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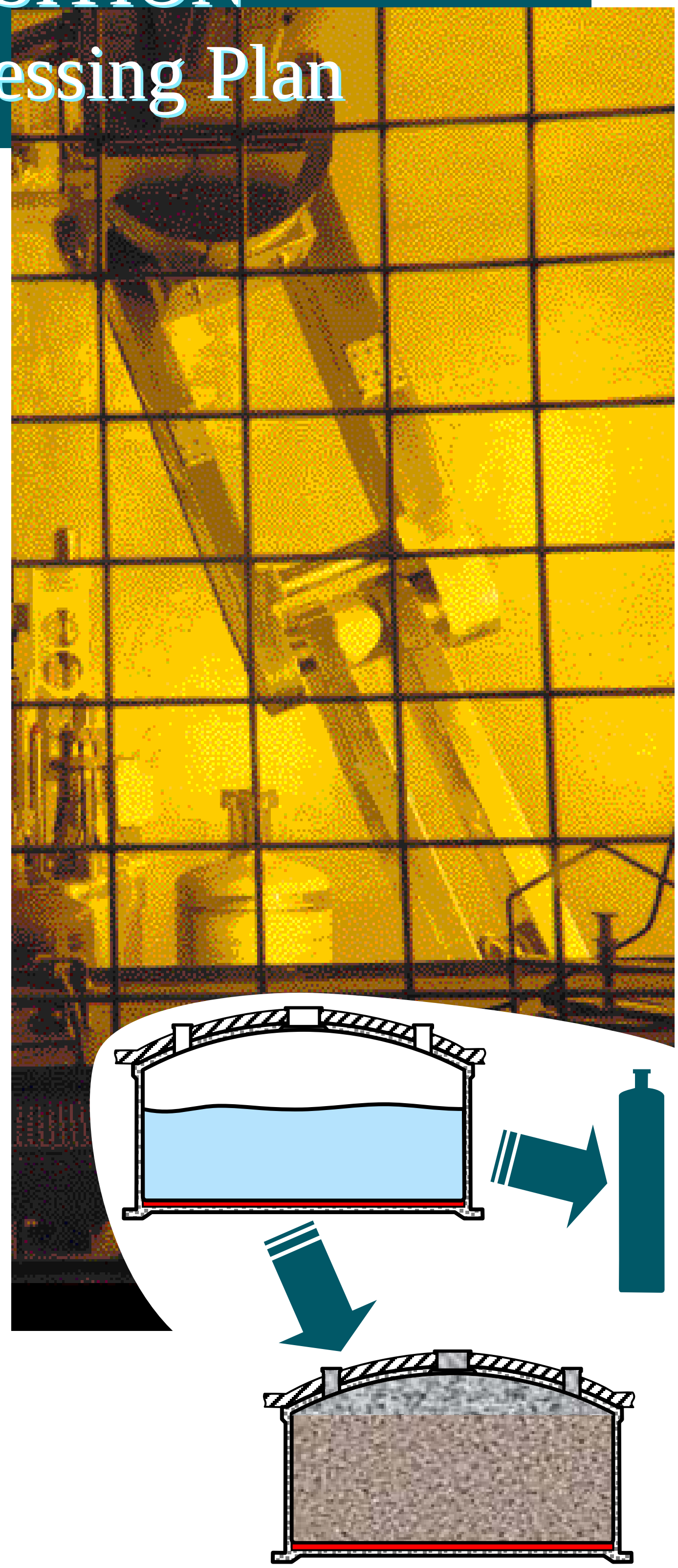
DISPOSITION Processing Plan

Savannah River Site Liquid Waste Planning Process

An Integrated System at the Savannah River Site



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FY06–FY12 Liquid Waste Disposition Processing Plan
Liquid Waste Planning Process

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1 Summary

This document, the "FY06–FY12 Liquid Waste Disposition Processing Plan" (DPP), recommends a planning basis for waste processing in the Liquid (Radioactive) Waste (LW) System through the initial year of operation of the Salt Waste Processing Facility (SWPF). To adequately plan activities during this time period requires some consideration of later years to ensure that sufficient activities are initiated in the time period FY06-FY12 to support goals in FY13 and beyond. Thus, although the document discusses some activities as late as FY15, the intent of this discussion is primarily to ensure that the plan is complete through FY12. The purpose of this document is to describe the recommended plan in sufficient detail to establish project objectives and execution schedules for the affected facilities and to provide input to the next revision of the Lifecycle Liquid Waste Disposition System Plan.

This document supersedes the Interim Processing Plan,[1] (IPP) issued in June 2005. A number of changes have occurred since the IPP was issued. Two changes have had particularly large impact:

- In response to concerns raised by the Defense Nuclear Facilities Safety Board (DNFSB), the Department of Energy (DOE) is upgrading the safety design specifications for the SWPF from Performance Category 2 to Performance Category 3, which delays the startup date from August 31, 2009 to September 30, 2011. Delaying the startup of SWPF delays the dates when large quantities of salt can be removed from waste tanks; it also increases the amount of time that tank space is challenged by continued operations of the Defense Waste Processing Facility (DWPF), H Canyon, and waste tank closure activities.
- The waste determination process for disposing of salt solution in the Saltstone Disposal Facility (SDF) took longer than originally envisioned, delaying the planned start of salt solution disposition at SDF from January 2006 to July 2006. As a result of this experience, DOE now expects future waste determinations for tank closure will also take longer. This advances the dates by which waste removal and heel removal must be completed so that the tanks can be closed by the commitment dates in the Federal Facility Agreement (FFA).

The goals of the DPP are to meet the following processing objectives:

- Continue storing liquid radioactive wastes in a safe and environmentally sound manner
- Meet tank closure regulatory milestones in the FFA
- Support continued nuclear material stabilization in H Canyon through at least 2013
- Provide tank space to support staging of salt solution adequate to feed SWPF at system capacity
- Sustain sludge vitrification in the DWPF, which requires timely sludge batch preparation

- Remove the tetraphenylborate (TPB) laden waste from Tank 48 so the tank is available to support DWPF feed batch preparation, tank closures, and SWPF feed batch preparation; and disposition the TPB-laden waste
- Minimize the quantity of radionuclides (curies) dispositioned in the SDF to be as low as practical, while meeting the stated goals

The DPP meets these objectives. However, the DPP has new scope that was not in the IPP. In addition, some scope that was in the IPP needs to be advanced to earlier dates. Also, the DPP requires continued limited use of structurally sound old-style tanks for a longer period than stated in the IPP. The major new scope items that were not in IPP, or that have been advanced to earlier dates, are as follows:

- New Decontaminated Salt Solution (DSS) lag storage is required to feed the Saltstone Production Facility (SPF) to provide buffer capacity between salt processing and SPF. The lag storage must be built in time so that Tank 50 (the current SPF feed tank, which provides this lag storage) can be used to support processing of waste from tank closures by January 2010.
- The TPB-laden waste in Tank 48 must be treated to destroy the TPB or aggregated to the SDF and the tank made available for other uses, including support for DWPF feed batch preparation (Sludge Batch 7), closures of two waste tanks in FY14 and one in FY15, and operation of H Canyon. Tank 48 needs to be available by January 2010 to support these needs. Having the tank available also allows it to be used as an SWPF feed batch preparation tank.
- A nitrogen-inerting system or some other organic control system is needed in Vault 4 for SDF to safely receive the organic-bearing wastes from the Modular Caustic-Side Solvent Extraction Unit (MCU). An inerting system would also allow Tank 48 waste to be sent to SDF and mixed with wastes from MCU if the decision is made to aggregate the Tank 48 waste.
- Technology must be developed and deployed to remove, earlier than previously planned, sludge heels and waste from the annuli of a number of tanks, several of which were not in the IPP planning window. Waste removal from the annulus of Tank 16 is an especially challenging activity because the annulus contains insoluble minerals formed from a combination of salt waste mixed with sandblasting material used to clean leak sites in the tank wall.
- Tank 42 must be used as a sludge storage tank to support closures of two waste tanks in FY14 and one in FY15. This will require modifications such as replacing or refurbishing the slurry pumps and associated instrumentation and services.

For a more complete list of the major scope changes, see section 9, "Changes in Project Scope to Support the DPP."

1.1 Summary of Sensitivity Cases

Five sensitivity cases were studied. The first three cases evaluated whether the defined processing objectives could be met if less waste or no waste were processed through the

Deliquification, Dissolution, and Adjustment (DDA) process. These cases would reduce the number of curies going to SDF. All five cases evaluated processing of Tank 48 waste by a new treatment technology, either on the current schedule or delayed schedules. The sensitivity cases showed that not executing DDA or delaying Tank 48 processing would cause a number of delays in processing compared to the Base Case due to the lack of waste tank storage space at critical times, as follows:

Base Case—The Base Case is the plan as described in the DPP. In the Base Case, Tank 48 waste is treated to destroy the TPB, making the tank available for other uses by January 2010, and sufficient DDA processing occurs to meet processing objectives. The Base Case meets all the DPP objectives.

Sensitivity Case 1—**No DDA** – No waste is processed by DDA, and the DPP process simulation is adjusted to accommodate the lack of space. In this case, tank closure dates are generally delayed by about 18 months, which does not meet FFA tank closure commitments. The process simulation indicates that the case will cause several DWPF feed breaks and a DWPF shutdown period because of lack of space to receive the DWPF Recycle. Also, H Canyon must be shut down for about 15 months.

Sensitivity Case 2—**Limited DDA to support DWPF operations** – Only a portion of the contents of Tank 49 (which contains dissolved salt solution from Tank 41) is processed through DDA. This is enough salt processing to avoid DWPF feed breaks. In this case, DWPF operates uninterrupted, but the high priority placed on DWPF operation causes a number of FFA tank closure commitments to be missed, some by about a year and others up to 40 months. Also, H Canyon is shut down for two to three years.

Sensitivity Case 3—**Same as Sensitivity Case 2 but send Tank 48 to Tank 24** – In this case, Tank 48 waste is sent to a Type IV waste tank and processed later. The results of this case are similar to Sensitivity Case 2, except that the later tank closures are delayed approximately 48 months, about 8 months longer than Sensitivity Case 2.

Sensitivity Case 4—**Tank 48 availability delayed by one year** – All of the DPP assumptions were used except that the availability of Tank 48 is delayed to January 2011. In this case, closure of two tanks planned for FY14 (currently Tanks 11 and 14) is delayed approximately 8 months beyond the FFA commitment. Also, one of the FY15 closures is delayed by approximately 11 months.

Sensitivity Case 5—**Tank 48 availability delayed by two years** – Same as Sensitivity Case 4 except the availability of Tank 48 is delayed to January 2012. In this case, closure of two tanks planned for FY14 (currently Tanks 11 and 14) is delayed approximately 20 months beyond the FFA commitment. Also, one of the FY15 closures is delayed by approximately 23 months.

2 Glossary

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
BWR	Bulk Waste Removal – process for removing most of the waste from a waste tank
CBU	Closure Business Unit – name of the former business unit that encompassed the business now in LWO. This acronym is used in the DPP only in document numbers.
Ci/gal	Curies per gallon
CSSX	Caustic Side Solvent Extraction – process for removing cesium from a caustic (alkaline) solution. The process is a liquid-liquid extraction process using a crown ether. SRS plans to use this process to remove Cesium-137 (^{137}Cs) from salt wastes.
DDA	Deliquification, Dissolution, and Adjustment – process for treating salt that is low in activity by removing the interstitial liquid (deliquification), dissolving the salt that remains, and adjusting the salt concentration to acceptable SPF feed concentrations
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DPP	(This document) FY06–FY12 Liquid Waste Disposition Processing Plan – basis for planning Liquid Waste operations in accordance with DOE requirements, commitments, and milestones
DPP Planning Window	time period that is the focus of the DPP, which is FY06 through FY12. Note that many actions must be taken during this window to prepare for events in later years, so the DPP forecasts many activities through later years to ensure activities needed during the planning window are adequately planned.
DSA	Documented Safety Analysis – Authorization Basis Document that describes systems and controls needed to maintain safety in a facility
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 HLW is vitrified (turned into glass)
EPA	Environmental Protection Agency
ETP	Effluent Treatment Project (formally called Effluent Treatment Facility) – SRS facility for treating contaminated wastewaters from F & H Areas
FFA	Federal Facility Agreement – tri-party agreement between DOE, SCDHEC, and EPA concerning closure of waste sites. The FFA contains commitment dates for closing specific LW tanks.
gal/yr	gallons per year
gpm	gallons per minute

GWSB Glass Waste Storage Building – SRS facilities with a below-ground concrete vault for storing glass-filled HLW canisters
HEU campaign – Highly Enriched Uranium campaign – a canyon campaign to recover highly enriched uranium from unirradiated fuel tubes
HEU Highly Enriched Uranium
HLW High Level Waste – highly radioactive waste resulting from the reprocessing of spent nuclear fuels and targets. Much of the LW in the Tank Farm is HLW.
HM H Modified – version of the Purex process modified to process enriched uranium streams. This is the primary process in H Canyon.
IPP The Interim Processing Plan – predecessor document that described the plan now described in the DPP. Superseded by the DPP
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
LLW Low Level Waste
LW Liquid (Radioactive) Waste – broad term that includes the liquid wastes from the canyons, HLW vitrified in DWPF, LLW solidified at SDF, and LLW wastes treated at ETP
LWO Liquid Waste Organization – the portion of the WSRC company that manages liquid radioactive waste operations and disposal
MCi million curies
MCU Modular CSSX Unit – small-scale modular unit that removes cesium from supernate using a CSSX process similar to SWPF
Mgal million gallons
MST Monosodium Titanate – finely divided solid used in ARP and SWPF that sorbs actinides and Sr-90
NRC Nuclear Regulatory Commission
Purex Plutonium-Uranium Extraction –process formerly used in F Canyon to extract plutonium and uranium from reactor rods
SAS Steam Atomized Scrubbers
SCDHEC South Carolina Department of Health and Environmental Control – state agency that regulates hazardous wastes at SRS
SDF Saltstone Disposal Facility – vaults that receive wet grout from SPF, where it cures into a grout called Saltstone. SDF is permitted as an industrial waste landfill.
Section 3116 – Section 3116 of the Ronald W. Reagan National Defense Authorization Act for FY 2005
SPF Saltstone Production Facility – SRS facility that mixes waste with dry materials to form a grout that is pumped to SDF
SRAT Sludge Receipt and Adjustment Tank (in DWPF)
SRS Savannah River Site

SWPF	Salt Waste Processing Facility – planned facility that will remove Cs-137 from Tank Farm salt solutions by the CSSX process and removes Sr-90 and actinides by treatment with MST and filtration
TPB	Tetraphenylborate – a chemical formerly used in the In-Tank Precipitation process. Tank 48 contains TPB-laden wastes that must be processed before the tank is used for other uses.
WAC	Waste Acceptance Criteria – document describing the characteristics of waste (composition, temperature, etc.) that can be accepted at a waste processing facility
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
WSRC	Washington Savannah River Company

3 Purpose

This is a planning document. The purpose of this document is two-fold:

1. It provides the baseline for waste processing activities during the period FY06 through FY12 (DPP Planning Window) from which key management decisions can be made to establish project objectives and execution schedules for the affected facilities in order to carry out the plan described in the DPP.
2. It will be used as input to the next revision of the Lifecycle LW Disposition System Plan,[2,3] including:
    - Assumptions required in development of the DPP
    - Identified technical and programmatic risks and opportunities

The DPP includes:

- *A description of the processing of salt solutions planned prior to the start up of the SWPF and the first year of operation of SWPF (The DPP Planning Window)*. The DPP identifies the material to be processed through DDA, Actinide Removal Process (ARP), MCU, the first year of SWPF operation, and planned dates for those operations.
- *A plan for sludge processing and preparing sludge batches in the Tank Farms to maintain full-capacity operation of DWPF.* Currently, the DWPF is processing sludge-only wastes. During the period examined in the DPP, the DWPF will continue to process sludge waste but will also begin to process concentrated salt waste, first from ARP/MCU (at relatively low rates) and then from SWPF (at much higher rates).
- *A plan for waste removal, heel removal, oxalic acid cleaning, and tank closure during the DPP Planning Window.* Spent solutions from waste removal, heel removal, and oxalic acid cleaning operations must be successfully managed throughout the LW System for tank closure to successfully meet FFA commitments.

The DPP focuses primarily on the time period FY06 through FY12, which is referred to as the "DPP Planning Window." The DPP forecasts many activities through later years because many actions must be taken during the DPP Planning Window to prepare for events in later years. For example, Tank 11 heel removal must be underway in FY12 so the tank can be closed in FY15. However, the DPP is not complete past FY12. For example, actions required during the time period FY13 through FY15 to support tank closures in FY16 and beyond have not been systematically addressed. The intent was to do enough planning in FY13 and beyond to provide confidence that all needed activities during the time period FY06 through FY12 are properly identified and planned.

The DPP is consistent with the consensus strategy developed by DOE and the State of South Carolina. At this time, discussions are ongoing between DOE and the South Carolina Department of Health and Environmental Control (SCDHEC) regarding the issuance of permits that are required to proceed with salt processing and disposal activities at SPF and SDF. Although the actual initiation of many of these activities may be later than depicted in this plan, and the completion of milestones may be impacted, the scope and sequence of these activities are still valid.

Key bases and assumptions used in the development of the DPP, including state permitting assumptions and schedules for waste determinations under the Section 3116 of the Ronald W. Reagan National Defense Authorization Act for FY 2005 (Section 3116), are summarized. Detailed assumptions used in preparing the DPP are contained in the input documents prepared for each of the major process areas: sludge processing inputs,[4] salt processing inputs,[5] and tank closure inputs.[6]

Several key attributes instrumental to the success of the DPP are discussed in detail. Also documented are some of the major DPP risks and opportunities.

This document is intended for long-term planning and does not contain sufficient detail to guide operation of individual process steps. The DPP uses simplifying assumptions for each process so that the entire LW System can be simulated at a reasonable level of complexity. Dates, volumes, and chemical or radiological composition information contained in this document are planning approximations only. To guide actual execution of individual processing steps in the future, more specific flowsheets will be developed that contain rates, compositions, and schedules, sometimes including possible ranges of each of these parameters.

This document will be revised when significant changes occur in the planning bases that impact successful implementation of the DPP (e.g., a delay in Section 3116 implementation or state permitting, or if problems are encountered during waste removal). Revisions to this document will be managed by issuing a revision to the document approved by all the indicated organizations. When the document is revised, each reviewer has the responsibility to determine if further documentation changes are needed in the facility for which they are responsible (such as a facility Change Request Form).

4 Background

This document assumes the reader is familiar with the LW System and the planned processes for treatment of salt wastes—DDA, ARP/MCU, and SWPF. For an overview of the LW System and the salt treatment processes, see Section 14.

Successful and timely salt waste removal and disposal is integral to efforts by the Savannah River Site (SRS) to proceed with all aspects of tank cleanup and closure, extending well beyond disposal of the solidified low-activity salt waste streams themselves. This is not only for the obvious reason that the salt waste must be removed and treated before the tanks may be closed. Less obviously, disposal of the salt waste will enable SRS to continue, without interruption, to remove and stabilize the high-activity sludge fraction of the waste. This is because SRS uses the tanks to prepare the high-activity waste so that it may be processed in DWPF. The issue is that the salt waste is filling up tank space needed to allow this preparation activity to continue. Thus, executing the DPP, which calls for removal and disposal of low-activity salt waste through DDA and ARP/MCU, is critical in order to relieve this tank space shortage and assure that vitrification of the high-activity fraction will be able to continue uninterrupted.

In addition, operating DDA and ARP/MCU as described in the DPP will enable continued stabilization of DOE Complex nuclear materials. It will also enable SWPF to be fed at nominal capacity when it begins operation, which would not be possible without DDA and ARP/MCU. This will allow DOE to complete cleanup and closure of the tanks years earlier than would otherwise be the case. That, in turn, will reduce the time during which the tanks – including many that do not have full secondary containment and have a known history of leak sites – continue to store liquid radioactive waste. Finally, the DPP will make more tank space available for routine operations, thereby reducing the number of transfers among tanks and increasing the safety of operations.

Therefore, executing the plan described in the DPP will accelerate the reduction of potential risk to the environment, the public, and SRS workers. It will also ensure that sludge is removed from tanks early enough so that tank closure regulatory milestones in the FFA are met on schedule.

In June 2005, the IPP was issued. Since June 2005, a number of changes in assumptions and bases have occurred that require significant changes to the plan. The most significant changes are:

- In response to DNFSB concerns, DOE is upgrading design specifications for SWPF from Performance Category 2 to Performance Category 3, which delays the planned startup date from August 2009 (the date assumed in the IPP) to September 2011. This delays the removal of salt waste from tanks at a time when the space occupied by this salt is needed to continue operation of the DWPF and to carry out tank closures required by the FFA.

- Experience with the new DOE waste determination process indicates waste determinations will take longer than planned in the IPP. This has two impacts:
  - The schedule for issuing SPF and SDF permits required for DDA has been delayed, causing the initiation of salt processing to be delayed from January 2006 to the current forecast of July 2006.
  - For tank closure permits, the time required for preparing the closure documentation and conducting the review and approval has increased. For the DPP, it is assumed that the schedule impact of the new requirements can be reduced by performing some activities at risk. However, even with the new, aggressive schedule, waste removal must be accomplished earlier from most tanks than previously planned.

In addition to the changes discussed above, a number of changes in key assumptions and bases have occurred:

- The start date for MCU has been advanced from February 2008 to August 2007.
- A nitrogen-inerting system or some other organic control strategy will be added to SDF Vault 4 to handle organic wastes from MCU. If an inerting system is used, this has the added benefit of enabling Vault 4 to receive Tank 48 wastes if the decision is made to aggregate the Tank 48 wastes.
- Flowsheet volumes and processing rates for aggregation of Tank 48 waste have been developed.
- Higher concentrations of aluminum were measured in Tank 11 sludge than predicted, which impacts the DWPF processing rate. DOE guidance was for DWPF to produce 250 cans/yr in FY06, FY07, and FY08, and 230 cans/yr thereafter. However, melt rate tests with simulated waste at SRNL indicate these rates cannot be achieved for waste with high aluminum concentration. In the DPP, the DWPF rate has been reduced from 250 canisters per year (cans/yr) to 186 cans/yr for sludge batches with high-aluminum concentration (currently predicted to be sludge batches 4, 5, and 6). The waste loading is also reduced for these batches.
- Phase 1 heel removal will require 500 thousand gallons (500 kgal) of water (which can be spent wash water from sludge washing), and Phase 2 heel removal will result in 200 kgal of waste after neutralization. The IPP accounted for only Phase 2 heel removal, but experience with Tank 5 and Tank 11 has demonstrated the need to include more water in heel removal planning.

5 Objectives

The objectives used in developing the DPP are as follows:

- Continue storing, transferring, and concentrating liquid radioactive wastes in a safe and environmentally sound manner.
- Support waste removal so that tank closures meet regulatory milestones in the FFA.
- Support continued nuclear material stabilization in H Canyon at least through 2013 (IPP called for H Canyon to operate only through 2011).
- Provide tank space to support staging of salt solution adequate to feed SWPF at 5 million gallons (Mgal) of salt solution during the initial year of operations. Feed SWPF at full system capacity in subsequent years.
- Sustain sludge vitrification in the DWPF at its nominal rate by maintaining sufficient space in the Tank Farm to receive the DWPF Recycle stream and preparing sludge feed batches in a timely manner.
- Remove and disposition the waste in Tank 48 so that the tank is available to support DWPF feed batch preparation (Sludge Batch 7), tank closures, and H-Canyon operation.
- Ensure that the quantity of radionuclides dispositioned to the SDF are as low as practical to meet the aforementioned goals.

6 Major Assumptions and Bases

The following are key assumptions and bases necessary to support successful DPP implementation.

- Tank Farm Infrastructure – The DPP assumes that Tank Farm infrastructure is maintained or upgraded as needed to accomplish transfers and other activities described. The DPP describes activities required but not details of how they will be accomplished or infrastructure required to execute them.

- Waste Disposition Timing –
  - Permit for Batch 0 at SPF, which consists of Effluent Treatment Project (ETP) waste and unirradiated canyon waste, is obtained in time and the facility is ready in time so Batch 0 (up to 300 kgal) can be initiated in time to support disposition of DDA waste.
  - Permits following the Salt Waste Disposal 3116 Waste Determination[7],[8] are received in time to support disposition of DDA waste.
  - Disposition of DDA waste at SDF (Batch 1) begins July 2006.

- ARP/MCU –
  - Begin processing in or about August 2007.
  - For the first batch, the average processing rate is at least 2 gallons per minute (gpm), half the nominal rate of 4 gpm.

- Sludge Batches - Because of greater-than-predicted amounts of sludge in Tank 11 and other factors, the sludge batch scheme for DWPF has been significantly revised.
  - Larger masses of sludge and higher aluminum concentrations have caused DWPF sludge batches to last longer than planned in the IPP.
  - If neptunium is disposed by sending to a sludge batch, the amount of waste is small enough that it has a negligible impact on the plan as long as the resulting sludge batch (after receiving neptunium) can be qualified immediately for feed to DWPF (i.e., no feed break).

- Tank 48 Disposition – The DPP includes two options for disposing of wastes from Tank 48. A required key decision is the selection of which option will be executed.
  - Base Case is to decompose the TPB in the waste by a new treatment technology, currently under development, resulting in Tank 48 being available for other service by January 2010.[11]
  - Tank 48 Alternative Option is to aggregate TPB-laden waste in Tank 48 to SDF so Tank 48 will be available by January 2010 to support DWPF feed batch preparation (Sludge Batch 7) and closures of Tanks 11, 14, and 15.
  - Regardless of the treatment technology chosen, the DPP assumes that concentrations and rates at which TPB-laden wastes (or products of the

decomposition process) go to SPF do not restrict rates at which SPF can receive other salt solutions.

- Tank 50 Replacement –DSS lag storage will be constructed in time so that Tank 50 can be used by January 2010 to support waste removal and heel removal, which are required to meet FFA tank closure commitments, and to ensure uninterrupted operation of DWPF.

- SWPF Startup –
  - SWPF initiates processing on September 2011. Up to a six-month advance of SWPF startup (March 2011) or as long as a six-month delay (March 2012) can be accommodated without significant impacts on other programmatic objectives, although some planning adjustments would be required.
  - SWPF is fed 5 Mgal in the first 12 months of operation and is fed at a yearly rate of 5.4 Mgal/yr while DWPF canister production rate is limited to 186 cans/yr because of lower melt rates for high-aluminum batches. When DWPF rate increases to 250 cans/yr, the SWPF rate increases to 6.4 Mgal/yr. Studies indicate this is the maximum average rate when DWPF and SWPF are close coupled.[10] SWPF will shut down during DWPF melter replacement outages because of the close coupling, so the average SWPF feed rate over a four-year period is 5.9 Mgal/yr.
  - The early batches to SWPF are primarily supernate rather than a mixture of supernate and salt. This raises the issue that some of the batches during the first year will have high Cs-137 concentrations, perhaps approaching SWPF limits, the DWPF canister heat load limit, or DWPF processing limits associated with personnel protection.

- H-Canyon Operations – Processing will continue through at least 2013. For planning purposes, the DPP assumes waste volumes generated will be comparable to volumes historically generated by H Canyon, although commitments have not been made to specific missions that cover the entire time period.

- Tank Cleaning and Closure – Tank cleaning and tank closures will be conducted to meet FFA commitments for the number of tanks required to be closed each fiscal year. For tank closure, the time required for characterizing the tank, preparing the closure documentation, and conducting the review and approval process has increased. For the DPP, it was assumed these actions can be accomplished in the challenging time period of 24 months. Previous schedules using DOE-provided guidance for NRC and DOE review durations indicate this process could take up to 39 months. Achieving 24 months will require significant improvements in the review process by Washington Savannah River Company (WSRC), DOE, and NRC; including conducting reviews and performing other work activities concurrently. The currently forecasted closures are as follows:

Fiscal Year	Tanks planned to be closed in the DPP
FY07	Tanks 18 and 19 (assumes no additional tank cleaning)
FY10	Tanks 5 and 6
FY11	Tank 4
FY12	Tanks 12 and 16
FY13	Tank 8
FY14	Tanks 11 and 14
FY15	Tanks 15 and 23

- DWPF Operations – DWPF operates at the following canister production rates.

Through end of Sludge Batch 3	262 cans/yr*
Sludge Batches 4, 5, and 6 (high-aluminum batches)	186 cans/yr
Sludge Batches 7 and 8 (high-iron batches)	250 cans/yr**

* Rate of 262 cans/yr meets the goal of producing 1,233 equivalent canisters in the current WSRC contract.

**For planning purposes, a four-month DWPF outage to replace the melter is assumed starting in May 2007 and every four years thereafter. Therefore, the average DWPF production rate over a four-year period is 230 cans/yr.

- SPF and SDF –
  - — Process up to 300 kgal of existing Tank 50 material (prior to any receipt of Tank 49 waste) as Batch 0 to run-in SPF in time to support the start of DDA processing.
  - — Processing of DDA wastes will begin 7/1/06.
  - — Vault 4 will be nitrogen inerted or some other organic control system will be added in time for SDF to receive wastes from ARP/MCU by August 2007. If a nitrogen-inerting system is installed, it has the added benefit of allowing Tank 48 waste to be processed at SDF if the Tank 48 Alternative Option is selected.
  - — DDA salt solution can be received by SPF at 83 kgal/week. Waste from ARP/MCU and SWPF can be accepted at needed process rates. In the process simulations supporting the DPP, the average feed rate to SPF is approximately 135 kgal/week when SWPF is operating.

See Section 13 for a more detailed list of assumptions and bases used in the DPP development.

7 The DPP

This section summarizes the key attributes of the DPP. More details on various aspects of the DPP are included in the subsections that follow. Each subsection includes a summary table of some key assumptions and associated technical or programmatic risks. The intent is to list assumptions and risks that have (or potentially have) a major impact on the DPP, because a complete list of assumptions and risks would be too large to include. More specific details on assumptions are included in separate input and assumption documents for salt processing[5], sludge processing[4], and tank closure[6]. Similarly, detailed discussion on risks and associated mitigation strategies are included in other documents such as the programmatic risk assessment report for LW,[9] and individual implementation project risk assessments.

The DPP also highlights some of the major programmatic key decisions. As with the assumptions and risks, the number of decisions that need to be made to successfully implement the DPP is very large. The DPP includes only those decisions with major impact.

In summary, the DPP meets the programmatic objectives as follows:

- DWPF meets the objective of producing 262 actual cans/yr through the end of Sludge Batch 3; 186 cans/yr for Sludge Batches 4, 5, and 6, which are batches high in aluminum; and 250 cans/yr thereafter except for years with melter outages. The Sludge Batch 3 rate of 262 cans/yr was selected to meet the goal of producing 1,233 equivalent canisters in the current WSRC contract. This is a conservative process simulation assumption, and lower rates can be accommodated with no other major impacts.
- For planning purposes, a DWPF outage of 4 months to replace the melter is assumed for May 2007 and every four years thereafter, which reduces the number of cans for that year. Actual outages will occur only when needed. Thus, after the high-aluminum batches are processed, the average DWPF rate over a 4-year period is approximately 230 cans/yr. Sludge batches are prepared in time to support these rates.
- Salt solution is transferred to SWPF at system rates.
    - — 5 Mgal for the initial year of operation in 2012
    - — 5.4 Mgal for 2013. (limited by 186 DWPF canisters forecast in this year[10])
    - — 6.4 Mgal/year for subsequent years.[10] Rate will be reduced in DWPF melter replacement outage years (a four month outage every four years). Thus, the average SWPF processing rate over a 4-year period is 5.9 Mgal/year.
- TPB-laden waste in Tank 48 is handled by one of the following methods:
    - — Base Case: The TPB in the waste is decomposed using a new treatment technology. The two leading candidates for the treatment technology at this time are wet-air oxidation and steam reforming.
    - — Tank 48 Alternative Option: TPB-laden waste is aggregated to SDF, and this aggregation continues while ARP/MCU is operating. This takes advantage of

the fact that Vault 4 is being nitrogen inerted or some other organic control system is installed to control flammability issues from receiving ARP/MCU treated waste.

- Tank closures are supported to meet FFA commitment dates. This requires continued limited use of structurally sound old-style tanks (as has been assumed in previous plans).
- Continuing nuclear material stabilization in H Canyon is accomplished.
- Limiting curies to SDF to levels as low as practical while meeting other goals is achieved.

The plan is detailed in the attached large, fold-out summary chart (Appendix I). Significant activities, estimated durations, key milestones, decision points, and a general logic for implementation are included.

Although the Appendix I chart is similar to a schedule chart, it is a plan, not a schedule. In using the plan, several things need to be kept in mind:

- Bars on the chart describe summary-level activities. For example, the bar "ARP & MCU Design, Construction, & Turnover to Operations," is a schedule hammock for approximately 4,800 scheduled activities that culminate in the startup of ARP/MCU in August 2007.
- For activities that require a project, many of the bars are plans only, with no project schedule at this time. Durations shown have been judged reasonable by knowledgeable personnel but may need to be adjusted when actual scopes and schedules for projects are developed. For example, one of the early bars, "Replacement DSS Lag Storage – Design & Construction," is a project that has just been initiated. The scope and schedule are being developed at this time. The duration shown is a planning judgment.
- For activities that require processing at particular rates, for example, "Sludge Batch 4 Preparation," process simulation has indicated that the activity can be accomplished in the time period shown with reasonable allowances for downtime, contingency, and interfaces between the processes. The bases and assumptions used in developing these rates and durations are described in the DPP. The process simulation has also shown that there is sufficient space in the Tank Farm to accomplish the activity as long as the required predecessor activities have been accomplished, and sufficient infrastructure is in place. The DPP describes any new infrastructure required to carry out the plan but does not describe existing infrastructure that must continue to be maintained. For example, the process simulation shows that as long as DDA and ARP/MCU process the quantities of salt solution planned, which requires new infrastructure, sufficient space will exist in the Type III tanks to accomplish the later activities in the time periods shown.
- The sequence of activities shown represents the best judgment of the planners. As scopes and schedules for each of these activities are developed, it may become apparent that funding or other constraints require changing the order of activities, or that activities planned in series can be accomplished in parallel (or vice versa).

7.1 Processing of Sludge Through DWPF

In the DPP, DWPF meets the objective of producing canisters at its nominal rate. This rate is assumed to be 262 cans/yr for Sludge Batch 3; 186 cans/yr for Sludge Batches 4, 5, and 6, which are high-aluminum batches; and 250 cans/yr for later batches. The purpose of this objective is to ensure that sludge is removed from the old-style tanks at the highest rate possible, with no interruptions. This is an important risk-reduction activity.

Producing canisters at the nominal rate requires that sludge feed batches are washed in time for each new batch to be ready when all sludge in the previous batch has been made into glass. This requires maintaining enough tank space to support continued evaporator operations to receive and evaporate decants from sludge washing in a timely manner. The DPP process simulation shows this can be accomplished.

In the IPP, Sludge Batches 6, 7, and 8 were close to their planned need dates, so there was risk that one or more batches might not be prepared in time, and canister production rates would need to be reduced. This risk still exists, but it is less of a concern than it was for the IPP. This is because 1) the processing rate for high-aluminum batches was reduced from 250 cans/yr to 186 cans/yr due to physical constraints associated with projected lower melt rates and 2) the masses of sludge in Tanks 4 and 11 were found to be higher than predicted, so sludge removed from these tanks will make more canisters than predicted in past plans. The result of these two factors is a delay in the dates when all sludge in each batch has been made into glass.

The experience in Tanks 4 and 11 (and in earlier sludge batches) suggests that currently predicted sludge masses for future batches may be systematically low. The effect of this potential extra sludge is minimal on the DPP because the DPP addresses only a few sludge batches. However, this extra sludge mass could have a large impact on future DWPF activity beyond the DPP planning window.

Table 1: Processing Sludge through DWPF

Assumptions		Risks
Current sludge batch plan in the DPP can be carried out.		Emergent events cause some assumptions in the DPP to be invalid (especially dates).

Assumptions		Risks
Tank Farm evaporators will be able to handle sludge washing solutions from planned batches on the schedule described in the DPP. The DDA process will occur early enough and Tank 50 will be available early enough to provide tank space to keep the 2F and 3H evaporator systems from becoming "salt bound".		The drop tank in an evaporator system will become "salt bound" (in particular, Tank 37 for the 3H Evaporator and Tank 27 for the 2F Evaporator), which interrupts sludge batch preparation and, consequently, canister production.
Assumptions used in the DPP (i.e., trapped gas retention in slurried sludge, settling rates, etc.) are realized or conservative.		Higher-than-anticipated gas retention or slower settling rates could delay sludge batch preparation and impact canister production rates.
DWPF can produce glass canisters at 262 cans/yr through the end of Sludge Batch 3; 186 cans/yr for Sludge Batches 4, 5, and 6; and 250 cans/yr thereafter. Coupled sludge and salt processing will not impact planned canister production rates.		DWPF may not be able to maintain these rates, especially for later batches when DWPF will also receive Strip Effluent and monosodium titanate (MST) Slurry from SWPF.
Receipt and associated handling of DWPF recycle in the Tank Farms supports planned DWPF processing rates. That is, even with the increased DWPF recycle volume resulting from SWPF operations, the combined planned use of recycle in the salt disposition process and continued 2H Evaporation is sufficient to support DWPF operations.		Unplanned 2H evaporator downtime could interrupt canister production. A delay or slowdown of DDA or ARP/MCU operation could impact the planned disposition of DWPF recycle in the salt disposition process.
If Pu or neptunium is disposed of in a DWPF Sludge batch, there is minimal impact on DWPF operation. The addition will not be made until it has been qualified.		Neptunium disposition could add sulfate that would require more washing or other adjustment in DWPF batching or operations plans. Qualification of a new batch could require a feed break.
Titanium limits in glass can be increased, or improved MST can be developed that will reduce the amount of titanium going to glass (a program is ongoing to develop an improved MST).		The currently forecasted MST usage in SWPF will cause the titanium limit for DWPF glass of 2% to be exceeded. Without some process improvement, SWPF rate will be restricted.

Assumptions	Risks
Glass Waste Storage Building #2 can accommodate canisters with up to 1000 watts/can of waste heat (safety calculations were done assuming canisters with 1000 watts/can).	Current canister heat load limit of 850 watts/can for Storage Building #2 may require a reduction of SWPF rate if the limit is imposed on each canister.
Sludge masses are as assumed.	If sludge mass estimates are systematically low (i.e., the real amount of sludge is higher than predicted), this could limit the rate at which sludge tanks can be cleaned, because processing the sludge in a given tank will take longer than currently predicted.

Key Decisions:

DPP-01: Evaluate if additional DWPF Recycle handling facilities or methods are needed to mitigate the effects of the large DWPF Recycle flows after SWPF startup.

DPP-02: Evaluate the increase in sludge masses over current projections and determine if sludge batching needs to be changed.

7.2 Processing of Salt Through DDA, ARP/MCU, and SWPF

Salt wastes will be processed by one of the three salt processes – DDA, ARP/MCU, or SWPF. Appendix B shows the planning baseline of salt solution processed through SPF for all three processes by fiscal year through FY14. The first table shows the planning baseline with the Base Case of decomposing the Tank 48 waste using a new treatment technology. In the Base Case, the Tank 48 waste is not processed through SPF. The second table shows the Tank 48 Alternative Option, in which the Tank 48 waste is aggregated through SPF. In the Tank 48 Alternative Option, the volume and activity of salt wastes processed through SPF are correspondingly increased.

7.2.1 DDA

During the DPP Planning Window, salt will be processed via the DDA process from Tank 41 only. This salt has been dissolved or will be dissolved in the future, and the solution will be or already has been transferred to Tank 49. (Note: aggregation of Tank 48 waste to SDF may also be included in the planned DDA wastes. For a discussion of aggregation, see section 7.3 , “Making Tanks 48 and 50 Available for Other Uses”)

In the IPP, plans were to also use the DDA process on salt in Tank 25. However, because the ARP/MCU startup date has been advanced and the start of salt processing delayed from January 2006 to July 2006, the first batch from Tank 25 will be an ARP/MCU batch rather than a DDA batch. This reduction in DDA processing results in a significant reduction in the number of curies disposed of in SDF.

The salt waste processed through DDA and ARP/MCU was carefully chosen to minimize the curies going to SDF while meeting other processing goals. The salts in Tanks 41 and 25 were selected. Selection of the tanks to undergo the DDA process was done by selecting Type III tanks that had the lowest activity supernate waste, did not contain large volumes of sludge, and were not being used for an operational function vital to Tank Farm processes, such as evaporator systems or sludge batch preparation. Only wastes in Type III tanks were considered because the Type III tanks meet current Environmental Protection Agency (EPA) requirements for full secondary containment and leak detection and are the only tanks approved for use in further processing. Tanks with the lowest supernate activity were chosen to minimize the activity being sent to SDF. Tanks with large volumes of sludge were not considered because this sludge could be carried over into SDF; avoiding these tanks also minimizes the activity being sent to SDF. Tanks performing vital functions were not considered because they are needed to carry out the plan of safely disposing of the wastes.

Table 2: Processing of Salt

Assumptions		Risks
SPF operating permit for the 0.2 curies per gallon (Ci/gal) modifications, which is needed for Batch 0, is received in time so that the run-in of SPF occurs early enough to support a DDA processing start date of 7/1/06.		Permit may not be received in time, and the initiation of DDA processing is delayed past 7/1/06, or SPF must start up on the higher-concentration waste in Batch 1 of DDA, which places site workers at greater risk due to the typical startup issues associated with a new process.
Permits necessary for DDA will be obtained on schedule so that the first DDA batch can be sent to SPF starting 7/1/06.		The planned schedule may not be met because DOE and the South Carolina Department of Health and Environmental Control (SCDHEC) cannot reach an agreement on a permit in a timely manner.
Tanks have been selected for DDA such that the concentration of each radionuclide or chemical is low enough to meet SDF Waste Acceptance Criteria (WAC) limits when the waste is properly prepared by DDA and aggregated with other wastes.		DDA batches cannot be sent to the SPF because SDF WAC limits are not met due to unanticipated high concentrations of radionuclides or because the DDA process does not work as well as assumed.

Key Decision:

DPP-03: Evaluate if the schedule needs to be adjusted because of delays in the permitting process.

7.2.2 ARP/MCU

ARP/MCU begins operation about August 2007 and processes salt solutions through the startup of SWPF. The processes operates at 37.5% attainment for the first batch and 75% attainment for subsequent batches except during feed batch preparation and qualification, and a few down periods for Tank Farm work related to SWPF startup.

MCU is a fast-track project with minimal contingency. Thus, problems in design and operation, such as recent problems uncovered during tests of the contactors, have a risk of delaying the startup or reducing the throughput. Also, MCU is designed only for a 3-year life. Since the equipment is designed for contact maintenance, maintenance, if required, may pose considerable personnel exposure concerns and be time-consuming and costly. Maintenance is expected to be minimal because of the short time the process will be operated and a robust design.

MCU has received a Phase 1 permit. The permit allows construction and testing of the process but requires that MCU be isolated from other LW processes (i.e., the permit will allow cold runs at MCU, but not cold runs involving other processes in LW). At a later date, plans are for SCDHEC to issue a Phase 2 permit that will allow transfers, thus enabling MCU to do any cold runs that are required involving other facilities and to process LW as designed.

Before MCU can be operated, modifications are required at DWPF, Tank 50, SPF, and SDF so that these processes can accommodate carryover of Isopar-L™, the main solvent used in MCU. The modifications required at SPF and SDF are described in more detail in the SPF and SDF section.

The first table in Appendix A shows the expected curies and volumes that will be sent to SPF from DDA and ARP/MCU. Tank 48 is assumed to be processed by aggregation. The second table shows the details of the process batches, i.e., what wastes are mixed to yield the indicated batches.

Table 3: ARP/MCU

Assumptions		Risks
Phase 2 MCU permit necessary for ARP/MCU to process LW will be obtained on schedule.		Planned schedule may not be met because of delays in the SCDHEC approval process.

Assumptions		Risks
MCU will be constructed and started up on schedule and will operate as designed.		Issues such as Isopar-L™ carryover to SPF or DWPF, problems with contactor operation, or other operating problems not yet discovered could delay the startup or reduce throughput. (Recently discovered issues include excessive vibration of the contactors, problems with contactor seals, foaming, and problems with contactor hydraulics. Much of the design is first-of-a-kind with limited test data.)
Processing rate will average at least 2 gpm for the first batch and 4 gpm (nominal facility capacity) for succeeding batches. Issues that arise will be resolved without delaying the schedule or reducing facility throughput. Minimal maintenance will be required.		Attainment of MCU may be limited by coupling with other processes, or by maintenance, operation, and radiation and contamination exposure challenges.
MCU performance will not degrade during long-term operation.		Problems such as buildup of waste deposits in unexpected places or other process problems could result in lower rates or attainment (for example, if parts of the process require frequent cleaning or maintenance).
Criticality issues in ARP and MCU will be resolved in time to support assumed schedules. Problems in early batches are minimal because uranium in these batches is low in enrichment, and no modifications to ARP or MCU are necessary. Necessary modifications are identified and accomplished before batches with high enrichment are processed.		Concentrations of actinides could create material with criticality potential in ARP, MCU, DWPF, SPF, or SDF. If the issues are not resolved in time, it could delay ARP/MCU operation or reduce throughput.
MCU will be a Hazard Category 3 facility, and maintaining this category will not require changes in the DPP.		Keeping MCU Hazard Category 3 may require restrictions on waste entering Tank 49, the MCU feed tank, to ensure that waste going to MCU will not exceed the inventory assumed in the Hazard Category analysis. These restrictions may impact DPP dates or throughputs.

Assumptions		Risks
Readiness assessment for MCU can be performed independent of the MCU Phase 2 construction permit, i.e., the readiness assessment does not require transfers to or from other LW processes.		It may not be possible to perform an acceptable readiness assessment before MCU is allowed to transfer to and from other LW processes (for example, if cold runs were required in which decontaminated supernate was transferred to Tank 50), which could delay startup.
Readiness assessments (including WSRC and DOE Operation Readiness Reviews) for MCU and associated facilities can be performed in time to support the MCU startup date.		Integrated readiness strategy may delay startup.
If MCU needs to be operated longer than currently planned, this extension can be accommodated with minimal process impact.		Engineering evaluations, equipment failures, or other problems associated with extended operation may require design modifications resulting in impacts to cost, schedule, and/or attainment.
Modifications required at DWPF, Tank 50, SPF, and SDF to receive carryover of Isopar-L™ are installed and put into operation on schedule.		Delays in installing these modifications or putting them into operation could prevent or delay startup of MCU.

Key Decisions:

DPP-04: Identify what modifications are needed to mitigate the criticality hazard at ARP and when modifications are needed.

There are no key decisions identified for MCU at this time.

7.2.3 SWPF

SWPF begins operation on September 2011. Sensitivity cases were considered in which the startup date is advanced by six months or delayed by six months. The process simulation supporting the DPP indicates that any startup date between March 2011 and March 2012 can be accommodated without affecting other milestones, although some changes in planning would be necessary. For example, if SWPF startup date were advanced, ARP/MCU could be shut down earlier, and some salt solutions planned for processing in ARP/MCU could instead be processed in SWPF. Early startups are easier to accommodate than late startups.

For the first 12 months, SWPF is assumed to accept 5 Mgal of salt solution. After 12 months, the rate is limited by the coupling to DWPF. When DWPF is producing 186 cans/yr, the SWPF rate is 5.4 Mgal/yr. When DWPF rate is 250 cans/yr, the SWPF rate is 6.4 Mgal/yr. Based on COREsim® modeling, these are reasonable rates to assume for planning purposes.[10] Also, because of the close coupling, SWPF shuts down for each DWPF melter replacement outage, which is assumed to be a four-month outage every four years. Thus, when DWPF is operating at 250 cans/yr, the average SWPF rate over a four-year period is 5.9 Mgal/yr.

These rates are considerably better than in the IPP. The much higher rates are a result of several changes. In particular, the DPP assumes that two additional tanks are made available for salt solution blending and staging:

- DSS lag storage is built to feed SPF, and necessary modifications are made to Tank 50 so that the tank is available January 2010.
- TPB-laden waste in Tank 48 is dispositioned so that the tank is available for other uses by January 2010.

Table 4: SWPF Operation

Assumptions	Risks
SWPF will be constructed and started up on schedule and will operate as designed. If a delay in startup or problems occurs during initial operation, the lost operations will be no more than 6 months. (The DPP process simulation indicates a delay of 6 months can be accommodated.)	Issues such as Isopar-L™ carryover to SPF or DWPF, or problems in construction, startup, and operation of SWPF could delay startup or reduce throughput, which would impact the DPP schedule.
SWPF will process 5 Mgal of DSS in the first 12 months, and at a rate of 5.4 Mgal/yr when DWPF is at 186 can/yr and 6.4 Mgal/yr when DWPF rate is 250 can/yr.	These rates may not be achievable because of wait times necessary for transfers, sampling, and analysis to verify feed solutions meet the SWPF WAC.
Sludge Receipt and Adjustment Tank (SRAT) capacity in the DWPF will not reduce the SWPF processing rate below 6.4 Mgal/yr.	SRAT capacity and cycle times in the coupling of DWPF and SWPF could reduce SWPF capacity and reduce the salt processing rate.
SWPF feed capacity is not impacted by coupling with the Tank Farm.	Interruptions with transferring out of Tank 49 will cause occasional outages of SWPF because there is minimal holdup volume at SWPF.

Assumptions		Risks
Tank Farm will be able to supply salt solution to SWPF at required rates. Appropriate infrastructure is in place to support preparation, staging, and feeding of salt solution, such as dedicated transfer routes, transfer equipment, and supporting drives and instrumentation.		High processing rate of SWPF will require dissolution in a number of tanks at once. SWPF rate may be limited by the rate at which salt dissolves or by transfer lines, etc.
SWPF processing rates are not impacted by coupling with SPF, i.e., new DSS lag storage has high enough capacity and SPF outages are short enough that lag storage can store the accumulated feed during most SPF outages, and then SPF can process fast enough to "catch up" so there is sufficient space for the next SPF outage.		SPF may not be able to sustain the needed rates over long periods of time or may require extended outages. SPF has never operated for more than a few months at sustained rates. Problems such as equipment failures or delays in receipt and handling of raw materials could require outages too long for the DSS lag storage to accommodate.

Key Decision:

DPP-05: Identify what enhancements are needed to Tank Farm infrastructure to ensure that salt solution can be sent to SWPF uninterrupted at nominal or improved rates.

7.3 Making Tanks 48 and 50 Available for Other Uses

Making Tank 48 and Tank 50 available for other uses is needed to support the DPP goals. The current service of each of these tanks is limited. Tank 48 is currently used for storing TPB-laden waste. Because of safety basis issues, TPB-laden waste cannot be sent to other tanks in the Tank Farm, nor can other wastes be sent to Tank 48. Tank 50 current holds low-level waste intended for feed to SPF and in the IPP was used as the DSS lag storage. DSS lag storage can be used only for low-level wastes that are qualified to send to SPF.

At least one tank (either Tank 48 or 50) is needed by January 2010 to support operation of the 3H Evaporator by supporting a Tank 37 salt dissolution. Operation of the 3H Evaporator is necessary to evaporate wastes generated during DWPF batch preparation, H-Canyon operations, and activities required to meet FFA tank closure commitments. In the current DPP plan, Tank 48 provides this support by receiving wastes from Tank 35, which allows storage of Tank 37 salt dissolution solution in Tank 35.

The second tank is needed by January 2010 to support FFA tank closure commitments by allowing bulk sludge removal from old-style tanks. The bulk sludge must be removed before Phase 1 heel removal can begin. In the current DPP plan, Tank 50 provides this support by receiving waste from Tank 42, which allows Tank 42 to be used to receive sludges from Tanks 13 and 14. This, in turn, enables the FY14 FFA tank closure commitments to be met (currently planned to be Tanks 11 and 14). Tank 50 also provides contingency space to ensure uninterrupted operation of DWPF if unexpected events occur, for example a delay in disposition of Tank 48 waste, an unexpected extended evaporator outage, or a delay in startup of SWPF.

Should the availability of one of these tanks be delayed beyond January 2010, a priority decision would be necessary to decide which wastes would go to the first tank to become available. For example, if Tank 48 availability was delayed, one option would be to use Tank 50 to support Tank 37 salt dissolutions, which are currently supported by Tank 48 in the DPP, and use Tank 48 when it becomes available later for the uses currently planned for Tank 50 (i.e., swap the uses of these two tanks). This would result in the delay of the closures of two tanks to be closed in FY14 (currently planned to be Tanks 11 and 14) beyond the FFA commitment dates but would allow DWPF to operate uninterrupted assuming no other unforeseen events occur. This scenario also has the added benefit of allowing H Canyon to operate uninterrupted. (The amount of space available is sufficient to allow H Canyon operation, which produces small quantities of waste in this period, but not enough to accommodate the larger quantities of wastes that must be processed to close Tanks 11 and 14.) This scenario is provided as an example only and is further explored in Sensitivity Cases 4 and 5 (discussed later in the DPP), in which Tank 48 availability is delayed by one year and two years, respectively.

New DSS Lag Storage

Tank 50 is made available for its intended service by constructing lag storage for the DSS stream feeding SPF and by making the necessary modifications, albeit relatively minor, to Tank 50 so that it can receive higher-activity wastes. (Tank 50 as currently configured can receive only low-level wastes.) Lag storage is needed between salt processing and SPF because of the large difference in processing rates between salt processing and SPF. Salt processing operates at average rates less than 20 gpm, whereas SPF operates at 100 gpm salt solution feed rate.

Scoping studies are currently underway to recommend the size and location of the DSS lag storage to support processing needs. The new lag storage should be large enough so that SWPF can continue to operate during most SPF outages. SPF has never operated for more than a few months at sustained rates. The lag storage needs to be large enough so that problems such as equipment failures at SPF or delays in receipt and handling of raw materials can be accommodated.

Table 5: New DSS Lag Storage

Assumptions		Risks
New DSS lag storage for feeding SPF is constructed and operational in time so that Tank 50 is empty and ready to receive higher-activity wastes by January 2010.		Project could be delayed, which would delay when Tank 50 is available for other uses.
Necessary modifications are made to Tank 50 by January 2010.		Project could be delayed, which would delay when Tank 50 is available for other uses.
DSS lag storage is large enough so that SPF outages have minimal impact on SWPF rates.		If lag storage is undersized or an extended SPF outage occurs, SWPF production would be impacted.

Key Decisions:

DPP-06: Determine the proper size and location of DSS lag storage.

The DPP describes two options for making Tank 48 available in time:

Base Case: *Decompose the Tetraphenylborate.* In this option, a process using a new treatment technology is constructed to decompose the tetraphenylborate in Tank 48 waste.[11] The treated stream after decomposition will still contain Cs-137 and other radionuclides, but the organic concentration is low enough that it can be mixed with other Tank Farm wastes and be evaporated, or the stream can be disposed of at DWPF..

At this time, the process to accomplish the decomposition has not been selected. The leading candidates for the new process are wet-air oxidation and steam reforming. If wet-air oxidation is chosen, the DPP assumes the treated stream from the new process, a salt solution which no longer has tetraphenylborate, is sent to the 2H Evaporator System. If steam reforming is chosen, the DPP assumes the treated stream from the new process is sent to a DWPF sludge batch and vitrified into glass. Both treatment technologies are still being developed at this time, and further development may show better ways to handle the treated streams, but these are the assumptions used in the development of the DPP.

Table 6: Tank 48 Base Case (Decomposition Process)

Assumptions		Risks
Tetraphenylborate can be decomposed at conditions that can reasonably be achieved in radioactive service.	[redacted]	Tetraphenylborate may be unusually difficult to decompose, and it may not be possible to achieve an effluent waste stream that can be safely evaporated or otherwise sent to its intended destination.
Research and development on the selected process, design, construction, startup, and operation can be accomplished quickly enough so that Tank 48 is available for other uses by January 2010.	[redacted]	Achieving this schedule may not be possible. Impacts of a one-year delay or a two-year delay are explored in Sensitivity Cases 4 and 5, respectively.
New process introduces no new safety hazards or processing issues not adequately identified as part of the research and development process (No surprises).	[redacted]	New process may introduce hazards or issues that delay startup.
Residual material remaining in Tank 48 at the completion of the decomposition program is sufficiently small and of acceptable composition that the tank can be used to prepare SWPF feed batches.	[redacted]	"Stubborn" deposits, other compounds produced by the decomposition process, or other problems would prevent the tank from being used to prepare SWPF feed batches.
If the treatment technology selected requires sending the treated stream to a DWPF sludge batch, the resulting sludge batch can be vitrified with minimal effect on the sludge batch schedule, DWPF production rates, and glass quality.	[redacted]	Treated stream may impact DWPF production rates, impact glass quality, or other effects that would require changes to the sludge batch schedule.
If the treatment technology selected requires sending the treated stream to the 2H Evaporator System, the composition of the Tank 48 waste after decomposition is acceptable for evaporation.	[redacted]	Residual organics could make the treated stream unacceptable for evaporation in the 2H Evaporator System, or components not affected by the process, such as aluminum, could make the product unacceptable. It may not be possible to construct a process that yields an acceptable treated stream at a reasonable cost.

Key Decisions:

Key decisions for Tank 48 options are listed after the Tank 48 Alternative Option table below.

Tank 48 Alternative Option: *Aggregate the Tank 48 waste to SDF.* This will require 0.2 Ci/gal modifications to two additional cells in Vault 4 (six cells have been modified to date).

The plan in IPP was to dedicate these two additional cells to Tank 48 waste and feed them at slow enough rates to keep the temperature of the grout below 55ºC, which limits benzene emissions. In the DPP, the new plan is to build a nitrogen-inerting system or install some other organic control system for Vault 4 so that this vault can receive the DSS stream from MCU, which contain Isopar-L™. After the organic control system is operating, the MCU DSS stream can be sent to any of the eight available cells in Vault 4. If the nitrogen-inerting system is chosen, it has the added benefit of allowing SDF to receive TPB-laden wastes from Tank 48 if the Tank 48 Alternative Option is selected.

The aggregation of Tank 48 will result in an additional volume of waste being processed at SPF, which advances the need date for Vault 2 at SDF. For the DPP, it has been assumed that completing the Tank 48 waste aggregation program, if implemented, will fill a volume equivalent to 3 cells in Vault 4 (about 3 Mgal).

For a discussion of the risks of TPB-laden waste at SDF, see the next section.

Table 7: Tank 48 Alternative Option (Aggregation)

Assumptions		Risks
Permits necessary for DDA and Tank 48 aggregation will be obtained on schedule.		Planned schedule may not be met because of issues raised in the SCDHEC approval process.
For transfers out of Tank 48, a Safety Basis Strategy is approved that allows existing Tank 48 Documented Safety Analysis (DSA) to be used with only wording changes.		Safety Basis Strategy is not approved by DOE, and field modifications are required for Tank 48.
Field modifications to Tank 50 are accomplished on schedule.		Necessary modifications are not completed in time, or it is discovered that additional modifications are needed.
A nitrogen-inerting system or some other organic control system is added to SDF Vault 4 to receive wastes from ARP/MCU. After the system is added, Tank 48 waste can also be received and mixed in any proportion with ARP/MCU waste.		Delays in installing the organic control system or issues with mixing Tank 48 waste with ARP/MCU wastes could delay the start of aggregation and delay when Tank 48 is available for other uses.

Assumptions	Risks
SPF and SDF will be able to receive Tank 48 waste at assumed rates.	Tank 48 aggregation might not be completed in time. See SPF and SDF section for a more complete discussion of the risks of receiving Tank 48 waste.
Residual material remaining in Tank 48 at the completion of aggregation is sufficiently small that the tank can be used to prepare SWPF feed batches.	"Stubborn" deposits or other problems would prevent the tank from being used to prepare SWPF feed batches.

Key Decisions:

DPP-07: Identify an alternative process for decomposition of the tetraphenylborate.

DPP-08: Once design parameters of the new process are known, identify what changes are needed to integrate the new process into the DPP.

DPP-09: Based on information available from evaluation of the alternative treatment technology, make a decision if Tank 48 will be treated by aggregation or by the new treatment technology. The evaluation must include the impact of the chosen option on other LW processes.

DPP-10: Evaluate if components not affected by the new process, such as aluminum, pose a problem in downstream processes.

7.4 Disposition of Salt Wastes at SPF and SDF

The decontaminated streams from DDA (including Tank 48 waste in the Tank 48 Alternative Option), ARP/MCU, and SWPF will be sent to the SPF and SDF for treatment and disposal. Executing the DPP requires that SPF can receive salt solution at the radionuclide concentrations and rates assumed.

The DDA wastes will have concentrations as high as 0.2 Ci/gal Cs-137. Six cells have been modified in Vault 4 to allow SDF to accept up to 0.2 Ci/gal Cs-137 wastes. Two more cells in Vault 4 (cells B and H) will be modified, so that a total of eight cells are available to receive 0.2 Ci/gal Cs-137 wastes. However, only one cell (100-feet by 100-feet surface area) with grout from 0.2 Ci/gal wastes can be exposed at a time because the skyshine from two cells would exceed exposure limits. The vault walls are shielded sufficiently to control radiation below exposure limits. However, skyshine, radiation shining vertically through the minimally-shielded roof of the vault, will reflect off air and water vapor. If Cs-137 concentrations are too high, skyshine will cause radiation rates at ground level surrounding the vaults to exceed exposure limits.

Plans are to pour grout to a cell for a period of time, then pour a "clean cap," a layer of non-radioactive grout that will reduce radiation shining through the roof of that cell, and then begin pouring grout in another cell. The pour schedule needs to be planned so that the maximum grout temperature in each cell is less than 95ºC and the volume of clean caps is reasonable. (The rate can be increased with more clean caps, but this uses up vault space with non-radioactive material.) Heat transfer calculations indicate that operating in this manner with eight cells will allow SPF to receive salt solution from DDA at a maximum rate of 83 kgal/week in Vault 4 and 100 kgal/week in Vault 2, a next generation vault to be constructed that has larger cells, although there are no plans to use Vault 2 for this purpose at this time.

Once all the DDA waste has been sent to SPF and SDF (including Tank 48 waste for the Tank 48 Alternative Option), the remaining salt solution will be either ARP/MCU or SWPF DSS, which will have much lower Cs-137 concentrations. At this point, the restrictions on the number of cells with exposed radioactive grout can be relaxed, and much higher pour rates are possible as long as sufficient cells are available so that the pour rate into each cell is slow enough to maintain the maximum grout temperature below some temperature (currently assumed to be 95ºC). The DPP assumes SPF can receive ARP/MCU DSS mixed with Tank 48 waste at 83 kgal/week as long as the mixed salt solution is less than 0.1 Ci/gal. (this is higher than ARP/MCU capacity.) The DPP also assumes that when SWPF begins operation, SDF can leave enough cells uncapped to process SWPF DSS at system rates. (The SWPF DSS is low enough in Cs-137 concentrations that a large number of cells can be left uncapped without exceeding exposure limits from skyshine.) In the DPP process simulations, the average feed rate to SPF when SWPF is operating is approximately 135 kgal/week.

All eight cells in Vault 4 will be nitrogen inerted or other organic controls will be implemented to mitigate the hazard of organic emissions from Isopar-L™ from ARP/MCU. A nitrogen-inerting system has the added benefit that TPB-laden wastes can be safely received if the Tank 48 Alternative Option is chosen. With nitrogen inerting, TPB-laden waste from Tank 48 or wastes from ARP/MCU can be sent to any of the eight cells and mixed in any proportions as long as SDF WAC limits are met.

The alternative to nitrogen-inerting currently being considered is temperature control. In this control strategy, the hazard posed by Isopar-L™ is mitigated by limiting the temperature. The pour schedule among the eight cells is planned so that pour rates into each cell are low enough to maintain the temperature below the designated safety limit. (The temperature limit currently being considered is 55°C.) Because the temperature limit is a safety requirement, implementing this strategy would presumably require safety class temperature monitoring and interlocks, although the details of this strategy are still being developed at this time.

Although nitrogen-inerting and temperature control are the only two SDF organic controls being considered at this time, any organic control strategy is acceptable as long as it is implemented in time to support startup of ARP/MCU. If the decision is made to aggregate the Tank 48 waste to SDF, nitrogen-inerting is the preferred strategy because it eliminates issues associated degradation of the tetraphenylborate in SDF. However, if the Base Case is implemented, which does not include aggregation of Tank 48 waste, other organic control strategies become more attractive.

The projected need dates for vaults based on the salt solution processing rates in the DPP are shown in Appendix C.

Table 8: SPF and SDF

Assumptions	Risks
Two more cells in Vault 4 will be modified to receive 0.2 Ci/gal Cs-137 wastes, and all eight cells will be nitrogen inerted or other organic controls implemented to receive wastes from ARP/MCU. Inerting will also allow receipt of wastes from Tank 48 (if the Tank 48 Alternative Option is chosen). ARP/MCU waste and Tank 48 waste can be mixed in any proportion.	Funding or other issues could delay these modifications, delaying DDA, Tank 48 aggregation, or ARP/MCU.
With eight cells available, SPF and SDF can receive salt solutions from DDA, ARP/MCU, and Tank 48 at up to 83 kgal/week. Rates when receiving SWPF wastes can meet SWPF capacity.	SPF has never operated over a long time (more than a few months) at sustained rates. Problems such as equipment failures, higher-than-expected temperatures in the grout, or limits on dry feed receipt and handling could reduce processing rates.
With only one cell uncapped, SPF and SDF can receive salt solution with Cs-137 concentrations up to 0.2 Ci/gal. Two cells can be uncapped if the concentration is below 0.1 Ci/gal.	Actual skyshine may be higher than estimated, and additional measures may be needed, such as decreasing the Cs-137 concentration limit or pouring thicker clean caps.
Sufficient vaults will be available to achieve required rates.	Sufficient funds may not be available to pay for needed vaults.
DSS lag storage will be operational in time so that Tank 50 can be used by January 2010 to support processing of wastes in support of tank closure.	If DSS lag storage is not available in time, an outage at SPF would cause a outage at ARP/MCU or SWPF.

Key Decisions:

DPP-11: Decide what vault fill sequencing and processing rate strategy will be pursued so that vaults can be procured in time to execute it.
DPP-12: Decide what organic control system is required at SDF.

7.5 Continuing Tank Farm Operations

7.5.1 Supporting Nuclear Material Stabilization

The current plan accommodates nuclear material stabilization in H Canyon through at least 2013. This is a significant change from the IPP, (and previous plans) which assumed nuclear material stabilization would be completed in 2011 or earlier, and only minimal shutdown flows would be received after that. For planning purposes, the DPP assumes that waste volumes generated will be comparable to volumes historically generated by H Canyon, although commitments have not been made to specific missions that cover the entire time period.

To accommodate this change requires that Tank 39 continue to be dedicated for canyon receipt at least through 2016 to accommodate shutdown flows from H Canyon. This is one of the reasons the 2F Evaporator System must continue to operate (see next section). Thus, the DPP relies heavily on aging Tank Farm evaporators to operate at reasonable attainment. An unanticipated extended outage of either the 2F or 3H Evaporator Systems could delay the preparation of a DWPF sludge batch, tank closures, or H-Canyon operation.

For simulation purposes, the DPP assumes that the remaining neptunium in H Canyon will be processed to remove the sulfate and disposed of in a sludge batch. The alternative plan would be to process the neptunium into oxide. The DPP can accommodate either processing option because the volume of neptunium solution is relatively small. For the case of disposing of the neptunium directly in a sludge batch, it is assumed that it can be added at any time with no impact on DWPF feed qualification (no feed break).

Table 9: Nuclear Materials Stabilization

Assumptions		Risks
Evaporation capacity is available as needed to receive nuclear material stabilization wastes.		Unplanned evaporator downtimes could cause unplanned outages of nuclear material stabilization.
Receipt of neptunium into a sludge batch will not cause a DWPF feed break because the resulting mixture would be qualified before the neptunium was sent.		DOE priorities might require that neptunium be sent before all of the qualification issues are resolved, resulting in a DWPF feed break.

Assumptions		Risks
Disposition of Tank 41 salt via DDA proceeds on schedule so that Tank 25 can be used as the 2F Evaporator System concentrate receipt tank.		DDA is delayed, impacting the 2F Evaporator System operation and, consequently, H-Canyon operation.

Key Decisions:

There are no key decisions for this area that affect the DPP.

7.5.2 Use of Tank 25 as the 2F Concentrate Receipt Tank

Meeting processing objectives associated with DWPF feed batch preparation, tank closure, and H-Canyon operations are dependent on the ability to operate the 3H and 2F evaporators to recover space. The most significant issue for each of these evaporators over the DPP Planning Window is to keep the concentrate receipt tanks from becoming "salt bound" (i.e., full of saltcake to the point that the evaporator system cannot be operated).

Appendix D shows projected system levels for the 2F Evaporator System during the DPP Planning Window. Tank 27, the current concentrate receipt tank in the 2F Evaporator System, is currently forecast to become salt bound in late 2006. The high salt level in Tank 27 is already adversely impacting the decant strategy for preparation of DWPF Sludge Batch 4. The successful disposition of Tank 41 salt solution by DDA enables the removal of significant salt from Tank 25 in 2006 through mid-2007. After Tank 25 salt removal is completed, the DPP requires conversion of Tank 25 so that it can be used again for 2F concentrate receipt service. Thus, the evaporator can support the following activities needed to maintain Tank Farm space:

- Receipt and evaporation of H-Canyon waste
- Sludge batch decants at the 3H (by reconstituting Tank 37 dissolved salt stored in Tank 35 in the 2F evaporator, allowing another Tank 37 salt removal campaign)
- Neutralized oxalic acid and other wastes from heel removal campaigns to prepare tanks for closure

The conversion of Tank 25 to a concentrate receipt tank requires several modifications and procedure changes similar to, but more extensive than, what was recently performed on Tank 27, which began concentrate receipt service in January 2004.

Table 10: Use of Tank 25

Assumptions		Risks
Tank 25 is converted to 2F concentrate receipt service.		Necessary modifications are not completed in time.

Assumptions	Risks
Disposition of Tank 41 salt via DDA proceeds on schedule so that Tank 25 can be used as the 2F concentrate receipt tank.	DDA is delayed, impacting 2F Evaporator operation and, consequently, H-Canyon operation, sludge batch preparation, and tank closures. (delayed past FFA regulatory milestones)
Volume and radionuclide concentrations of the interstitial liquid in the Tank 25 salt are as estimated.	Volume of interstitial liquid is larger than forecast, or radionuclide concentrations are higher than forecast, resulting in impacts to H-Canyon operation, sludge batch preparation, and tank closures.

Key Decisions:

DPP-13: After sampling and characterizing Tank 25 salt cake, determine if revised volumes and concentrations are acceptable.

7.5.3 Periodic Salt Dissolutions in Tank 37

Due to large amounts of salt in the tanks slated for sludge removal during the DPP Planning Window (i.e., Tanks 4, 12, 14, and 15), preparing future sludge batches will result in the need for a significant amount of salt concentrate receipt space in the evaporator concentrate receipt tanks. Based on the current forecast, Tank 27 (the 2F Evaporator concentrate receipt tank) will be filled up to about 330" of salt (the salt fill limit) by late 2006 and will no longer be able to support sustained evaporator operations.

Appendix E shows projected system levels in the 3H Evaporator System. A Tank 37 salt removal campaign was completed in October 2005. Even after removing about 175 kgal of salt from Tank 37, it is anticipated that the 3H Evaporator will be filled to 330" of salt prior to processing of Sludge Batch 6 decants in 2007 (due to processing associated with Sludge Batch 4 and 5 decants and further evaporation of concentrated supernate from the 2F System).

Due to the large amount of salt expected from Tanks 4 and 12 during sludge batch preparation, a salt removal campaign in 2007 (prior to Sludge Batch 6) will allow the 3H System to operate through the processing of Sludge Batch 6 decants before again reaching 330" of salt in Tank 37. Additional salt removal campaigns would then be required prior to Sludge Batch 7 (in late 2010) and Sludge Batch 8 (in 2013) to position the 3H Evaporator System for efficient processing of sludge batch decants. Salt solution removed from each salt removal campaign will eventually be processed in SWPF after interim storage in one of several tanks (e.g., one salt batch originating from Tank 37 is stored in Tank 50 after this tank is converted to higher-activity service).

7.5.4 2H Evaporator System

Reliable operation of the 2H Evaporator System is needed to ensure that the DWPF Recycle, the largest stream received by the Tank Farm, can be managed. An extended outage, such as occurred in 2000 because of sodium aluminosilicate, could cause a shutdown of the DWPF. This year, a planned outage to remove sodium aluminosilicate deposits had to be extended because the evolution took longer than forecast. The first outage was followed by a second outage due to DSA issues. These two outages have resulted in the space for receiving DWPF Recycle to be as low as 1½ months of DWPF operation. Work is ongoing to develop a better flowsheet for removing sodium aluminosilicate deposits to minimize the extent of these outages. Appendix F shows projected system levels in the 2H Evaporator System.

The DWPF Recycle rate is between 1.5 and 1.9 Mgal/yr during sludge-only operations (the rate depends on canister production rate). The rate is expected to increase to approximately 2.7 Mgal/yr after the startup of SWPF, because of extra water in the strip effluent stream and MST slurry, and because the high Cs-137 concentration will require the operation of two Steam Atomized Scrubbers (SASs) in the DWPF melter offgas system. Currently, only one SAS is operated intermittently.

DWPF Recycle that is not used for salt solution molarity adjustment needs to be evaporated and can be evaporated only in the 2H Evaporator System. Experience has shown that silica in the DWPF Recycle combines with aluminum compounds in other wastes to form sodium aluminosilicate deposits that plug lines and concentrate uranium, preventing operation of the evaporator and creating a potential criticality hazard. To eliminate the criticality hazard, uranium enrichment in the 2H Evaporator System is limited to levels that prevent a criticality even if significant sodium aluminosilicate deposits form, unlike the other two evaporator systems, which are controlled to limit the possibility of deposits. Also, to prevent plugging and extended outages, aluminum-bearing wastes (most other Tank Farm wastes) are excluded from the 2H Evaporator System. The only other major waste that might be sent to the 2H Evaporator System is the Tank 48 waste after decomposition of the tetraphenylborate.

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

Table 11: 2H Evaporator System

Assumptions		Risks
Uranium enrichment limits for DWPF and the 2H Evaporator will permit sludge processing without the need to add depleted uranium or other controls that impact the process. Currently DWPF is limited to a feed of 0.93% enriched uranium, and the 2H Evaporator is limited to feed of 0.7% enriched uranium. Work to safely increase these limits is ongoing.		If the DWPF and 2H Evaporator uranium enrichment limits are not increased sufficiently to allow planned sludge batch processing, depleted uranium will have to be added or additional criticality controls may need to be in place, which may slow or delay processing of sludge through DWPF.
Accumulation of deposits will be slow enough that routine cleaning outages can be accomplished and still meet the assumed evaporator attainment of 50%.		An unexpectedly fast accumulation of deposits or some other issues related to accumulation could cause the attainment to be less than 50%, resulting in impacts to DWPF processing.
Cleaning of evaporator deposits can be accomplished with reasonable effort and time.		Unexpectedly stubborn deposits could cause an extended outage.
Evaporator and associated infrastructure continue to perform adequately.		Breakdowns, leaks, or other infrastructure problems could cause an extended outage. The 2H Evaporator System is aging and is at risk for infrastructure problems.

Key Decisions:

DPP-14: Develop a better flowsheet for removing sodium aluminosilicate deposits that can be executed with shorter outages or identify ways to reduce the amount of deposits.

7.5.5 Transfer Line Infrastructure

Executing the plan described in the DPP requires more frequent transfers than has historically occurred in the Tank Farm, especially after the startup of SWPF, when large volumes of salt solution (at least 6.4 Mgal/yr) will be delivered to the facility. The Tank Farm transfer line infrastructure is aging and subject to leaks, failures of equipment and instrumentation, pluggage, and other problems. Because of the greatly increased pace of transfers after the startup of SWPF, short downtimes due to unexpected conditions will be more difficult to accommodate without impact because the idle time of transfer lines will be reduced.

Also, the DPP requires transfers that cannot be made with the current infrastructure, such as transfers to support ARP/MCU and SWPF. New infrastructure must be constructed to accomplish these new activities while also continuing activities that have been historically performed, such as waste removal and evaporation. Discoveries of unexpected conditions in existing transfer systems, such as leaks or pockets of high-activity waste, could impact the installation of new transfer lines and equipment.

The transfers planned in the DPP are generally based on the known current infrastructure and changes planned in the Waste Transfer Line Project and in projects for new facilities. The actions described in the DPP can be executed as long as the planned changes are made, and significant failures of key transfer equipment, such as leaks, do not occur or can be mitigated quickly enough to allow activities to proceed as planned. The DPP does not attempt to explain all the changes needed or the specific risks of failure of certain pieces of transfer equipment.

Most of these changes have already been recognized, and the needed actions identified. However, the DPP has been changed significantly in the last few months, so it is possible that changes in scheduling may require some adjustment to the plans for waste transfer line upgrades. A review of the plans for waste transfer line upgrades is needed to ensure that it is still consistent with the DPP (See the Key Decisions below).

A few of the most significant assumptions and risks are listed in the table below. More assumptions and risks are listed in the Strategic Plan for the Waste Transfer Line Project[12] and are not repeated in the DPP.

Table 12: Transfer Line Infrastructure

Assumptions		Risks
Transfer line upgrades required to execute the DPP are implemented on schedule. Several major upgrades include: • HDB-2 Area upgrades to support bulk waste removal (BWR) and heel removal from Tanks 13, 14, and 15 and to provide a more dedicated route to move large volumes of stored DWPF Recycle from Tanks 21 and 22 on the West Hill of H Tank Farm to salt solution preparations tanks on the East Hill • East Hill upgrades to support the preparation and feeding of 6 Mgal/yr of salt solution to the SWPF		Upgrades will not occur on schedule, for example, because of unanticipated conditions discovered when aging transfer lines are uncovered for tie-ins with new transfer lines. Also, unanticipated leaks or failures in existing equipment will impact the execution of the DPP. If the upgrades do not occur on schedule, this could impact waste removal, operation of DWPF, and operation of SWPF.

Assumptions	Risks
Inter-area line is capable of supporting Tank 25 dissolution per rates in the Tank 25 operating plan.	Slow transfer rates required for dissolution cannot be maintained for such long transfers.

Key Decisions:

DPP-15: HDB-2 transfer routing and required modifications must be identified and logically tied to transfer planning required to support the DPP.

DPP-16: On the H Tank Farm East Hill, transfer routing and required modifications must be identified and logically tied to transfer planning required to support the DPP.

7.5.6 Managing Type III Tank Space

A shortage of waste storage space exists in Type III/IIIA compliant tanks in both F- and H-Tank Farms. There is a risk that a leak in a primary tank or other adverse event could occur that would prevent execution of the DPP. Appendix G shows the projected operating space in Type III tanks.

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

The lack of space is especially critical in the 2F and 3H Evaporator Systems. Space is needed for evaporator concentrate receipt, to support periodic salt dissolutions, and storage of high-hydroxide waste that does not precipitate into salt. This “boiled-down” liquid is commonly referred to as liquor, and removing the liquor from an evaporator system is referred to as deliquoring. Evaporator operations are severely impacted when the concentrate receipt tank has a salt level greater than 300". The evaporator can no longer be effectively operated when the concentrate receipt tank level is 330" or greater – at this point, the evaporator system is “salt bound.” The only viable concentrate receipt tank for the 3H System is Tank 37. In October 2005, about 175 kgal of salt (about 50") was removed from Tank 37. During this salt removal campaign, the average salt level in Tank 37 dropped from about 337" to about 282". The 2F concentrate receipt tank, Tank 27, has about 295" of waste, which is already limiting the size of transfers that can be made into the 2F Evaporator System. Following the completion of Sludge Batch 4 preparation it is estimated that the salt level in Tank 27, the last available concentrate receipt tank in the 2F System, will be approaching 330".

Table 13: Managing Type III tank Space

Assumptions	Risks
Management of Type III tank space occurs as described in the DPP.	A tank leak or other adverse, unplanned event could prevent execution of the DPP.
2F and 3H Evaporator Systems will operate as assumed in the DPP.	Salt levels in Tank 37 or Tank 27 increase faster than planned, causing outage of the 3H Evaporator System or 2H Evaporator System, respectively.
Disposition of Tank 41 salt via DDA proceeds on schedule so that Tank 25 can be used as the 2F Evaporator concentrate receipt tank, and Tank 37 can continue to be used as the 3H Evaporator concentrate receipt tank.	DDA is delayed, impacting 2F and 3H Evaporator operation, which impacts all programmatic objectives related to schedule, as described elsewhere in the DPP.
Salt processing via ARP/MCU proceeds on schedule to support periodic de-liquoring of the 2H Evaporator System.	ARP/MCU is delayed, impacting the 2H Evaporator System's ability to process DWPF Recycle at sufficient rates (evaporator rate is greater than receipt rate), impacting DWPF operation.
Tank 48 disposition (either by a new treatment technology or by another method) proceeds on schedule so that the tank is available as planned by January 2010.	Tank 48 disposition is not completed on schedule, which impacts a number of programmatic objectives as described elsewhere in the DPP.
New DSS lag storage is constructed and becomes operational in time that Tank 50 is available as planned.	New DSS lag storage is not ready in time, which delays tank closures and DWPF feed batch preparation, as described elsewhere in the DPP.

Key Decisions:

There are no key decisions for this area.

7.5.7 Continued Limited Use of Structurally Sound Old-Style Tanks

The IPP and previous processing planning documents assumed some continued limited use of structurally sound old-style tanks beyond simply storing the waste that is already in them. The use of Type I and II old-style tanks in this manner is limited to directly supporting waste removal, heel removal, or annulus cleaning of other old-style tanks. Type IV tanks are used indirectly to support waste removal.

In the DPP the amount of time that old-style tanks will be used in this manner is extended. Waste stays in the F-Area Type I tanks longer than in the IPP, because of the delay of SWPF startup, the determination of more sludge than anticipated in tanks planned for upcoming DWPF sludge batches, and because of the lower DWPF canister rate for Sludge Batches 4, 5, and 6. Also, after Tank 48 waste has been treated in the new decomposition process, depending on the treatment technology selected, the Tank 48 waste may be sent to the 2H Evaporator System. Tank 48 waste would mix with DWPF Recycle that is concentrated and later stored in a Type IV tank (In the Tank 48 Alternative Option, the TPB-laden waste goes directly to SDF).

Continued limited use of structurally sound old-style tanks is permitted by the FFA until the date at which the tanks need to be removed from service. However, continued use of these tanks increases the period of time in which a tank leak might prevent use of a tank needed to execute the DPP. Also, sending waste into an old-style tank has a greater risk of revealing a leak than simply storing waste (which will happen in all of the old-style tanks that are still in service). This risk is somewhat mitigated by other changes made in the DPP, particularly the recovery of Tank 48 and Tank 50 for other uses. However, the risk still exists.

Table 14 shows the current list of old-style tanks forecasted for some function other than storing waste currently in them. As the processing plan is revised, the tanks to be used may be changed, but types of service should be similar to those listed in the table. For example, a change in tank use may be required if a new leak site were discovered or if tank closure plans changed.

Table 14: Forecasted Use of Old-Style Tanks

Tank(s)	Type	Forecasted Continued Service in the DPP
Tanks 7 & 8	I	Storage of waste from Tanks 4, 5 & 6 - sludge slurry, supernate, and waste from heel removal and annulus cleaning (if required). Current plans are to consolidate the sludge heels in Tank 7 and store supernate in Tank 8.
Tank 11	I	Tank 16 annulus cleaning solutions and staging of sludge waste from Tank 12
Tank 13	II	Staging of wastes from Tanks 11, 14, 15, and 16 - sludge slurry, supernate, and waste from heel removal and annulus cleaning
Tanks 21 –24	IV	• DWPF receipt and storage, including storage of concentrated DWPF Recycle from the 2H Evaporator System • Treated waste from the Tank 48 decomposition process that has been evaporated (if a treatment technology is chosen that requires sending waste to the 2H Evaporator System)

Table 15: Continued Use of Old-Style Tanks

Assumptions		Risks
No unexpected leaks are discovered that prevent the continued use of tanks storing waste in the DPP (reactivation of leak sites is expected during waste removal from tanks that have previously leaked because water is being added to the tanks to perform waste removal).		Discovery of a tank leak or other adverse, unplanned event could impact execution of the DPP.
Use of these tanks is not impeded for some reason other than leaks (e.g., there is a regulatory objection or inspections reveal an unacceptable defect).		Restriction on the use of old-style tanks could impact execution of the DPP.

Key Decision

DPP-17: Assess the condition of tanks planned for use to ensure that continued use of these tanks is acceptable.

7.6 Waste Removal and Tank Closure

Tank closures will require Section 3116 waste determinations. Experience with the Section 3116 waste determination for salt disposal and the ongoing effort for closure of Tanks 18 and 19 suggest this will increase the time required to close a tank.

Tanks 18 and 19 have undergone waste removal and are ready to close. The DPP assumes that closure of these tanks will have no impact on scheduling of other activities because no further waste removal or tank cleaning is required. The current schedule for Tanks 18 and 19 shows closures of the tanks approximately 6 months beyond the FFA commitment dates of 2/28/07 and 10/31/06, respectively. The draft basis for the Section 3116 waste determination for Tanks 18 and 19 is currently being reviewed by the NRC, and closure cannot proceed until this review is completed. DOE has proposed new closure dates to SCDHEC and EPA in the annual tank status report.[13]

Figure 1 compares the generic tank closure schedule assumed in the IPP (18 months); a schedule in which all critical path activities are performed in sequence (39 months); and the challenge schedule assumed in the DPP (24 months).

The generic schedule when all activities are performed in sequence is much longer than the IPP schedule for a number of reasons. First of all, NRC review of the Section 3116 waste determinations will be required and will require nine months.

Second, avoiding overlap of reviews at NRC, DOE Savannah River, and DOE Headquarters is desirable. Significant changes were made to the salt disposal waste determination as a result of comments from NRC and from DOE Headquarters. Therefore, if NRC, DOE Savannah River, and DOE Headquarters reviews of a Section 3116 waste determination overlap, there is risk that changes during the review cycle will cause delays. In the IPP, these schedules overlapped significantly.

Third, it is desirable to avoid placing the grout contract at risk, i.e., waiting to place the grout contract until after all the reviews are complete. Under the schedule anticipated in the IPP, the grout contract would be placed six months before the end of the reviews, obligating funds when the schedule is still uncertain. As discussed above, experience with the salt Section 3116 waste determination suggest that issues raised during the review have the potential to delay the process.

When a schedule for all activities required to close a tank is laid out sequentially, the total time from the end of heel removal until the tank is closed is 39 months:

- WSRC samples and analyzes the residual in the tank, performs performance assessment modeling, and prepares the draft waste determination and the necessary permits – 11 months
- DOE Savannah River, DOE Headquarters, and NRC review the draft waste determination; WSRC makes any necessary revisions; and DOE issues the waste determination – 13 months
- SCDHEC reviews and approves the closure module – 5 months
- WSRC places a grout contract, modifies the tank equipment as required to receive grout, isolates the tank from the rest of the Tank Farm, modifies the safety basis, and then fills the tank with grout – 10 months

Obviously, this is much longer than the schedule assumed in the IPP, which called for the entire process to take 18 months. For the purposes of planning in the DPP, it was assumed that the process could be completed in 24 months. This assumes WSRC completes the initial activities in 8 months; assumes reviews by DOE and NRC can be accomplished in 7 months; and calls for placing the grout contract, at risk, 6 months before the anticipated date that SCDHEC will approve closure of the tank. Meeting this schedule, especially when a number of tanks are being closed, will be a challenge but is necessary to meet the FFA commitment dates. In particular, it will require close coordination between DOE Savannah River, DOE Headquarters, and NRC.

The DPP process simulation supports tank closures during the DPP Planning Window assuming that performance objectives for waste removal have been met using the current heel removal flowsheet assumptions. The currently planned tank closures are shown in Table 16. A complete tank closure plan, including expected durations for bulk waste removal, heel removal, annulus cleaning, and other activities is shown in Appendix H.

Table 16: Tank Closures Planned in the DPP

Year	Number of Tanks Required by FFA	Designated Tanks in DPP to meet FFA Requirements
FY07	2	Tanks 18 and 19 (assumes no additional residual waste removal)
FY10	2	Tanks 5 and 6
FY11	1	Tank 4
FY12	2	Tanks 12 and 16 (Tank 16 is assumed to require annulus cleaning only)
FY13	1	Tank 8
FY14	2	Tanks 11 and 14
FY15	2	Tanks 15 and 23

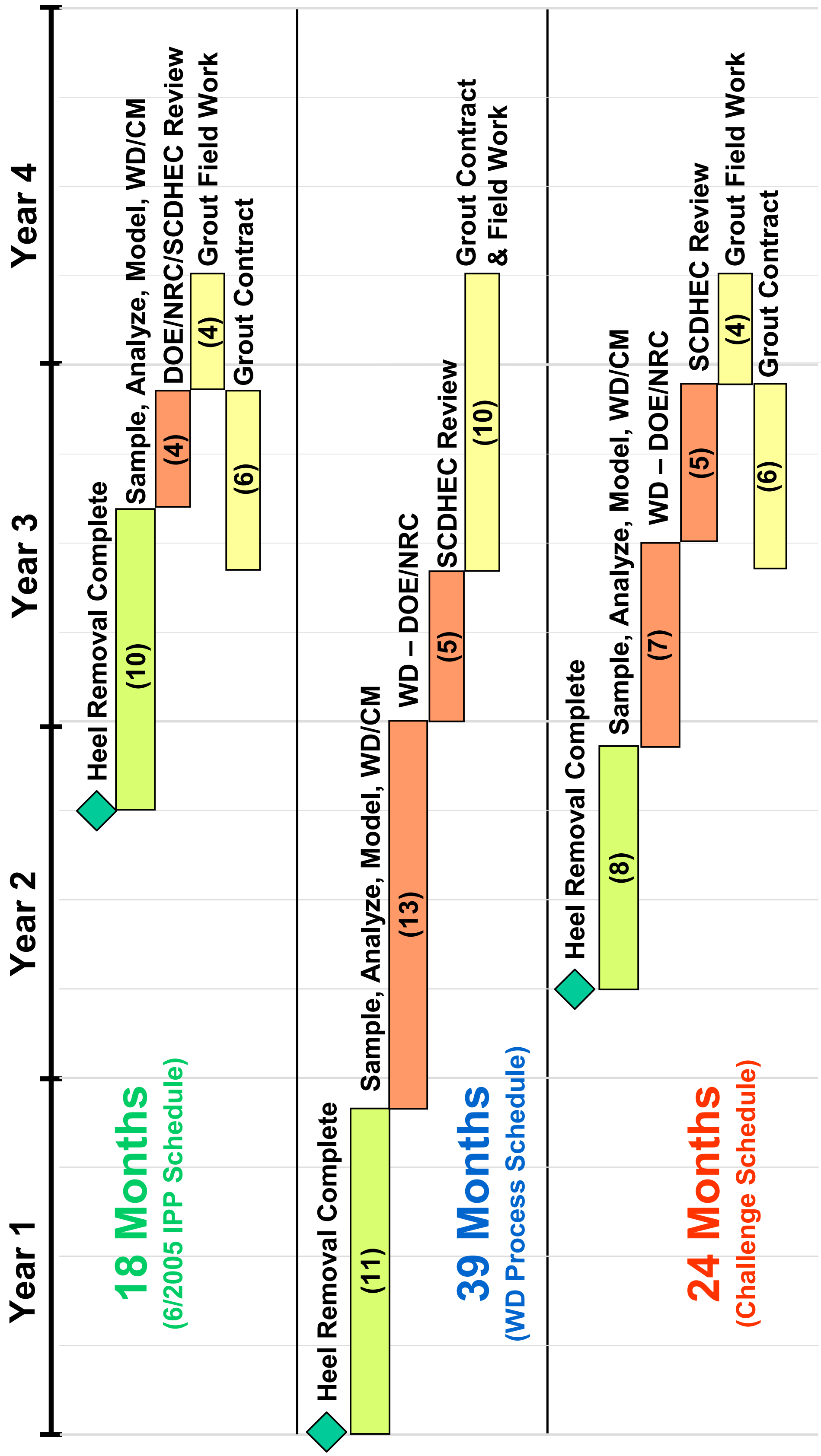


Figure 1: Tank Closure Schedules Before and After Section 3116

All the tanks other than 16, 18, and 19 will require bulk waste removal followed by heel removal. Tanks 5, 6, 11, 12, 14, 15, and 16 will require annulus cleaning. As the Tank 16 primary tank was cleaned in a previous demonstration campaign, only annulus cleaning is required, i.e., cleaning of secondary containment only. Waste removal from annuli of Tanks 5, 6, 11, 12, and 15 should be straightforward, as these annuli contain only small to modest quantities of salt. However, Tank 14 contains a large quantity of salt, about 13 inches, and will require a larger volume of water for dissolution and removal. Tank 16 contains salt mixed with sandblasting material that was used for cleaning leak sites to help determine the cause of the large amount of cracking that occurred in this tank. Over the years, the sandblasting material and waste have reacted to form mineral compounds that resist dissolution in water or in oxalic acid, which is the strongest cleaning agent normally used in the Tank Farm. Removal of the waste from the annulus of Tank 16 is a significant challenge.

Experience on Tanks 5 and 11 suggests that more water may be needed for heel removal than previously planned. In the IPP, the phrase “heel removal” meant oxalic acid cleaning. For the DPP, it is assumed that heel removal will proceed in two phases. Phase 1 will consist of mechanical cleaning and is assumed to require 500 kgal of inhibited water. Phase 2 will be oxalic acid cleaning and is assumed to create about 200 kgal of neutralized solution.

Closing the above tanks meets the regulatory commitment schedule under the FFA for the total number of tanks to be closed through FY15, assuming the schedule is changed for Tanks 18 and 19. The FFA schedule currently reflects Tanks 14, 11, and 12 being closed first, but space constraints due to sludge batch processing in H Area during FY09–FY11 are such that the identified F-Area tanks are planned to be closed first. Available space in Tanks 7 and 8 will be used to support heel removal from Tanks 4, 5, and 6 during these earlier years to minimize impacts on limited Type III tank space. Similarly, Tanks 13 and 11 are assumed to be used to support the heel removal of the earlier H-Area tanks shown.

Based on preliminary discussions with SCDHEC, it appears that modifying the FFA schedule to reflect closure of the appropriate tanks will be acceptable as long as the commitment for total number of old-style tanks per year is met and processing justifications for the proposed sequence can be demonstrated.

Table 17: Heel Removal and Tank Closure

Assumptions	Risks
Waste determinations for tank closures and permitting can be accomplished in the times assumed, and the time from the end of tank cleaning to end of grouting will be 24 months or less. Performing concurrent reviews and other strategies needed to reduce the schedule from 39 months to 24 months are successful.	Because waste determinations under Section 3116 and permitting of tank closures are new activities with new issues, waste determinations and permitting may take longer than anticipated or require actions that are not anticipated. The 24-month schedule is aggressive and requires concurrent activities not under the control of any one agency. It will require improved coordination between WSRC, DOE, and NRC.
Heel removal can be accomplished in the times allotted with planned techniques.	Unexpectedly "stubborn" waste mounds or other problem could delay heel removal or require development of new technologies, tools, and methods.
Heel removal can be accomplished using 500 kgal of inhibited water and less than 200 kgal of oxalic acid. If other cleaning reagents are required, they can be developed and deployed in time to meet the schedule and will not result in larger waste volumes.	With the new pumps planned for heel removal, larger volumes of inhibited water or oxalic acid may be required, or new equipment (e.g., better spray techniques) may be required. Also, the pump configuration may not be adequate in all tanks to support removal of the heel to a low enough level to allow use of oxalic acid.
DSA issues with the oxalic acid flowsheet can be resolved: 1) criticality, 2) a possible floating layer of sodium oxalate solids after neutralization of the spent oxalic acid, 3) waste tank corrosion during chemical cleaning, and 4) free hydrogen production due to corrosion.	Resolution of these issues may impact the flowsheet or facility requirements for heel removal.
Assumed level of heel removal is sufficient to meet the Section 3116 waste determination criteria.	If the criteria cannot be met, additional heel removal may be required, which could delay the program and increase the amount of waste that must be handled in the LW system.

Assumptions	Risks
With the exception of Tank 16 and 14, annulus cleaning can be accomplished with volumes of liquid much smaller than required for bulk waste removal and heel removal. The assumption is that most of the material in the annulus is salt that will readily dissolve. Tank 14 has a large quantity of salt in the annulus. Tank 16 has especially stubborn deposits and will require the largest amount of liquid of any annulus cleaning.	Some tanks (especially Tank 16, which is known to have insoluble solids in the annuli) may require significant amounts of cleaning solution, which may increase the amount of waste that must be handled in the LW system. Also, it is possible that the Tank 16 annulus cannot be cleaned sufficiently in time to the meet the FFA commitment date.
Methods can be developed and deployed to characterize the residual in the primary of tanks. Projections are that in some tanks, it may be necessary to prove that the residual contamination is less than the amount of radioactive materials in100 gallons of the sludge in that tank (The volume and composition of the residual will be different from the original sludge). Also, cooling coils hamper the use of visual techniques, which were used in past closures.	Convincing reviewers that all contamination in the tank has been accounted for, especially in regions not visible because of cooling coils, may take longer than anticipated or require techniques not currently anticipated.
Methods can be developed and deployed to characterize the amount of residual in the annuli of tanks to support closure documentation.	Convincing reviewers that all contamination in the annulus has been accounted for may take longer than anticipated or require techniques not currently anticipated.
SCDHEC will agree to changing tank numbers identified in the FFA as long as the number of tanks closed per year is the same.	SCDHEC may resist any changes to the FFA.
Fill materials and techniques for closing the cooling coils and annuli in Type I and II tanks that meet all the requirements are developed in time.	Materials and techniques are not developed in time.
Current methods and assumptions for modeling performance of closed waste tanks (e.g., oxidation of grout, release rate of Tc-99, performance assessment modeling methods) will continue to be sufficient.	Reviewers such as the NRC may require new performance modeling techniques not currently anticipated or require improved data not currently available.

Assumptions		Risks
Leaks that develop during waste removal can be adequately managed with planned techniques, and no significant degradation of tanks occurs during the tank closure period.		Leaks may be larger than anticipated, requiring repairs or other adjustments not currently anticipated, or unexpected degradation of a tank may occur.

Key Decisions:

DPP-18: Identify what is needed to develop and implement annulus removal technology, especially for Tank 16.

DPP-19: Identify what is needed to characterize the remaining waste in tanks and annuli, especially in regions not accessible to current inspection techniques.

DPP-20: Decide what new heel removal techniques should be developed to reduce the risk that "stubborn" deposits delay a tank closure.

DPP-21: Evaluate if current planning, which counts on 24 months from the end of heel removal to tank closure, is adequate or if changes in the Section 3116 Waste Determination process or other efficiencies should be pursued to reduce the risk of a delay.

DPP-22: Identify what techniques are needed to close cooling coils in the tanks that have coils.

8 Significant Differences Between the DPP and IPP

The plan presented in the DPP has a number of significant differences from the plan in the IPP. This is because of significant changes in bases and assumptions. Table 18 summarizes some of the major differences.

Table 18: Major Changes in Bases and Assumptions

Item	FY06–FY12 LW Disposition Processing Plan (This document)	Interim Processing Plan (June 2005)	Impact of changing to the new plan
SWPF Startup Date	Current project schedule is September 2011. If the startup is delayed, DPP assumes the facility is running at full capacity within 6 months.	SWPF startup in August 2009	Delays when new salt space becomes available. If Tank 50 and Tank 48 are not available as assumed in the DPP, the delay in SWPF startup would impact tank closure dates, slow down DWPF sludge batch preparation, and impact H-Canyon operations.
DDA initiates processing	July 2006 – schedule was delayed because of delay in DOE issuance of the Section 3116 Waste Determination for salt processing.	January 2006	DDA is limited to Tank 41 salt only. Tank 25 salt goes to ARP/MCU rather than DDA, reducing the curies to SDF. Reduces tank space to feed SWPF at full capacity (Note: this is offset by making Tanks 48 and 50 available).
Tank Closure Waste Determi-nations	Assumes time from end of tank cleaning to end of grouting can be accomplished in 24 months, even with the added requirement of a 9-month review by NRC.	Assumed time from end of tank cleaning to end of grouting was 18 months.	Requires that waste removal from tanks to be closed is advanced to meet the FFA commitment dates. Holding the time to 24 months will require concurrent actions and coordination between WSRC, DOE, and NRC.

Item	FY06–FY12 LW Disposition Processing Plan (This document)	Interim Processing Plan (June 2005)	Impact of changing to the new plan
Tank 50	Supports staging and eventual processing of waste to support closing Tanks 11 and 14 in FY14 and Tank 15 in FY15. Also, after startup of SWPF, Tank 50 is used as a salt solution preparation tank for SWPF. (Assumes new DSS lag storage will be constructed).	Always used as DSS lag storage. Not available to support tank closures or to use as a salt solution preparation tank for SWPF	Allows SWPF to run at full rate while ensuring uninterrupted DWPF operation and enabling tank closures to occur on schedule even with the delay in SWPF startup.
Tank 48	The tetraphenylborate in this waste is decomposed, or the waste is aggregated to SDF in time so the tank can be used by January 2010 to support staging and eventual processing of wastes generated by DWPF sludge batch preparation, H Canyon, and closing Tanks 11 and 14 in FY14 and Tank 15 in FY15.	Not available for other uses. Processing rate of SWPF is impacted in early years, although SWPF starts up early enough that Tank 48 not being available doesn't impact DWPF operation, H Canyon, or closing Tanks 11 and 14 in FY14 or Tank 15 in FY15.	Allows DWPF and H Canyon to run uninterrupted and tank closures to meet the FFA commitments even with the delay in SWPF startup. Allows SWPF to run at nominal rates.
ARP/MCU Initiates Processing	August 2007	February 2008	Accelerates gaining Caustic Side Solvent Extraction (CSSX) operating experience. Reduces the quantity of radionuclides going to SDF because DDA campaign is shortened.

Item	FY06–FY12 LW Disposition Processing Plan (This document)	Interim Processing Plan (June 2005)	Impact of changing to the new plan
H-Canyon Operation	H-Canyon operation through at least 2013	H-Canyon operation through 2011	Reduces flexibility in plan and adds salt to the 2F and 3H Evaporator Systems. However, because of other changes (mainly availability of Tanks 48 and 50), this extra waste can be accommodated with no impact to critical commitments.
DWPF Canister Rate	Processing rate of 262 cans/yr initially, reduced to 186 cans/yr for high-aluminum batches (Sludge Batches 4 through 6) and 250 cans/yr thereafter. (A 4-month melter replacement outage occurs every 4 years, which results in the same net rate of 230 cans/yr)	Processing rate of 250 cans/yr through FY08 and 230 cans/yr thereafter (reduced rate accounts for melter replacement outages, which were not explicitly simulated for the IPP).	Timing of sludge batches is extended accordingly. Delays need for sludge batch preparation and associated large volumes of spent wash water.
Sludge Mass	Tank 11 has higher mass of sludge and higher concentration of aluminum because recent sample results have been incorporated into planning. Mass of sludge in Tank 4 is larger based on recent sludge sounding.	Used Waste Characterization System (WCS) predictions for mass of sludge and concentrations of components in Tanks 4 and 11.	Timing of sludge batches is extended accordingly. Delays need for sludge batch preparation and associated large volumes of spent wash water.

Item	FY06–FY12 LW Disposition Processing Plan (This document)	Interim Processing Plan (June 2005)	Impact of changing to the new plan
SWPF Salt Solution Initial Processing Rate	Tanks 48 and 50 are available for salt solution feed preparation before SWPF startup.	Tanks 48 and 50 were not available for salt solution feed preparation before SWPF startup.	Availability of Tanks 48 and 50 allows system to meet full SWPF processing rate after initial year of operation, whereas IPP required four years to reach full rate.
SWPF Salt Solution Maximum Processing Rate	COREsim® modeling focused specifically on SWPF/DWPF interfaces concluded that 6.4 Mgal/yr processing rate is the maximum possible rate. When DWPF melter replacement outages are accounted for, the average rate over a 4-year period is 5.9 Mgal/yr.	Initial COREsim® modeling concluded that 5.7 Mgal/yr was the maximum possible rate when DWPF coupled to SWPF.	More focused COREsim® modeling has shown that increased rate is possible.

9 Changes in Project Scope to Support the DPP

Section 8 has described the major changes in processing dates and durations that are required as a result of the new assumptions and bases in the DPP. The purpose of this section is to highlight the major changes in project scope that must occur to support these processing changes.

New Scope – Major scope items that are new in the DPP (not identified in the IPP) are as follows:

- Modifications required to allow Tank 25 to serve as the 2F Evaporator concentrate receipt tank to support DWPF operation, tank closures, and H-canyon operations
- New DSS lag storage is required between salt processing and SPF. The lag storage must be built in time so that Tank 50 can be used to support waste processing required to close Tanks 11, 14, and 15, and to ensure uninterrupted operation of DWPF.
- Tank 42 must be used as a sludge storage tank, which will require modifications such as replacing or refurbishing the slurry pumps. This also supports closure of Tanks 11, 14, and 15.

Accelerated Scope – Major items identified in IPP, for which the required dates are earlier in the DPP are as follows:

- A process using a new treatment technology must be constructed and operated to decompose the tetraphenylborate in Tank 48 waste and the tank made available for other uses by January 2010 so that Tank 48 can be used in supporting DWPF sludge batch preparation and tank closures.
- Technology must be developed and deployed to remove the waste from the annulus of Tanks 14 and 16. This scope was outside the planning window of the IPP but is within the DPP Planning Window. Waste removal from the annulus of Tank 16 is an especially challenging activity because the annulus contains insoluble minerals formed from a combination of salt waste mixed with sandblasting material used to clean leak sites on the tank.
- Additional heel removal equipment is needed on Tanks 4, 5, and 6. Experience with Tank 5 indicates that the currently planned equipment is not adequate in Tank 5 to clean the tank and may not be adequate in Tanks 4 and 6, which have similar cooling coil arrangements.
- The 2F evaporator pot will be replaced during the time when Tank 25 is being modified to serve as the 2F Evaporator System concentrate receipt tank.
- Waste removal from the annuli of Tanks 5, 6, 11, 12, 14, and 15 to support tank closure commitments
- Heel Removal and/or chemical cleaning of Tanks 4, 5, 6, 8, 11, 12, 14, 15, and 23 to support tank closure commitments

Existing Projects that are Still Required – Quite a few projects that were required by the IPP are still required. Some of the major projects include, for example:

- HDB-2 Area upgrades to support bulk waste removal (BWR) and heel removal from Tanks 13, 14, and 15 and to provide a more dedicated route to move large volumes of stored DWPF Recycle from Tanks 21 and 22 on the West Hill of H Tank Farm to salt solution preparation tanks on the East Hill.
- Modifications and upgrades to transfer systems, pumps, and other infrastructure to allow selected H-area East Hill tanks to serve as blend tanks and hub tanks for feeding SWPF. These include:
    - Modifications to allow Tank 49 to receive waste at the same time it is serving as the SWPF feed tank (referred to as "feed and bleed")
    - Modifications to Tanks 41, 42, 48, and 50 to establish dedicated transfer routes to Tank 49 (or routes with minimal conflict with other processes), and to provide mixing capability for these tanks
    - Higher capacity pumps to expedite the large volumes of supernate to be transferred
    - Upgrades to instruments to reduce downtime, e.g., more installed spares to avoid downtimes during maintenance
    - Variable speed drives dedicated to specific pumps to avoid the need for multiple-pump drives
- Construction of SDF vaults
- Modifications to training simulators needed because of the new salt processes

Projects Not Driven by DPP – Some projects are still required, but the need dates are not directly driven by the DPP schedules. These are not described in the DPP. Some examples are:

- Control room consolidation
- Upgrades to inhibited water systems
- Upgrades to training simulators that do not directly support a new project

Consult the Liquid Waste Operation (LWO) project database for more information. This database is currently maintained by the Planning, Integration, and Technology (PIT) Department in LWO.

10 Process Simulation Tools

The DPP assumes that the tools used for LW process simulations yield reasonable estimates of parameters of interest. This document is intended for long-term planning and does not contain sufficient detail to guide operation of individual process steps. The DPP process simulation uses simplifying assumptions for each process so that the processes for the entire LW System can be simulated at a reasonable level of complexity. Any dates, volumes, and chemical or radiological composition information contained in this document are planning approximations only. To guide actual execution of individual processing steps in the future, flowsheets will be developed that contain rates, compositions, and schedules, sometimes including possible ranges of each of these parameters.

The DPP process simulation was performed using a suite of software that includes:

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

11 Opportunities

There are a number of opportunities for potentially improving the schedule or recovering from emergent schedule problems. These potential opportunities are described in this section.

11.1 Increase DWPF Rate

The discovery of higher-than-expected amounts of aluminum in several batches has caused the planned canister production rate to be reduced for Sludge Batches 4, 5, and 6. Research to increase the canister production rate with high aluminum wastes could potentially reduce the life-cycle cost of the DWPF, especially if combined with reduction of the aluminum by aluminum dissolution (see below).

11.2 Aluminum Dissolution

For all of the sludge batches that have been prepared for DWPF, sample results of the slurried batches have shown more sludge than predicted by WCS. There is the possibility that future batches have been similarly under predicted, and the total number of canisters produced by DWPF will be larger than currently forecasted. This would have small impact on the DPP, because the DPP Planning Window covers only a few batches, and most of the sludge processed during this window is from batches for which the higher-than-expected sludge masses have already been included in the sludge batch plan. However, there is the possibility that waste removal in a tank could be delayed if the mass of sludge in that tank (or an earlier tank) is significantly higher than current projections, especially for tanks planned to be closed beyond the DPP Planning Window. Higher sludge masses would have significant impact on the system in the years beyond the DPP Planning Window.

One potential way to reduce the number of canisters is to perform aluminum dissolution on high-aluminum batches. The dissolved aluminum would be included in a salt batch and (later) processed at SWPF. Aluminum dissolution could potentially decrease the total number of canisters by increasing waste loading and could also increase the melt rate for high-aluminum batches.

Aluminum dissolution had been previously planned as an in-tank operation. Studies indicated that this process removed mainly the easy-to-dissolve aluminum compound gibbsite in sludge. However, much of the aluminum is in the form of a harder-to-dissolve compound, boehmite. Boehmite will dissolve, but it requires higher sodium hydroxide concentrations and either higher temperatures or more time. An aluminum dissolution process that would remove boehmite would either require extensive modifications to an existing tank or require construction of a new facility, i.e. something much more extensive than aluminum dissolution as previously envisioned.

Another challenge of aluminum dissolution is that it requires large volumes of sodium hydroxide and generates salt and salt solutions that must be stored until startup of SWPF. Given the current tight space situation in the Tank Farm, it may not be possible to perform aluminum dissolution until after startup of SWPF. A technical evaluation is being initiated to determine if aluminum dissolution would be beneficial to the overall LW disposition program.

11.3 Increase Maximum Annual SWPF Processing Rate

The capacity to prepare salt solution for feed to SWPF will be greatly increased by freeing up Tank 50 and Tank 48 for feed preparation. However, this shifts the bottleneck to the process interface between SWPF and DWPF. Additional COREsim® modeling runs indicate that the processing rate at SWPF will be limited to an estimated 6.4 Mgal/yr when DWPF is running at 250 cans/yr because of the lack of lag storage between SWPF and DWPF for Strip Effluent and MST slurry and because of cycle time issues in the SRAT[10]. With the current configuration, SWPF will have an outage whenever DWPF has more than a short outage (approximately a day). This coupling of the two facilities will limit the SWPF processing rate.

This close coupling could be avoided by modifications that would reduce the close-coupling of the two facilities. Process modeling is currently ongoing to determine what changes would be most beneficial.

11.4 Reduce Batch Qualification and Sample Wait Times

Currently, the timing of feed batches to ARP/MCU and SWPF are limited by times required for sampling and analysis to verify that salt solution meets WAC limits, MCU Hazard Category limits, and criticality requirements. The current assumption is that 60 days will be required to take a sample, analyze it for required constituents, and prepare required documentation.

The wait time could be reduced by reducing the number of analyses that are required for each WAC sample. Currently, a large number of constituents are required. If the list could be reduced to those constituents that actually have a high likelihood of exceeding the limit, the amount of work (and hence, time) required to process the sample would be reduced.

11.5 Recovery of HEU and other Special Materials in H Canyon

Highly Enriched Uranium (HEU) fuel that has not been irradiated is currently being processed through H Canyon to recover the HEU. Since the fuel has not been irradiated, it is not spent nuclear fuel. Thus, the waste from this campaign is low-level waste, and most of the waste is being disposed of at SDF. Disposing of the waste at SDF greatly reduces the impact this waste has on LW tank space and also reduces the number of DWPF canisters generated from this waste.

To dispose of the waste at SDF required running H Canyon long enough on unirradiated fuel so that residues from previous campaigns with spent nuclear fuel were flushed from the process. The current unirradiated fuel campaign ends this year.

An opportunity exists to recover HEU and other Special Materials from materials that are low in radionuclides and which, when processed, will produce low-level waste (i.e. the materials are not spent nuclear fuel or highly radioactive and so do not produce high-level waste). By taking advantage of the current "clean" condition of the canyon, the waste is not contaminated with residues from spent nuclear fuel, and so most of the waste can be sent to SDF. Thus, Tank Farm space is not a significant factor to consider in planning campaigns. Also, sending the wastes to SDF will mean that these wastes will not result in an increase in DWPF canisters. Thus, the cost of disposing of these wastes is much lower than would have been the case if they were processed at the same time as spent nuclear fuel, which would have required the wastes to be processed as high-level waste.

Commitments have not been made for these campaigns, but processing of a number of such materials is being discussed, and other materials may be identified in the future. For example, these include pieces from the Super Kukla test facility at the Nevada Test Site; HEU from Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratory; and pieces from test facilities at the University of Virginia, University of Michigan, and Pacific Northwest National Laboratory. These are examples of materials that will eventually need to be processed that are not spent nuclear fuel or highly radioactive.

11.6 Reduce the Cost of Processing Wastes from Nuclear Materials

Reducing the number of DWPF canisters produced from the waste from nuclear materials processing would significantly decrease the cost of disposing of these wastes. This would be an economic benefit for nuclear-materials processing campaigns that are already planned, and would improve the economics of processing nuclear materials for which a disposition path has not been selected. For most nuclear materials, the actual quantity of waste generated from processing is relatively small compared to other quantities in the SRS LW System, and the waste could be accommodated with small changes to the DPP if no neutron poisons were required. However, the required neutron poisons result in large increases in the number of DWPF canisters generated from these wastes.

The number of DWPF canisters generated from nuclear materials waste could be significantly reduced by using neutron poisons that are effective at lower concentrations or by some other criticality control strategy. For example, gadolinium is a neutron poison that is effective at concentrations that are a couple of orders of magnitude lower than the currently approved poisons. Gadolinium is approved as a neutron poison in the Tank Farm but is not credited in the DWPF DSA because of the concern that it could separate from fissile materials. Work is currently ongoing to determine if gadolinium could be credited as a neutron poison in the DWPF. If this could be accomplished, fewer DWPF canisters would be generated as a result of waste from processing nuclear materials containing plutonium or enriched uranium. It is also possible that other techniques could be identified to reduce the amount of neutron poison or reduce the number of DWPF canisters that the poisons produce.

11.7 Improve Waste Removal and Tank Cleaning Techniques

Improvement of waste removal and tank cleaning techniques could improve the schedules in the DPP or perhaps decrease the cost. Waste removal as currently planned is expensive, takes years, and requires large quantities of water and oxalic acid that must be processed elsewhere in the LW System. In fact, waste removal is one of the drivers for the need to make Tanks 48 and 50 available for other uses and for operation of the 2F and 3H Evaporator Systems. Also, existing techniques might not be adequate to clean some tanks well enough to be closed.

Improvements that would be beneficial to the DPP are techniques that would:

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

12 Sensitivity Cases

To explore the possibility of not using DDA and to explore other options for dispositioning Tank 48 wastes, five sensitivity cases were studied. The assumptions used for each of the cases are described in section 13.10, “Assumptions and Bases for Sensitivity Cases.” The sensitivity cases showed that reducing or eliminating DDA has system-wide impacts in processing compared to the Base Case due to lack of waste tank storage space. They also show that a delay of the availability of Tank 48 delays tank closures in FY14 and beyond.

The Base Case that is used for comparison is the plan described in the DPP. In the Base Case, tetraphenylborate in Tank 48 waste is decomposed using a new treatment technology, and sufficient DDA processing occurs to meet processing objectives. The Base Case meets all the DPP objectives.

The sensitivity cases and a summary of their impacts are as follows:

12.1 Sensitivity Case 1 – No DDA

In Sensitivity Case 1, the DDA process is not used, and schedules for other activities are adjusted to accommodate the resulting lack of space.

Not using the DDA process impacts most DPP goals. First of all, Tank 41 has much less space available at the end of 2006 than in the Base Case. Therefore, to remove the necessary amount of salt from Tank 25 so that it can serve as the 2F Evaporator System concentrate receipt tank requires waiting for the startup of ARP/MCU. The restart of the 2F Evaporator (with Tank 25 as the concentrate receipt tank) is delayed from August 2007 to December 2008 (ARP/MCU first processes the waste in Tank 49, and then Tank 49 is used to receive the dissolved salt solution from Tank 25). This delays the closure of F-Area Tanks 4, 5, and 6 by approximately 18 months because waste removal and heel removal from these tanks requires operation of the 2F Evaporator System. Closure of later tanks is similarly delayed.

Second, Sensitivity Case 1 has significant impacts on DWPF operation. Sludge Batches 5, 6, and 7 are late (i.e., preparation of the batch is not completed before the previous batch has been used up). This causes three separate feed breaks in DWPF operation in Feb 2009, June 2011, and November 2013. Each feed break lasts 2 to 5 months. Also, the process simulation shows there is not enough space to deliquor the 2H Evaporator System, so this system becomes unable to receive DWPF Recycle, forcing a shutdown of DWPF in March 2009 for about 6–12 months. (The DWPF melter can continue to operate during a feed break outage, although no canisters can be poured, but a complete DWPF shutdown, which requires the melter to be permanently shut down, is required when there is insufficient tank space to receive DWPF Recycle.) The duration and timing of the shutdown is highly dependent on other variables. In the current process simulation, this recycle shutdown overlaps the feed break waiting for Sludge Batch 5, although uncertainties in other variables may cause them to happen at different times, or may cause the shutdown to be shorter or longer than simulated.

Third, Sensitivity Case 1 impacts H-Canyon operations. The process simulation shows that Tank 39, the H-Canyon receipt tank, is filled in late 2008 or early 2009, and H Canyon must be shut down. H Canyon must remain shut down until ARP/MCU processes enough salt solution so that enough receipt space exists to receive H-Canyon waste without jeopardizing Tank Farm operations (approximately 15 months).

Fourth, the use of old-style tanks is extended because waste removal has been delayed from many tanks.

Finally, not doing DDA reduces the amount of space available for SWPF feed preparation at the time of SWPF startup, increasing the risk that SWPF must be fed at a reduced rate in the early years. It also forces the operation of DWPF and H Canyon to rely on successful startup and coupled operation of ARP, a first-of-a-kind new process, and MCU, also a first-of-a-kind new process. If problems develop during construction or startup of either process, DWPF and H Canyon may be impacted.

12.2 Sensitivity Case 2 – Limited DDA to Support DWPF Operations

In Sensitivity Case 2, use of the DDA process is limited to the amount needed to keep DWPF operating at nominal rates. This case places the highest priority on DWPF operations at the expense of tank closures and H-Canyon operation. For the process simulation, it was assumed that use of DDA is limited to 380 kgal of supernate in Tank 49, which is only Batch 1 of the Base Case.

In Sensitivity Case 2, the amount of salt space is very limited and most salt space must be dedicated to supporting DWPF operation. Also, the scheduling of evaporator campaigns is adjusted to ensure that enough space is available to evaporate decants from DWPF sludge batch washing. This allows DWPF to operate uninterrupted but requires delaying evaporator campaigns that are required to support tank closure and to support operation of H Canyon. Most tank closures are delayed by around 40 months. H Canyon is shut down for two to three years.

Also, the decision to limit DDA is not reversible. To sustain DWPF operations, Tank 41 must be used for storing higher-curie solutions than the interstitial liquid it currently contains. If the decision is made to forgo using DDA on the salt in Tank 41, it will not be possible to do DDA later. This is because the low-curie interstitial liquid currently in the tank, which makes DDA possible, will be mixed with higher-curie liquid. Therefore, for example, if unforeseen problems occur during startup of SWPF, tank closures will be further delayed (longer than 40 months), and it will not be possible to mitigate this delay by performing DDA later.

12.3 Sensitivity Case 3 – Case 2 with Tank 48 Waste Sent to Tank 24

The process simulation for this case also limits DDA processing to that necessary to sustain DWPF operations. This case is similar to Sensitivity Case 2 with the exception that Tank 48 waste is sent to a Type IV tank (probably Tank 24) and "parked" until it can be processed. Similar to Sensitivity Case 2, only 380 kgal of supernate in Tank 49 is processed through DDA.

This case has most of the same attributes as Sensitivity Case 2, with the exception that tank closures are delayed 8 months longer than Sensitivity Case 2 (i.e., 48 months later than the Base Case). This is because Tank 24 must be dedicated to holding Tank 48 waste and is no longer available to use as storage space for DWPF Recycle or to support tank closures. This requires other adjustments to the plan that further delay tank closures.

While it is true that the space in Tank 48 becomes available after the transfer to Tank 24, this space does not benefit the tank closure schedule until a number of years after SWPF startup. The use of Tank 48 is restricted to SWPF feed because of the residual tetraphenylborate. Before the space in Tank 48 impacts the tank closure schedule, the SWPF must operate long enough to clear out enough space so that waste removal can proceed.

12.4 Sensitivity Case 4 – Tank 48 availability delayed by one year

In this case, the availability of Tank 48 is delayed by one year, from January 2010 to January 2011. In the Base Case, Tank 48 availability supports the removal of Tank 37 salt, allowing 3H Evaporation to support wastes generated from DWPF feed batch preparation, H Canyon, and tank closures. Tank 50 supports sludge removal to allow the tanks to be closed.

To minimize impacts to the DPP goals, the new missions of Tanks 48 and 50 are swapped. Tank 50 is used to support the removal of Tank 37 salt, allowing the 3H Evaporator System to support wastes generated from DWPF feed batch preparation, H Canyon, and tank closures. After Tank 48 is made available in January 2011, sludge removal can begin from Tanks 13 and 14, but the delay causes the FFA commitment dates for two tanks in FY14 to be missed by 8 months. The FFA commitment date for one of the tanks to be closed in FY15 is missed by 11 months because all three of the tanks (two tanks for FY14 and one tank for FY15) need to use storage space in Tank 13.

12.5 Sensitivity Case 5 – Tank 48 availability delayed by two years

This case is similar to Case 4, except that Tank 48 availability is delayed by two years instead of one year. The fact that Tank 48 availability is being delayed by an extra year further delays sludge removal from Tanks 13 and 14. This delays the tank closure dates by an additional 12 months. The two FY14 closures are now 20 months late, and one FY15 closure is 23 months late.

13 Description of Assumptions and Bases

Details on the key assumptions and bases for the DPP are outlined below. For more detail, see the input documents that have been prepared for each of the major process areas: the sludge processing inputs[4], the salt processing inputs[5], and the tank closure inputs[6].

13.1 Permitting

On January 17, 2006 the Secretary of DOE signed the Section 3116 Waste Determination for salt waste disposal. A number of permits could not be issued until the Waste Determination was issued. The DPP assumes that these permits will be obtained on schedule to support the 7/1/06 initiation of DDA processing. The major operating permits and other SCDHEC actions that are currently scheduled are as follows:

Batch 0 The waste currently in Tank 50 and wastes being received into Tank 50 – Disposal of these wastes at SDF will require:

- Wastewater permit for recent modifications to SPF
- Approval of reduced sampling of grout
- Minor modification to air quality permit

Future Batches From DDA (Including Tank 48 aggregation), ARP/MCU, and SWPF:

- Wastewater permit for 0.2 Ci/gal waste
- Permit for Tank 48 aggregation (If the Tank 48 Alternative Option is chosen)
- Industrial Solid Waste Landfill permit for SDF Vaults 2 and 4 with 0.2 Ci/gal waste
- Phase 2 MCU permit
- Minor modification to air quality permit

Permits for Vaults 3, 5, 6, and future vaults will be needed but are not currently scheduled.

13.2 Tank Farm

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

DWPF Recycle has a high concentration of silica due to the vitrification process. When this stream is mixed with high aluminum streams from Purex and H Modified (HM) processing in the canyon, there is a potential for forming sodium aluminosilicate. Experience has shown that sodium aluminosilicate can co-precipitate sodium diuranate in the evaporator, causing a potential criticality concern.

In order to prevent the potential for criticality, a feed qualification program is in place to prevent the formation of a sodium aluminosilicate scale in the 2F and 3H evaporators, and to prevent accumulation of enriched uranium in the 2H evaporator. It is assumed that scale may accumulate in the 2H evaporator, but uranium enrichments and masses will be well below criticality concerns

a. The 2H Evaporator System is used to evaporate DWPF Recycle. The 2F and 3H Evaporators are used to process other streams that will not produce scale, which include canyon wastes and sludge batch decants. In the DPP process simulation, unless otherwise noted, the evaporator system feed and concentrate receipt tanks are defined as:
   - 3H; Feed – Tank 32; Receipt – Tank 37
   - 2H; Feed – Tank 43; Receipt – Tank 38
   - 2F; Feed – Tank 26; Receipt – Tank 27 initially, changing to Tank 25 in August 2007 and beyond
b. Feed Rates – The following evaporator feed rates were assumed based on operation of the evaporators during the indicated time periods. During each of these time periods the indicated evaporator ran continuously and steadily at conditions that were judged to be favorable for good operation. Thus, the weekly rates shown are the theoretical rates at which the evaporators could operate with continuous good operation.

EVAPORATOR FEED RATE

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

c. Evaporator utilities are as follows (note that the DPP process simulation starts in January 2006):

Evaporator	Through January 2006	February 2006 and beyond
2F	60%	50%
2H	60%	50%
3H	50%	30%*

*50% utility is assumed when operating. Due to periodic salt dissolutions and feed availability, average percentage of operating time is lower

For reference, past utilities are provided below:

Evaporator	FY01	FY02	FY03	FY04	FY05	Average
2F	50%	65%	51%	46%	51%	53%
2H	0% *	59%	67%	58%	54%	60%
3H	30%	30%	43%	27%	12%	28%

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

d. Tank Inventories and Chemistry – Starting inventories and chemistry for all tanks are taken from the WCS as of 12/20/05. This was used as the starting point for all tank chemistry with the following exceptions:
   - Tank 5 – Sludge level was changed to coincide with information reported in Tank 5 sludge mapping (M-ESR-F-00109 Rev. 0[14]).
   - Tank 15 – Sludge and salt levels were changed to coincide with CBU-PIT-2005-00285[15]. Assumed no supernate in Tank 15 to coincide with CBU-PIT-2005-00108[16].
   - Tank 21 – Sodium concentration was adjusted such that it was consistent with the WCS tank chemistry.
   - Tank 34 – Sludge level was adjusted to reflect a sludge sounding completed 9/26/05 (sludge level of 58.1"; SW11.1-WTE, Section 7.2 Rev 14, IPC-2.
   - Tank 39 – Sludge level was changed to coincide with CBU-PIT-2005-00285.
   - Tank 41 – It was assumed that there was no free supernate in Tank 41 and the reel tape reading was actually the salt level (CBU-SPT-2005-00209).

e. Tank Leak Sites – Per C-ESR-G-00003 Rev 0 with the following exception:
   - Tank 5 lowest known leak site is 24" (per 10/20/05 morning report narrative for FDP – "*Identified new potential leak site in T5 under the west riser around the 24" level.*")

f. General supernate simulation assumptions:
   - Sodium concentration is adjusted to preserve charge balance.
   - Solution density is determined by concentration, using empirical relationships. Volume of blends is determined by using the density relationships and solving for volume. Therefore (correctly so), volumes are not additive.

- Supernate is divided and tracked into two separate parts: free liquid and interstitial liquid. Interstitial liquid is further sub classified into liquid that is interstitial in salt, drained salt, and sludge. The different fractions are tracked discretely until a process requires them to intermix such as during salt dissolution or sludge slurrying.
- Supernate (or dissolved salt solution) is evaporated by removing water. Mass is conserved in the calculations. If the evaporated liquor exceeds saturation for a given component, it is precipitated and treated as saltcake in the evaporator bottoms receipt tank.
- Suspended solids settle at a rate consistent with the settling model in D. T. Hobbs, "Particle Size and Settling Velocity of Tank 41H Insoluble Solids," WSRC-TR-95-0249, May 30, 1995. Settling rates are a function of liquid level and specific gravity.
- Jet dilution for transfers is 4% by volume unless there is a reason to use a higher jet dilution (i.e., Inter-Area Line Transfers).

g. The transfer jets and pump heights are from SW11.1-WTE-7.2 Rev 14 IPC 3 unless there are known plans to make changes that will impact the process simulation.

13.3 Influents

13.3.1 Material Stabilization

H-Canyon – Waste receipts in the Tank Farm are per CBU-HCP-2005-00105 with the following exceptions:

a. Added an additional year of receipts accounting for additional HEU waste (mimicked FY06 receipts for FY07 and pushed out FY07– FY11 to FY08– FY12). Thus, the DPP assumptions account for missions already planned and assume that later receipts will continue at historical rates, although there are not commitments to specific missions that cover the entire time period.
b. Added an additional year of receipts (mimicked original FY11 receipts for FY13 – shutdown flows are from FY14– FY16)
c. Assumed that U Recovery Waste for FY06 and FY07 will be sent to Saltstone. U Recovery waste for FY08 and beyond is sent to Tank 39 and is processed as high-level waste. This assumes that the canyon will continue to process either unirradiated fuel or other materials that produce low-level waste for at least a year beyond the current unirradiated fuel campaign, which ends in FY06. See section 11.5 for a discussion of possibilities being discussed.

Tank Farm Receipts from H Canyon (kgal/yr)

Waste	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	Shutdown Flows FY14–FY16	Total
Pu Discard	0	0	103	88	88	88	88	88	0	**543**
U Recovery Waste	221	221	212	212	212	212	212	212	0	**1,714**
Misc.	61	61	0	0	20	0	40	40	295	**1,107**
Total	**282**	**282**	**315**	**300**	**320**	**300**	**340**	**340**	**885**	**3,364**

13.3.2 DWPF Recycle

SpaceMan Plus™ approximates the flowrate of the DWPF Recycle that is returned to the Tank Farm based on DWPF processing rates and modes. The annual flowrate is estimated using the following algorithm:

a. The basic formula for calculating DWPF Recycle is as documented in CBU-PIT-2006-00020:

$$\text{Recycle (gal/yr)} = (\text{Canisters / year}) \times (5{,}151 \text{ gallons / canister}) + (143{,}000 \text{ gal/yr overhead}) + (\text{SAS volume}) + (\text{ARP/MCE volume}) + (\text{SWPF volume})$$

b. The Steam Atomized Scrubber (SAS) volumes are as follows:

	SAS Operation	Additional Recycle (gal/yr)
Sludge Only Operation	1 SAS stage full time	395,000
When ARP/MCU operating	1 SAS stage full time plus 1 SAS stage half time	593,000
When SWPF operating	2 SAS stages full time	790,000

c. When ARP/MCU or SWPF is operating the volumes of the Strip Effluent stream and the Sludge/MST stream are included in the formula.

d. The Tank Farms will be able to receive DWPF Recycle after the startup of MCU with no issues (i.e., the solvent from MCU will not create issues in receiving DWPF Recycle).

e. The construction and operation of a DWPF Recycle evaporator is not assumed during the DPP Planning Window (i.e., the Tank Farm will receive the full recycle volume)

13.3.3 Effluent Treatment Project

a. ETP will continue to operate.

b. Concentrate will be returned to the Tank Farm at 120,000 gallons per year. Concentrations are assumed to be at the Waste Compliance Plan limits (X-WCP-H-00002, Rev. 3).

c. ETP will continue to perform oxalic acid filter cleanings twice per month, which will result in sodium oxalate, as well as other insoluble solids, being transferred to Tank 50. Operation of the slurry pumps in Tank 50 during transfers to SPF will suspend solids to prevent accumulation in Tank 50.

d. ETP stream will be transferred to Tank 50 until new DSS lag storage is available. At that time, the ETP stream will be sent to the new lag storage.

13.3.4 Heel Removal and Tank Closure

Heel removal and tank closure processing bases and assumptions for the DPP are documented in CBU-PIT-2006-00047.[6] This section lists a few key bases and assumptions from this memo.

a. After BWR, it is assumed that 10–20 kgal of waste (heel) remains. This heel requires two phases of heel removal to be performed to prepare the tank for closure. It is anticipated that BWR equipment (mixers, transfer pumps, etc) may be reused to support heel removal phase 1 and phase 2.
   - i. Phase 1 employs mechanical methods (hydraulic agitation, spraying, lancing, pulse jet mixing, a recycle loop, etc) to augment existing BWR equipment to reduce the heel to a volume less than 5,000 gallons.
   - ii. Phase 2 employs oxalic acid chemical treatment of the heel to dissolve solids that could not be removed by mechanical methods alone. In this phase, hydraulic agitation is used to enhance dissolution.

b. The time from when heel removal is complete until the tank is closed (filled with grout) is 24 months. Thus, the planned end date for heel removal must be at least 24 months earlier than the needed closure date to meet FFA commitments. This assumes that WSRC completes the initial activities in 8 months; DOE and NRC complete their reviews in 7 months; and the grout contract is placed, at risk, 6 months before the anticipated date that SCDHEC will approve closure of the tank.

13.4 Salt Solution Processing

Salt solution processing bases and assumptions for the DPP are documented in CBU-PIT-2006-00056.[5] This section lists the key bases and assumptions from this memo.

It is assumed that saltcake in each tank is homogeneous and dissolves at uniform composition, top to bottom. This is a simplifying assumption made to reduce the complexity of SpaceMan Plus™. Actually, the composition of salt will vary, and the composition of dissolved salt solution will change as salt removal proceeds because of differences in the solubility of various salts. In SpaceMan Plus™, the intent is to simulate the average composition of salt solution from each tank, so that the overall durations and volumes are correct. When planning transfers in an actual salt removal campaign, simulations or models more detailed than SpaceMan Plus™ will be used.

13.4.1 DDA

a. The initial DDA waste, dissolved from Tank 41 and currently staged in Tank 49, will be sent to Tank 50 before the SDF permits applicable to this waste are received. The waste would be sent only after considerable assurances existed that the permit would be granted and other pre-requisites are met. This is required to achieve the planned schedule.

b. It is assumed that criticality concerns will not impact the DDA schedule.

13.4.2 ARP/MCU

The DPP assumes that ARP and MCU are always operated together.

ARP

a. Facility modifications on 241-96H will be complete in time to support the August 2007 startup date for ARP. Once operational, the initial feed tank will be Tank 49.
b. Enrichment controls will add negligible volume. (This is a simplified simulation assumption. The anticipated volume of any enrichment strategy is small enough that there is no benefit to reprogramming SpaceMan Plus™ to include it).
c. ARP/MCU coupled processing can continue until two months before the SWPF begins processing salt solution.
d. Initial Tank 25 salt dissolution and associated transfer to Tank 41 can be accomplished without the benefit of a salt solution staging tank in F-Tank Farm by transferring through the inter-area line. This transfer can be successfully integrated with other required transfers without significant impacts on other processing objectives.

Modular CSSX (MCU)

a. MCU is ready for radioactive operation August 2007. Schedule is not affected by DNFSB recommendation 2004-2. (Delays in the MCU schedule are possible. A delay of a few months will not affect the DPP significantly, but August 2007 is the date that was used in the DPP process simulation.)
b. The DPP summarizes the projected volume and sodium and cesium concentrations of solution produced for treatment in the MCU. This is based on the specified salt tank dissolution sequence. SpaceMan Plus™ calculates the other chemical and radiochemical quantities, using its internal ARP model. ARP provides the clarified feed for the MCU.

13.4.3 SWPF

a. The SWPF will start processing salt solution in September 2011. An examination of the DPP process simulation indicates that any SWPF startup date between March 2011 (−6 months) and March 2012 (+6 months) can be managed with appropriate adjustments to transfer planning.
b. During non-radioactive testing (cold runs) of the SWPF, the amount waste sent to other LW facilities (DSS, strip effluent, and MST slurry) is negligible, i.e. this volume is assumed to be small enough that it does not need to be simulated.
c. Salt feed dissolution is sequenced as the SpaceMan Plus™ process simulation progresses. In the DPP, the SWPF rate was increased by feeding predominantly supernate in the early batches rather than the mixture of supernate and salt that was planned in the IPP. Feed batches that are predominantly supernate have significantly higher Cs-137 concentration of the strip effluent stream than batches that contain salt.

It was assumed that the problems associated with these high Cs-137 concentrations can be resolved. In particular:

- SWPF can handle the Cs-137 concentration of strip effluent, which may be close to the limit of 5.25 Ci/gal.
- The second Glass Waste Storage Building canister heat load limit will be raised to at least 1,000 watts/can, preferably 1,500 watts/can. This will allow more strip effluent from SWPF to be incorporated into each canister of glass. Having the ability to occasionally load higher quantities of Cs-137 into a canister will decrease the problems of coupling between the two facilities.

13.5 SPF and SDF Modifications & Operations

a. Salt solution processed at SPF will not exceed 0.18 Ci/gal Cs-137 (to protect 0.2 Ci/gal WAC limit based on shielding calculations) prior to SWPF operations. After SWPF startup, material processed will be <0.0002 Ci/gal Cs-137.
b. Salt solution will be sent to SPF on the schedule shown in Appendix A.
c. SPF is available to begin processing in time so that some of the existing waste in Tank 50 (which consists primarily of ETP bottoms) can be processed. The purpose of this campaign, referred to as Batch 0, is to run-in the equipment added for the 0.2 Ci/gal modifications. However, processing of salt solution will not begin until the receipt of applicable SPF and SDF permits.
d. The rates for SPF are as shown in the table below.[5]

SPF Processing Rates

Salt Solution Condition	Rate (gal/week of salt solution)
0.2 Ci/gal to Vault 4	83 kgal/week
0.2 Ci/gal to Vault 2 (not required in DPP process simulation)	100 kgal/week
After SWPF Startup (<0.01 Ci/gal)	>125 kgal/week

e. SPF and SDF WAC, DSA, and permits can be revised to accept feed material resulting from salt waste processing.
f. SPF and SDF WAC, DSA, and permits can be revised to accept material from Tank 48.
g. SDF modifications to mitigate flammability issues (e.g., nitrogen inerting or other organic control strategy, blowers, purge, Lower Flammability Limit monitoring, backshift monitoring by DWPF) will be funded and implemented to support processing needs.

13.6 Tank 48

As explained in the Tank 48 section, two options are being considered to dispose of the waste in Tank 48. The Tank 48 Base Case is to decompose the tetraphenylborate in the Tank 48 waste using a new treatment technology.
The Tank 48 Alternative Option is to aggregate the waste through SDF.

Tank 48 Base Case

a. A decomposition process is developed. At this time, the leading candidates are wet-air oxidation and steam reforming.
b. The decomposition process rate is high enough and the facility is built early enough that Tank 48 is clean and available for other uses by January 2010.
c. If the treatment technology selected requires that the effluent be sent to the 2H Evaporator System, the composition of the effluent is acceptable to the 2H Evaporator System, where it mixes with DWPF Recycle, and the concentrate from the system can be sent to an old-style tank. The volume of concentrate produced is small (i.e., if rinsing of Tank 48 generates a large volume of waste that is treated by the new treatment technology, the waste is mostly water and can be boiled down to a small volume of concentrate).
d. If the decomposition process requires that the effluent be sent to a DWPF sludge batch (or transferred to DWPF in some other manner), the amount of effluent is small enough that it does not affect the DPP (i.e. it was not included in the DPP process simulation)

Tank 48 Alternative Option

a. Existing Tank 48 waste can be dispositioned at SDF through aggregation. This can be accommodated in Tank 50 and at SDF.
b. Aggregation volumes will be per CBU-PIT-2004-00012, Rev. 2.[17]
c. Tank 48 waste can be sent to Tank 50 at the same time as waste containing Isopar-L™ (from MCU).

13.7 Tank 50

a. During the DPP Planning Window, sufficient space will be maintained in Tank 50 to accommodate a low-level waste (LLW) stream from H Canyon consisting of waste generated from unirradiated fuel and for continued receipt of ETP concentrate.
b. To ensure SDF WAC requirements are met, the material balance approach for Tank 50 management will be acceptable for canyon LLW. The Tank Farm DSA is modified to allow Tank 50 to receive waste containing Isopar-L™ from MCU and SWPF, and TPB-laden waste from Tank 48. A temperature interlock and any other required physical modifications to Tank 50 are installed in time to support receipt of these wastes.
c. Operable mixing pumps will remain in Tank 50 and will be used during transfers to SPF to suspend and remove the accumulated solids. Assumed that downtimes will be of short enough duration to not affect average rates (e.g., if the pumps are down for two months, SPF can sprint to catch up).

13.8 Transfer Planning

No tank leaks or other adverse events occur that require removal of some or all of the waste from a tank. (Note: there is some contingency in the DPP to accommodate minor adverse events, but a major tank leak would require revising the DPP.)

13.9 DWPF

DWPF sludge preparation and processing bases and assumptions for the DPP are documented in CBU-PIT-2006-00018.[4] This section lists the key bases and assumptions from this memo.

13.9.1 Sludge Batch Preparation

One of the major DPP objectives is to ensure that sludge preparation can continue at a rate to ensure that there is not a DWPF feed break.

A number of changes have occurred in the DWPF sludge batch preparation plan since the IPP was issued. This is largely due to two factors:

- A sludge sounding in Tank 4 showed that the tank contains more sludge than shown in records. A sample of Tank 11 sludge, after slurrying, had a higher sludge concentration and contained more aluminum than predicted.
- The canister production rate has been reduced from 250 cans/yr to 186 cans/yr for batches that are high in aluminum (primarily HM Wastes). With the new batching scheme, Batches 4, 5, and 6 are high in aluminum.

DWPF canister rate is assumed to be as follows:

Sludge Batch	Canisters	Comments
Through end of Sludge Batch 3	262 cans/yr	Assumed higher rate required to meet the maximum of 1,233 canisters produced by the end of the contract period – this rate is conservative for planning purposes
Sludge Batches 4, 5, and 6	186 cans/yr*	Reduction needed due to high aluminum levels in these batches. Rate is based on measured melt rates in small-scale melter tests with simulated waste at SRNL, comparing high-iron wastes to high-aluminum wastes.
Sludge Batches 7 and 8	250 cans/yr*	Nominal rate for high iron batches

*For planning purposes, a DWPF outage of 4 months to replace the melter is assumed for June 2007 and every four years thereafter, which reduces the number of cans for that year Actual outages will occur only when needed.

Table 19: Canister Production and Sludge Batch Need Dates for DPP[4]

SLUDGE BATCH	TANKS	PROJECTED SLUDGE OXIDE LOADING (SOL) %	CANISTER PRODUCTION RATES (CANS/YEAR)	ACTUAL CANS @ PROJECTED SOL	DATE BATCH FINISHED @ PROJECTED SOL[a]	DATE NEXT SLUDGE BATCH PREPARATION STARTS
up to 3/14/2005	-	-	-	1,826	3/14/2005	-
SB3 (Current through Nov 05)	7, 18	39	-	179	11/30/2005	-
SB3 to 1,233 Equivalent Canisters	7, 18	40.3[b]	262[b]	232	10/1/2006	-
SB4	11	34[c]	186[c]	124	6/1/2007	-
DWPF MELTER OUTAGE					10/2/2007	-
SB4	11	34	186	251	2/5/2009	-
SB5	11, 5, 6	34	186	429	5/27/2011	SB5 Preparation Start (10/1/2006)
DWPF MELTER OUTAGE					9/26/2011	-
SB6	4, 12 (70%)[d]	34	186	406	11/30/2013	SB6 Preparation Start (12/7/2007)
SB7	12 (30%), 13 (50%)	38[e]	250[e]	389	6/21/2015	SB7 Preparation Start (10/2010)
DWPF MELTER OUTAGE					10/21/2015	-
SB8	13 (50%), 14, 15 (20%)	38	250	370	4/14/2017	SB8 Preparation Start (11/2013)

[a] Dates are approximate and represent when Tank 40 gets to a 40" heel [except SB3 which is driven by the objective to make 1,233 cans (This could happen between October and December 2006)]. Actual dates depend on canister production rates.
[b] SOL and canister production rates required to meet 1,233 canister production goal.
[c] This plan assumes an SOL of 34 wt% and 186 cans/year production rates for high-aluminum sludge.
[d] Percentages are approximate and used for planning calculations. The percentages indicate the portion of insoluble sludge mass in the waste tank(s) received in Tank 51.
[e] This plan assumes a Sludge Oxide Loading of 38 wt% and 250 cans/year production rates for high-iron sludge.

a. The following bases were used in the determination of batches.
    - Calculation of sludge masses, endpoints for washing of batches; and durations, dates, volumes, and composition of batches are as described in CBU-PIT-2006-00018.[4]
    - Sludge batch heat is not limited by canister heat load limits in the Glass Waste Storage Building (GWSB). The design basis for GWSB #2 is 850 watts/can, although safety analysis and design calculations were performed at 1000 watts/can. The design basis of 850 watts/can could be exceeded for a small number of canisters with the current batching scheme when SWPF is run at high rates (this puts more Cs-137 in each canister). It is assumed that canisters can be produced up to 1,000 watts/can as long as the average for the building is less than the design basis of 850 watts/can.

b. Canister Production Assumptions:
    - All batches are fed until Tank 40 is down to a 40" heel except Sludge Batch 3.
    - Waste Loading is as indicated in the table for each batch. Note: There may be potential to increase this loading for some of the sludge batches following experimental testing and after gaining additional processing experience.

c. Disposition of remaining neptunium from H Canyon does not increase sludge batch decant volumes greater than forecast. Neptunium solution will be processed through first cycle to remove contaminants such as sulfate.

d. If neptunium is transferred to a sludge batch, the resulting batch can be qualified immediately, and there is no feed break to DWPF.

13.9.2 Other DWPF Assumptions

a. Modifications necessary to receive Isopar-L™ into the Strip Effluent Feed Tank and SRAT are completed before startup of MCU.

b. DWPF production rates are as determined by GlassMaker model (G. A. Taylor, "GlassMaker: A System Planning Tool for Sludge to Glass," WSRC-TR-2000-00343, Rev. 0, October 31, 2000).

c. These parameters were provided for simulating DWPF
    - Feed chemical and radiochemical masses and concentrations are calculated by SpaceMan Plus™.
    - Strip Effluent is received in the Strip Effluent Feed Tank from both the SWPF and the MCU. Its working volume is 9,600 gallons. Washed MST/Sludge slurry is received in the Precipitate Reactor Feed Tank. Its working volume is 6,000 gallons.

d. The method of calculating the volume of the DWPF Recycle is described in section 13.3.2

13.10 Assumptions and Bases for Sensitivity Cases

This section describes assumptions and bases that were different for the sensitivity cases. In general, all the assumptions and bases described for the Base Case were held constant except for the assumptions and bases described in this section.

Sensitivity Case 1—No DDA

a. No salt solution is processed using the DDA process. All salt solution is processed either through ARP/MCU or through SWPF using the same assumptions and bases as for the Base Case.

Sensitivity Case 2—Limited DDA to Support DWPF Operations

a. Only 380 kgal in Tank 49 are processed using DDA (Base Case Batch 1).

Sensitivity Case 3—Case 2 with Tank 48 Waste "Parked"

a. Only 380 kgal in Tank 49 are processed using DDA (Base Case Batch 1)
b. Tank 48 waste is transferred to Tank 24 and processed later. The entire volume of Tank 48 is available for use in preparing feed for SWPF.

Sensitivity Case 4—Tank 48 Availability Delayed by a Year

a. The contents of Tank 48 are processed by some treatment technology that allows the tank to be used as an SWPF feed preparation tank.
b. The process is completed in time so that Tank 48 is available to use as an SWPF feed preparation tank by January 2011, which is one year later than in the DPP.

Sensitivity Case 5—Tank 48 Availability Delayed by Two Years

This is the same as Sensitivity Case 4, except the delay in Tank 48 availability is two years. Tank 48 is available to use as an SWPF feed preparation tank by January 2012.

14 System Description

14.1 History

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

Since it became operational in 1951, SRS, a 300-square-mile DOE Complex located in the State of South Carolina, has produced nuclear material for national defense, research, medical, and space programs. The separation of fissionable nuclear material from irradiated targets and fuels resulted in the generation of large quantities of radioactive waste which are currently stored onsite in large underground waste storage tanks. Approximately 36.5 Mgal[18] of radioactive waste are currently stored at SRS. Most of the tank waste inventory is a complex mixture of chemical and radioactive waste generated during the acid-side separation of special nuclear materials and enriched uranium from irradiated targets and spent fuel using the Plutonium–Uranium Extraction (Purex) process in F-Canyon and the modified Purex process in H Canyon (HM process). Waste generated from the recovery of Pu-238 in H Canyon for the production of heat sources for space missions is also included. The waste was converted to an alkaline solution; metal oxides settled as sludge; and supernate evaporated to form saltcake.

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

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

Continued long-term storage of these radioactive wastes poses an environmental risk. Therefore, since 1996, DOE and its contractor, Washington Savannah River Company (WSRC), have been removing waste from tanks, pre-treating it, vitrifying it, and pouring the vitrified waste into canisters for long-term disposal in a Federal repository (see the process flowchart in Figure 2 following this section). As of April 27, 2006, 2,100 canisters of waste have been vitrified and are ready for shipment to a Federal repository when the repository is licensed and operational. All canisters vitrified to date contain sludge-only waste.

14.2 Tank Storage

SRS has a total of 51 underground waste storage tanks, all of which were placed into operation between 1954 and 1986. There are four types of waste tanks – Types I through IV. Type III tanks are the newest tanks and were placed into operation between 1969 and 1986. There are a total of 27 Type III tanks. These tanks meet current EPA requirements for full secondary containment and leak detection. The remaining 24 tanks do not have full secondary containment and do not meet EPA requirements for secondary containment. Type I tanks are the oldest tanks and were constructed between 1952 and 1953. Type II waste tanks were constructed between 1955 and 1956. There are eight Type IV tanks that were constructed between 1958 and 1962. Two of these Type IV tanks, Tanks 17 and 20 in F Tank Farm, have been isolated, operationally closed, and grouted. Twelve tanks without secondary containment have a history of leakage[19]. Sufficient waste has been

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

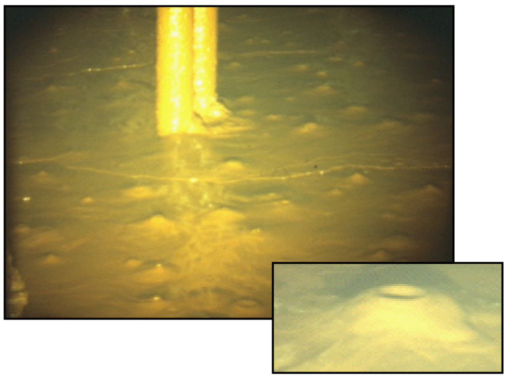
removed from these tanks such that there are currently no active leak sites. The first tank, lacking secondary containment, began receiving waste in 1954. This tank is still in service.

Approximately 36.5 Mgal of radioactive waste, containing 424 million curies (MCi)[18] of radioactivity, are currently stored in 49 active waste storage tanks located in two separate locations, H Tank Farm (29 tanks) and F Tank Farm (20 tanks). This waste is a complex mixture of insoluble metal hydroxide solids, commonly referred to as sludge, and soluble salt supernate. The supernate volume is reduced by evaporation, which also concentrates the soluble salts to their solubility limit. The resultant solution crystallizes as salts. The resulting crystalline solids are commonly referred to as saltcake. The saltcake and supernate combined are referred to as salt waste (combined 33.6 Mgal).

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.

The sludge component of the radioactive waste represents approximately 2.9 Mgal (8% of total) of waste but contains approximately 194 MCi (46% of total). The salt waste makes up the remaining 33.6 Mgal (92% of total) of waste and contains approximately 230 MCi (54% of total). Of that salt waste, the supernate accounts for 17.9 Mgal and 217 MCi of the 230 MCi total salt related curies. The saltcake accounts for the remaining 15.7 Mgal and 13 MCi[18]. The sludge contains the majority of the long-lived (half-life > 30 years) radionuclides (i.e., actinides) and strontium. The sludge is currently being stabilized in DWPF through a vitrification process that immobilizes the waste in a borosilicate glass matrix.

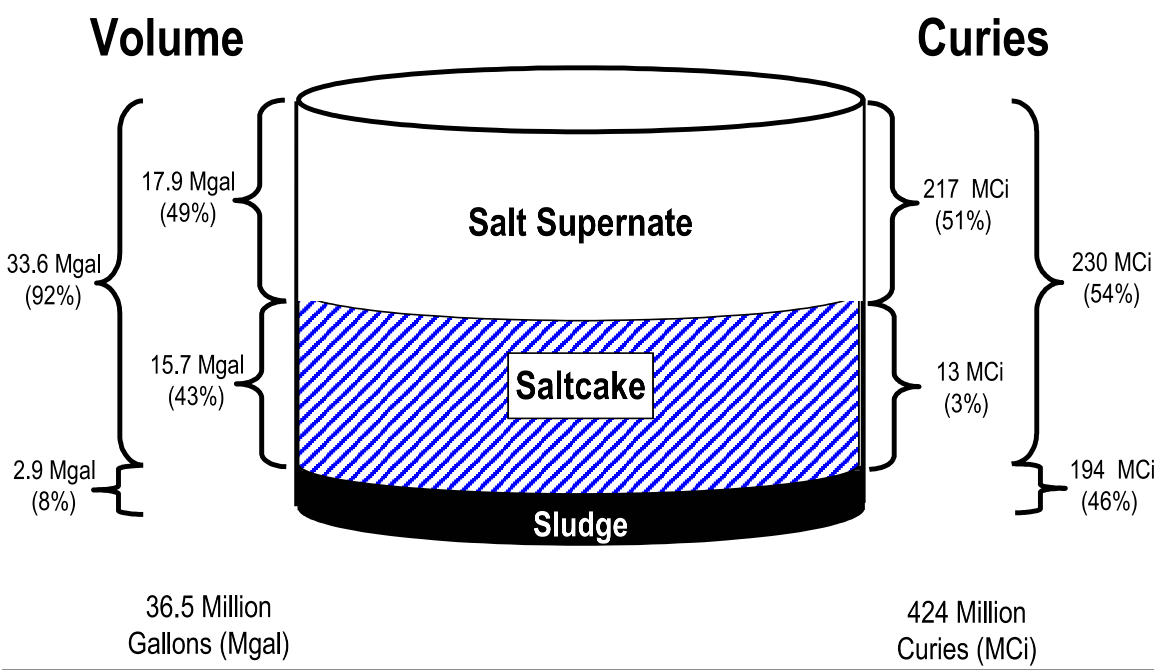
Radioactive waste volumes and radioactivity inventories reported herein are based on the Waste Characterization System (WCS) [20] database, which includes the chemical and radionuclide inventories on a tank-by-tank basis. WCS is a dynamic database frequently updated with new data from ongoing operations 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 F and H-Canyon waste and DWPF Recycle. Volumes and curies referenced in this evaluation are current as of March 31, 2006 [18].



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

Approximately 95% [18] of the salt waste radioactivity is short-lived (half-life 30-years or less) 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 [21]. 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.

Waste Tank Composite Inventory (As of 3/31/06)



14.3 Waste Tank Space Management

To make better use of available tank storage capacity, incoming liquid waste is evaporated to reduce its volume. This is critical because most of the SRS Type III waste storage tanks are already at or near full capacity. Since 1951, the Tank Farms have received over 140 Mgal of liquid waste, of which over 100 Mgal have been evaporated, leaving approximately 36.5 Mgal in the storage tanks. Projected available tank space is carefully tracked to ensure that the Tank Farms do not become "water logged", a term meaning that so much of the usable Type III compliant tank space has been filled that normal operations and waste removal and processing operations cannot continue. A portion of tank space must be reserved as contingency space should a new tank leak be realized. Waste receipts and transfers are normal Tank Farm activities as the Tank Farms receive new or "fresh" waste from the H-Canyon stabilization program, liquid waste from DWPF processing (typically referred to as "DWPF Recycle"), and wash water from sludge washing. The Tank Farms also make routine transfers to and from waste tanks and evaporators. Currently, there is very little "fresh" waste that has not had the water evaporated from it to its maximum extent. The working capacity of the Tank Farms has steadily decreased and this trend will continue until salt processing becomes operational or the system becomes water logged. Three evaporator systems are currently operating at SRS - the 2H, 3H, and 2F systems.

14.4 Waste Removal From Tanks

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

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

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

14.5 Safe Disposal of the Waste

The goal is to convert all of the waste into one of two final waste forms: Glass, which will contain 99% of the radioactivity; and Saltstone grout, which will contain most of the volume. Each of the waste types at SRS needs to be treated to accomplish disposal in these two waste forms. The sludge must be washed to remove non-radioactive salts that would interfere with glass production. The washed sludge can then be sent to DWPF for vitrification. The salt must be treated to separate the bulk of the radionuclides from the non-radioactive salts in the waste. Starting in approximately 2011, this separation will be accomplished in SWPF. However, until the startup of SWPF, DDA and ARP/MCU will be used to accomplish this separation.

14.6 Salt Processing

A final DOE technology selection for salt solution processing was completed and a Record of Decision for the Salt Processing Environmental Impact Statement was issued in October 2001. The Record of Decision designated CSSX as the preferred alternative to be used to separate cesium from the salt waste. In parallel, SRS evaluated the implementation of other salt processing alternatives for specific waste portions that would not need to be processed in a CSSX facility (SWPF) and could be processed before SWPF was operational.

The DPP calls for using four different processes to treat salt:

- **Deliquification, Dissolution, and Adjustment** —for salt in selected tanks that are relatively low in radioactive content (e.g., Tank 41), the treatment of deliquification (i.e., extracting the interstitial liquid) is sufficient to produce a salt that meets the SDF WAC. Deliquification is an effective decontamination process because the primary radionuclide in salt is Cs-137, which is highly soluble. To accomplish the process, the salt is first deliquified by draining and pumping. The deliquified salt is dissolved by adding water slowly and pumping out the solution. Then the solution is adjusted to the proper salt concentration for grouting, either by mixing with other wastes or by adding water.

- **Actinide Removal Process** —for salt in selected tanks (e.g., Tank 25), even though extraction of the interstitial liquid reduces Cs-137 and soluble actinide concentrations, the Cs-137 or actinide concentrations of the resulting salt are too high to meet the SDF 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. If the soluble actinides in the original salt solution are sufficiently low, then the stream will not require the MST strike and will only be filtered prior to being sent to the MCU. After SWPF startup, ARP will send clarified salt solution to SWPF for cesium removal.

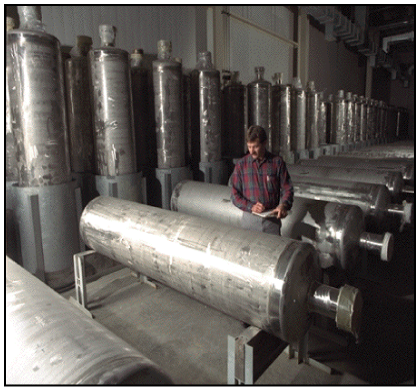
- **Modular CSSX Unit** —for tanks with salt that is too high in activity for deliquification to sufficiently reduce Cs-137 concentrations, the salt in these tanks must be further treated to reduce the concentration of Cs-137 using the CSSX process. After approximately 2011, this will be done in a new facility, SWPF. However, so that some of these wastes can be treated before SWPF startup, DOE will build a small-scale modular CSSX unit. Salt to be processed will first be processed through ARP and then through the modular unit. This unit will allow processing of salt waste with higher Cs-137 concentrations at a relatively low rate.

- **Salt Waste Processing Facility** —this is the full-scale CSSX process. The facility incorporates both the ARP and CSSX process in a full-scale shielded facility capable of handling salt with high levels of radioactivity. After startup of SWPF in approximately 2011, all remaining salt waste will be processed through this facility.

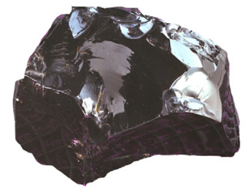
14.7 Sludge Processing

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

14.8 DWPF Vitrification



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

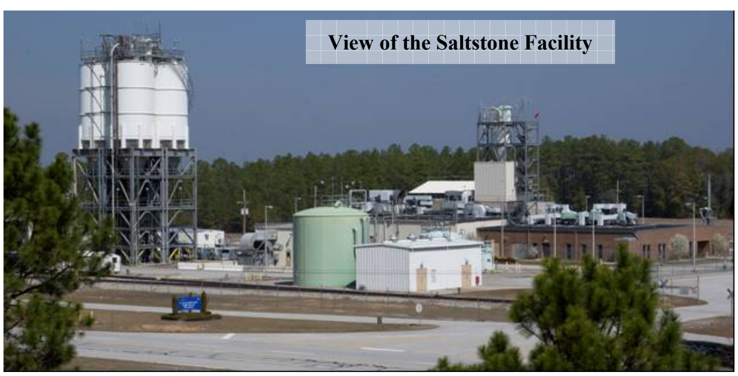


Sample of Vitrified Radioactive Glass

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

14.9 Saltstone: On-Site Disposal of Low-Level Waste

The Saltstone Facility, located in Z-Area, consists of two facility segments: SPF and SDF. SPF is permitted as a wastewater treatment facility per SCDHEC Regulations R.61-67. SPF receives and treats the salt solution to produce grout by mixing the LLW liquid stream with cementitious materials (cement, flyash, and slag). A slurry of the components is pumped into the disposal vaults, located in SDF, where the Saltstone grout solidifies into a monolithic, non-hazardous, solid LLW form. SDF is permitted as an Industrial Solid Waste Landfill site, as defined by SCDHEC Regulations R61-66 and R.61-107.16.



View of the Saltstone Facility

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

Approximately 15 feet of overburden were removed to prepare and level the site for vault construction. All vaults will be built at or slightly below the grade level that exists after the overburden and leveling operations are complete. The bottom of the Saltstone grout monoliths will be at least 5 feet above the historic high water table beneath the Z-Area site, thus, avoiding disposal of waste in a zone of water table fluctuation. Run-on and runoff controls are installed to minimize site erosion during the operational period.

The current vault (Vault 4) has the dimensions of approximately 200 feet wide, by 600 feet in length, by 26 feet in height. The vault is divided into 12 cells, with each cell measuring approximately 100 feet by 100 feet. The vault is covered with a sloped, permanent roof that has a minimum thickness of 4 inches, and a minimum slope of 0.24 inches/foot. The vault walls are approximately 1.5 feet thick, with the base mat having a thickness of 2 feet. Operationally, the cells of the vault will be filled to a height of approximately 25 feet with Saltstone, and then a layer of uncontaminated grout, with an average thickness of 2 feet, will be poured to fill in the space between the Saltstone grout and the sloped roof. The other current vault (Vault 1) has the dimensions of approximately 100 feet wide, by 600 feet in length, by 25 feet in height. The vault is divided into 6 cells, with each cell measuring approximately 100 feet by 100 feet.

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

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

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

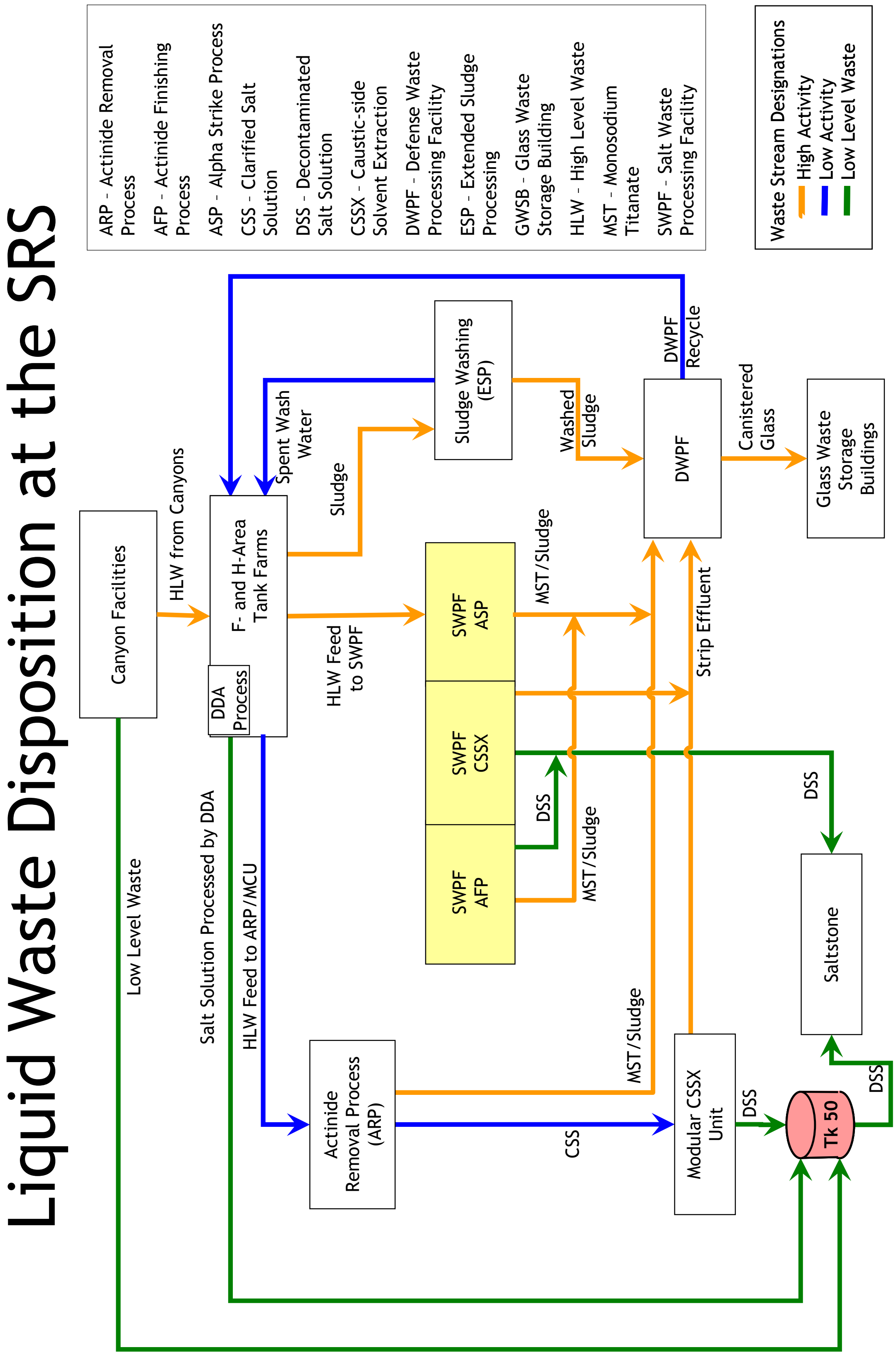


Figure 2: Process Flowsheet

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Appendix A – Salt Batch Plans

DDA & ARP/MCU Salt Planning Baseline

(Nominal 0.2 Ci/gal (Cs-137) Feed to Saltstone) [a]

		Feed to Saltstone (kgal) [a]					Total Curies to Saltstone (kCi) [b]			Cs-137 Ci/gal	
SDF Feed Batch No.	Source Tanks	DDA	ARP/ MCU	Total Salt	LLW [c]	Total	DDA	ARP/ MCU	Total	DDA	ARP/ MCU
Batch 0	(Tk 50 LLW)				300	**300**			**<1**	-	-
Batch 1	41	720	-	720	440	**1,160**	360	-	**360**	0.16	-
Batch 2	41	760	-	760	70	**830**	250	-	**250**	0.15	-
Batch 3	41	1,000	-	1,000	150	**1,150**	320	-	**320**	0.14	-
Batch 4	41+25	140 [d]	1,200	1,340	200	**1,540**	40	30	**70**	0.14	0.01
Batch 5	24	-	1,300	1,300	90	**1,390**	-	50	**50**	-	0.02
Batch 6	24	-	1,300	1,300	80	**1,380**	-	20	**20**	-	0.01
Batch 7	25	-	1,100	1,100	80	**1,180**	-	100	**100**	-	0.04
Batch 8	41	-	950	950	100	**1,050**	-	20	**20**	-	0.01
Special	(Tk 50 LLW) [e]	-	-	-	370	**370**	-	-	**<1**	-	-
Totals w/o Tk 48 Aggregation		**2,620**	**5,850**	**8,470**	**1,880**	**10,350**	**970**	**220**	**1,190**	-	-
Special	48	2,700 [g]	-	2,700	150	**2,850**	820	-	**820**	<0.2	
Totals w/ Tk 48 Aggregation		**5,320**	**5,850**	**11,170**	**2,030**	**13,200**	**1,790**	**220**	**2,010**	[f]	

Salt Feed to Saltstone

(DDA & ARP/MCU Only) [a]

Batch No.	Transfers	Volume (kgal) [a]	Total Curies (kCi) [a] [b]	Cs-137 Concentration (Ci/gal) [a]
B1	(Aggregation Material [h]) ->50	340	[i]	[i]
	49->50	380	380	0.50
	50 -> Z	**1,160**	**360**	**0.16**
B2	(Aggregation Material) ->50	450	[i]	[i]
	41->49 Dissolution	910	350	0.19
	49->50	680	370	0.27
	50 -> Z	**830**	**250**	**0.15**
B3	(Aggregation Material) ->50	300	[i]	[i]
	49->50	450	240	0.27
	50 -> Z	**1,150**	**320**	**0.14**
B4	25->49 Dissolution	770	320	0.21
	49 -> ARP/MCU [j]	1,100	310	0.14
	ARP/MCU -> 50 -> Z [d]	**1,540**	**70**	**0.02**
B5	24->49	630	660	0.52
	49 -> ARP/MCU [j]	1,100	590	0.27
	ARP/MCU -> 50 -> Z	**1,390**	**50**	**0.02**
B6	24->49	580	270	0.23
	49 -> ARP/MCU [j]	1,100	290	0.13
	ARP/MCU -> 50 -> Z	**1,380**	**20**	**0.01**
B7	49->41	120	60	0.27
	25->41 Dissolution	620	1,500	1.24
	41->49	630	1,300	1.01
	49 -> ARP/MCU [j]	960	1,200	0.61
	ARP/MCU -> 50 -> Z	**1,180**	**100**	**0.04**
B8	41->49 Dissolution	660	290	0.22
	49 -> ARP/MCU [j]	830	280	0.17
	ARP/MCU -> 50 -> Z	**1,050**	**20**	**0.01**

Notes

[a] Volumes and curies are planning approximations. Actual values will be determined via detailed flowsheet calculations.

[b] For planning purposes, total curies are estimated by doubling Cs-137 curies per the methodology documented in CBU-SPT-2004-00038. In more detailed modeling, the total curies are estimated by summing individual radionuclides.

[c] Volumes represent ETP and HEU waste receipts in Tank 50. Tank 48 LLW volume represents NaOH added to Tank 50 to support Tank 48 aggregation.

[d] 140 kgal of DDA from Tank 41 remains in Tank 50 after Batch #3 Saltstone processing is complete.

[e] Volume accounts for ETP and HEU waste receipts into Tank 50 in between salt solution batches.

[f] Due to salt waste characterization uncertainty, total curies to Saltstone could be as high as 4,000 kCi.

[g] Tank 48 aggregation would occur in parallel with Batches 4 & 5. Volumes shown represents additional volume resulting from aggregation.

[h] Aggregation material source - Tank 21, 22, & 23 and future low level waste transferred to Tank 50.

[i] Radionuclide contribution to total curies from recycle stream is insignificant and was not included in the “Total Curies” calculation.

[j] 241-96H, 512-S, and MCU will be operated as one unit. A DF of 12 for Cs-137 is used for MCU.

Appendix B – Salt Processing by Fiscal Year

Salt Processing Through FY14 not Including Tank 48 Aggregation Volumes and Activity						
End of Fiscal Year	Batch	Yearly Tk50 Salt Solution to SPF (kgal) [a]	Cumulative Tk50 Salt Solution to SPF (kgal) [a]	Yearly Activity to SPF/SDF (kCi) [b]	Cumulative Activity to SPF/SDF (kCi) [b]	Salt Solution Cs-137 Activity to SPF (Ci/gal)
FY06	Batch 0,1_P [c]	1,300	1,300	310	310	0.16
FY07	Batch 1_P,2,3,4_P [d]	2,460	3,760	630	940	0.16, 0.15, 0.14, 0.02
FY08	Batch 4_P	1,330	5,090	60	1,000	0.02
FY09	Batch 5,6_P	2,000	7,090	60	1,060	0.02, 0.01
FY10	Batch 6_P,7	2,120	9,210	110	1,170	0.01, 0.04
FY11	Batch 8	1,140	10,350	20	1,190	0.01
FY12	SWPF Batch 1,2,3_P	3,050	13,400	0.2	1,190	< 0.0002
FY13	SWPF Batch 3_P,4,5,6,7_P	6,480	19,880	0.4	1,191	< 0.0002
FY14	SWPF Batch 7_P,8,9,10,11,12_P	7,600	27,480	0.8	1,191	< 0.0002

[a] Includes all material transferred to SPF during processing of the batch, including ETP and HEU material received in Tank 50.

[b] Activity numbers include daughter products of Cs-137 and Sr-90.

[c] "P" denotes a batch that is partially processed during the Fiscal Year.

[d] ARP/MCU processing begins with Batch 4.

Salt Processing Through FY14 Including Tank 48 Aggregation Volumes and Activity						
End of Fiscal Year	Batch	Yearly Tk50 Salt Solution to SPF (kgal)	Cumulative Tk50 Salt Solution to SPF (kgal) [a]	Yearly Activity to SPF/SDF (kCi) [b]	Cumulative Activity to SPF/SDF (kCi) [b]	Salt Solution Cs-137 Activity to SPF (Ci/gal)
FY06	Batch 0,1_P [c]	1,300	1,300	310	310	0.16
FY07	Batch 1_P,2,3,4_P [d]	2,570	3,870	750	1,060	0.16, 0.15, 0.14, 0.17-0.15
FY08	Batch 4_P	4,020	7,890	740	1,800	0.17-0.03
FY09	Batch 5,6_P	2,050	9,940	80	1,880	0.04-0.03, 0.01
FY10	Batch 6_P,7	2,120	12,060	110	1,990	0.01, 0.04
FY11	Batch 8	1,140	13,200	20	2,010	0.01
FY12	SWPF Batch 1,2,3_P	3,050	16,250	0.2	2,010	< 0.0002
FY13	SWPF Batch 3_P,4,5,6,7_P	6,480	22,730	0.4	2,011	< 0.0002
FY14	SWPF Batch 7_P,8,9,10,11,12_P	7,600	30,330	0.8	2,011	< 0.0002

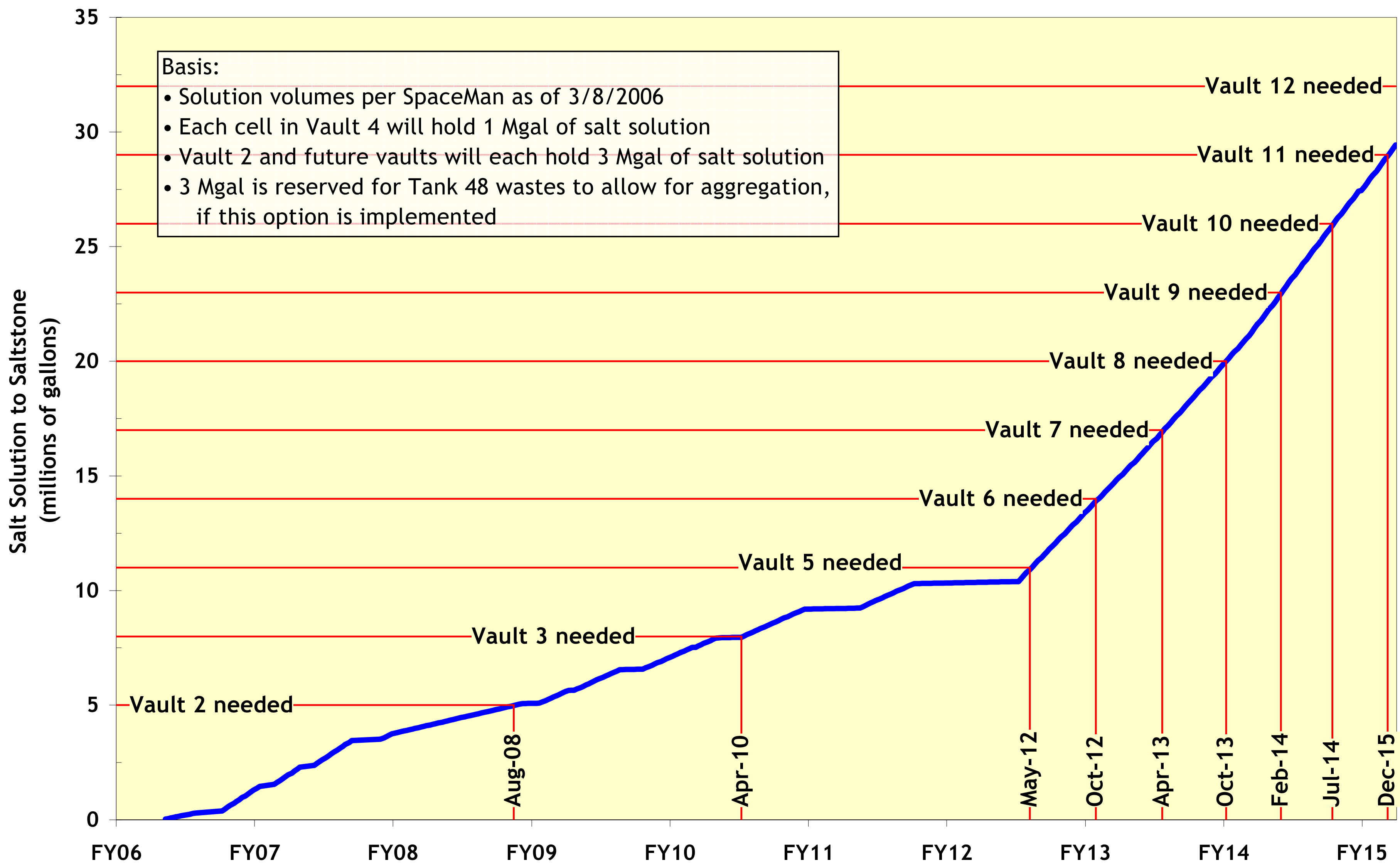
[a] Includes all material transferred to SPF during processing of the batch, including ETP, HEU and NaOH material received in Tank 50.

[b] Activity numbers include daughter products of Cs-137 and Sr-90.

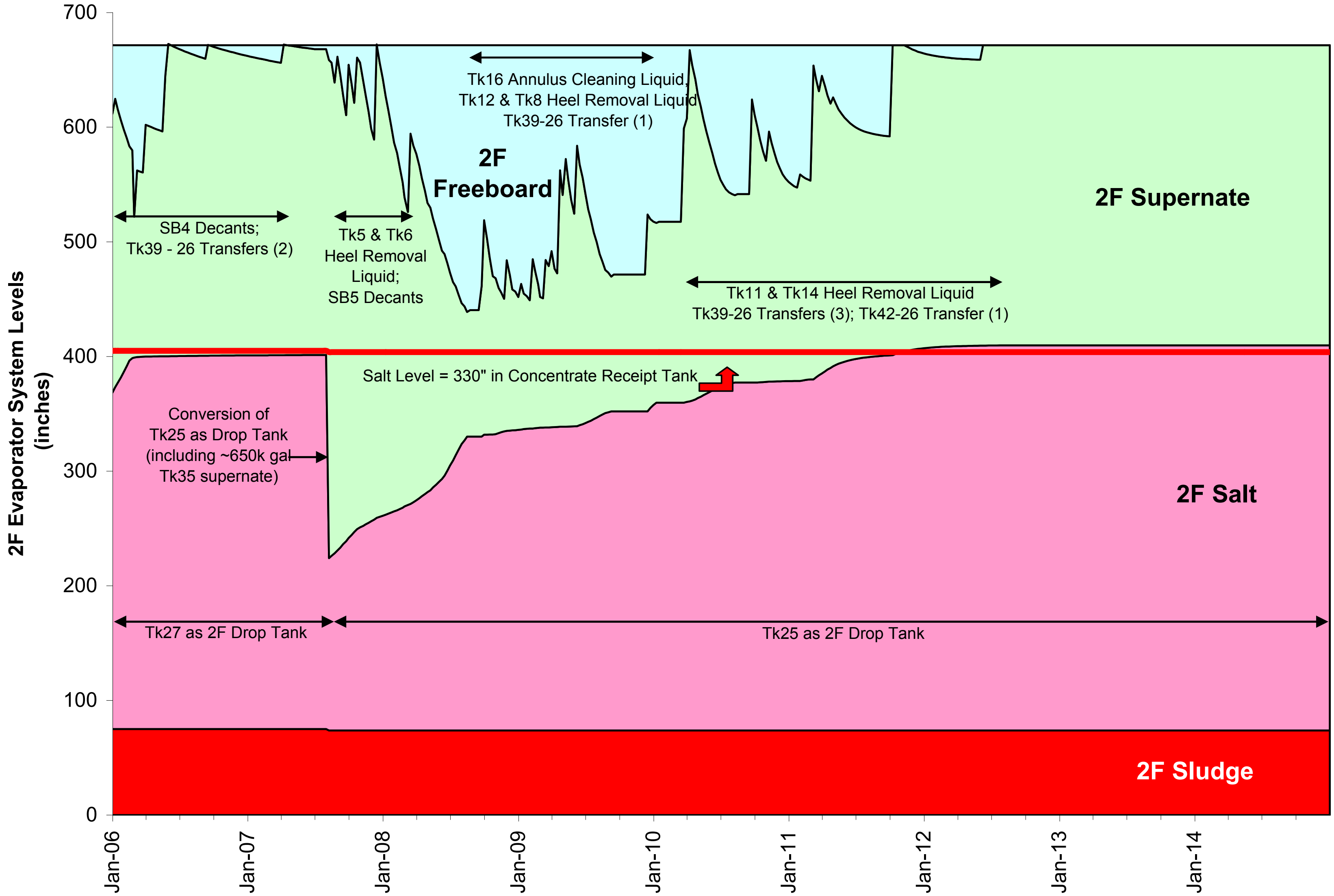
[c] "P" denotes a batch that is partially processed during the Fiscal Year.

[d] ARP/MCU processing begins with Batch 4. Tank 48 aggregation process occurs during Batches 4 and 5.

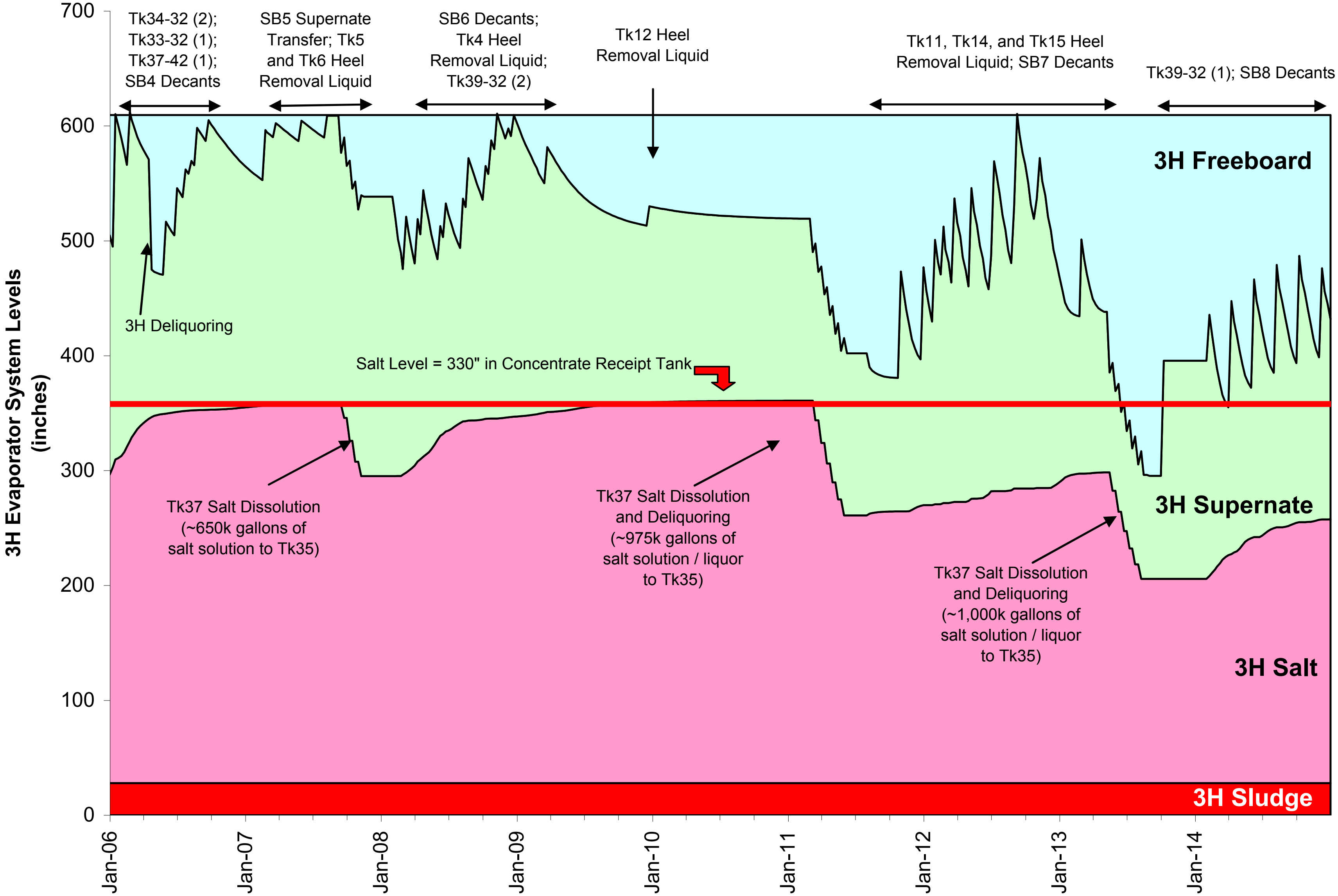
Appendix C – Projected Saltstone Fill and Vault Needs



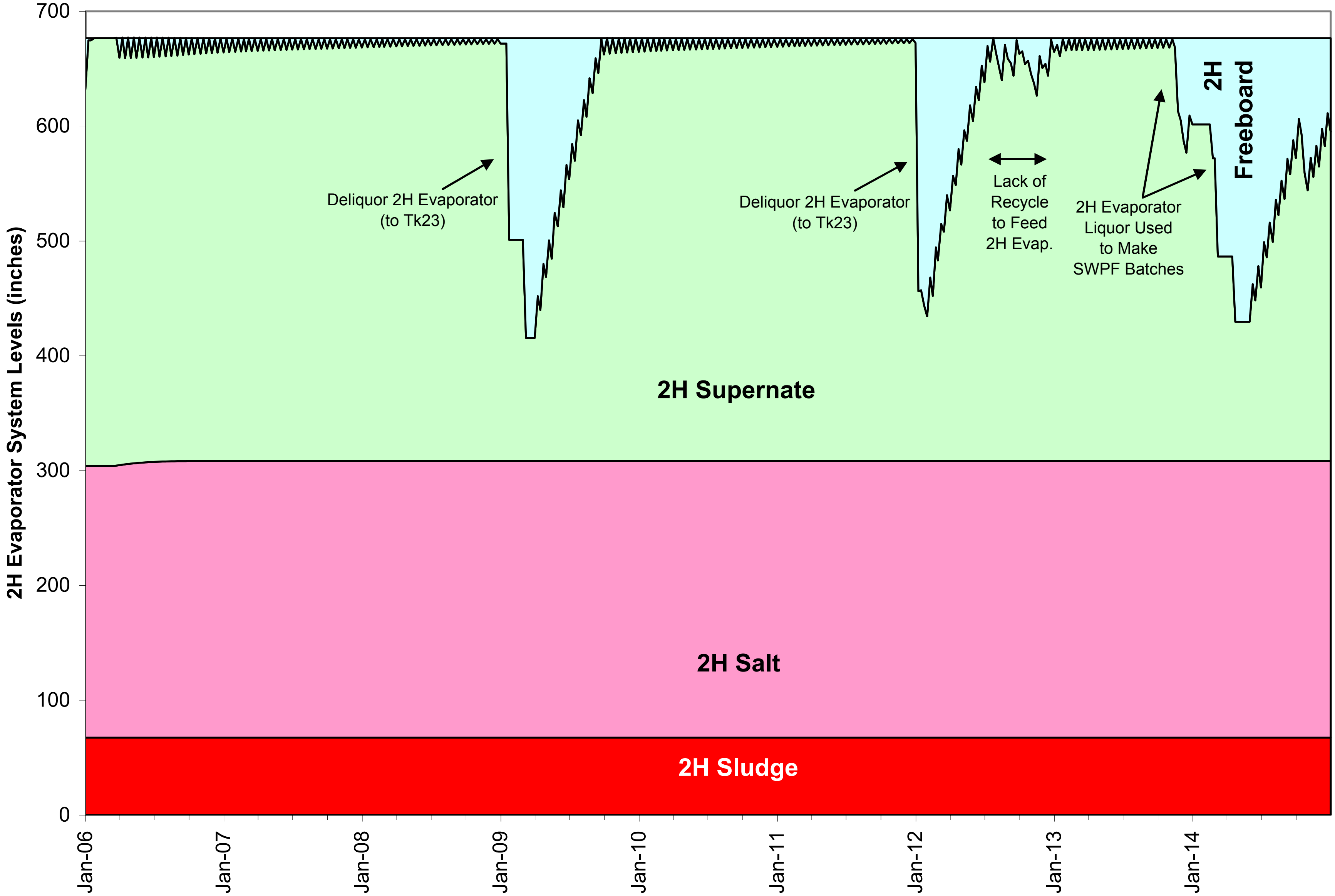
Appendix D – 2F Evaporator System Projected Levels



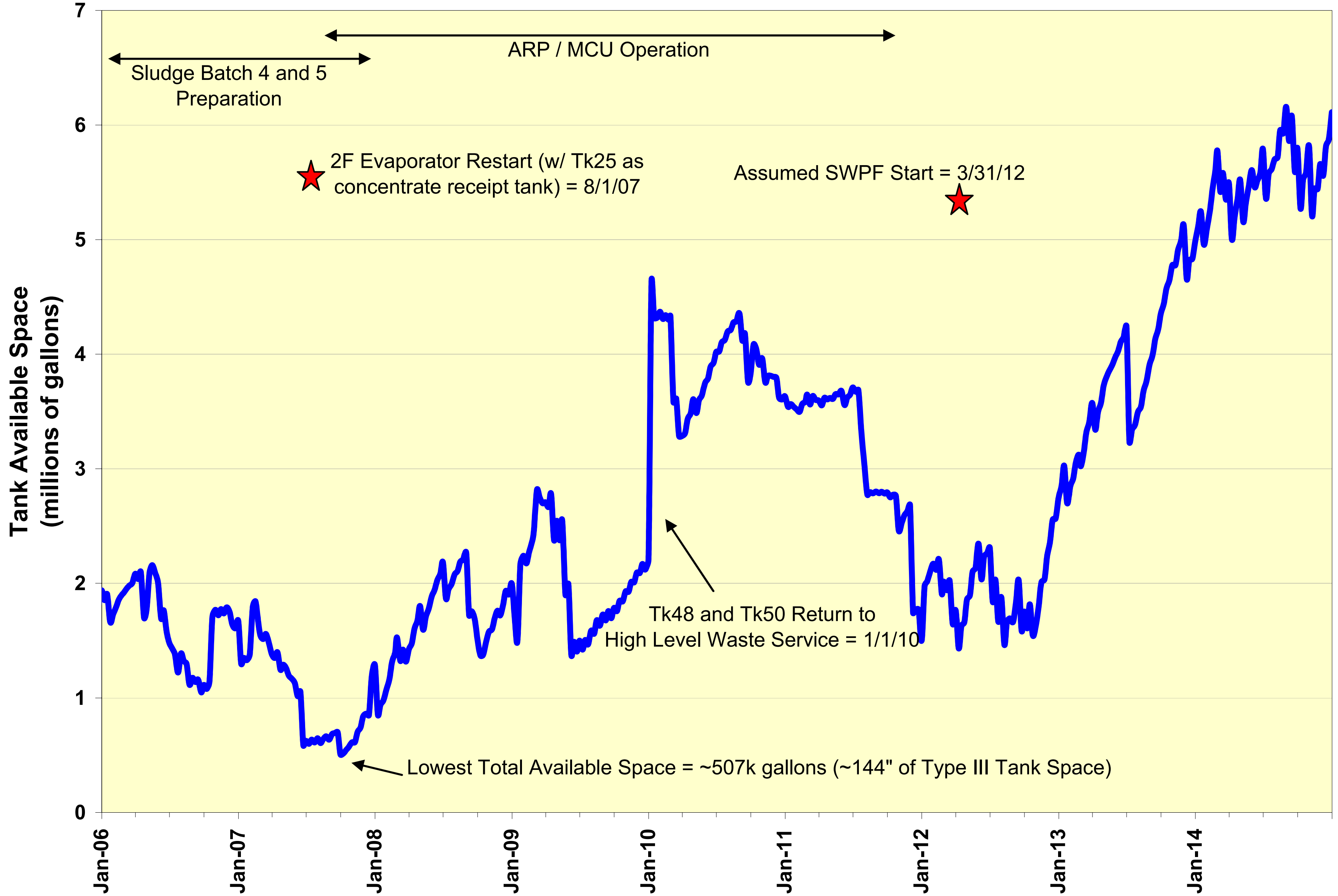
Appendix E – 3H Evaporator System Projected Levels



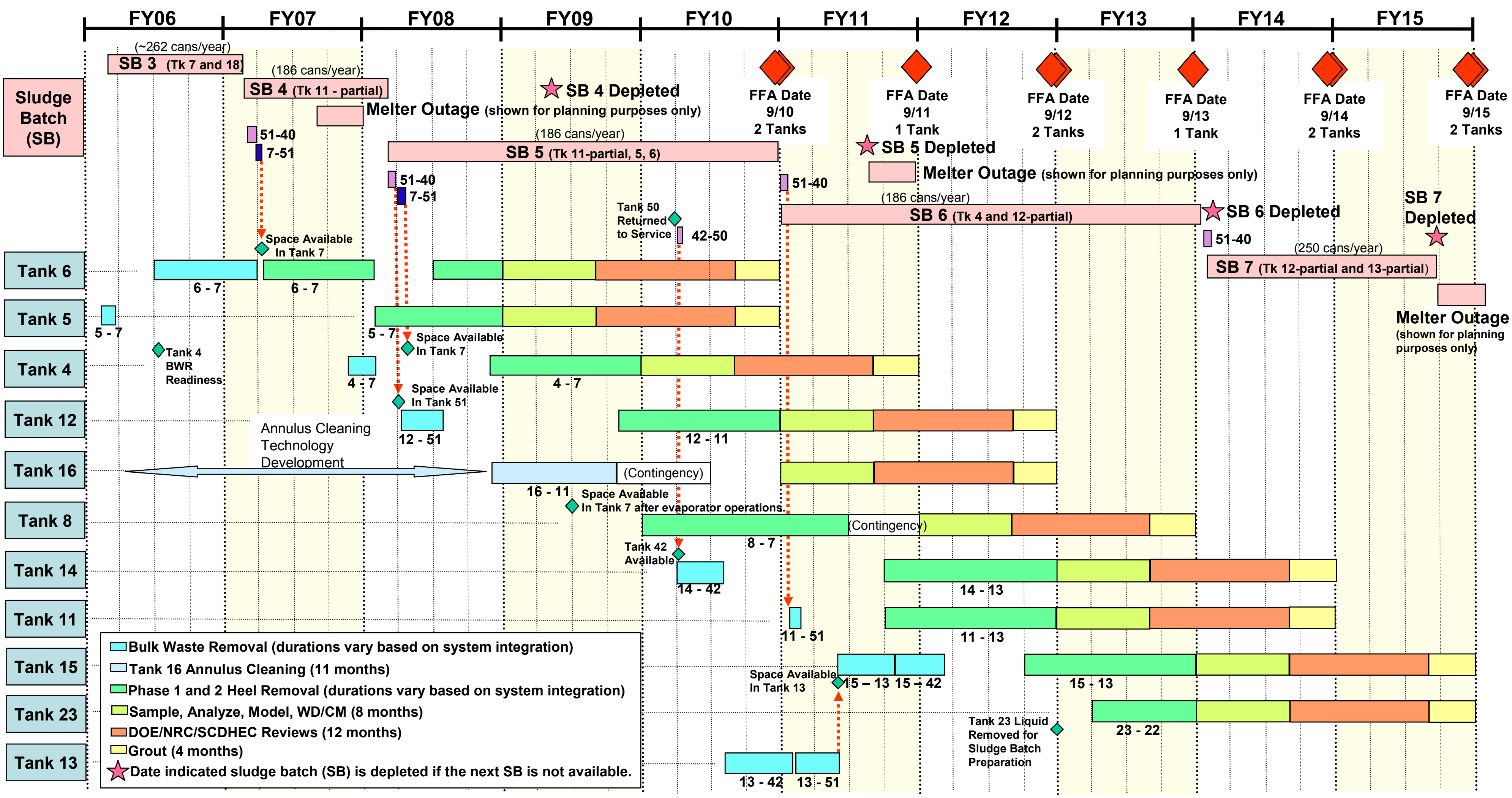
Appendix F – 2H Evaporator System Projected Levels



Appendix G – Type III Tank Available Operating Space



Appendix H – Tank Closure Critical Path and Sludge Batch Schedule



Appendix I – FY06–FY12 Liquid Waste Disposition Processing Plan

See the foldout chart that is attached to the DPP.

Distribution:

I. P. Amidon, 766-H
D. W. Armstrong, 703-H
D. C. Ballard, 704-S
K. A. Barley, 766-H
S. M. Blanco, DOE, 766-H
B. D. Blocker, 766-H
R. H. Blocker, 766-H
M. N. Borders, 704-26F
R. T. Burkhart, 766-H
S. R. Bush, 766-H
T. B. Caldwell, 766-H
S. G. Campbell, 766-H
T. E. Chandler, 704-Z
D. P. Chew, 766-H
W. C. Clark, 704-56H
W. D. Clark, Jr., DOE, 766-H
D. T. Conrad, 766-H
P. D. d'Entremont, 766-H
M. M. Ewart, DOE, 704-S
N. R. Davis, 766-H
W. T. Davis, 704-S
W. B. Dean, 766-H
V. G. Dickert, 766-H
M. D. Drumm, 766-H
J. L. Dunning, 766-H
C. A. Everatt, DOE, 704-S
S. D. Fink, 773-A
D. D. Fowler, 766-H
E. J. Freed, 704-56H
B. A. Gifford, 766-H
K. D. Gilbreath, 766-H
J. M. Gillam, 766-H
J. C. Griffin, 773-A
B. A. Hamm, 766-H
K. D. Harp, 766-H
K. A. Hauer, 704-S
P. J. Hill, 766-H
R. N. Hinds, Jr., 766-H
D. E. Hintze, DOE, 704-S
M. D. Hopkins, 766-H
H. M. Inouye, 703-H
W. L. Isom, Jr., 766-H
E. T. Ketusky, 766-H
T. A. Le, 766-H
J. S. Ledbetter, 766-H
W. I. Lewis, III, 766-H
M. A. Lindholm, 766-H
D. B. Little, 703-H
M. J. Mahoney, 766-H
J. E. Marra, 773-A
B. A. Martin, 766-H
D. Maxwell, 766-H
J. W. McCullough, Jr., DOE, 766-H
H. A. McGovern, 241-246H
R. E. Meadors, 703-H
M. S. Miller, 704-S
J. L. Newman, 766-H
Q. L. Nguyen, 766-H
J. E. Occhipinti, 704-S
L. D. Olson, 766-H
J. E. Owen, 704-30S
T. E. Pate, 703-H
W. D. Pearson, DOE, 704-S
J. M. Phillips, 703-H
J. A. Pike, 766-H
P. A. Polk, DOE, 704-S
W. G. Poulson, 766-H
S. H. Reboul, 766-H
F. J. Riddle, 704-S
M. A. Rios-Armstrong, 766-H
S. J. Robertson, 766-H
T. C. Robinson, 766-H
L. B. Romanowski, 766-H
K. H. Rosenberger, 766-H
T. D. Ross, 703-H
E. Saldivar Jr., 766-H
P. D. Schneider, 704-Z
H. B. Shah, 766-H
D. C. Sherburne, 704-S
F. M. Smith, Jr., 766-H
L. K. Sonnenberg, 766-H
T. J. Spears, DOE, 704-S
R. H. Spires, 766-H
P. C. Suggs, DOE, 766-H
J. L. Thomas, 766-H
S. A. Thomas, 766-H
D. G. Thompson, 704-Z
H. Q. Tran, 766-H
T. M. Treger, DOE, 704-S
W. B. Van Pelt, 704-S
J. R. Vitali, 766-H
K. S. Wierzbicki, 766-H
A. W. Wiggins, 241-246H
S. W. Wilkerson, 704-S
R. W. Williams, 703-H
F. E. Wise, 703-H