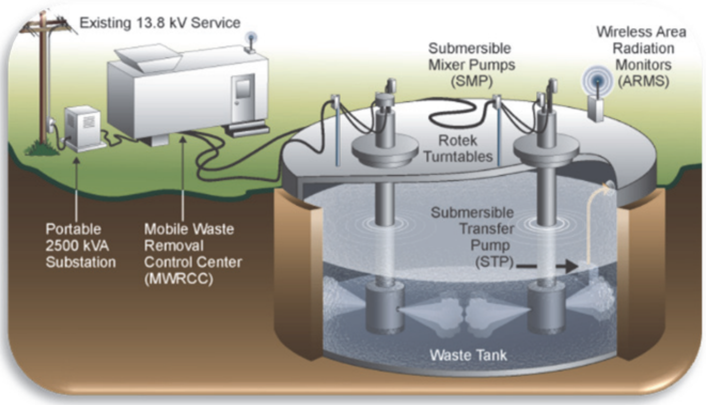



**Figure 4-3 — *WOW Deployment for BWRE***

***Sludge Removal***

Sludge removal operations are typically conducted with two, three, or four mixing pumps. Sufficient liquid is added to the tank to suspend sludge solids; existing supernate is used to minimize introduction of new liquids into the system. Operation of the mixing pumps suspends the solids, which are then transferred as a slurry from the tank. This operation is repeated, periodically lowering the mixer pumps, until the remaining contents of the tank can no longer be effectively removed by this method.

Sludge batches were originally configured to preferentially remove sludge from Type I, II, and IV tanks. Bulk sludge has been successfully removed from all old-style tanks except Tank 15. Currently, sludge batch configurations balance the sludge batch composition of Plutonium Uranium Reduction Extraction (PUREX) process and the modified PUREX process in H-Canyon (HM) sludges, to optimize sludge batch preparation and processing in DWPF (see §7.1 for a description of these sludge types). Tank 13, a Type II tank in H-Tank Farm (HTF), will be used to store and transfer sludge from other tanks, as necessary, until Tank 13 heel removal is performed in FY24.

***Salt Removal***

Salt waste removal may be accomplished using a modified density gradient process (see Figure 4-4) followed by mechanical agitation, or semi-continuous dissolution (see Figure 4-5)

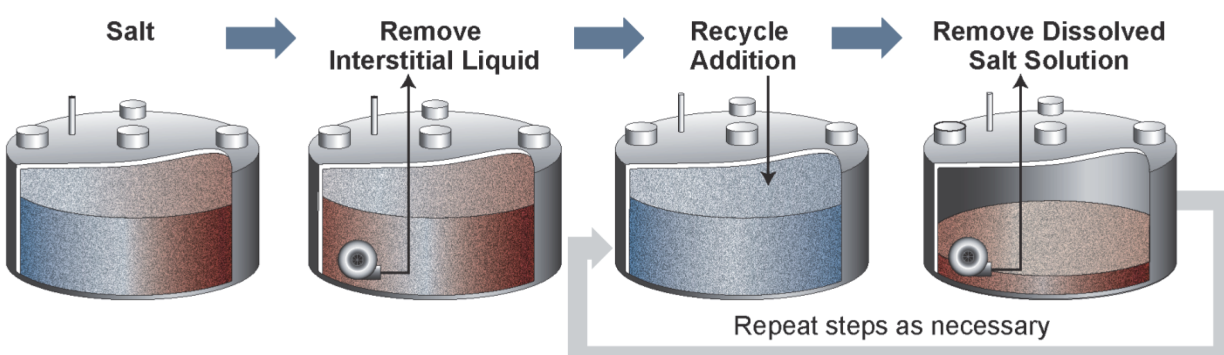



**Figure 4-4 — *Modified Density Gradient Salt Removal***

During modified density gradient salt dissolution, a well is mined through the saltcake down to the tank bottom. An off-the-shelf, disposable transfer pump is installed at the bottom of the well, along with instruments to monitor waste density. Water is added to dissolve the salt and, as the density increases, the saturated solution migrates to the bottom of the well where it is pumped out. The initial process involves no moving parts in the tank except the transfer pump.

DWPF recycle may be used where possible to dissolve salt in order to conserve new-style tank space. The dissolved salt solution is prepared as close to saturation as possible prior to pumping out the tank. As salt dissolution progresses and the soluble fraction is pumped from the tank, the insoluble materials dispersed throughout the salt matrix may blanket the underlying salt and the dissolution rate can decrease significantly. Removal of salt and insoluble solids from the bottom of the tank may require installation of mixing pumps to complete waste removal. Mixer pumps suspend and remove insoluble solids at the end of the dissolution step, similar to sludge removal.

An alternative to the Modified Density Gradient Salt Removal process is Semi-Continuous Dissolution (SCD) utilizing a Dissolution Water Skid (DWS) (see Figure 4-5 — *Dissolution Water Skid*). This process adds well water to the tank via the DWS, and transfers dissolved salt solution from the tank at approximately the same rate. The well water is distributed evenly to several (nominally three) risers in the tank. Each of the risers is equipped with a low volume mixing eductor installed above the salt cake, but below the supernate level. During dissolution, the saltcake level is periodically checked, and the low volume mixing eductors and transfer pump are gradually lowered as the saltcake level decreases.

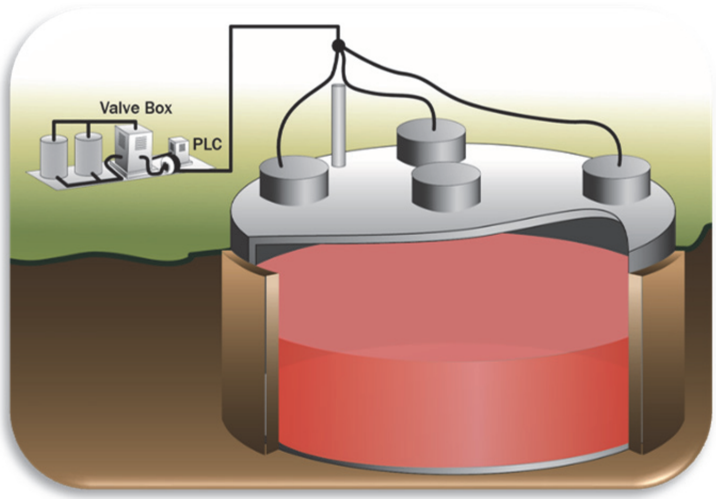


**Figure 4-5 — *Dissolution Water Skid***

Other methods of salt dissolution may be pursued on a case-by-case basis. For example, beginning in late FY10 and continuing to the present, Tank 41 salt dissolution has been achieved gradually by receiving recycle directly from DWPF until the level is approximately twelve inches above the saltcake. It is then recirculated with a transfer pump for several days just prior to transferring out to Tank 23 for use in a salt batch. The resultant dissolved salt has been used in the make-up of ARP/MCU salt batches beginning with Salt Batch #5.

***Heel Removal***

After BWRE has removed the material that can be removed with the technologies discussed above, heel removal is performed. Heel Removal can consist of a combination of mechanical heel removal and chemical cleaning. In general mechanical heel removal is done prior to chemical cleaning, and is discussed below in some detail. Depending on tank conditions, however, chemical cleaning may be performed prior to mechanical heel removal or some mechanical heel removal and some chemical heel removal may be performed back and forth to provide removal to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical.

***Mechanical Heel Removal***

For mechanical heel removal, this *Plan* assumes vigorous mixing continues, using mixing pumps, until approximately 5 kgal or less of material remain. Additional mechanical removal may be achieved through directing pumps discharges in specific patterns to impact remaining material.

***Chemical Cleaning***

Chemical cleaning may be performed on sludge tanks when mechanical heel removal has not removed the material to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical. In bulk oxalic acid (OA) cleaning, the tank is modified to address chemical compatibility concerns and OA is added to the tank and mixing pumps operated. The contents of the tank are agitated for a short period and then transferred to a receipt tank for neutralization. This process is repeated one to three times based on chemical flowsheet projections.

***Tanks with Documented Leak Sites***

Several Type I, II, and IV tanks have documented leak sites. All Type IV tanks having documented leak sites have been operationally closed; however, waste removal operations on some of the Type I and II tanks could potentially reactivate old leak sites or expose new leak sites in those tanks. Contingency equipment and procedures will be utilized to contain leakage and prevent release to the environment. Specific plans will avoid liquid levels above known leak sites, when feasible, and focused monitoring will be employed where these levels cannot be avoided. As a result of program progress to date, of the 14 SRS tanks (all old-style tanks) with leakage history:

- 4 are operationally closed and grouted (Tanks 5, 6, 19, and 20)
- 2 were cleaned (Tanks 12 and 16)
- 4 contain essentially dry waste, with little or no free liquid supernate (Tanks 1, 9, 14, and 15)
- 4 contain liquid supernate at a level below known leak sites (Tanks 4, 10, 11, and 13)

Of the remaining 10 old-style tanks (none of which have any known leakage history):

- 2 are operationally closed and grouted (Tanks 17 and 18)
- 2 contain essentially dry waste, with little or no free liquid supernate (Tanks 2 and 3)
- 6 contain liquid supernate. (Tanks 7, 8, and 21 through 24)

***Annulus Cleaning***

Some Type I and II tanks have waste in the annulus space, typically a soluble form of salt appearing as dried nodules on tank walls at leak sites and at the bottom of the annulus pan. These tanks will be inspected to determine if Annulus Cleaning is required. For those tanks requiring annulus cleaning, this waste will be removed from the annulus to the extent technically practicable from an engineering perspective and the highly radioactive radionuclides removed to the maximum extent practical before declaring the tank ready for grouting

### 4.5.2 Tank Closure and Stabilization

Type I, II, and IV tanks are planned operational closure in accordance with a formal agreement between the DOE, Region IV of the EPA, and SCDHEC as expressed in the SRS currently approved FFA. Six of these tanks in F-Tank Farm (FTF); Tanks 5, 6, 17, 18, 19, and 20; were operationally closed and stabilized (grouted) — Tanks 17 and 20 in 1997, Tanks 18 and 19 in 2012, and Tanks 5 and 6 in 2013.

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

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

The closure process includes sampling and characterization, initial drafting of closure documents, first-time review process, annulus and coil closure, and stabilization by grouting. This *Plan* assumes thirty months from the last removal of any material until completion of grouting. This is greater than that experienced with Tanks 5 and 6; however, lessons learned from those closures combined with anticipated efficiencies are forecast to enable a thirty-month cycle.

***Sampling and Characterization***

Before declaring a tank ready for grouting, the tank and annulus are inspected, the residual volume is determined, and the residual is sampled in accordance with a sample plan. Laboratory analysis of the samples yields concentrations of radiological and non-radiological constituents in the remaining material. The SCDHEC approved Sampling Analysis Program Plan and associated Quality Assurance Program Plan currently recognizes SRNL as the laboratory that performs residual characterization. Concentration and volume data are used to characterize the residual material to produce radiological and non-radiological inventories for the Closure Module (CM). Tank-specific closure documents are prepared to demonstrate compliance with State and DOE regulatory requirements as well as NDAA §3116.

***Tank Isolation***

Tank isolation is the physical process of isolating transfer lines and services from the tank and removing the tank from normal operations. Tank isolation may include cutting and capping or blanking mechanical system components (transfer lines, water piping, air piping/tubing, steam piping, etc.) and disconnecting electrical power to all components on the tank.

***Closure Documentation Development***

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

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

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

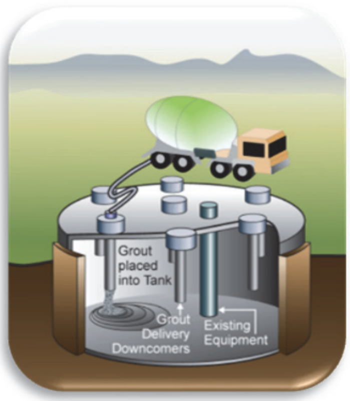



**Figure 4-6 — *Grout Placement***

***Grout Selection and Manufacture***

A reducing grout provides long-term chemical durability and minimizes leaching of residual waste over time. The reducing grout selected is self-leveling, and encapsulates the equipment remaining inside the tank and annulus. The grout also provides for intruder prevention in tanks that do not have a thick concrete roof. Grouting activities include field modifications, temporary ventilation installation, grout plant mobilization, and grout procurement.

***Grout Placement***

Grout fill operations, including site preparation, pumper truck set up, grout plant set up (if required), grout delivery lines, and grout equipment setup are established around the tanks (see Figure 4-6). A sequence for tanks with an annulus will be developed so that voids are filled and the structural integrity of the tank is maintained. Generally, grouting the annulus and primary tank in alternating steps provides structural support for the tank wall.

***Equipment Grouting***

For tanks with installed equipment or cooling coils, internal voids are filled with a flowable grout mixture. In those tanks where the cooling coils have broken, alternative techniques are used to minimize voids in the grout matrix.

***Riser Grouting and Capping***

The final step, after filling the tank, may include encapsulating select risers. When necessary, forms are built around the risers and grout is used to encapsulate the risers providing a final barrier to in-leakage and intrusion. The final grouted tank configuration is an integral monolith free of voids and ensuring long-lasting protection of human health and the environment (see Figure 4-7).

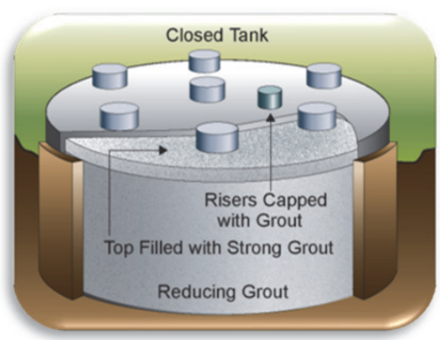



**Figure 4-7 — *Grouted Tank***

## 4.6 *Base Operations*

### 4.6.1 Supporting Nuclear Material Stabilization

A continuing portion of the mission of the Tank Farms, especially HTF, is safe receipt, storage, and disposition of waste yet to be received from H-Canyon and HB-Line. This *Plan* supports nuclear material stabilization in H-Canyon through 2025 (with shutdown flows through 2026), though on a limited basis in FY14, FY15, and FY16. Tank 39 will continue to be used for H-Canyon receipt through shutdown of H-Canyon. It may be supplemented as necessary, however, with Tank 35 during BWRE campaigns in Tank 39. The 3H Evaporator system will continue to operate. Salt must be removed from the Evaporator concentrate receipt tanks to allow continued evaporator operation. Thus, this *Plan* relies on Tank Farm evaporators to operate at reasonable attainment.

This *Plan* assumes the maximum volume that can be received in Tank 39 from H-Canyon is 100 kgal in FYI4 and 200 kgal/year in FY15 and FY16[21]. Beginning in FY17, waste volumes from H-Canyon are transferred to Tank 39 at no more than 300 kgal/yr per the *Functional Service Agreement between SRNS and SRR*[22]. An alternate disposal path for some waste (e.g., Pu or Np bearing waste) allows insertion into a DWPF sludge batch "just-in-time" via receipt into the sludge processing tank (Tank 51) or the DWPF feed tank (Tank 40). Plutonium discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings or failing to comply with canister fissile material concentration limits. Additionally, LLW is transferred from H-Canyon into Tank 50 for direct disposal in SPF.

It is recognized that the H-Canyon mission may be changed in the coming years such that new waste streams may be received into the LW system. As new streams are identified, they will be evaluated and impacts to LW processing will be reviewed.

#### 4.6.2 DWPF Recycle Handling

DWPF recycle is the largest influent stream received by the Tank Farm. In this *Plan*, disposition of the recycle stream is handled through evaporation in the 2H Evaporator System and through the beneficial reuse of the low sodium molarity (less than 1.0 molar sodium) recycle stream. The DWPF recycle rate will remain between 1.5 and 1.9 Mgal/yr prior to SWPF operations. The rate depends on canister production rate and Steam Atomized Scrubbers (SAS) operation as well as DWPF recycle reduction initiatives. The rate could increase to as high as 3.2 Mgal/yr after the startup of SWPF because of extra water in the SE stream and MST slurry and because the higher Cs-137 concentrations could require the operation of two SAS stages in the DWPF melter offgas system; currently, only one SAS stage is operated. This higher rate, however, could be mitigated by the DWPF recycle reduction initiatives discussed in §4.2, above. DWPF recycle is exclusively evaporated in the 2H Evaporator System due to chemical incompatibility with other waste streams. It may, however, be beneficially reused for salt solution molarity adjustment, salt dissolution, heel removal, etc. Beneficial reuse minimizes the utilization of the 2H Evaporator. LW system modeling forecasts that the life cycle processing outlined herein can adequately handle the DWPF recycle stream through the end of the *Plan*. DWPF recycle will be supplemented by Inhibited Water (IW), as required, for salt dissolution and adjustment.

#### 4.6.3 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 SWPF. Because of the greatly increased pace of transfers after the startup of SWPF, short downtimes due to unexpected conditions requiring repair will be more difficult to accommodate without impact because the idle time of transfer lines will be reduced.

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

The transfers in this *Plan* are generally based on the known current infrastructure and modifications planned in the SWPF transfer line tie-ins and in projects for new facilities. The actions described can be executed as long as the planned modifications are made and significant failures of key transfer equipment do not occur or can be mitigated quickly enough to allow activities to proceed as planned. This *Plan*, however, does not attempt to explain all the modifications needed or the failure of specific pieces of transfer equipment.

#### 4.6.4 Tank 48 Treatment

Tank 48 contains legacy organic from previous salt treatment processes. Several technologies have been considered, including Fluidized Bed Steam Reforming and Copper Catalyzed Peroxide Oxidation, to treat the organic components and enable the waste to be dispositioned as grout or vitrified glass. Technology selection and design is assumed to begin around 2022. Once the bulk of the Tank 48 waste has been treated, the remaining heel will be grouted in place as part of Tank 48 closure.

#### 4.6.5 Effluent Treatment Facility

The Effluent Treatment Facility (ETF), located in H-Area, collects and treats process wastewater that may be contaminated with small quantities of radionuclides and process chemicals. The primary sources of wastewater include the 2H and 3H Evaporator overheads and H-Canyon. The wastewater is processed through the treatment plant and pumped to Upper Three Runs Creek for discharge at an NPDES permitted outfall. Tank 50 receives ETF residual waste for storage prior to treatment at SPF and final disposal at SDF. A 35-kgal Waste Concentrate Hold

Tank provides storage capacity at ETF to minimize transfer impacts directly to Tank 50 or SPF during SWPF operations.

#### 4.6.6 Managing Type III Tank Space

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

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

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. Lack of evaporator working space would hinder tank removals from service, canister production rate at the DWPF, or H-Canyon support.

This *Plan*, as did previous revisions of the *Plan*, utilizes Type I, II, and IV tanks to store supernate generated by sludge preparation:

- Tank 8 stores aluminum-laden supernate from the LTAD of Sludge Batches 5, 6, 10, 11, 12, and 13
- Tank 4 and Tank 7 store dissolved salt solution
- After Tank 8 aluminum-laden supernate is processed, Tank 8 will store dissolved salt solution
- Tank 11 stores salt dissolution material
- Tank 7 and Tank 11 will support heel removal activities from Tanks 1, 2, and 3, and Tanks 9 and 10, respectively
- Tank 21 through Tank 24 will remain in service through 2029:
  - Tank 21 will continue service as a salt blend tank for ARP/MCU and SWPF
  - Tank 22 will continue to receive DWPF recycle
  - Tank 23 will continue to stage dissolved salt solution for salt batch preparation
  - Tank 24 will continue to store concentrated DWPF recycle.

The EPA and SCDHEC concurred with the use of Tank 8 to store aluminum-laden supernate[23], Tank 7 to support closure of Tanks 5 and 6 by storing liquids from cooling coil flushes, and Tank 11 to support BWRE in Tank 10 by receiving dissolved salt solution from Tank 10 until it is transferred to Tank 21 for inclusion in Salt Batch 7 and heel removal activities in Tank 12 by receiving and storing dewatering material from Tank 12[24,25]. Pre-decisional presentations have been made to regulatory agencies regarding further use of tanks as described above.

### 4.7 *Closure Sequence for the Liquid Waste System*

After the HTF and FTF tanks and ancillary equipment has been closed the Liquid Waste facilities outside the Tank Farm — DWPF, SWPF, ARP/MCU, SPF, SDF, and associated ancillary equipment — will be available for beneficial reuse, if required. Otherwise, these facilities will be available for removal from service.

While the general priority is to close geographically proximate equipment and facilities, thus minimizing cost, the actual sequence of the shutdowns is predicated on the capability of the facilities to process the particular blends required by the salt and sludge treatment processes. The priority (but not necessarily the sequence) for shutdowns as modeled is:

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

The key elements of the systematic closure sequence for shutting down and closing the LW System are summarized in Table 4-3:

**Table 4-3 — *Closure Activities***

| | |
|---|---|
| FY25-FY34 | - H-Canyon processing influents cease (FY25)<br>- H-Canyon shutdown flow influents cease (FY26)<br>- Waste removal is complete from all Type I, II, and IV tanks (FY30)<br>- All Type I, II, and IV tanks are operationally closed (FY32) |
| FY35–FY38 | - FTF waste removal is completed (FY35)<br>- 3H Evaporator shut down (FY35)<br>- 2H Evaporator shut down (FY38)<br>- HTF (West Hill) waste removal is complete (FY36) |
| FY39–FY42 | - HTF (East Hill) HLW removal is complete (FY39)<br>- SWPF shut down (FY39)<br>- Waste removal is complete from all Type III tanks (FY40)<br>- DWPF shut down (FY40)<br>- SPF shut down (FY41)<br>- All Type III tanks are operationally closed (FY42) |

Once closure activities are complete, the remaining facilities may be chemically cleaned and flushed as necessary.

# 5. Alternative Analyses

## 5.1 *Support SWPF at the rated capacity*

The unavoidable funding reductions and delays in Salt Waste Processing Facility (SWPF) construction and operation have significantly impacted completion of the near term scope of this *Plan*. These impacts are expected to result in:

- Failure to meet four FFA BWRE commitments associated with 12 tanks and five FFA Operational Closure commitments associated with 18 tanks.
- Missing the STP waste disposition milestone by 7 years
- The inability to support planned H-Canyon processing.

Most notably, these emerging issues are now projected to impact the ability of the DOE's new SWPF to operate at rated capacity and to suspend tank closure activities until the mid-2020s. Immediate action must be taken to advance these critical work scopes under the challenges they face. Future success and avoidance of further delays/impacts will require uninterrupted focus and an ability to cost effectively execute work scopes in a manner that enables performance of additional over-the-baseline opportunities.

To mitigate these impacts while addressing regulator concerns about future Liquid Waste closure activities, several scopes of work are necessary (see Figure 5-1):

- Accelerated delivery of DWPF Enhancements, ELAWD II, 24/7, Accelerate Sludge BWRE
  - — Increased Salt Processing
  - — Increase the nominal processing rate
- ARP/MCU Acceleration
  - — Actinide Removal using Large Tank MST Strike
  - — Increased Filtration Capability
- SDU — Two year acceleration of the SDU build schedule
- Canister Storage — Increase GWSB #1 capacity

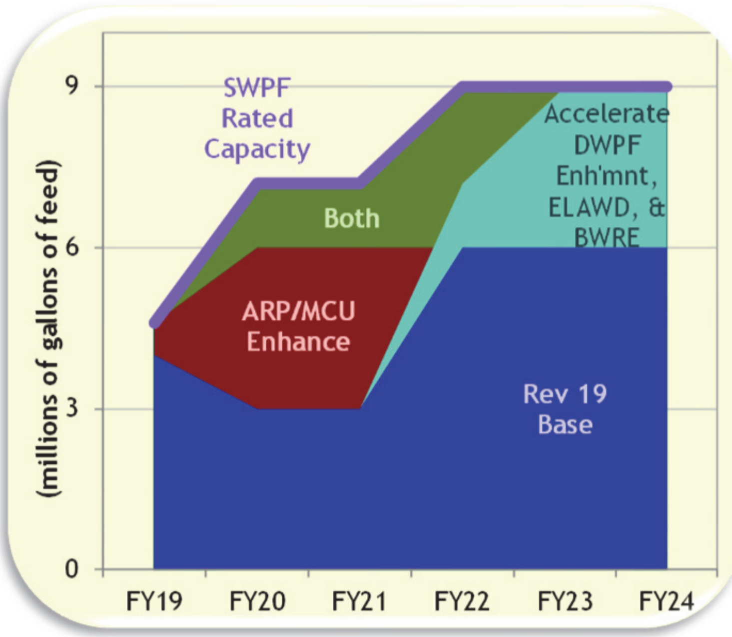



**Figure 5-1 — *SWPF Throughput Improvement***

***<u>DWPF Enhancements, ELAWD II, 24/7, Accelerate Sludge BWRE</u>***

Due to the highly integrated nature of the LW system, operation of SWPF at its rated capacity will require the rest of the LW system to be able to supply SWPF with qualified feed at the desired rate and will require that the effluents from SWPF be processed at the downstream facilities at least as fast as they are generated by SWPF. SWPF was originally designed to operate at 6 Mgal/yr. Operation of SWPF at rates higher than the original design throughput will require modifications to the downstream facilities to accommodate the greater volume of effluents from SWPF. Acceleration of several scopes currently in the baseline will enable a 50% increase in SWPF processing from a maximum of 6 Mgal/year up to 9 Mgal/year.

Four specific actions are included within this activity:

*<u>DWPF Enhancements</u>*

For DWPF to accommodate the increases in influents resulting from SWPF operation above 6 Mgal/yr (increased volumes of MST and SE), streamlining the DWPF melter feed preparation system is required. Several process improvements (collectively called DWPF Enhancements) would streamline the DWPF melter feed preparation system:

- Implementation of an alternate reductant
- Processing of SE in the SME
- Addition of dry process frit to the SME

*ELAWD phase II / Saltstone 24/7 Operations*

To enable SPF to accommodate the increases in DSS influents resulting from SWPF startup, streamlining the SPF dry feed preparation system is required for SWPF operation above 6 Mgal/year. Additionally, to support SWPF processing rates above 6 Mgal/year, SPF operations will be conducted on a 24/7 schedule which will require increased staffing over the current 4/10 schedule. This is included in the base *Plan* for completion by FY24. To support SWPF at the rated capacity requires completion of these activities by the second year of SWPF operations.

*Sludge Batch Acceleration*

Additionally, waste retrievals and sludge batch preparation must be accelerated to support increased ARP/MCU processing. Increased ARP/MCU throughput will require increased canister production at DWPF which in turn requires accelerated sludge waste retrievals and sludge batch preparation. As noted above, limited expected funds prevent sludge retrieval and batch preparation ahead of just-in-time delivery to the base *Plan*.

***Increased Salt Processing***

With 95% of the remaining waste to be treated being salt waste and SWPF start-up currently projected to be October 2018, two major thrusts for the SRS HLW system are apparent. *First*, SRR must be in the best position possible from a tank space management perspective to feed SWPF at the highest rates possible when it begins operations. *Second*, processing as much salt waste in the interim is paramount to both creating space and making progress towards salt disposition.

To close the gap in needed tank space and salt treatment, the nominal ARP/MCU processing rate must be increased to 4.7 Mgal/year. This approach will provide two additional blend tanks for SWPF salt feed preparation, provide an additional 4 Mgal of salt treatment prior to SWPF startup, and provide enough tank space to prepare salt feed and close the gap to ensure SWPF full capacity projections can be met. This provides the ability to close tanks at a faster rate and reduce life-cycle costs.

Increasing salt processing entails three actions:

*Actinide Removal using Large Tank MST Strike*

This will implement a large tank MST strike in the current salt batch preparation tank, Tank 21, to perform the actinide removal steps currently performed in 241-96H. This is accomplished by performing a "large tank" strike with MST in Tank 21. This prepares a large quantity of salt at one time with MST versus preparing small batches in 241-96H. This eliminates the small batch strike unit operations in 241-96H, decouples the MST stream from DWPF operations, and also makes 241-96H available for re-use.

*Increase Filtration Capability.*

In this action, the cross-flow filter in 512-S is replaced with a higher capacity rotary microfilter (RMF) module also installed in a waste tank. The first two actions together eliminate the current bottlenecks to salt processing and free up valuable real estate for other missions.

*MCU NGS Phase 2 Throughput Improvements.*

This action will expand the capability of the NGS by performing modifications to MCU that increase capacity to 12 gal/min, increasing throughput to 4.7 Mgal/year from 2 Mgal/year.

***Saltstone Disposal Unit Acceleration***

This activity accelerates SDU construction completion dates to accommodate results from increases in salt processing delivered by the first two activities.

***Interim Canister Storage***

This activity provides up to an additional 2,251 glass waste canister storage locations within GWSB #1. This is accomplished by completely emptying one vault (of four) at a time in GWSB #1 in order to mass modify those canister positions to a double stacked configuration. This will result in additional locations being available for use in subsequent sludge batches.

## 5.2 *SRNL Closure Sample Analysis limitations*

This *Plan* assumes that the SRNL lab utilized to analyze the samples for tank closure is able to receive, analyze, and report for as many tanks as needed. Current capacity is only two tanks in a given year. Upgrading to be able to handle the sample for four tanks requires additional funding for lab technicians, equipment, and supplies to be able to begin processing this volume of samples in 2026.

Were SRNL limited to two tanks per year the closure process for all the tanks would be extended to 2047 from 2042. Similarly, the final Type I tank closure would be extended to 2034, missing the FFA commitment of 2022 by 12 years.

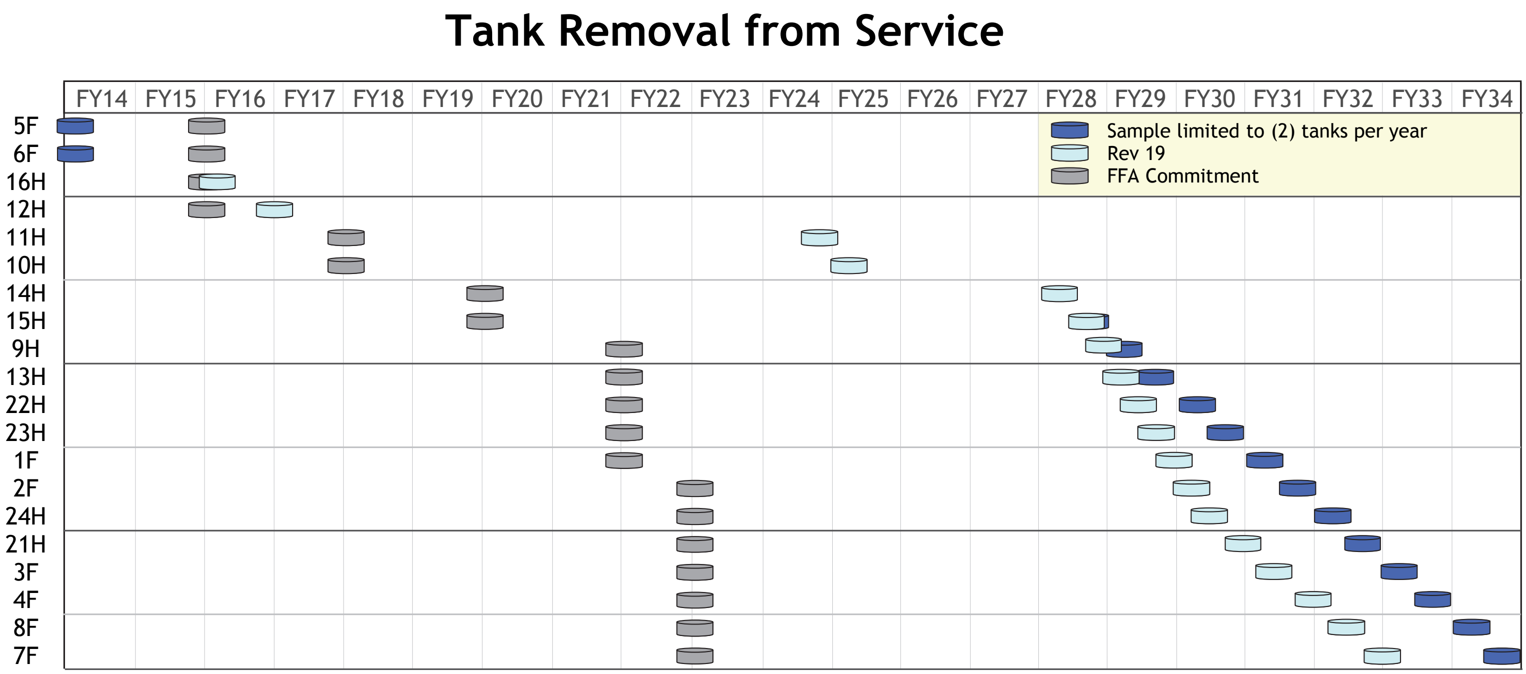



Figure 5-2 — *Tank Removal from Service for two/year SRNL samples*

## 5.3 *Alternate Risk Reduction*

Per the request made in the Smith to Bair letter[15] and based on the comparison between the risk reduction and tank closure acceleration, further evaluation will be performed of an alternative strategy that focuses on reducing risk by removing the bulk of the waste out of the old-style tanks while maximizing the utilization of interim salt processing and the Salt Waste Processing Facility (SWPF) capabilities to provide three Type III blend tanks as soon as possible. This alternative risk reduction case will be issued as an addendum to Revision 19 when the modeling effort is complete.

# 6. Description of Assumptions and Bases

The major assumptions and planning bases are the results of an agreement between SRR and DOE[14,15,16]. These assumptions address the planning period to the end of the program.

## 6.1 *Priorities for Plan Development*

1. Continual Safe Storage of liquid waste in tanks and vitrified canisters in storage
2. Risk Reduction through Waste Disposition
3. Tank Cleaning and Stabilization.

## 6.2 *Funding*

This *Plan* was developed assuming the funding required to achieve the planned project and operations activities will be available, within the following restrictions:

- Revision 19 of the *Plan* assumes receipt of:
  - $407.1M new Budget Authority (BA) to the LW contractor in FY14 (based on expected funds letter received March 2014[2])
  - $430M/yr (constant dollar funding) to the LW contractor FY15 - FY19
    - OMB recommended escalation factors will be used to determine projected buying power of this constant dollar funding in outyears
    - Includes Glass Waste Storage Project (GWSP) Line Item beginning in FY15
    - Does not include funding for the initial twelve months of SWPF operations
  - $525 M (in FY20 and escalated thereafter) per year until the end of the program.
    - Includes Line Item funding, including assigned contingency, for SDUs beginning with SDU-7
    - Includes $80M/yr (in FY20 and escalated thereafter) for operation of SWPF
- The following items are supplemental to LW contractor funding: SWPF (project and initial year of operation), Landlord services, Essential Site Services (ESS - Section J), DOE Managed, and pension and legacy cost (e.g., Section J and SLAs)
- No "re-pricing" for site services is realized.

## 6.3 *Regulatory Drivers*

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

- **Federal Facility Agreement (FFA)** – Commits the Department of Energy to operationally close the Type I, II, and IV tanks (Tanks 1–24) no later than 2022. The specific schedule for the Type I, II, and IV tanks is per the *Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18*[17], which is the schedule for the currently approved FFA.
- **Site Treatment Plan (STP)** – "Upon the beginning of full operations, DWPF will maintain canister production sufficient to meet the commitment for the removal of the backlogged and currently generated waste inventory by 2028." This is satisfied by removing waste (including heels) from all Type III tanks by 2028; Types I, II, and IV having had the waste removed in compliance with the FFA above.

Timely regulatory approvals are necessary to support this Plan.

## 6.4 *Waste Removal and Tank Removal from Service Program*

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

***Waste Removal***

- Types I, II, and IV tanks (Tanks 1–24):
  - Waste Removal and Tank Removal from Service commitments are per the FFA
    - Types I, II, and IV tanks (including Tanks 4, 7, 8, 11, and 21 through 24) may be used to optimize output of the Plan
- Type III and IIIA (Tanks 25–51)
  - While the Type III and IIIA tanks are not included in the FFA, commitment for completion of waste removal (bulk waste and heel) from all tanks is per the STP
  - Tanks are not required to be isolated and grouted to meet the STP
- Waste removal and cleaning activities could include mechanical, chemical, and water washing operations
- After the initial BWRE campaign in a sludge tank, a ~3 to 6 inch heel (10–20 kgal) of waste remains

- After the initial BWRE campaign in a salt tank, ~ 2 to 3 feet (90–130 kgal depending on the type of tank) of insoluble/low solubility material waste (heel) remains
- Two Phases of Waste Heel Removal are available for use:
  - Mechanical Cleaning uses mechanical agitation
    - Assumed to take three months of operation unless otherwise stated
    - Heel solids volume reduced to less than 5 kgal
  - If needed, Chemical Cleaning uses OA or advanced/specialized mechanical or chemical technology
    - Assumed to take three months of operation unless otherwise stated
  - For some tanks with high waste turnover, e.g. Tank 8, mechanical cleaning may not be required; however, flushing could be required prior to chemical cleaning
  - This *Plan* assumes Tanks 4, 7, 8, 11, 13, 14, 15, 26, 32, 33, 34, 35, 39, 42, 43, 47 are the sludge tanks that have chemical cleaning. No other tanks are planned for chemical cleaning. These tanks will be sampled and analyzed after BWRE complete to determine the necessary amount of chemical cleaning
  - Monitoring during heel removal will inform the decision to do mechanical or chemical cleaning.
  - Tank cleaning is complete for Tanks 12 and 16.

***Annulus Cleaning***

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

***Tank Removal from Service***

- Stabilization of a waste tank (i.e. grouting of primary tank, annulus space, and cooling coils as specified in the applicable Closure Module) is to be completed within 30 months of receipt of concurrence to enter the residual waste sampling and analysis phase
  - Drying & Sampling (6 months on critical path): including Tank Drying, Sample Prep Documents, Volume Determination Cessation Presentation and Sampling
  - Sample Analysis (7 months on critical path): including Lab Analysis and Sample Analysis Report (SAR)
  - Closure Documentation (14 months on critical path): including DQA, Inventory Determination, Special Analysis, MEP, Class C Calculation, Closure Module, and Tier 2
  - Grouting (3 months on critical path)
- Based on current capacity limitations of SRNL infrastructure, final isolation lab samples are limited to two tanks per year. This *Plan* assumes that SRNL infrastructure will be enhanced or additional labs will be qualified to enable the receipt, analysis, and report for as many tanks as needed
- Overall tank closure priority will support area closure in the following order, as feasible:
  4. F-Tank Farm
  5. H-Tank Farm West Hill
  6. H-Tank Farm East Hill
- Within six months of stabilization, tank waste systems will be removed from the *F and H Area High Level Radioactive Waste Tank Farms Construction Permit No. 17424-IW* in accordance with the applicable and approved Interim Record of Decision.

***Regulatory Approvals***

- SCDHEC will approve activities associated with waste removal, stabilization, and operational closure and maintenance and monitoring of waste tank systems will be performed and completed as described in the *Industrial Wastewater General Closure Plan for F-Area Waste Tank Systems*[26] or the *Industrial Wastewater General Closure Plan for H-Area Waste Tank Systems*[27]. Operational closure activities will be performed and completed as described in tank-specific closure modules which are generated per the approved General Closure Plan
- The HTF WD and associated HTF §3116 Basis Document, and the HTF Tier 1 Closure Plan will be approved by DOE in time to support the FY15 FFA tank closure milestones (i.e., Removal from Service of Tanks 12 and 16)
- DOE will approve any necessary waste determination documents to support this *Plan*
- DOE will maintain NEPA documentation necessary to support this *Plan*.

## 6.5 ***DWPF Production***

Canister production and sludge batch need dates are projected by the *Sludge Batch Plan*[18]

- The *Plan* assumes Melter #2 replacement in a four-month outage in FY16, coincident with an MCU contactor outage. In the event of a melter replacement outage before FY16, ARP/MCU will enter a forced outage and an evaluation will be performed to determine the prudence of initiating premature contactor bearing replacement

- After that, the Plan assumes a four-month melter replacement outage every 96 months (eight years) continues through the life of the program (i.e., 92 months of operations with four months of outage every 96 months). Even though replacement is assumed in this Plan every 96 months, actual replacement will be done upon failure of the Melter
- The final eight-year melter replacement forecast falls in the last full year of SWPF operation. A one-year extension is assumed to support uninterrupted SWPF production
- An operational spare melter is to be available when a melter is replaced to mitigate the risk associated with "infant mortality"
- A four-month DWPF outage, beginning June 2018, is required for SWPF tie-ins immediately prior to SWPF becoming operational. During this outage DWPF plans to implement productivity enhancements to support increased influents from SWPF
- DWPF recycle is beneficially reused
- The current washing plan assumes washing to 1.25 M Na (as compared to 1.5M Na in Rev 18 of this *Plan*)
- Supplemental glass waste storage will be available no sooner than October 2018
- DWPF canisters will maintain a concentration limit of 897 g/$m^3$ of fissile material in the glass[28]. Sludge batch preparation will supply feed for the DWPF to ensure the canisters remain within this requirement
- The canister heat load will be less than 834 watts per canister
- Pu discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings while continuing to comply with the canister fissile material concentration limits
- Shipment of canisters off-site for final disposition is not in the scope of this *Plan.*

## 6.6 ***Salt Program***

***ARP/MCU***

- ARP/MCU processing rates:
  - The ARP/MCU facilities will operate until permanently shut down six months in advance of the startup of SWPF to allow for SWPF tie-ins and modifications to Tank 49. This assumes:
    - upgrading ARP/MCU facilities as required to maintain the operating rate for the extended life
    - a four-month ARP/MCU outage to rebuild contactors in every fourth year of operations after 2012
  - ARP/MCU facilities operate to ensure the total Interim Salt Treatment curies emplaced in SPF are within the amount identified in *Savannah River Site – Liquid Waste Disposition Processing Strategy*[10] (SRS LW Strategy), as amended by letter from the South Carolina Department of Health and Environmental Control (SCDHEC) to DOE-SR[11] and the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*[7]
  - A four-month outage in FY16 is planned, coincident with a DWPF melter change-out. This outage will allow for ARP/MCU facility upgrades, which may include contactor bearings, weir adjustment, etc.
  - Nominally ARP/MCU will produce:
    - For each gallon processed, ~1.2 gal of DSS for SPF
    - For each gallon processed, ~0.08 gal of SE for DWPF
    - For each gallon processed, ~0.02 gal of MST solids/sludge for DWPF
      Note: actual operating experience in ARP/MCU since beginning NGS processing varies slightly from these assumptions. As the process is being optimized and data is still being collected and analyzed, however, these rates are assumed for this *Plan*.

***SWPF***

- SWPF becomes operational September 30, 2018
  - SWPF tie-ins will require a four-month outage of DWPF operations, a two-month outage of SPF operations, and a cessation of ARP/MCU six months prior to SWPF operations
- Annual processing throughput (*Long Term Processing Capacity at SWPF – Inputs to System Plan*[29])
  - Initial twelve months: 4.625 Mgal/yr processing rate
  - Second twelve months: 7.2 Mgal/yr nominal processing rate
  - Subsequent years: 9.0 Mgal/yr nominal processing rate
  - Nominally SWPF will produce:
    - For each gallon processed, ~1.2 gal of DSS for SPF
    - For each gallon processed, ~0.08 gal of SE for DWPF
    - For each gallon processed, ~0.02 gal of MST solids/sludge for DWPF

- The SWPF feed chemistry is per SWPF Feed Specification Radionuclide Limits of the SWPF *Waste Acceptance Criteria*[30] including:
  - the initial one million gallons of feed to SWPF will be (at 6.44 M Na):
    - ≤ 1.0 Curies per gallon (Ci/gal)
  - all batches are planned to be at 6.44 M Na
  - additional blending may be required to meet other feed criteria, such as:
    - OH > 2 M
      - Caustic (50% NaOH) additions are planned during salt dissolution and batch preparation, as needed to meet the minimum 2 M OH requirements
    - Al < 0.25 M
    - Si < 842 mg/L
- Tank Farm feed preparation infrastructure modifications required to support SWPF processing rates including:
  - H-Tank Farm Blend tanks readiness for salt solution preparation
  - F-Tank Farm Blend tanks readiness for salt solution preparation
  - Tank 49 readiness as SWPF feed tank
  - Mixing capabilities
  - Enhanced transfer capabilities
  - Transfer routes provided to feed tank.

## 6.7 ***Saltstone Production***

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

- During ARP/MCU operations:
  - May require operation of more than one cell and the use of "cold caps" to meet radiological control requirements
- During SWPF operation:
  - SPF and SDF will support SWPF processing rates
  - Additional operational time (i.e., multiple shifts, additional operating days each week, etc.) and adequate SDU receipt space to match production streams from SWPF are planned
  - Modifications will provide sufficient contingency storage capacity to minimize impacts to SWPF or ETF due to SPF or SDF outages
- SPF will be in a 2-month outage just prior to SWPF operations for SWPF tie-ins
- Since neither ARP/MCU nor SWPF process during melter replacement outages, SPF is not planned to operate other than to run off any backlog material that may be in the feed tanks
- Per the Morton to Burnau letter (2012-01-19)[31], all SDUs beginning with SDU-6 will be large disposal cells
- Three SDUs, SDU-2, SDU-3, and SDU-5 are in service. Neither Vault 1 or Vault 4 are planned to receive additional saltstone grout:
  - Each gallon of DSS feed, when added to the cement, flyash, and slag, makes 1.76 gallons of grout
  - SDU-2, SDU-3, and SDU-5 have two 150-foot diameter by 20-foot tall disposal cells. Each cell will contain ~2,300 kgal of grout. Therefore, each cell holds ~1,290 kgal of Tank 50-material feed solution; each SDU holds ~ 2,580 kgal of Tank 50-material feed solution
  - SDU-6–SDU-13 will be a single 375-foot diameter by 43-foot tall disposal cell which can contain 32 Mgal of grout. With the cold cap it will have a capacity of 30 Mgal of contaminated grout or 17.1 Mgal of Tank 50-material feed solution.
- SDU-6 will be available for use in May 2017.

## 6.8 ***Base Operations***

### ***Evaporation***

The primary influents into the Tank Farms are DWPF recycle and H-Canyon waste 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 are two evaporators in H-Area.

DWPF recycle has a high concentration of silica due to the vitrification process. When this stream is mixed with aluminum streams from PUREX and HM canyon processing, there is a potential for forming sodium aluminosilicate. Experience has shown that sodium aluminosilicate can co-precipitate sodium diuranate in the evaporator, causing a potential criticality concern. In order to prevent the potential for criticality, a feed qualification program is in place to minimize the formation of a sodium aluminosilicate scale in the 3H Evaporator 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 3H Evaporator is used to process streams that minimize scale production, i.e., canyon wastes and sludge batch decants. The evaporator system feed and concentrate receipt tanks configuration is:
  - 3H: Feed – Tank 32; Receipt – Tanks 30 and Tank 37
  - 2H: Feed – Tank 43; Receipt – Tank 38
- Evaporator Capacity – The following evaporator utilities and capacity are based on historical experience.

**Table 6-1 — *Evaporator Capacity***

| Evaporator | Space Gain Capacity |
|---|---|
| 2H | 200 kgal/mo |
| 3H | 100 kgal/mo |

***General Assumptions***

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

***Separations Canyon Operations***

- Sufficient tank space volume is available to support the projected receipt of HLW into Tank 39 from H-Canyon operations through FY25. LLW waste, mainly from the General Purpose (GP) Evaporator, dispositioned in SPF are received into Tank 50 and direct discards of Pu and neptunium materials to the DWPF feed system are received into Tank 40, or Tank 51
- Shutdown flows for H-Canyon are assumed in FY26 and are as outlined in *H-Canyon Liquid Waste Generation Forecast for H-Tank Farm Transfer*[32]
- Additional material sent directly to sludge batches increases total DWPF canister count by as much as 100 canisters (these additional canisters are included in the 8,582 forecast canisters of this *Plan*):
  - Fissile isotope concentration of SRS HLW canisters will be maintained below 897 g/m$^3$
  - Pu discards from H-Canyon will be supported to the extent allowable without negatively impacting planned canister waste loadings and complying with canister fissile material concentration limits.

***Effluent Treatment Facility***

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

***Dismantlement and Decommissioning (D&D)***

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

# 7. System Description

## 7.1 *History*

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

Since it became operational in 1951, SRS, a 300-square-mile DOE Complex located in the State of South Carolina, has produced nuclear material for national defense, research, medical, and space programs. The separation of fissionable nuclear material from irradiated targets and fuels resulted in the generation of over 150 Mgal of radioactive waste. As of December 2013, approximately 37 Mgal[33] of radioactive waste are currently stored onsite in large underground waste storage tanks at SRS. Most of the tank waste inventory is a complex mixture of chemical and radioactive waste generated during the acid-side separation of special nuclear materials and enriched uranium from irradiated targets and spent fuel using the Plutonium Uranium Reduction Extraction (PUREX) process in F-Canyon and the modified PUREX process in H-Canyon (HM process). Waste generated from the recovery of Pu-238 in H-Canyon for the production of heat sources for space missions is also included. The waste was converted to an alkaline solution; metal oxides settled as sludge, and supernate evaporated to form saltcake.

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

Because of differences in the material processed by 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 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 saltcake for tank removal from service, receipts of DWPF recycle, and space limitations restricting full evaporator operations, salt solutions have been transferred between the two Tank Farms. Intermingling of PUREX and HM salt waste will continue until high capacity salt waste processing can begin.

Continued long-term storage of these radioactive wastes poses a potential environmental risk. Therefore, since 1996, DOE and its contractors have been removing waste from tanks, pre-treating it, vitrifying it, and pouring the vitrified waste into canisters for long-term disposal in a permanent canister storage location (see *Figure 7-2 — Process Flowsheet*). As of December 31, 2013, DWPF had produced 3,754 vitrified waste canisters (see Figure 7-3 — *Liquid Waste Program — Current Status*).

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

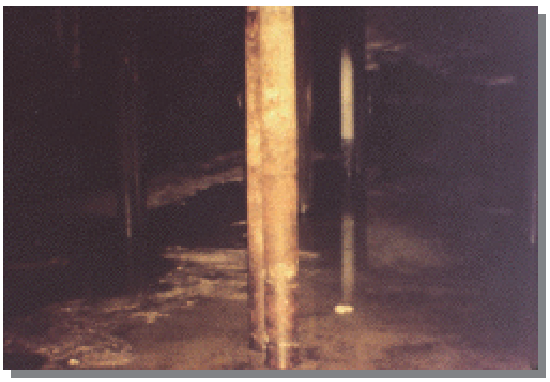
## 7.2 *Tank Storage*

SRS has 51 underground waste storage tanks, all of which were placed into operation between 1954 and 1986. There are four types of waste tanks — Types I through IV. Type III tanks are the newest tanks, placed into operation between 1969 and 1986. There are 27 Type III tanks. Type I tanks are the oldest tanks, constructed in 1952 through 1953. Type II waste tanks were constructed in 1955 through 1956. There are eight Type IV tanks, constructed in 1958 through 1962. Four Type IV tanks, Tanks 17 through 20 and two Type I tanks, Tank 5 and Tank 6, all in F-Tank Farm, have been isolated, operationally closed, and grouted. Fourteen tanks without full secondary containment have a history of leakage[34]. As a result of program progress to date, of these 14 SRS tanks (all old-style tanks) with leakage history:

- 4 are operationally closed and grouted (Tanks 5, 6, 19, and 20)
- 2 have been cleaned, pending further evaluation (Tanks 12 and 16)
- 4 contain essentially dry waste, with little or no free liquid supernate (Tanks 1, 9, 14, and 15)
- 4 contain liquid supernate at a level below known leak sites (Tanks 4, 10, 11, and 13)

Of the remaining 10 old-style tanks (none of which have any known leakage history):

- 2 are operationally closed and grouted (Tanks 17 and 18)
- 2 contain essentially dry waste, with little or no free liquid supernate (Tanks 2 and 3)
- 6 contain liquid supernate (Tanks 7, 8, and 21 through 24).



**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.**

When waste disposition began in 1996, the inventory of waste in the SRS tank system contained approximately 550 Million curies. Currently, 37.3 Mgal of radioactive waste, containing 287 million curies (MCi)[33] of radioactivity, are stored in 43 active waste storage tanks located in two separate locations, H-Tank Farm (27 tanks) and F-Tank Farm (16 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.

The sludge component of the radioactive waste represents approximately 2.7 Mgal (7% of total) of waste but contains approximately 137 MCi (48% of total). The salt waste makes up the remaining 34.6 Mgal (93% of total) of waste and contains approximately 150 MCi (52% of total). Of that salt waste, the supernate accounts for 18.7 Mgal and 138 MCi and saltcake accounts for the remaining 15.9 Mgal and 12 MCi[33]. The sludge contains the majority of the long-lived (half-life > 30 years) radionuclides (e.g., actinides) and strontium. The sludge is currently being stabilized in DWPF through a vitrification process that immobilizes the waste in a borosilicate glass matrix while the salt is being separated in the ARP/MCU process into a higher level component being stabilized in DWPF and a lower level component being dispositioned in SPF.

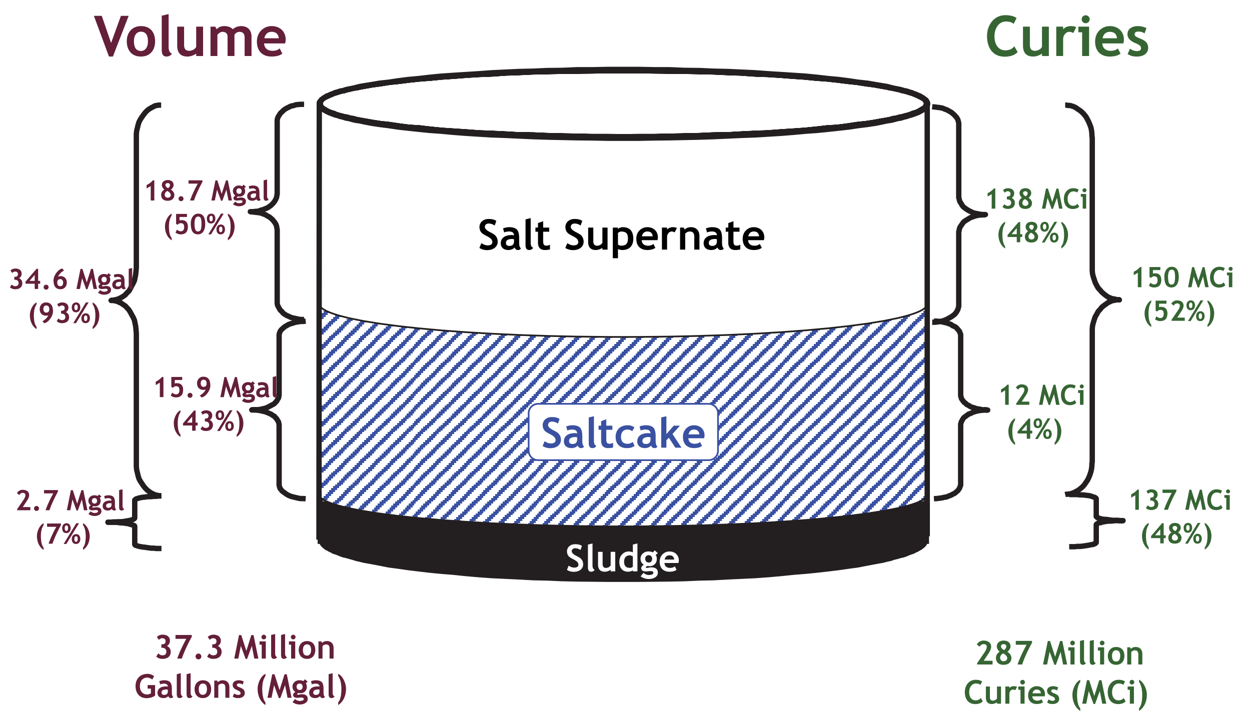
**Sludge consists of insoluble solids that settle to the bottom of a tank. Note the offgas bubbles, including hydrogen generated from radiolysis.**

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

Well over 95%[33] 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[35]. As a result, the cesium concentration in the saltcake is much lower than that in the liquid supernate and interstitial liquid fraction of the salt waste.

**Figure 7-1 — *Waste Tank Composite Inventory (as of December 31, 2013)*[33]**




## 7.3 *Waste Tank Space Management*

To make better use of available tank storage capacity, incoming liquid waste is evaporated to reduce its volume. This is important because most of the SRS Type III waste storage tanks are already near full capacity. Since 1951, the Tank Farms have received over 150 Mgal of liquid waste, of which over 110 Mgal have been evaporated, leaving approximately 37.3 Mgal in the storage tanks. Projected available tank space is carefully tracked to ensure that the Tank Farms do not become "water logged," meaning that so much of the usable Type III tank space has been filled that normal operations and waste removal and processing operations cannot continue. A contingency allotment of 1.3 Mgal is not included as working space. This amount is equivalent to the size of the largest tank and is reserved for the unlikely event that a full tank failed such that all its material had to be removed. Waste receipts and transfers are normal Tank Farm activities as the Tank Farms receive new or "fresh" waste from the H-Canyon stabilization program, liquid waste from DWPF processing (typically referred to as "DWPF recycle"), and wash water from sludge washing. The Tank Farms also make routine transfers to and from waste tanks and evaporators. Since initiation of interim salt waste treatment (DAA and ARP/MCU), the working capacity of the Tank Farms has been maintained. Two evaporator systems are currently operating at SRS — the 2H and 3H systems.

Space in new-style tanks is used for various operations for waste processing and disposal. Tank space is recovered through evaporator operations, DWPF vitrification, ARP/MCU Treatment, and saltstone disposal. This valuable space has been used to: (1) retrieve waste from and clean old-style tanks; (2) prepare, qualify, and treat sludge waste for disposal; (3) prepare, qualify, treat, and dispose salt waste; and (4) support nuclear materials stabilization and disposal through H-Canyon. The Tank Farm space management strategy is based on a set of key assumptions involving projections of DWPF canister production rates, influent stream volumes, Tank Farm evaporator performance, and space gain initiative implementation. The processing of salt and sludge utilizes new-style tank space to retrieve and prepare waste from old-style tanks, and therefore nominal empty space in new-style tanks will increase only after all waste in old-style tanks is processed. Sludge processing through the DWPF removes the highest risk material from the old-style tanks. However, for every gallon of sludge processed, 1.3 gallons of salt waste is formed due to sludge washing and DWPF processing operations to return the resulting low hazard salt waste to the Tank Farm. Similarly, salt waste retrieval, preparation, and batching typically require the use of four gallons of tank space per gallon of salt waste treated. Given these parameters, the "key to reducing the overall risk is processing high-level waste as expeditiously as possible and managing the total tank space efficiently," as recognized by the DNFSB letter dated January 7, 2010[12].

New-style tank space is a currency used to prepare for permanent immobilization and disposition of high level waste in a vitrified waste form and low-level waste in a grouted waste form. Additionally, some "old-style" tanks (e.g., Tank 21–Tank 24) support immobilization and disposition of high-level waste. The tank space management program maintains sufficient space to allow continued DWPF operations. The tank space management program also provides the necessary tank space to support staging of salt solutions to sustain salt waste disposition currently through ARP/MCU and subsequently through SWPF. Of the 27 new-style tanks (with a total nominal volume of 35.1 million gallons) in the SRS Liquid Waste System:

- 5 (Tanks 38, 41, 43, 49, and 50) are dedicated to salt batching, qualification, and disposition (including DWPF recycle beneficial reuse and the 2H Evaporator)
- 6 (Tanks 29, 30, 32, 37, 40, and 51) are dedicated to sludge batching, qualification, and disposition (including the 3H Evaporator)
- 1 (Tank 39) is dedicated to uninterrupted H-Canyon waste receipts
- 15 (Tanks 25, 26, 27, 28, 31, 33, 34, 35, 36, 42, 44, 45, 46, 47, and 48) are dedicated to safe storage of legacy liquid waste pending retrieval and disposition.

There are currently ~6 Mgals of empty space (~17%) in these new-style tanks:

- 2.4 Mgals is margin as defense-in-depth operational control coupled with SC/SS SSCs to facilitate reasonably conservative assurance of more than adequate dilution and ventilation of potentially flammable vapors
- 1.3 Mgals is procedurally-required minimum contingency space for recovery from the unlikely event of a bulk waste leak elsewhere in the system
- 2.3 Mgals is operational "working" space variously used to provide:
    - Additional contingency transfer space as operational excess margin above the procedurally-required minimum
    - Excess margin to preserve salt batch quality and maintain uninterrupted treatment and disposition through ARP/MCU and Saltstone
    - Excess margin to preserve sludge batch quality and maintain uninterrupted immobilization through DWPF
    - Excess margin to preserve uninterrupted support for H-Canyon.

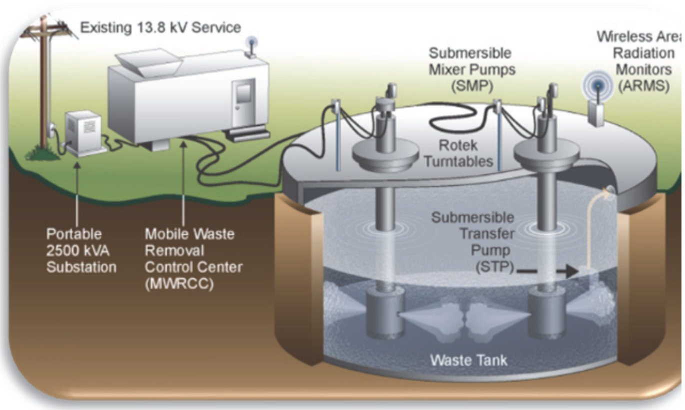
## 7.4 ***Waste Removal from Tanks***

The first step in the disposition of sludge and salt waste is bulk waste removal efforts (BWRE). Sludge is removed from the tank and transferred to a feed preparation tank ensuring sludge waste is continuously available for treatment at DWPF. Salt is dissolved, removed, and staged for treatment at ARP/MCU or SWPF.

To reduce the two-to-four year period required for installation of substantial structural steel and large mixing and transfer pumps — with their attendant infrastructure — required for BWRE, a Waste on Wheels (WOW) innovation was developed. The WOW concept minimizes new infrastructure. Portable and temporary equipment meet tank infrastructure needs. Additional purchased pumps and WOW equipment perform accelerated BWRE operations concurrently in both Tank Farms. The primary components of the WOW system are:

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

WOW equipment is deployed at the tank as a field operating station, providing temporary power and control for BWRE equipment. When BWRE is completed on one tank, the WOW equipment is reconfigured to support waste removal on the next tank. Pumps are sized to fit through 24-inch openings in old style tanks. To the extent that risers are available, pumps are set in optimal configurations within the waste tanks. Product lubricated bearings and motor cooling eliminate the need for bearing and seal water supply. These pumps have exterior fittings and fixtures so the pumps can be decontaminated, minimizing radiation exposure to personnel during relocation to another tank. Disposable transfer pumps transfer the waste to a receipt or hub tank using existing underground transfer lines and diversion boxes. If the transfer system is degraded or non-existent, above-grade hose-in-hose technology is deployed, rather than investing in costly repairs. Temporary shielding is supplied as necessary to reduce exposure to personnel.




**WOW Deployment for BWRE**

## 7.5 *Safe Disposal of the Waste*

The goal is to convert all of the waste into one of two final waste forms: Glass, which will contain over 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 2018, this separation will be accomplished in SWPF. However, until the startup of SWPF, ARP/MCU accomplishes this separation.

## 7.6 *Salt Processing*

Four different processes treat salt:

- **Deliquification, Dissolution, and Adjustment** (DDA) –**D**eliquification (i.e., extracting the interstitial liquid) is an effective decontamination process because the primary radionuclide in salt is Cs-137, which is highly soluble. To accomplish the process, the salt was first deliquified by draining and pumping. The deliquified salt was then **D**issolved by adding water and pumping out the salt solution. The resulting salt solution was aggregated with other Tank Farm waste to **A**djust batch chemistry for processing at SPF. For salt in Tank 41 as of June 9, 2003, which was relatively low in radioactive content, treatment using DDA-solely was sufficient to meet the SPF WAC. Tank 41 has since received additional salt dissolution from Tank 25 and there is no longer any qualified feed for the DDA-solely process. No further DDA-solely is planned.
- **Actinide Removal Process** (ARP) – For salt, even though extraction of the interstitial liquid reduces Cs-137 and soluble actinide concentrations, the Cs-137 or actinide concentrations of the resulting salt are too high to meet the SPF WAC. Salt from these tanks first will be sent to ARP. In ARP, MST is added to the waste as a finely divided solid. Actinides are sorbed on the MST and then filtered out of the liquid to produce a low-level waste stream that is sent to MCU. The MST, containing the actinides, is sent to DWPF.
- **Modular CSSX Unit** (MCU) – The ARP low-level waste stream requires reduction in the concentration of Cs-137 using the CSSX process. MCU is a solvent extraction process for removal of Cs-137 from caustic salt solutions. The solvent used is a four-part solvent with the key ingredient being the cesium extractant (previously BoB Calix but, beginning September 2013, the NGS is Max Calix). This solvent is fed to a bank of centrifugal contactors while the waste is fed to the other end in a counter-current flow. The solvent extracts the cesium, with each successive contactor stage extracting more, resulting in a DSS stream and a cesium-laden solvent stream. The solvent stream is stripped of its cesium, washed, and the solvent is reused. The cesium-laden strip effluent is transferred to DWPF. MCU has a dual purpose:
    - — demonstrating the CSSX flowsheet
    - — treating salt waste to enable accelerated closure of Type I, II, and IV tanks and uninterrupted vitrification of HLW at DWPF

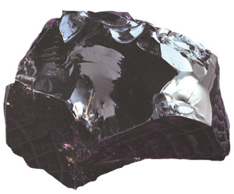
- **Salt Waste Processing Facility** (SWPF) – This is the full-scale CSSX process. This planned facility will incorporate both the ARP and CSSX processes in a full-scale shielded facility capable of handling salt with high levels of radioactivity.

## 7.7 *Sludge Processing*

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

## 7.8 *DWPF Vitrification*

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 a canister has cooled, it is 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 canister is then ready to be stored on an interim basis on-site. A low-level recycle waste stream from DWPF is returned to the Tank Farms. DWPF has been operational since 1996.

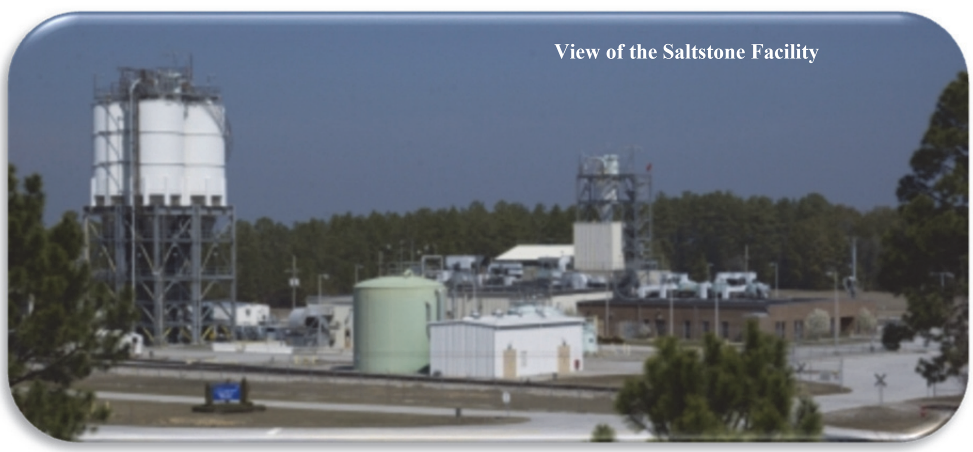


**Sample of Vitrified Radioactive Glass**

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

## 7.9 *Saltstone Disposition*

The Saltstone Facility, located in Z-Area, consists of two facility segments: the Saltstone Production Facility (SPF) and the Saltstone Disposal Facility (SDF). SPF is permitted as a wastewater treatment facility per SCDHEC regulations. SPF receives and treats the salt solution to produce grout by mixing the LLW liquid stream with cementitious materials (cement, flyash, and slag). A slurry of the components is pumped into Saltstone Disposal Units (SDU), 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.



**View of the Saltstone Facility**

Future salt waste processing will impose significantly greater production demands. After SWPF startup, feed of decontaminated salt solution to the SPF could reach as high as 12.8 Mgal/year. In anticipation of this future demand, SRS completed installation of Enhanced Low Activity Waste Disposal (ELAWD) improvements. The ELAWD Phase 1 improvements provided equipment modifications to increase operating margins, reliability, and controls. Also, during the ELAWD Phase 1 outage, the Mixing and Transfer System was modified to connect SPF to SDU-2.

ELAWD Phase 2 will modify the dry feeds system and connect SPF to new larger capacity salt solution feed receipt tanks. Lastly, modifications that support converting from the present day-shift staffing to 24/7 operations are planned.

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

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

The first SDU (Vault 1) is approximately 100 feet wide by 600 feet in length by 25 feet in height, divided into six cells and the second SDU (Vault 4) is approximately 200 feet wide by 600 feet in length by 26 feet in height, divided into twelve cells. Neither is planned for future use in emplacing contaminated grout.

SDU-2, SDU-3, and SDU-5, currently in use, consist of two cells, each cell nominally 150 feet diameter by 22 feet high each. This design is used commercially for storage of water. After accounting for interior obstructions (support columns, drainwater collection systems, etc.) and the requirement for a 2-foot cold cap, the nominal useable volume of a cell is 2,300 kgal. Recent operating experience has resulted in approximately 1.76 gallons of grout being produced for each gallon of DSS feed, yielding a nominal cell capacity of approximately 1,290 kgal of DSS.

The next generation of units, SDU-6 through SDU-13 will be a 375-foot diameter 43-foot tall single-cell design. The vaults will hold 30 Mgal of contaminated grout or 17.1 Mgal of DSS feed.

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

Construction of the SDF and the first two vaults were completed between February 1986 and July 1988. The SDF started radioactive operations June 12, 1990. SDU-2 began filling in September 2012. SDU-3 and SDU-5 began filling in October 2013. The large SDU-6 site preparation is complete and construction began in December 2013, Future SDUs will be constructed on a “just-in-time” basis in coordination with salt processing production rates.

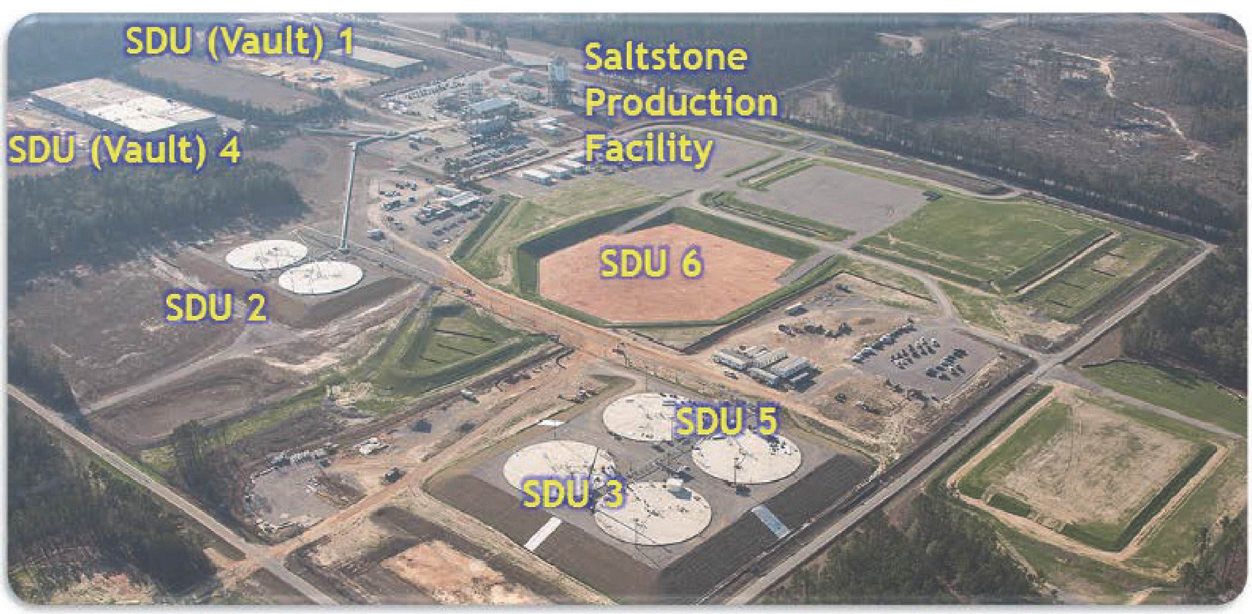


**Figure 7-2 — *Process Flowsheet***

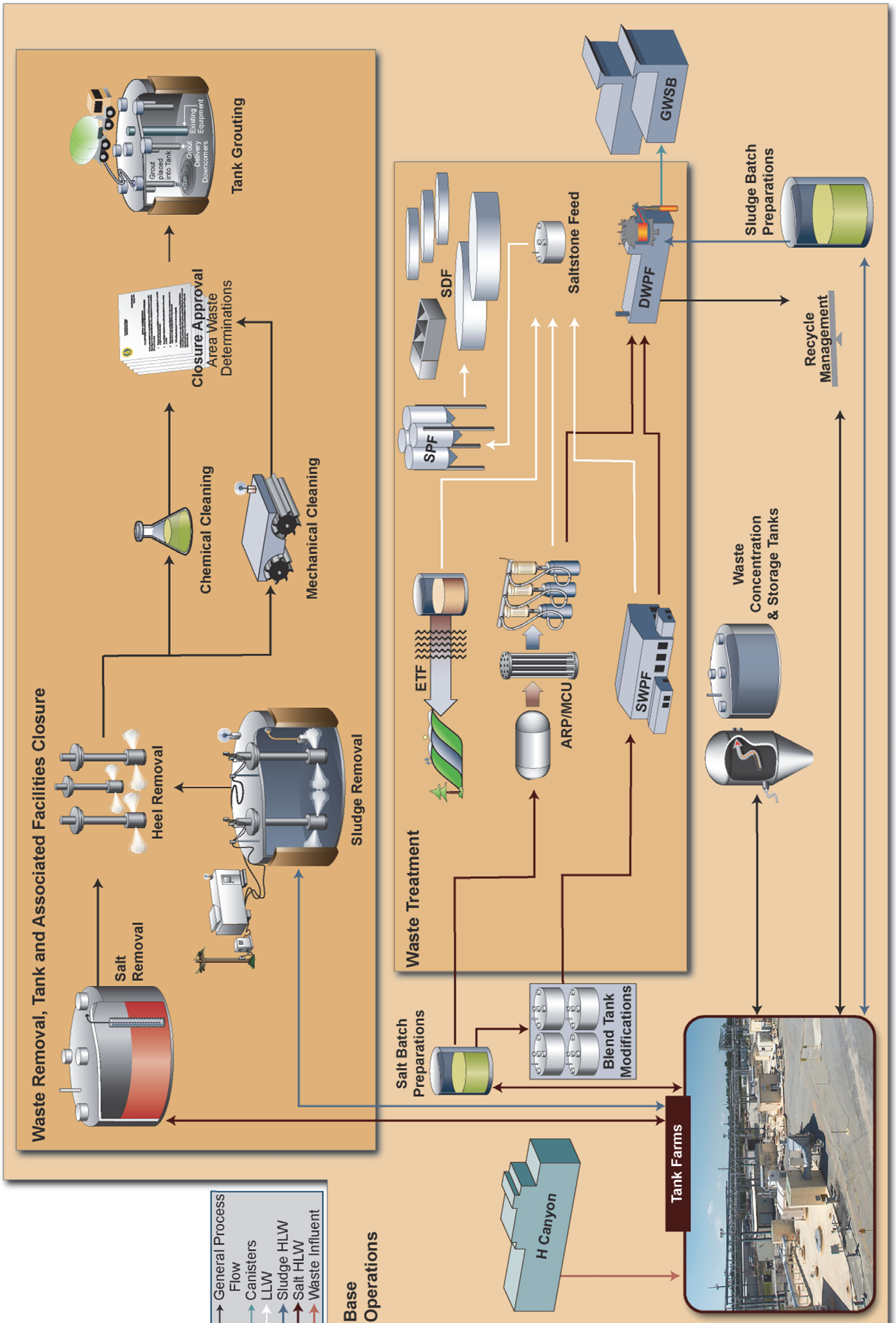
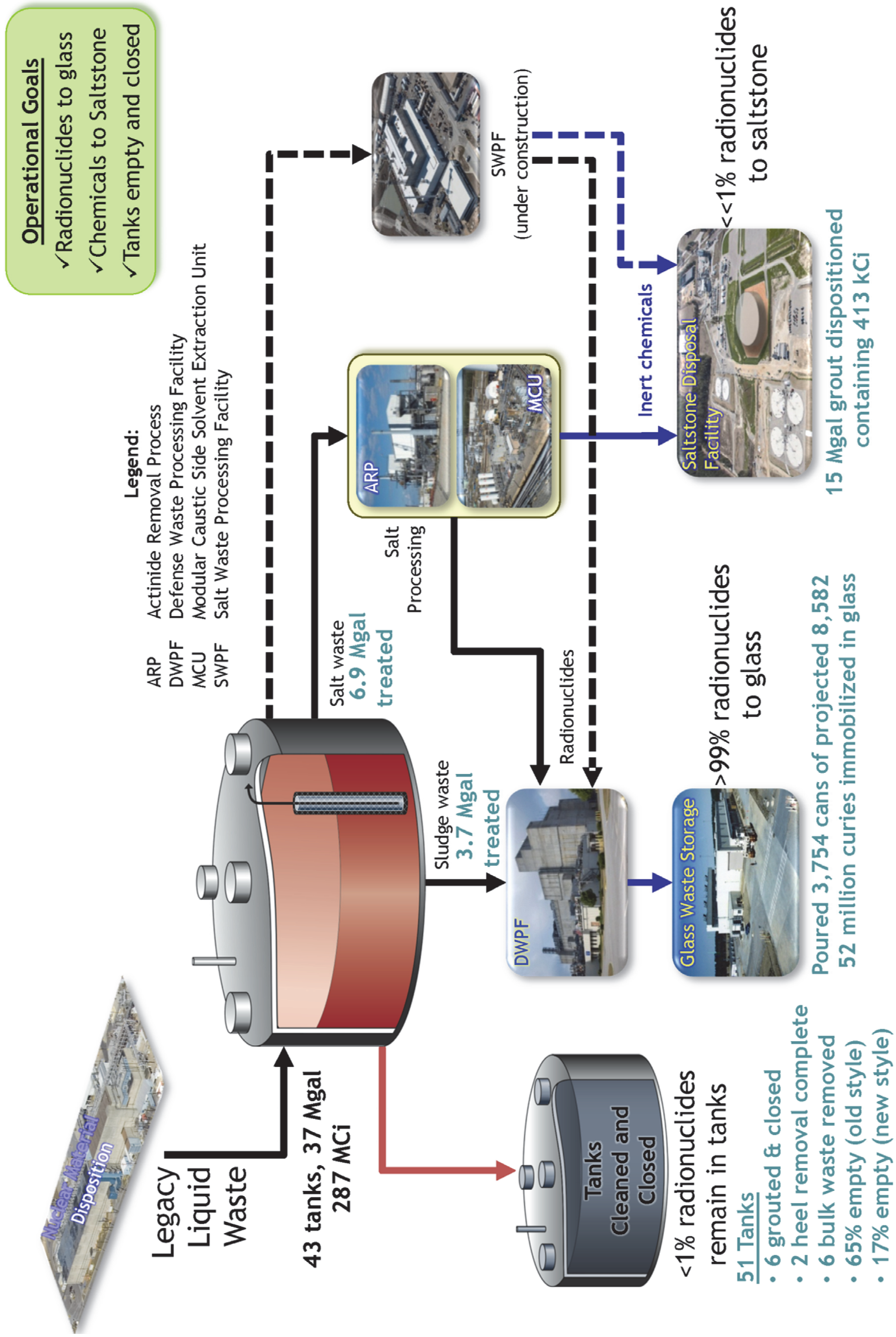


**Figure 7-3 — *Liquid Waste Program — Current Status***



# Appendix A — *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] |
|---|---|---|---|---|---|
| Actual canisters poured through December 2013 (Sludge Batches 1 through 8): | | | | 3,754 | |
| SB8 (to completion) | 12 Heel Removal; H-Canyon Solids; 13 | 36% | various | 359 | Feb 2016 |
| SB9 | 12 Chemical Cleaning; 22 solids from DWPF; H-Canyon Solids; 13 | 36% | various | 51 | May 2016 |
| DWPF Melter Replacement — June 2016 thru September 2016 | | | | | |
| SB9 (to completion) | (cont'd) | 36% | various | 268 | Feb 2018 |
| SB10 (LTAD) | 22 Solids from DWPF; H-Canyon Solids; 13, 15, & 26 | 36% | various | 60 | May 2018 |
| SWPF Tie-In Outage — June 2018 thru September 2018 | | | | | |
| SB10 (to completion) | (cont'd) | 40% | 276 | 276 | Sep 2019 |
| SB11 (LTAD) | 10, 15 Heel Removal; 13, 15, 6, 33, & 35 | 40% | 276 | 345 | Dec 2020 |
| SB12 (LTAD) | 11 Heel Removal; 33, 35, & 39 | 40% | 276 | 345 | Mar 2022 |
| SB13 (LTAD) | 9 & 11 Heel Removal; 13, 33, 34, 35, & 39 | 40% | 276 | 345 | Jun 2023 |
| SB14 | 33, 35, & 39 | 40% | 276 | 253 | May 2024 |
| DWPF Melter Replacement — June 2024 thru September 2024 | | | | | |
| SB14 (to completion) | (cont'd) | 40% | 276 | 92 | Jan 2025 |
| SB15 | 14 Heel Removal; 13, 14, 32, 33, & 35 | 40% | 276 | 345 | Apr 2026 |
| SB16 | 13 Heel Removal; 32, 33, 35, & 47 | 40% | 276 | 345 | Jul 2027 |
| SB17 | 33, 35, 39, 43, & 47 | 40% | 276 | 345 | Oct 2028 |
| SB18 | 8 & 22 Heel Removal; 22, 33, 35, 39, & 43 | 40% | 276 | 299 | Nov 2029 |
| SB19 | 1, 2, 3, 4, 7 & 23 Heel Removal; 35 & 33 | 40% | 276 | 184 | Jul 2030 |
| Heel & Simulated Sludge Batch 20 [c] | 21, 24, 33, & 35 Heel Removal | 40% | 276 | 667 | Dec 2032 |
| DWPF Melter Replacement — June 2033 thru September 2033 | | | | | |
| Heel Batch 21 [d] | 28, 33, 35, 45, 46, & 47 Heel Removal | 30% | 30 | 43 | Sep 2034 |
| Heel Batch 22 [d] | 26, 27, 29, 30, 31, 33, 35, 41 & 44 Heel Removal | 30% | 44 | 117 | May 2037 |
| Heel Batch 23 [d] | 25, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, & 51 Heel Removal | 36% | 67 | 89 | Sep 2038 |
| | | | **Total Canisters Produced:** | **8,582** | |

[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 33 and 35, for example, are also used to stage sludge that is removed from other tanks. Some BWRE may be accelerated with respect to this table as conditions dictate.

[b] Dates are approximate and represent when Tank 40 gets to approximately 100,000 kg of insoluble solids left in the tank. Actual dates depend on canister production rates

[c] SB20 contains mainly simulated sludge to maintain canister production in support of SWPF

[d] Lower production rate assumed for dilute heel processing

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

# Appendix B — *Canister Storage*

| End of Fiscal Year | SRS Cans Poured | | SRS Cans in GWSB #1 (2,251 capacity)[a] | | SRS Cans in GWSB #2 (2,339 capacity)[b] | | SRS Cans in Supplemental Storage [c] | |
|---|---|---|---|---|---|---|---|---|
| | Yearly | Cum. | Added | Cum. | Added | Cum. | Added | Cum. |
| *FY96* | *64* | *64* | *64* | *64* | | | | |
| *FY97* | *169* | *233* | *169* | *233* | | | | |
| *FY98* | *250* | *483* | *250* | *483* | | | | |
| *FY99* | *236* | *719* | *236* | *719* | | | | |
| *FY00* | *231* | *950* | *231* | *950* | | | | |
| *FY01* | *227* | *1,177* | *227* | *1,177* | | | | |
| *FY02* | *160* | *1,337* | *160* | *1,337* | *Numbers in italics are actuals — through FY13. FY14 and on are forecast based on modeling assumptions* | | | |
| *FY03* | *115* | *1,452* | *115* | *1,452* | | | | |
| *FY04* | *260* | *1,712* | *260* | *1,712* | | | | |
| *FY05* | *257* | *1,969* | *257* | *1,969* | | | | |
| *FY06* | *245* | *2,214* | *244* | *2,213* | *1* | *1* | | |
| *FY07* | *160* | *2,374* | *28* | *2,241* | *132* | *133* | | |
| *FY08* | *225* | *2,599* | | *2,241* | *225* | *358* | | |
| *FY09* | *196* | *2,795* | | *2,241* | *196* | *554* | | |
| *FY10* | *192* | *2,987* | *3* | *2,244* | *183* | *737* | [d] | |
| *FY11* | *264* | *3,251* | | *2,244* | *260* | *997* | | |
| *FY12* | *277* | *3,528* | | *2,244* | *277* | *1,269* | | |
| *FY13* | *224* | *3,752* | | *2,244* | *224* | *1,493* | | |
| FY14 | 120 | 3,872 | | 2,244 | 120 | 1,613 | | |
| FY15 | 156 | 4,028 | | 2,244 | 156 | 1,769 | | |
| FY16 | 136 | 4,164 | | 2,244 | 136 | 1,905 | | |
| FY17 | 168 | 4,332 | | 2,244 | 168 | 2,073 | | |
| FY18 | 160 | 4,492 | | 2,244 | 160 | 2,233 | | |
| FY19 | 276 | 4,768 | | 2,244 | 106 | 2,339 | 170 | 170 |
| FY20 | 276 | 5,044 | | 2,244 | | 2,339 | 276 | 446 |
| FY21 | 276 | 5,320 | | 2,244 | | 2,339 | 276 | 722 |
| FY22 | 276 | 5,596 | | 2,244 | | 2,339 | 276 | 998 |
| FY23 | 276 | 5,872 | | 2,244 | | 2,339 | 276 | 1,274 |
| FY24 | 184 | 6,056 | | 2,244 | | 2,339 | 184 | 1,458 |
| FY25 | 276 | 6,332 | | 2,244 | | 2,339 | 276 | 1,734 |
| FY26 | 276 | 6,608 | | 2,244 | | 2,339 | 276 | *2,010* |
| FY27 | 276 | 6,884 | | 2,244 | | 2,339 | 276 | 2,286 |
| FY28 | 276 | 7,160 | | 2,244 | | 2,339 | 276 | 2,562 |
| FY29 | 276 | 7,436 | | 2,244 | | 2,339 | 276 | 2,838 |
| FY30 | 276 | 7,712 | | 2,244 | | 2,339 | 276 | 3,114 |
| FY31 | 276 | 7,988 | | 2,244 | | 2,339 | 276 | 3,390 |
| FY32 | 276 | 8,264 | | 2,244 | | 2,339 | 276 | 3,666 |
| FY33 | 81 | 8,345 | | 2,244 | | 2,339 | 81 | 3,747 |
| FY34 | 30 | 8,375 | | 2,244 | | 2,339 | 30 | 3,777 |
| FY35 | 44 | 8,419 | | 2,244 | | 2,339 | 44 | 3,821 |
| FY36 | 44 | 8,463 | | 2,244 | | 2,339 | 44 | *3,865* |
| FY37 | 52 | 8,515 | | 2,244 | | 2,339 | 52 | 3,917 |
| FY38 | 67 | 8,582 | | 2,244 | | 2,339 | 82 | 3,999 |

[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; 7 are contingency positions for placement of canisters if GWSB #2 is temporarily unavailable.

[b] GWSB #2 was built with 2,340 standard storage locations. One archived non-radioactive canister is stored in GWSB #2 yielding a usable storage capacity of 2,339 standard canisters. GWSB #2 received its first radioactive canister in June 2006. It is expected to reach maximum capacity in FY19.

[c] This *Plan* assumes supplemental canister storage is available in early FY19.

[d] Typically, several canisters are in the vitirification building pending transfer to canister storage. All cans will be transferred to canister storage before the DWPF is cleaned and flushed.

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

# Appendix C — *Salt Solution Processing*

| End of | Salt Solution (kgal) | | | | to Tank 50[b] (kgal) | | | | | SDU |
|---|---|---|---|---|---|---|---|---|---|---|
| Fiscal Year | DDA-solely | ARP/MCU | SWPF | Total [a] | DSS | H-Can | 512-S | ETF | Total | Numbers [c] |
| Total as of end of FY10 | 2,800 | 980 | | 3,780 | 3,151 | 682 | | 3,019 | 6,492 | 4 |
| FY11 | | 1,063 | | 1,063 | 1,487 | 200 | | 64 | 1,751 | 4 |
| FY12 | | 706 | | 706 | 901 | 19 | | 24 | 1,251 | 4 & 2 |
| FY13 | | 1,317 | | 1,317 | 1,566 | 24 | 65 | 69 | 1,724 | 2 |
| FY14 | | 800 | | 800 | 960 | 29 | 42 | 68 | 1,098 | 2- 5 |
| FY15 | | 1,500 | | 1,500 | 1,800 | 30 | 75 | 96 | 2,001 | 3 & 5 |
| FY16 | | 1,200 | | 1,200 | 1,440 | 30 | 60 | 96 | 1,626 | 3 & 5 |
| FY17 | | 2,000 | | 2,000 | 2,400 | 30 | 100 | 96 | 2,626 | 3 -6 |
| FY18 | | 1,000 | | 1,000 | 1,200 | 30 | 50 | 96 | 1,376 | 6 |
| FY19 | | | 4,000 | 4,000 | 5,126 | 30 | | 96 | 5,252 | 6 |
| FY20 | | | 3,000 | 3,000 | 3,845 | 30 | | 96 | 3,971 | 6 |
| FY21 | | | 3,000 | 3,000 | 3,845 | 30 | | 96 | 3,971 | 6 |
| FY22 | | | 6,000 | 6,000 | 7,689 | 30 | | 96 | 7,815 | 6-7 |
| FY23 | | | 6,000 | 6,000 | 7,689 | 30 | | 96 | 7,815 | 7 |
| FY24 | | | 6,000 | 6,000 | 7,689 | 30 | | 96 | 7,815 | 7-8 |
| FY25 | | | 9,000 | 9,000 | 11,534 | 30 | | 96 | 11,660 | 8 |
| FY26 | | | 9,000 | 9,000 | 11,534 | 18 | | 96 | 11,648 | 8-9 |
| FY27 | | | 9,000 | 9,000 | 11,534 | | | 96 | 11,630 | 9-10 |
| FY28 | | | 9,000 | 9,000 | 11,534 | | | 96 | 11,630 | 10-11 |
| FY29 | | | 9,000 | 9,000 | 11,534 | | | 96 | 11,630 | 11 |
| FY30 | | | 9,000 | 9,000 | 11,534 | | | 96 | 11,630 | 11-12 |
| FY31 | | | 9,000 | 9,000 | 11,534 | | | 96 | 11,630 | 12-13 |
| FY32 | | | 9,000 | 9,000 | 11,534 | | | 96 | 11,630 | 13 |
| FY33 | | | 2,250 | 2,250 | 2,883 | | | 96 | 2,979 | 13 |
| **Total** | **2,800** | **10,567** | **102,250** | **115,617** | **145,937** | **1,302** | **393** | **5,163** | **152,743** | |

[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-solely, ARP/MCU and SWPF processes. Each gallon of salt solution treated via ARP/MCU and SWPF yields ~1.2 gallons of DSS

[b] Low Level Waste receipts to Tank 50 include the DSS from salt processing, LLW from H-Canyon, ARP (512-S) filter cleaning discards, and the ETF low level stream.

[c]
- SDU-1 and SDU-4 are no longer planned to receive contaminated grout.
- SDU-2, SDU-3, and SDU-5 have two ~2.9-Mgal cylindrical cells, each capable of receiving ~1.3 Mgal of Tank 50 DSS.
- Beginning with SDU-6, the SDU will consist of a single 30 Mgal cylindrical cell, capable of receiving ~17 Mgal of DSS
- Each gallon of Tank 50 feed, when added to the cement, flyash, and slag, generates approximately 1.76 gallons of grout
- Bleed water recycling consumes 5% of the vault space, reducing the available space for feed solution.

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

# Appendix D — *Salt Batch Composition*

| Year | Batch | Hub Tanks | Blend Tank | Begin Processing | Source Tanks | Reason |
|---|---|---|---|---|---|---|
| FY14-FY16 | ARP/MCU B7 | 8, 23, 35 | 21 | Mar-2014 | Tk23 liquid (Tk41 SD); Tk11 liquid (Tk10 SD); Tk38 liquid (2H liquor); DWPF recycle | SD from Tk10 & Tk41 |
| | ARP/MCU B8 | 8, 23, 35 | 21 | Dec-2014 | Tk23 liquid (Tk22, Tk41 SD and Tk35 supernate); Tk35 supernate; Tk8 liquid (SB5 & SB6 LTAD leachate); Tk38 liquid (2H liquor); DWPF recycle | leachate from Tk8 (SB6), Tk35 (Tk37 2010 & 2014 SD), & Tk41 |
| | ARP/MCU B9 | 8, 23, 35 | 21 | Jul-2015 | Tk23 liquid (Tk41 SD, Tk35 supernate and Tk37 SD); Tk35 supernate (Tk37 SD); Tk8 liquid (SB5 & SB6 LTAD leachate); Tk38 liquid (2H liquor); DWPF recycle | |
| | ARP/MCU B10 | 8, 23, 35 | 21 | Feb-2016 | Tk23 liquid (Tk41 SD and Tk37 SD); Tk35 supernate (Tk37 SD); Tk8 liquid (SB5 & SB6 LTAD leachate); Tk38 liquid (2H liquor). | |
| | Outage for DWPF Melter Replacement and MCU Rebuild Contactors (June 2016 thru September 2016) | | | | | |
| FY17-FY18 | ARP/MCU B11 | 8, 23, 35 | 21 | Dec-2016 | Tk23 liquid (Tk41 SD and Tk37 SD); Tk35 supernate (Tk37 SD); Tk8 liquid (SB5 & SB6 LTAD leachate); Tk38 liquid (2H liquor). | leachate from Tk8 (SB10), Tk10 SD,Tk35 (Tk37 2014 & 2016 SD), & Tk41 SD |
| | ARP/MCU B12 | 8, 23, 35 | 21 | Jul-2017 | Tk23 liquid (Tk41 SD and Tk37 SD); Tk35 supernate (Tk37 SD); Tk8 liquid (SB10 AD leachate); Tk38 liquid (2H liquor). | |
| | ARP/MCU B13 | 8, 23, 35 | 21 | Dec-2017 | Tk23 liquid (Tk41 SD and Tk37 SD); Tk35 supernate (Tk37 SD); Tk8 liquid (SB10 AD leachate); Tk38 liquid (2H liquor). | |
| | Outage for SWPF Tie-ins (April 2018 thru September 2018)<br>(Note: any remaining qualified ARP/MCU material will be included in SWPF Batch 1) | | | | | |
| FY19 | SWPF B1 | 8, 23, 35 | 21 | Oct-2018 | Tk23 liquid (Tk37 & Tk41 SD); Tk35 supernate (Tk37 SD); Tk8 liquid (SB10 LTAD leachate) | leachate from Tk8 (SB11), Tk36 SD (to succeed Tk22), Tk27 SD (for SWPF Hub), & Tk41 SD |
| | SWPF B2 | 8, 23, 42 | 21 | Dec-2018 | Tk23 liquid (Tk41 SD and Tk10 SD via Tk11); Tk42 conc. supernate; Tk8 liquid (SB10 LTAD leachate) | |
| | SWPF B3 | 8, 23, 42 | 21 | Mar-2019 | Tk23 liquid (Tk41 & Tk36 SD); Tk42 conc supernate; Tk8 liquid (SB10 & SB11 LTAD leachate) | |
| | SWPF B4 | 8, 23, 42 | 21 | Jul-2019 | Tk23 liquid (Tk41 & Tk36 SD); Tk42 conc supernate (including Tk25 and Tk27 conc supernate via Tk25); SB11 LTAD leachate from Tk8 | |
| FY20 | SWPF B5 | 8, 23, 42 | 21 | Nov-2019 | Tk23 liquid (Tk36 SD and Tk27 SD via Tk26); Tk42 conc supernate (including Tk25, Tk26 and Tk37 conc supernate via Tk35); SB11 LTAD leachate from Tk8 | leachate from Tk8 (SB12), Tk9 SD, Tk36 SD, Tk27 SD (for SWPF Hub), & Tk26 and Tk34 (for SWPF Blend & Tk34 sludge removal) |
| | SWPF B6 | 8, 23, 42 | 21 | Mar-2020 | Tk23 liquid (Tk9 SD and Tk27 SD via Tk26); Tk42 conc supernate (including Tk34 conc supernate via Tk25 and Tk9 conc supernate); SB12 LTAD leachate from Tk8 | |
| | SWPF B7 | 8, 23, 42 | 21 | Jul-2020 | Tk23 liquid (Tk9 SD and Tk27 SD via Tk26); Tk42 conc supernate (including Tk34 conc supernate via Tk25 and Tk9 conc supernate); SB12 LTAD leachate from Tk8 | |
| FY21 | SWPF B8 | 8, 23, 42 | 21 | Nov-2020 | Tk23 liquid (Tk36 SD and Tk34 SD via Tk26); Tk42 conc supernate(including Tk34 conc supernate via Tk25 and Tk9 conc supernate); SB12 LTAD leachate from Tk8 | leachate from Tk8 (SB12 & 13), Tk9, Tk34 (for SWPF Blend), Tk36 (to replace Tk22 Recycle Receipt), & Tk36 (2021 Tk37 SD) |
| | SWPF B9 | 8, 23, 42 | 21 | Mar-2021 | Tk23 liquid (Tk36 SD and Tk34 SD via Tk26); Tk42 conc supernate (including Tk34 conc supernate via Tk25 and Tk9 conc supernate); SB12 LTAD leachate from Tk8 | |
| | SWPF B10 | 8, 23, 42 | 21 | Jul-2021 | Tk23 liquid (Tk25 SD via Tk26); Tk42 conc supernate (including Tk37 conc supernate via Tk35); SB13 LTAD leachate from Tk8 | |
| FY22 | SWPF B11 | 25 | 26 | Oct-2021 | Salt solution from Tk27 (Tk27 SD and Tk25 SD from Tk25 and stored inTk26); Tk34 conc supernate via Tk25 | leachate from Tk8 (SB13), Tk34 (for SWPF Blend), & Tk36 (to replace Tk22 Recycle Receipt), & Tk35 (2021 Tk37 SD), Tk44 SD |
| | SWPF B12 | 8, 23, 42 | 21 | Dec-2021 | Tk23 liquid (Tk37 SD via Tk36 and Tk25 SD via Tk26/27); Tk42 conc supernate (including Tk37 conc supernate via Tk35); SB13 LTAD leachate from Tk8 | |
| | SWPF B13 | 25 | 26 | Feb-2022 | Salt solution from Tk27 (Tk27 SD and Tk25 SD); Tk34 conc supernate via Tk25 | |
| | SWPF B14 | 8, 23, 42 | 21 | Apr-2022 | Tk23 liquid (Tk37 SD via Tk36 and Tk25 SD via Tk26/27); Tk42 conc supernate (including Tk37 conc supernate via Tk35); SB13 LTAD leachate from Tk8 | |
| | SWPF B15 | 25 | 26 | Jun-2022 | Salt solution from Tk27 (Tk27 SD and Tk44 SD); Tk25 liquid (Tk44 supernate/IL) | |
| | SWPF B16 | 8, 23, 42 | 21 | Aug-2022 | Tk23 liquid (Tk25 and Tk27 SD via Tk26/Tk41 and Tk9 SD via Tk41); Tk42 conc supernate (including Tk37 conc supernate via Tk35 and Tk44 supernate/IL via Tk25); SB13 LTAD leachate from Tk8 | |
| FY23 | SWPF B17 | 25 | 26 | Oct-2022 | Salt solution from Tk27 (Tk27 SD and Tk44 SD); Tk25 liquid (Tk47 supernate/IL) | leachate from Tk8 (SB12 & 13), Tk27 & Tk44 (SWPF Hub), Tk14 SD, Tk37 SD (for 3H Evap), Tk36 SD, Tk47 SD (future sludge removal) |
| | SWPF B18 | 8, 23, 42 | 21 | Dec-2022 | Tk23 liquid (Tk25, Tk26,F45 and Tk27 SD via Tk26/Tk41 and Tk9 SD via Tk41); Tk42 conc supernate (including Tk37 conc supernate via Tk35 and Tk44 supernate/IL via Tk25); SB13 LTAD leachate from Tk8 | |
| | SWPF B19 | 25 | 26 | Feb-2023 | Salt solution from Tk27 (Tk27 SD and Tk44 SD); Tk25 liquid (Tk47 supernate/IL) | |
| | SWPF B20 | 8, 23, 42 | 21 | Apr-2023 | Tk23 liquid (Tk33 SD via Tk51/Tk7); Tk42 conc supernate (Tk47 supernate/IL via Tk25 and Tk14 supernate/IL via Tk13) | |
| | SWPF B21 | 25 | 26 | Jun-2023 | Tk27 liquid (Tk27 SD and Tk44 SD); Tk25 liquid (Tk34 conc supernate) | |
| | SWPF B22 | 8, 23, 42 | 21 | Aug-2023 | Tk23 liquid (Tk36 SD, TK14 SD via Tk13, Tk47 SD via Tk8); Tk42 conc supernate (Tk47 supernate/IL via Tk25 and Tk14 supernate/IL via Tk13) | |

| Year | Batch | Hub Tanks | Blend Tank | Begin Processing | Source Tanks | Reason |
|---|---|---|---|---|---|---|
| FY24 | SWPF B23 | 25 | 26 | Oct-2023 | Tk27 liquid (Tk27 SD and Tk44 SD); Tk25 liquid (Tk1 & 2 supernate/ IL via Tk33) | Tk1 & 2 SD, Tk27 & Tk44 (SWPF Hub), Tk47 (for sludge batch prep), & Tk36 |
| | SWPF B24 | 8, 23, 42 | 21 | Nov-2023 | Tk23 liquid (Tk36 SD and Tk47 SD via Tk8); Tk42 conc supernate (Tk32 supernate) | |
| | SWPF B25 | 44 | 34 | Dec-2023 | Tk44 SD; Tk25 liquid (Tk1 & 2 supernate/ IL via Tk33) | |
| | SWPF B26 | 25 | 26 | Feb-2024 | Tk27 salt solution; Tk25 liquid (Tk1 & 2 supernate/ IL via Tk33) | |
| | SWPF B27 | 7, 23, 42 | 21 | Mar-2024 | Tk23 liquid (Tk1 & Tk2 SD via Tk7); Tk42 conc supernate (Tk32 supernate) | |
| | SWPF B28 | 44 | 34 | Apr-2024 | Tk44 liquid (Tk47 SD and Tk47 SD via Tk8); Tk25 liquid (Tk1 & 2 supernate/IL via Tk33) | |
| | Outage for DWPF Melter Replacement (June 2024 thru September 2024) | | | | | |
| FY25 | SWPF B29 | 7, 23, 42 | 21 | Oct-2024 | Tk23 liquid (Tk1 & Tk2 SD via Tk7; Tk32 SD via Tk41, and Tk36 SD); Tk42 conc supernate (Tk32 supernate) | Tk1, Tk2, & Tk3 SD; Tk44 SD, Tk47 (for sludge batch prep) |
| | SWPF B30 | 25 | 26 | Nov-2024 | Tk27 salt solution (Tk47 SD); Tk25 liquid (Tk37 supernate/ IL) | |
| | SWPF B31 | 44 | 34 | Dec-2024 | Tk44 liquid (Tk47 SD); Tk25 liquid (Tk37 supernate/ IL) | |
| | SWPF B32 | 7, 23, 42 | 21 | Feb-2025 | Tk23 liquid (Tk1 & Tk2 SD via Tk7); Tk42 conc supernate (Tk32 supernate) | |
| | SWPF B33 | 27 | 26 | Mar-2025 | Tk27 salt solution (Via Tk8; Tk47 SD and Tk7 salt solution (contains Tk1 and Tk2 SD); Tk25 liquid (Tk37 supernate/IL) | |
| | SWPF B34 | 44 | 34 | Apr-2025 | Tk44 liquid (Tk47 SD); Tk25 liquid (Tk37 supernate/ IL) | |
| | SWPF B35 | 7, 23, 42 | 21 | Jun-2025 | Tk23 liquid (Tk1, Tk2, and Tk3 SD via Tk7); Tk42 conc supernate (Tk24 supernate) | |
| | SWPF B36 | 27 | 26 | Jul-2025 | Tk27 salt solution (Tk1, Tk2, and Tk3 SD via Tk7/Tk8); Tk25 liquid (Tk47 supernate/IL) | |
| | SWPF B37 | 44 | 34 | Aug-2025 | Tk44 salt solution (Tk45 SD); Tk25 liquid (Tk45 supernate/ IL) | |
| FY26 | SWPF B38 | 7, 23, 42 | 21 | Oct-2025 | Tk23 liquid (Tk1, Tk2, and Tk3 SD via Tk7); Tk42 conc supernate (Tk24 supernate) | Tk2, & Tk3 SD (heel removal); Tk29, Tk44, & Tk46 SD; Tk47 (for sludge batch prep) |
| | SWPF B39 | 27 | 26 | Nov-2025 | Tk27 salt solution (Tk1, Tk2, and Tk3 SD via Tk7/Tk8); Tk25 liquid (Tk47 supernate/IL) | |
| | SWPF B40 | 44 | 34 | Dec-2025 | Tk44 salt solution (Tk45 SD); Tk25 liquid (Tk45 supernate/ IL) | |
| | SWPF B41 | 7, 23, 42 | 21 | Feb-2026 | Tk23 liquid (via Tk41; Tk32 SD and from Tk7, Tk1, and Tk2 SD); Tk30 liquid (Tk37 and Tk26 supernate/IL) | |
| | SWPF B42 | 27 | 26 | Mar-2026 | Tk27 salt solution (Tk1, Tk2, and Tk3 SD via Tk7/Tk8); Tk25 liquid (Tk47 supernate/IL) | |
| | SWPF B43 | 44 | 34 | Apr-2026 | Tk44 salt solution (Tk44 and Tk45 SD); Tk25 liquid (Tk45 supernate/ IL) | |
| | SWPF B44 | 7, 23, 42 | 21 | Jun-2026 | Tk23 liquid (via Tk41; Tk32 SD and from Tk7, Tk1, and Tk2 SD); Tk30 liquid (Tk37 and Tk26 supernate/IL) | |
| | SWPF B45 | 27 | 26 | Jul-2026 | Tk27 salt solution (Tk1, Tk2, and Tk3 SD via Tk7/Tk8); Tk25 liquid (Tk46 supernate/IL) | |
| | SWPF B46 | 44 | 34 | Aug-2026 | Tk44 salt solution (Tk45 SD); Tk25 liquid (Tk46 supernate/ IL) | |
| FY27 | SWPF B47 | 7, 23, 42 | 21 | Oct-2026 | Tk23 liquid (remaining in Tk41, Tk29 SD, Tk3 SD via Tk7); Tk30 liquid (including Tk29 supernate/IL) | Type III Salt Dissolution |
| | SWPF B48 | 27 | 26 | Nov-2026 | Tk27 salt solution (Tk45 SD); Tk25 liquid (Tk46 supernate/IL) | |
| | SWPF B49 | 44 | 34 | Dec-2026 | Tk44 salt solution (Tk45 SD); Tk25 liquid (Tk46 supernate/ IL) | |
| | SWPF B50 | 41 | 21 | Feb-2027 | Tk41 liquid (remaining in Tk41); Tk30 liquid (including Tk29 supernate/IL) | |
| | SWPF B51 | 27 | 26 | Mar-2027 | Tk27 salt solution (Tk45 SD); Tk25 liquid (Tk28 supernate/IL) | |
| | SWPF B52 | 44 | 34 | Apr-2027 | Tk44 salt solution (Tk45 SD); Tk25 liquid (Tk28 supernate/ IL) | |
| | SWPF B53 | 41 | 21 | Jun-2027 | Tk41 liquid (Tk29 and Tk38 SD); Tk30 liquid (including Tk29 supernate/IL) | |
| | SWPF B54 | 27 | 26 | Jul-2027 | Tk27 salt solution (Tk46 SD and salt solution leftover from Tk23 (Tk29 SD, Tk3 SD via Tk7, and Tk1 and Tk2 SD via Tk7/Tk41)); Tk25 liquid (Tk28 supernate/ IL; Tk29 and Tk30 supernate/IL via Tk30) | |
| | SWPF B55 | 44 | 34 | Aug-2027 | Tk44 salt solution (Tk45 and Tk46 SD); Tk25 liquid (Tk28 supernate/ IL; Tk29 and Tk30 supernate/IL via Tk30) | |
| FY28 | SWPF B56 | 41 | 21 | Oct-2027 | Tk41 liquid (remaining in+F88 Tk23 and Tk38 SD); Tk30 liquid (Tk31 supernate/IL) | Type III Salt Dissolution |
| | SWPF B57 | 27 | 26 | Nov-2027 | Tk27 salt solution (Tk46 and Tk29 SD); Tk25 liquid (Tk24 supernate) | |
| | SWPF B58 | 44 | 34 | Dec-2027 | Tk44 salt solution (Tk28 SD); Tk25 liquid (Tk24 supernate) | |
| | SWPF B59 | 30 | 42 | Feb-2028 | Tk41 liquid (Tk31 and Tk38 SD); Tk30 liquid (Tk24 supernate) | |
| | SWPF B60 | 27 | 26 | Mar-2028 | Tk27 salt solution (Tk28 SD); Tk25 liquid (Tk47 supernate including supernate/IL from Tk42, Tk35, and Tk37) | |
| | SWPF B61 | 44 | 34 | Apr-2028 | Tk44 salt solution (Tk45 and Tk46 SD); Tk25 liquid (Tk47 supernate including supernate/IL from Tk42, Tk35, and Tk37) | |
| | SWPF B62 | 30 | 42 | Jun-2028 | Tk41 liquid (Tk31 and Tk38 SD); Tk30 liquid (Tk31 supernate/IL) | |
| | SWPF B63 | 27 | 26 | Jul-2028 | Tk27 salt solution (Tk28 and Tk29 SD); Tk25 liquid (via Tk30; Tk24 supernate and Tk31 supernate/IL) | |
| | SWPF B64 | 44 | 34 | Aug-2028 | Tk44 salt solution (Tk46 SD); Tk25 liquid (via Tk30; Tk24 supernate and Tk31 supernate/IL) | |

| Year | Batch | Hub Tanks | Blend Tank | Begin Processing | Source Tanks | Reason |
|---|---|---|---|---|---|---|
| FY29 | SWPF B65 | 30 | 42 | Oct-2028 | Tk41 liquid (Tk31 and Tk38 SD); Tk30 liquid (Tk31 supernate/IL) | Type III Salt Dissolution |
| | SWPF B66 | 27 | 26 | Nov-2028 | Tk27 salt solution (Tk28 and Tk29 SD); Tk25 liquid (via Tk30; Tk24 supernate and Tk31 supernate/IL; via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B67 | 44 | 34 | Dec-2028 | Tk44 salt solution (Tk28 and Tk46 SD); Tk25 liquid (via Tk30; Tk24 supernate and Tk31 supernate/IL; via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B68 | 30 | 42 | Feb-2029 | Tk41 liquid (Tk31 and Tk38 SD); Tk30 liquid (Tk31 supernate/IL) | |
| | SWPF B69 | 27 | 26 | Mar-2029 | Tk27 salt solution (Tk29 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B70 | 44 | 34 | Apr-2029 | Tk44 salt solution (Tk28 and Tk46 SD); Tk25 liquid ( via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B71 | 30 | 42 | Jun-2029 | Tk41 liquid (Tk29, Tk31 and Tk38 SD); Tk30 liquid (Tk35 and Tk39 supernate via Tk37; Tk36 supernate/Il) | |
| | SWPF B72 | 27 | 26 | Jul-2029 | Tk27 salt solution (Tk28 and Tk29 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B73 | 44 | 34 | Aug-2029 | Tk44 salt solution (Tk44 and Tk46 SD); Tk25 liquid ( via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| FY30 | SWPF B74 | 30 | 42 | Oct-2029 | Tk41 liquid (Tk29, Tk31 and Tk38 SD); Tk30 liquid (Tk35 and Tk39 supernate via Tk37; Tk36 supernate/Il) | Type III Salt Dissolution |
| | SWPF B75 | 27 | 26 | Nov-2029 | Tk27 salt solution (Tk28 and Tk29 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B76 | 44 | 34 | Dec-2029 | Tk44 salt solution (Tk28 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B77 | 41 | 42 | Feb-2030 | Tk41 liquid (Tk31 SD); Tk30 liquid (Tk35 and Tk39 supernate via Tk37; Tk36 supernate/Il) | |
| | SWPF B78 | 30 | 39 | Mar-2030 | Tk31 direct SD; Tk30 liquid (Tk36 and Tk37 supernate/IL) | |
| | SWPF B79 | 44 | 34 | 4/10/1030 | Tk44 salt solution (Tk46 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B80 | 41 | 42 | Jun-2030 | Tk41 liquid (Tk29 SD); Tk35 liquid (Tk35 and Tk39 supernate via Tk37) | |
| | SWPF B81 | 30 | 39 | Jul-2030 | Tk31 salt solution (Tk31 and Tk36 SD); Tk35 liquid (Tk37 supernate/IL) | |
| | SWPF B82 | 44 | 34 | Aug-2030 | Tk44 salt solution (Tk29 and Tk46 SD; from Tk7; Tk38 SD via Tk45); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| FY31 | SWPF B83 | 41 | 42 | Oct-2030 | Tk41 liquid (Tk29 and Tk36 SD); Tk35 liquid (37 supernate/IL, Tk30 supernate, and Tk24 supernate via Tk32) | Type III Salt Dissolution |
| | SWPF B84 | 30 | 39 | Nov-2030 | Tk31 salt solution (Tk31, Tk29 and Tk36 SD); Tk35 liquid (37 supernate/IL, Tk30 supernate, and Tk24 supernate via Tk32) | |
| | SWPF B85 | 44 | 34 | Dec-2030 | Tk44 salt solution (Tk46 SD; from Tk7; Tk38 SD via Tk45); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B86 | 41 | 42 | Feb-2031 | Tk41 liquid (Tk38 SD); Tk35 liquid (Tk30 and Tk32 supernate) | |
| | SWPF B87 | 30 | 39 | Mar-2031 | Tk31 salt solution (Tk29 and Tk36 SD); Tk35 liquid (37 supernate/IL, Tk30 supernate, and Tk24 supernate via Tk32) | |
| | SWPF B88 | 44 | 34 | Apr-2031 | Tk44 salt solution (Tk29 and Tk44 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B89 | 41 | 42 | Jun-2031 | Tk41 liquid (Tk37 and Tk38 SD); Tk35 liquid (including Tk43 supernate/IL) | |
| | SWPF B90 | 30 | 39 | Jul-2031 | Tk31 salt solution (Tk30 and Tk31 SD); Tk35 liquid (including Tk43 supernate/IL) | |
| | SWPF B91 | 44 | 34 | Aug-2031 | Tk44 salt solution (from Tk27; Tk38 SD via Tk45; Tk36 SD via Tk29); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| FY32 | SWPF B92 | 41 | 42 | Oct-2031 | Tk41 salt solution (Tk30 and Tk37 SD); Tk35 liquid (Tk24 supernate via Tk32; Tk32, Tk35, and Tk37 supernate/IL via Tk47) | Type III Salt Dissolution |
| | SWPF B93 | 30 | 39 | Nov-2031 | Tk31 salt solution (Tk36, Tk37 and Tk38 SD); Tk35 liquid (Tk24 supernate via Tk32; Tk32, Tk35, and Tk37 supernate/IL via Tk47) | |
| | SWPF B94 | 44 | 34 | Dec-2031 | Tk44 salt solution (Tk44 SD and from Tk27; Tk38 SD via Tk45); Tk25 liquid (Tk32, Tk35, and Tk37 supernate/IL via Tk47) | |
| | SWPF B95 | 41 | 42 | Feb-2032 | Tk30 salt solution (from Tk41; Tk37 and Tk30 SD); Tk35 liquid (Tk24 supernate via Tk32; Tk32, Tk35, and Tk37 supernate/IL via Tk47) | |
| | SWPF B96 | 30 | 39 | Mar-2032 | Tk31 salt solution (Tk36 SD via Tk29); Tk35 liquid (Tk24 supernate via Tk32; Tk32, Tk35, and Tk37 supernate/IL via Tk47) | |
| | SWPF B97 | 44 | 34 | Apr-2032 | Tk44 salt solution (Tk44 SD and Tk36 SD via Tk29); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| | SWPF B98 | 41 | 42 | Jun-2032 | Tk30 salt solution (from Tk41; Tk37 and Tk30 SD); Tk35 liquid (Tk24 supernate via Tk32) | |
| | SWPF B99 | 30 | 39 | Jul-2032 | Tk29 salt solution (Tk36 and Tk37 SD); Tk35 liquid (Tk24 supernate via Tk32) | |
| | SWPF B100 | 44 | 34 | Aug-2032 | Tk44 salt solution (Tk37 SD); Tk25 liquid (via Tk47; Tk42, Tk35 and Tk37 supernate/IL) | |
| FY33 | SWPF B101 | 41 | 42 | Oct-2032 | Tk30 salt solution (Tk31 and Tk38 SD); Tk35 liquid (Tk24 supernate via Tk32) | Type III Salt Dissolution |
| | SWPF B102 | 30 | 39 | Nov-2032 | Tk29 salt solution (Tk36 and Tk37 SD); Tk35 liquid (Tk24 supernate via Tk32) | |

# Appendix E — *Tank Farm Influents and Effluents*

| End of Fiscal Year | Influents (kgal) | | | | | | Effluents (kgal) | | Total Inventory[e] |
|---|---|---|---|---|---|---|---|---|---|
| | H-Canyon[a] | | | DWPF | | | | Sludge to | |
| | LW | LLW | Other Mat'l[b] | Recycle[c] | 299-H | ETF | DSS to SPF | DWPF | |
| **FY14** | 100 | 18 | 30 | 1,053 | 12 | 68 | 1,098 | 252 | **37,060** |
| **FY15** | 200 | 18 | - | 1,315 | 12 | 96 | 2,001 | 245 | **37,060** |
| **FY16** | 200 | 18 | - | 1,089 | 12 | 96 | 1,626 | 457 | **36,660** |
| **FY17** | 300 | 18 | - | 1,396 | 12 | 96 | 2,626 | 456 | **36,510** |
| **FY18** | 300 | 18 | - | 1,194 | 12 | 96 | 1,376 | 467 | **35,885** |
| **FY19** | 300 | 18 | - | 2,341 | 12 | 96 | 5,252 | 455 | **35,785** |
| **FY20** | 300 | 18 | - | 2,244 | 12 | 96 | 3,971 | 452 | **35,685** |
| **FY21** | 300 | 18 | | 2,244 | 12 | 96 | 3,971 | 291 | **35,635** |
| **FY22** | 300 | 18 | | 2,534 | 12 | 96 | 7,815 | 458 | **34,735** |
| **FY23** | 300 | 18 | | 2,534 | 12 | 96 | 7,815 | 465 | **35,095** |
| **FY24** | 300 | 18 | | 1,930 | 12 | 96 | 7,815 | 460 | **33,935** |
| **FY25** | 300 | 18 | | 2,823 | 12 | 96 | 11,660 | 463 | **32,325** |
| **FY26** | 50 | 18 | | 2,823 | 12 | 96 | 11,648 | 465 | **31,500** |
| **FY27** | - | - | | 2,823 | d | 96 | 11,630 | 414 | **29,525** |
| **FY28** | | | | 2,823 | | 96 | 11,630 | 319 | **26,350** |
| **FY29** | | | | 2,823 | | 96 | 11,630 | 319 | **23,125** |
| **FY30** | | | | 2,823 | | 96 | 11,630 | 101 | **20,500** |
| **FY31** | | | | 2,823 | | 96 | 11,630 | 28 | **18,175** |
| **FY32** | | | | 2,823 | | 96 | 11,630 | 6 | **12,175** |
| **FY33** | | | | 1,198 | | 96 | 2,979 | 6 | **6,865** |
| **FY34** | | | | 657 | | 96 | 753 | 6 | **4,570** |
| **FY35** | | | | 780 | | 96 | 876 | 6 | **3,650** |
| **FY36** | | | | 780 | | 60 | 840 | 6 | **2,600** |
| **FY37** | | | | 785 | | 60 | 845 | 17 | **1,800** |
| **FY38** | | | | 842 | | 60 | 902 | 143 | **800** |
| **FY39** | | | | - | | 20 | 20 | - | **50** |
| **FY40** | | | | | | - | - | - | **-** |

[a] H-Canyon receipts are based on Ling-to-Blackmon[36] for the duration and the *Liquid Waste Functional Service Agreement*[37] between SRNS and SRR for the volume. The shutdown flow volume for H-Canyon, as outlined in *H-Canyon Liquid Waste Generation Forecast For H-Tank Farm Transfer*[32], is assumed in FY26.

- LW is the main component of H-Canyon waste and is received into Tank 39
- LLW consists primarily of General Purpose (GP) H-Canyon Evaporator concentrate received in Tank 50
- Other materials, which may include uranium, plutonium, neptunium, etc., are received directly into sludge batches, via either the sludge preparation tank (Tank 51) or the DWPF feed tank (Tank 40).

[b] Various nuclear materials, including plutonium, uranium, neptunium, etc., from H-Canyon may be introduced into sludge batches to the extent allowable without negatively impacting planned canister waste loadings while continuing to comply with the canister fissile material concentration limits. At the time of publication of this *Plan*, H-Canyon did not have a forecast for processing this material past FY14. The H-Canyon forecast for these materials will be included in future versions of this *Plan*, as it is made available.

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

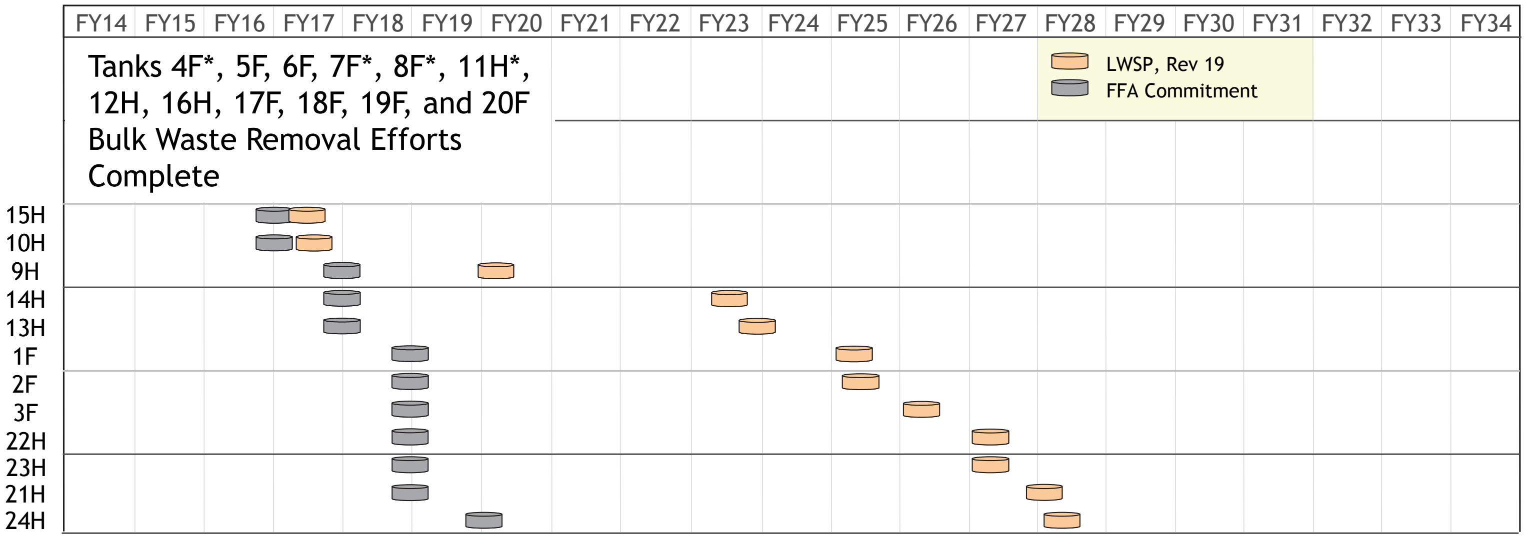
[d] Maintenance Facility (299-H) receipts mainly consists of dilute nitric acid stream, decon solutions, and steam condensate. These waste streams from decontaminating equipment are collected in the 299-H pump tank, neutralized, and sent to Tank 39. Since utilities are provided by H-Canyon, when it is shut down, maintenance activities will be performed in the DWPF maintenance cell.

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

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

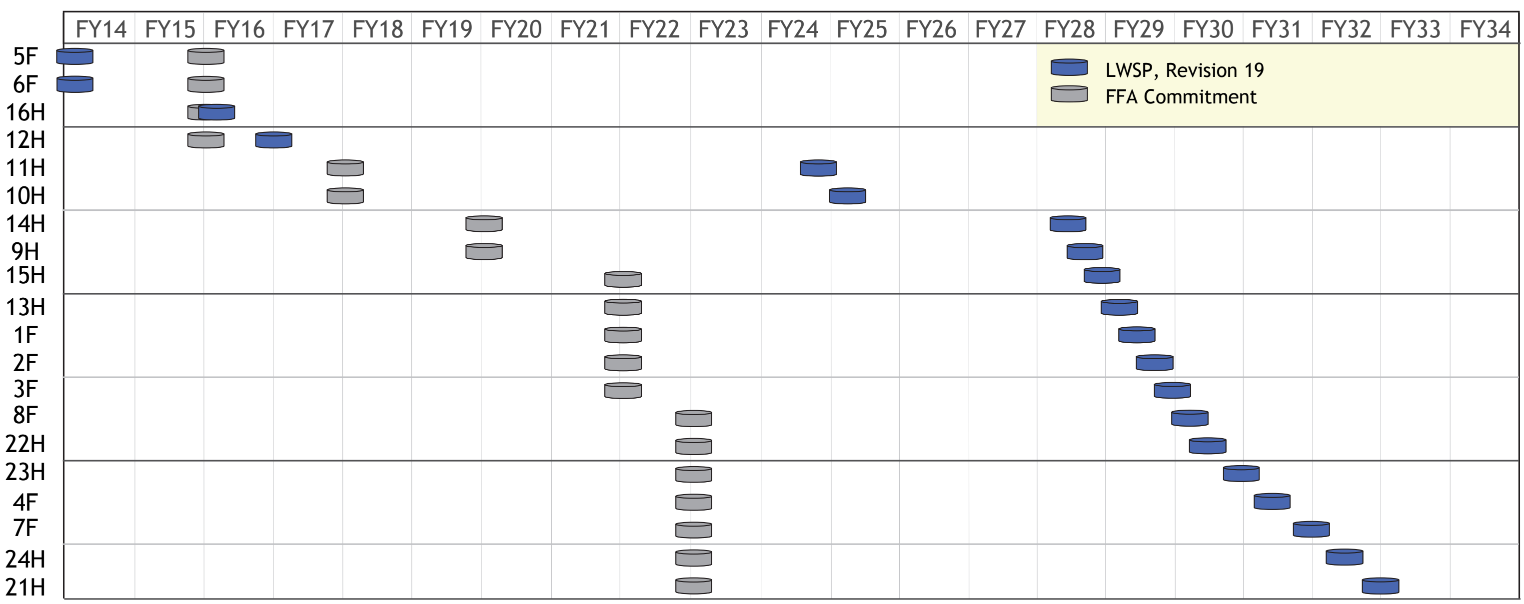
## Appendix F — *BWRE & Removal from Service*

### Bulk Waste Removal Efforts

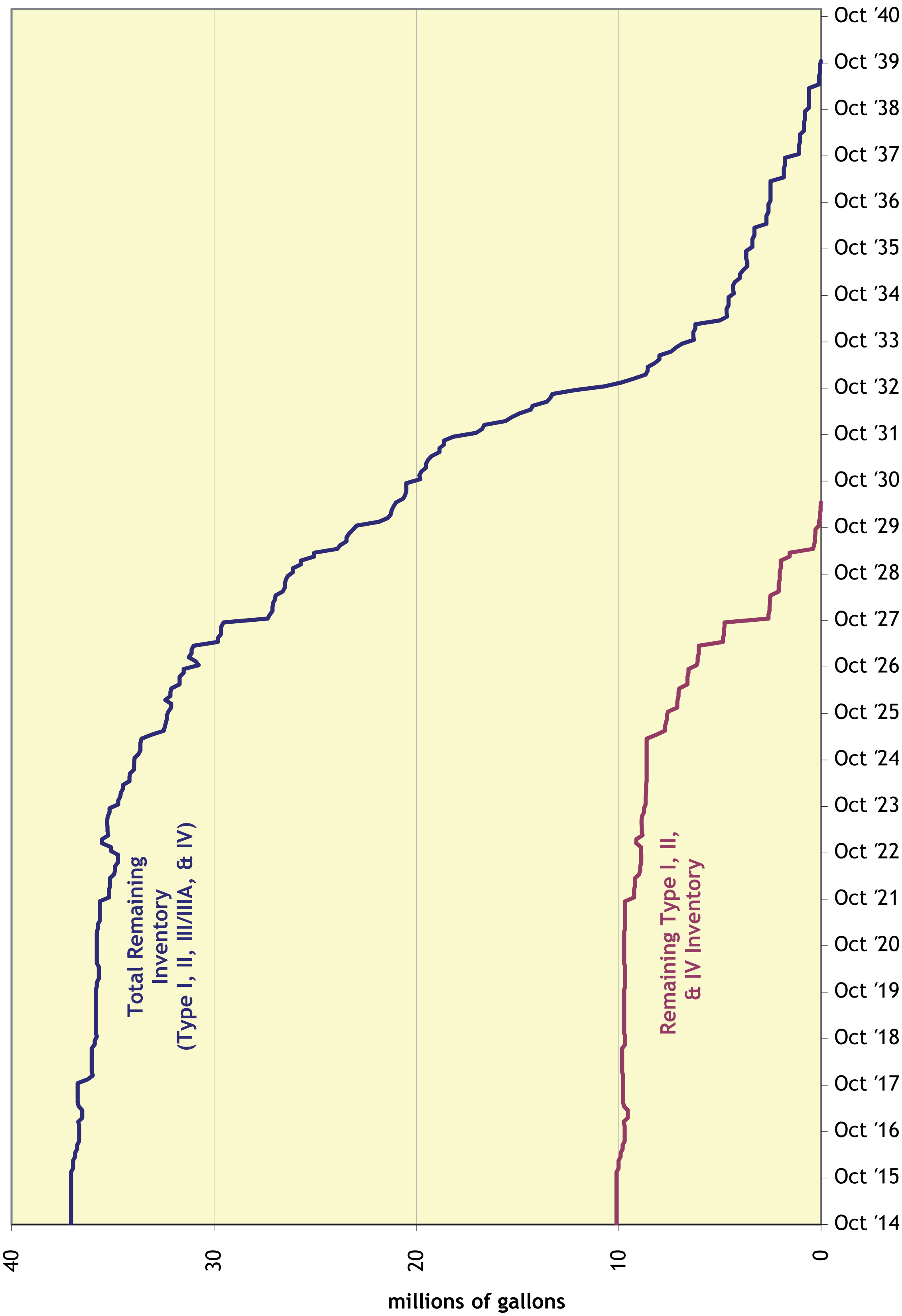



*These tanks are planned to store material after completion of BWRE (see §4.6.6 — *Managing Type III Tank Space*)

### Tank Removal from Service



# Appendix G — *Remaining Tank Inventory*



# Appendix H — *LW System Plan — Revision 19 Summary*

(see attached foldout chart)

## Appendix I — *Priority Analysis (from Revision 18 of the* Plan)

The overarching priorities are expressed through specific goals related to the various parts of the LW system. As documented in Revision 17 of this *Plan*, startup of SWPF by October 2014 was necessary to achieve compliance with all regulatory requirements. The delay of SWPF, however, adversely affects these regulatory commitments:

- Meet tank bulk waste removal efforts regulatory milestones in the currently-approved FFA
- Meet tank removal-from-service regulatory milestones in the currently-approved FFA
- Meet the waste treatment goals identified in the STP

In addition, projected funding is insufficient to perform all activities needed for optimum performance of the Liquid Waste scope. Given the limited funding and the SWPF delay, prioritization criteria must be applied to guide allocation of the funding to the activities that provide the best value to DOE. For the purposes of this plan, two sets of prioritization criteria were evaluated:

Option A (Closure Acceleration Priority)

1. Safe Storage
2. Tank Cleaning & Grouting
3. Hazard Elimination & Risk Reduction

Option B (Risk Reduction Priority)

1. Safe Storage
2. Hazard Elimination & Risk Reduction
3. Tank Cleaning & Grouting

Option A places a preference on funding final cleaning and grouting of waste tanks to maximize compliance with near term regulatory requirements, while activities that improve waste processing rates (e.g., SCIX) receive limited funds. Option B gives preference to activities that maximize sludge and salt processing while cleaning and grouting activities (e.g., Tank 12 acid cleaning) are only funded if funds remain after salt and sludge acceleration activities are fully funded. In order to select the prioritization criteria to be used for the base case in this plan, modeling results based on the two prioritization techniques were examined and provide a comparison of achieving the FFA Bulk Waste Removal and Tank Closure Commitments. As depicted in Figure I-1, the Closure Acceleration case provides a marginal improvement in BWR compliance by improving waste removal on tanks containing immobile dry salt at the expense of waste removal on tanks containing sludge that is both more mobile and more hazardous. The benefit of pursuing a closure acceleration path to near term tank closures is demonstrated in. Figure I-2. It is worth noting that focusing on tank closure in the near term ultimately delays closure of the last old-style tank.

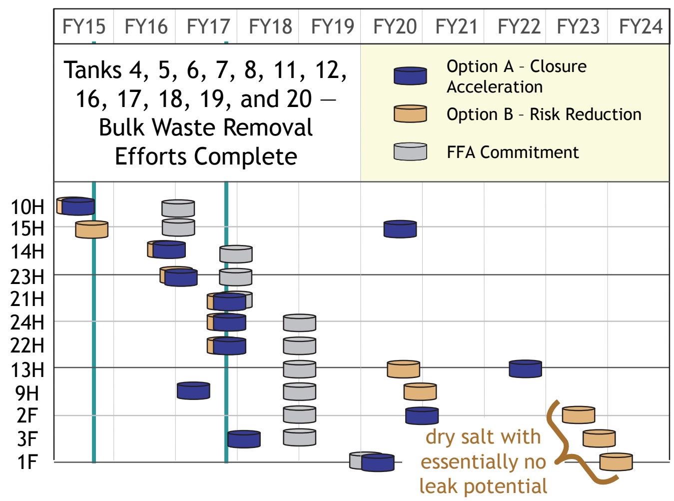



**Figure I-1 — *Bulk Waste Removals***

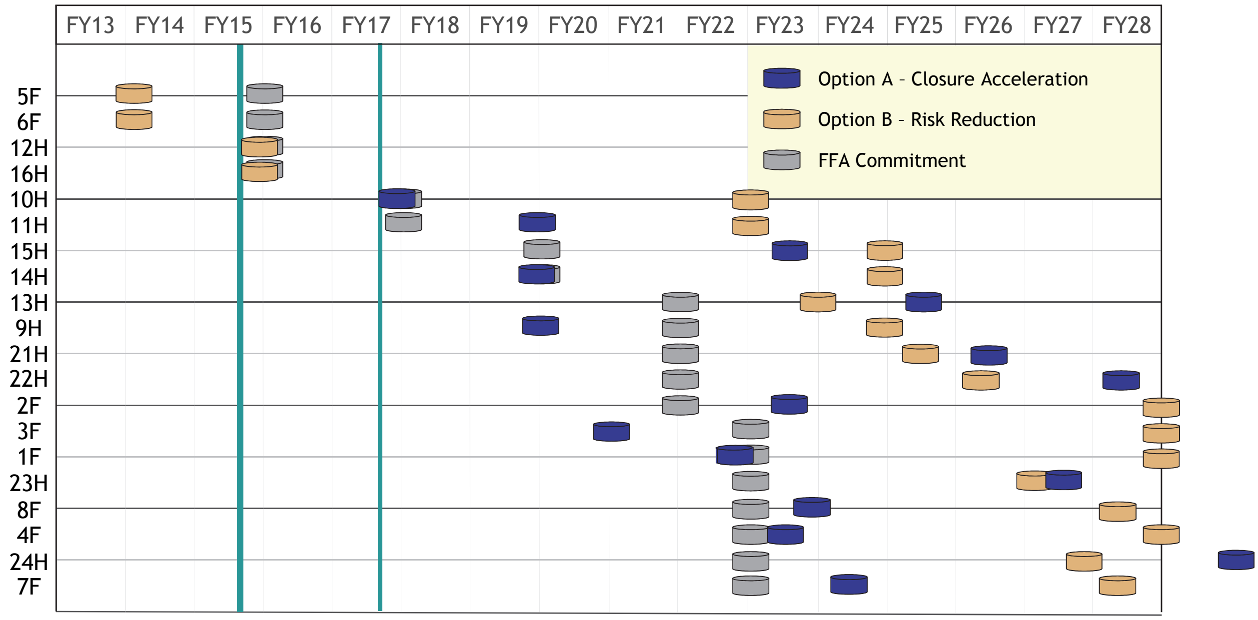



**Figure I-2 — *Tank Closures***

The consequence of focusing on near term closures is the significant increase in unstabilized curies remaining in the waste tanks. This undesirable result is clearly demonstrated in Figure I-3. As a result of this examination, it is clear that the significant real benefit of maximized risk reduction far outweighs the limited perceived benefit of near term closures. In recognition of this determination, Option B (Risk Reduction Priority) has been chosen as the prioritization criteria for this plan.

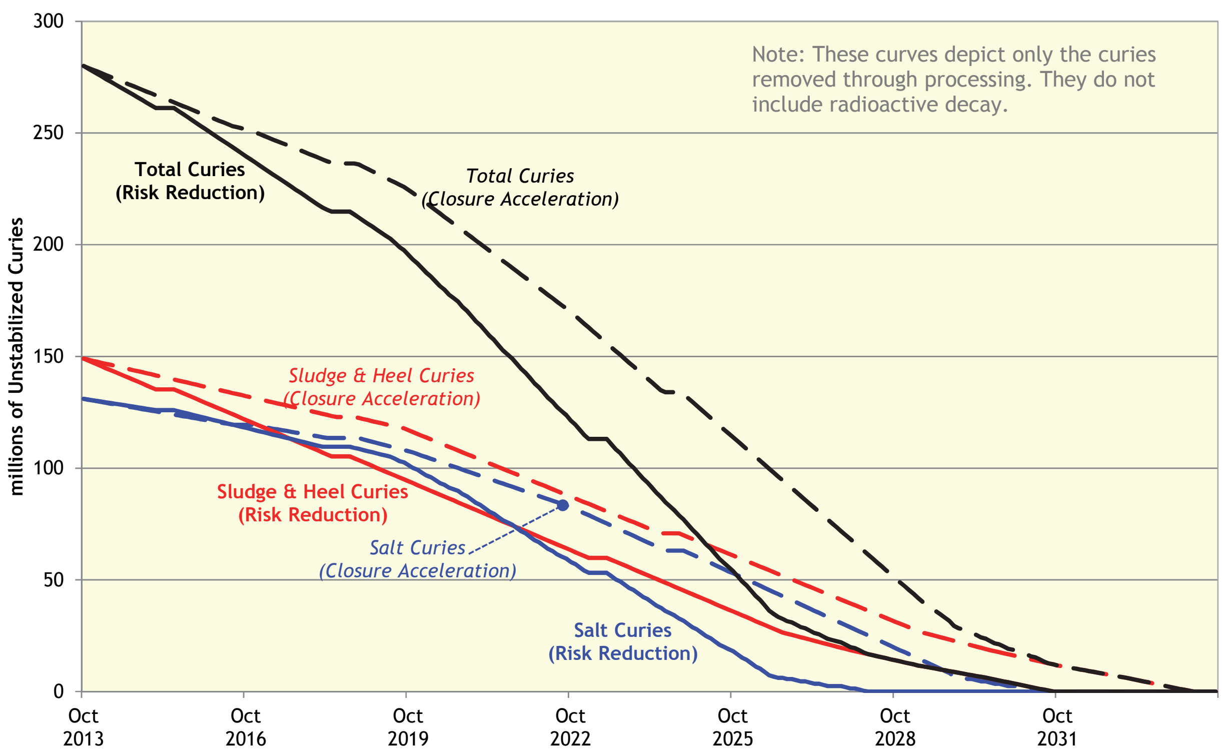



**Figure I-3 — *Curies at Risk***

# Appendix J— *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 |
| BWRE | **Bulk Waste Removal Efforts** |
| CCPO | **Copper Catalyzed Peroxide Oxidation** |
| Ci/gal | Curies per gallon |
| CM | **Closure Module** |
| CSSX | **Caustic Side Solvent Extraction** – process for removing cesium from a caustic (alkaline) solution. The process is a liquid-liquid extraction process using a crown ether. SRS plans to use this process to remove Cesium-137 (Cs-137) from salt wastes. |
| CST | **crystalline silicotitanate** |
| D&D | **Dismantlement and Decommissioning** |
| DCS | **Digital Control System** |
| DDA | **Deliquification, Dissolution, and Adjustment** |
| DNFSB | **Defense Nuclear Facilities Safety Board** |
| DOE | **Department of Energy** |
| DOE-SR | The **DOE Savannah River** Operations Office |
| DSS | **Decontaminated Salt Solution** – the decontaminated stream from any of the salt processes – DDA, ARP/MCU, or SWPF |
| DWPF | **Defense Waste Processing Facility** – SRS facility in which LW is vitrified (turned into glass) |
| EA | **Environmental Assessment** |
| ECC | **Enhanced Chemical Cleaning** |
| EIS | **Environmental Impact Statement** |
| ELAWD | **Enhanced Low Activity Waste Disposal** |
| EPA | **Environmental Protection Agency** |
| ETF | **Effluent Treatment Facility –** SRS facility for treating contaminated wastewaters from F & H Areas |
| FFA | **Federal Facility Agreement** – tri-party agreement between DOE, SCDHEC, and EPA concerning closure of waste sites. The currently-approved FFA contains commitment dates for closing specific LW tanks |
| FESV | **Failed Equipment Storage Vault** |
| FTF | **F-Tank Farm** |
| FY | **Fiscal Year** |
| 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 |
| HTF | **H-Tank Farm** |
| IL | **Interstitial Liquid** |
| IPABS | **Integrated Planning, Accountability, & Budgeting System** |
| ITR | **Independent Technical Review** |
| IW | **Inhibited Water** – well water to which small quantities of sodium hydroxide and sodium nitrite have been added to prevent corrosion of carbon steel waste tanks |
| kgal | **thousand gallons** |
| LTAD | **Low Temperature Aluminum Dissolution** |
| LLW | **Low Level Waste** |
| LW | **Liquid** (Radioactive) **Waste** – broad term that includes the liquid wastes from the canyons, HLW for vitrification in DWPF, LLW for disposition at SDF, and LLW wastes for treatment at ETF |
| MCi | **Million Curies** |
| MCU | **Modular CSSX Unit** – small-scale modular unit that removes cesium from supernate using a CSSX process similar to SWPF |
| Mgal | **million gallons** |
| MSB | **Melter Storage Box** |
| MST | **monosodium titanate** |
| NDAA | Ronald W. Reagan **National Defense Authorization Act** for Fiscal Year 2005, Public Law 108-375 |
| NDAA §3116 | **Section 3116** – Defense Site Acceleration Completion — of the **NDAA** |
| NEPA | **National Environmental Policy Act** |
| NGS | **Next Generation Solvent** |
| NPDES | **National Pollution Discharge Elimination Systems** |
| NRC | **Nuclear Regulatory Commission** |
| OA | **Oxalic Acid** |
| PA | **Performance Assessment** |
| PBR | **President's Budget Request** |
| PEP | **Project Execution Plan** |
| PEIS | **Programmatic Environmental Impact Statement** |
| PUREX | **Plutonium Uranium Reduction Extraction** |
| RCRA | **Resource Conservation and Recovery Act** |
| RFS | **Removed from Service** |
| RMF | **Rotary Microfilter** |

ROMP **Risk** and **Opportunity Management Plan**
SAC **Specific Administrative Controls**
SAS **Steam Atomized Scrubber**
SB **Sludge Batch**
SC **Safety Class**
SCDHEC **South Carolina Department of Health and Environmental Control** – state agency that regulates hazardous wastes at SRS
SCIX **Small Column Ion Exchange**
SD **Salt Dissolution**
SDI **Salt Disposition Initiative**
SDF **Saltstone Disposal Facility** – SRS facility containing Saltstone Disposal Units
SDU **Saltstone Disposal Units** – Disposal Units that receive wet grout from SPF, where it cures into a solid, non-hazardous Saltstone
SE **Strip Effluent**
SEIS **Supplemental Environmental Impact Statement**
SME **Slurry Mix Evaporator**
SMP **Submersible Mixer Pump**
SOL **Solids Oxide Loading**
SPF **Saltstone Production Facility** – SRS facility that mixes decontaminated salt solution and other low-level wastes with dry materials to form a grout that is pumped to SDF
SRD **Spent Resin Disposal**
SRNS **Savannah River Nuclear Solutions**
SRR **Savannah River Remediation** LLC
SRS **Savannah River Site**
SS **Safety Significant**
SSC **Structure, System, or Component**
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
TSR **Technical Safety Requirements**
UUM **Unirradiated Uranium Material**
WAC **Waste Acceptance Criteria**
WCHT **Waste Concentrate Hold Tank**
WCS **Waste Characterization System** – system for estimating the inventories of radionuclides and chemicals in SRS Tank Farm tanks using a combination of process knowledge and samples
WD **Waste Determination**
WOW **Waste on Wheels**
wt% **weight percent**

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# Appendix H — LW System Plan — Revision 19 Summary