HLW-2000-00019

Converting Waste to Glass

Savannah River Site High Level Waste System Plan

An Integrated System at the Savannah River Site

Revision 11

April 2000

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High Level Waste Division

High Level Waste System Plan Revision 11 (U)

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Table of Contents

Appendices

Attachments


Saltstone Facility
DWPF Facility
H Tank Farm Facility

Executive Summary

The Savannah River Site (SRS) in South Carolina is a 300-square-mile Department of Energy (DOE) complex that has produced nuclear materials for national defense, research, and medical programs since it became operational in 1951. As a waste by-product of this production, there are approximately 35 million gallons of liquid, high-level radioactive waste currently stored on an interim basis in 49 underground waste storage tanks. Continued, long-term storage of these liquid, high-level wastes in underground tanks poses an environmental risk (nine of the SRS tanks have a waste leakage history). Therefore, the High Level Waste (HLW) Division at SRS has, since FY96, been removing waste from tanks; pre-treating it; vitrifying it; and pouring the vitrified waste into canisters for long-term disposal. From FY96 to the end of FY00, over 900 canisters of waste will have been vitrified. The canisters vitrified to date have all contained sludge waste. Salt waste processing was suspended in FY98 because the facility could not cost effectively meet both the safety and production requirements of the HLW System. DOE selection of an alternative salt processing technology is expected in FY01, with construction of a salt processing facility scheduled to be completed by FY10, depending on available funding.

This Executive Summary will focus on three key sections:

- Comparison of scope and funding in the Requirements Case and the Target Case
- Review of SRS's proven HLW track record
- Discussion of key process issues facing the HLW system.

Comparison: Requirements Case and Target Case

Funding over the next ten years will play a key role in determining the success of the High Level Waste Program at SRS. There are two funding cases included in this revision of the HLW System Plan. The Requirements Case provides excellent risk reduction by expediting waste removal from "high risk" tanks, processing an average of 250 canisters per year and initiating salt processing activities by mid-FY10. This case is the basis for the "Planning Case" in the FY02 Paths to Closure document. The Target Case provides good risk reduction, processes an average of 200 canisters per year, and, likewise, initiates salt processing activities by mid-FY10. This case is the "Target Case" in the April 2000 FY02 OYB submittal. In the Target Case, funding levels for waste removal, tank closure and canister production are reduced over the next 10 years in support of the Department's need to complete the high priority 94-1 Nuclear Materials Stabilization Missions at the site. Also, the completion dates of sludge and salt processing are more evenly matched so that the number of "salt-only" canisters are essentially eliminated. However, even in the Target Case, substantial increased funding will be required over the next 10 years, primarily associated with the construction and startup of the Salt Processing Facility and second Glass Waste Storage Building. It is critical to the program's success that these increased funding levels are supported in FY02 and beyond. Funding levels below the Target Case will have substantial negative impacts on the risk reduction activities associated with removing waste from high-risk tanks, tank closures and the immobilization of High Level Waste.

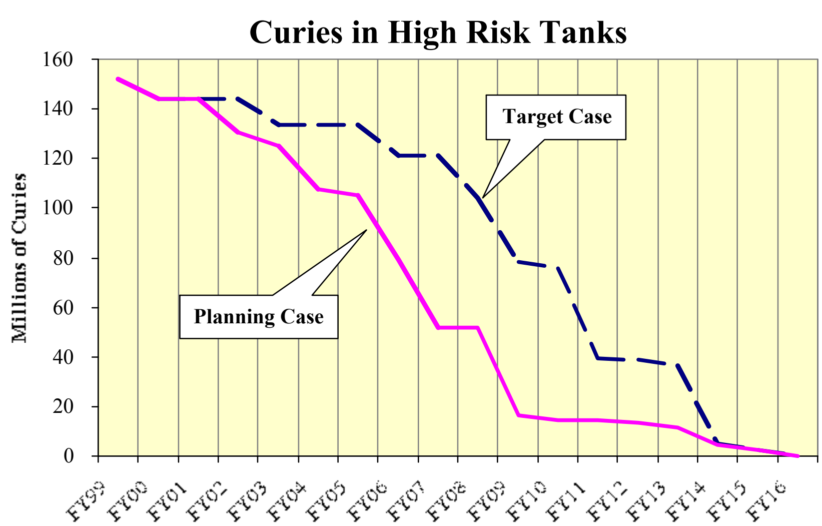
Fiscal Year	Funding Level (in millions of dollars)	
	Requirements Case	**Target Case**
2001	**$409**	**$390**
2002	**476**	**436**
2003	**595**	**528**
2004	**710**	**635**
2005	**680**	**671**
2006	**646**	**673**
2007	**664**	**665**
2008	**712**	**706**
2009	**726**	**708**
2010	**745**	**715**

Comparison of Cases	Requirements	Target
DWPF Sludge Production (in average canisters per year)		
• FY00	250	250
• FY01 to FY10	250	200
• FY11 to End of Program	250	225
Date by which the 9 "High Risk" Sludge Tanks are Emptied	FY09	FY14
Date by which all "High Risk" Sludge Tanks are Emptied	FY16	FY16
Date Salt Processing Becomes Operational	FY10	FY10
Number of Salt-Only Canisters Produced	409	0
Total Number of Canisters Produced	6,044	5,649
Date by which Waste Processing is Completed	FY22	FY23
Are all Regulatory Commitments met?	Yes	Yes
FY01 Funding Above Budget Target ($ in millions)	$19	-
FY02 Funding Above Budget Target ($ in millions)	$39	-
Estimated Life-Cycle Costs		
• Costs in escalated dollars ($ in billions)	$17.5	$17.9
• Costs in constant 1999 dollars ($ in billions)	$12.3	$12.5

Both Cases Minimize the Environmental Risks of Continuing to Store HLW in "High Risk" Tanks

In both the Requirements and the Target Cases, waste is removed from the 16 Type I and II "high-risk" tanks by FY16. However, in the Requirements Case, waste is removed from the 9 sludge "high risk" tanks approximately 5 years sooner than in the Target Case: in FY09 versus FY14. The Type I and Type II tanks are described as being "high risk" because they do not meet current secondary containment and leak detection standards, sit near or at the water table, and together store 5.6 million gallons of waste and 152 million curies of radioactivity. Removing waste from these tanks as soon as possible is important, given the environmental risks posed by continuing to store HLW in these aging tanks.

The age and condition of the 16 Type I and II waste storage tanks at SRS is of increasing concern. They were placed in service between 1954 and 1964. Over the years, nine of these tanks have leaked waste from the primary tank into the secondary pan (tank annulus). In one case, some waste leaked from the secondary pan into the environment. In the last two years, two additional tank integrity issues have arisen: a lateral crack and increased corrosion.



Tank Annulus showing High Level Waste that has leaked from the Primary Tank in the past and has solidified

- One "high risk" tank has developed a type of leak site not previously seen: a crack running parallel to the weld seam, above the waste level, approximately 18 inches in length. If other tanks develop similar leak sites, the risk of releases and the complexity and cost of future waste removal will be increased.
- Increased corrosion has been seen in several of the tanks' secondary containment pans. In several cases these secondary pans, which represent the last lines of defense for waste, already contain waste from previous leaks in the main walls of the tanks. Although SRS maintains an aggressive program to monitor the integrity of all waste tanks and all waste is being appropriately managed, these recent findings underscore the urgency to complete waste removal as soon as possible.

Both Cases Meet Regulatory Commitments

There are two primary regulatory drivers for waste removal: the Federal Facilities Agreement (FFA) and the Site Treatment Plan (STP). The FFA requires that the 22 non-compliant tanks be emptied and closed on an approved tank-by-tank schedule. The STP requires that processing of all high-level waste (both existing and future) be completed by FY28.

These two drivers can be summarized as:

- Close all non compliant Tanks by 2022 (FFA)
- Immobilize all High Level Waste by 2028 (STP)

Both cases meet these regulatory commitments.

Both Cases fund the Salt Processing Project on schedule for a FY10 Startup

Both the Requirements and Target Cases assume that the Salt Processing facility will be in operation by mid FY10. Since all parts of the waste removal process at SRS are operational except the salt processing plant, it is critical that focus and funding levels be maintained.

Salt waste processing was suspended in FY98 because the facility could not cost effectively meet both the safety and production requirements for the High Level Waste System. Since then a rigorous systems evaluation has been completed on all available salt processing technologies. Research and Development for process selection is continuing on the most promising alternatives. By the end of FY01, DOE is scheduled to have selected the preferred technology for salt processing. It will then become critical to fund and construct the chosen salt processing alternative in a timely and expeditious manner.

High Level Waste Program a Proven Success

The High Level Waste System at SRS has been successful over the last several years as it has transitioned from a safe storage operation to a waste removal and canister production operation. During the same time period, substantial cost reductions have been identified and incorporated into the program.

DWPF Production Successes

The number of canisters filled at DWPF has increased each year since startup in FY96:

- FY96 64 canisters filled (goal was 60)
- FY97 169 canisters filled (goal was 150)
- FY98 250 canisters filled (goal was 200)
- FY99* 236 canisters filled (goal was 200)

*Note: FY99 was a year in which substantial Y2K upgrades were also accomplished.

To accomplish these production rates, a number of improvements have been implemented at DWPF

- Reduced sample turnaround times
- Improved operating and sampling sequences to minimize flow sheet bottlenecks
- Increased fill height in canisters
- Developed and used replaceable melter pour spout inserts
- Installed Temporary Modifications to allow Y2K modifications with minimal impact to canister production

Additional improvement actions are currently being pursued which include such items as:

- Reducing melter sample loop flushing
- Revising acid addition strategy to increase the melt rate
- Evaluating the removal of the center thermowell in the melter to allow higher heat loads in the melter

First HLW Tank Closures in the DOE Complex

SRS met the challenge of emptying and closing the first two high-level waste tanks in the DOE complex. This required the site to:

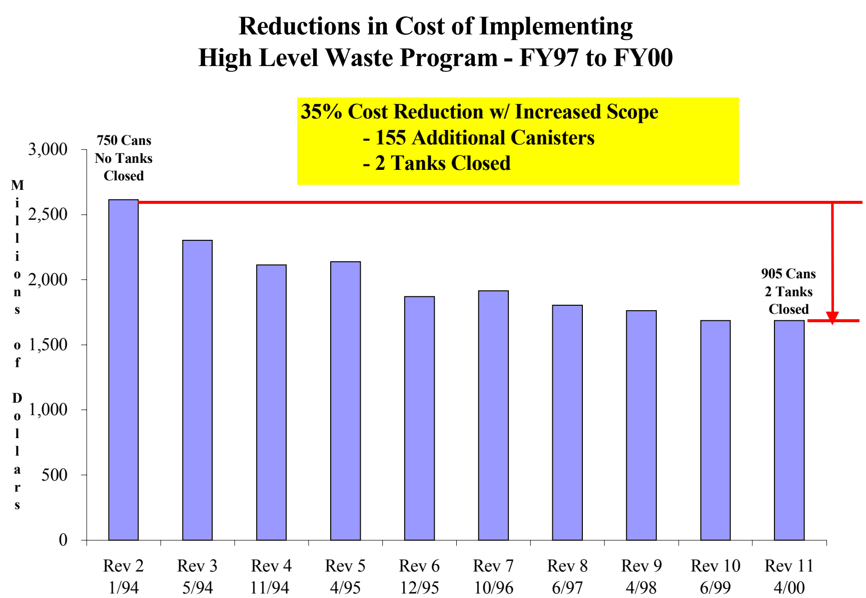
- Work effectively with regulators, the public and industry to reach agreement on the closure method
- Develop closure plans and criteria based on waste characterization, analysis and modeling
- Design, build, test and deploy new technology and tools to remove waste from the tanks
- Remove residual waste material from the tanks
- Isolate and the tanks from operating Tank Farm processes
- Fill the tanks with a cement-like grout to complete closure

Maximizing Accomplishments while Focusing on Cost Reductions

The estimated costs for the High Level Waste Program at SRS have been reduced significantly over the last several years. Each revision of the System Plan since Revision 2 in 1994 has included cost estimates for the waste removal program. To illustrate how these cost estimates have been reduced, the graph below compares the estimated costs for the four-year period FY97-FY00. The graph shows that

- Planned Funding has decreased 35%;
- Planned Canister Production has increased from 750 to 905 a 21% increase;
- Planned Tank Closures have increased from zero to two.

To realize these cost reductions, SRS has had in place since 1994 an aggressive Productivity Improvement Program and scope prioritization process. The savings in the HLW program alone amount to a 35% cost reduction for the four-year period. This has enabled SRS to reduce costs and absorb mandatory funding reductions while increasing its commitment to safety, canister production, and tank closure.



Benchmarking results confirm Competitive Position and Well-run Condition

In early FY00, DOE commissioned the Logistics Management Institute, Inc. (LMI) to conduct a site-wide cost effectiveness review of SRS. LMI conducted several External Independent Reviews (EIRs) across the site, one of which focused on DWPF. In their draft report (final report not issued), LMI stated the following:

> *"…the DWPF has continued to increase production in an environment of declining budgets. …the team observed no significant opportunities for cost savings or reductions within the DWPF budget at this time."*
>
> *"The EIR team believes the organization and management of DWPF is a model that might be applicable for comparable operations at other DOE sites."*

Continuing Drive for Cost Efficiencies

In FY00, another strong drive for cost efficiencies has been made. The FY00 action plan, when fully implemented, will decrease the cost of the HLW program by $26 million in FY01 and all future years. Over the planned 22-year life of the HLW program these actions will result in a Life Cycle Cost reduction of approximately $860 million. These reductions will place the HLW Program in an extremely cost competitive position; and, therefore, it is unlikely that significant additional reductions will be possible in future years. However, the site will continue its drive for cost effectiveness to ensure that a highly competitive cost position is maintained.

Key Process Issues

Work is currently underway to address several key process issues that have significant impacts on HLW's ability to implement the HLW System Plan. A more detailed explanation of these issues is contained in Sections 7 and 8.

Tank Farm Usable Tank Storage Space

The amount of usable tank storage space in the Tank Farms continues to decrease. This is a result, not only of on-going receipts of Canyon wastes and DWPF recycle, but also of the delay in the startup of salt processing to FY10. It is only when salt processing starts up that significant volumes of waste in the tank farms are reduced. This is because the old-style Type I, II and IV tanks (Tanks 1-24) are excluded from the calculation of "usable tank space" since they do not meet current requirements for secondary containment and leak detection, with the exception of storing dilute waste in Tanks 21-24. When sludge is removed from one of the older tanks, the vacated space is not counted toward "usable tank space." In fact, after water is used to wash the sludge, the wash water will contain soluble salts that goes to Type III tanks for storage, so that the net result is an overall decrease in "usable tank space."

Due to the urgency of space management, a HLW Space Management Team (Space Team) was chartered to recommend space gain initiatives. The Space Team issued a final report in August 1999. Since that time additional space management initiatives have been developed. The current group of space management initiatives that will be required to provide adequate space until the Salt Processing Facility becomes operational in FY10 is listed below:

- Continue to evaporate liquid waste, including the backlog of liquid waste that is waiting to be fully concentrated;
- Convert Tank 49 previously identified as a salt processing tank back into a HLW storage tank.
- Manage ETF bottoms without the use of Tank 50 as a temporary storage location and convert Tank 50 back into a HLW Storage Tank;
- Reduce the DWPF Recycle Stream sent to the Tank Farm;
- Implement the small volume gain ideas to achieve small incremental storage volumes;
- Move Tank 26 sludge into an earlier sludge batch and place the 2F Evaporator in standby;
- Reduce the minimum emergency space (presently set at 2,600 kgal for the F & H Tank Farms) to the Authorization Basis (AB) minimum requirement of 1,300 kgal;
- Retrofit Tank 35 to act as a salt receipt tank for the 3H Evaporator System;
- Implement an Acid Evaporator to process DWPF Recycle to avoid sending it to the Tank Farms (only required for the Requirements Case)

Uncertainties in Tank Space Assumptions

The Tank Farm space management strategy is based on a set of key assumptions involving canister production rates, influent stream volumes, Tank Farm evaporator performance, and space gain initiative implementation. Significant changes in any of these key assumptions will impact HLW's ability to successfully support planned processing commitments due to a lack of Tank Farm waste storage space.

For example, the different DWPF canister production rates assumed for the Requirements (250 cans/yr average) and Target (200 cans/yr average) Cases result in the implementation of a different Tank Farm space management strategy. This is because the forecast yearly DWPF recycle streams will be less for the Target Case than it is for the Requirements Case. In addition, the timing of ESP sludge preparation batches and the resulting washwater decants to the Tank Farm will be different. Therefore, the timing and need for the space gain initiatives required for the Requirements Case will be different from that in the Target Case.

In addition, the impact on Tank Space from changes in Canyon waste forecasts involving existing missions or from potential new Canyon missions must be continually assessed. The Canyon forecasts have significantly increased in the past year as planned processing campaigns are better defined. At present the Canyon forecasts 6.2 million gallons of waste transfers over the next 6-8 years; last year this forecast was 3.0 million gallons. NMS&S will continue to refine their waste stream forecasts based on processing experience gained over the next few years. To ensure clear and timely communications, weekly interface meetings have been initiated between HLW and NMS&S

Due to the uncertainties in key Tank Farm space assumptions, the space management strategy must be continually evaluated. This is necessary to balance limited resources between the risk reduction gained from removing waste from tanks and the implementation of space gain initiatives required to maintain adequate space. Both the DNFSB 94-1 Nuclear Materials Stabilization Missions and the HLW processing activities must be accommodated in the space available.

Salt Processing Disposition

Salt waste processing was suspended in FY98 because the facility could not cost effectively meet both the safety and production requirements for the High Level Waste System. A final DOE selection of the preferred salt processing technology is expected in FY01. The start up of the selected salt processing facility is scheduled for FY10. Conclusions and recommendations made in Revision 11 of the HLW System Plan can be significantly impacted depending on the final alternative selected and its associated startup date. The successful conclusion of this issue is critical to the overall success of the HLW System.

Age of the HLW Facilities

The material condition of many HLW facilities constructed from the early 1950s to the late 1970s has deteriorated. Routine repairs to service systems in the Tank Farms have escalated into weeks of unplanned downtime due to poor condition of the service piping and obsolete instrumentation. The Tank Farm cannot be shut down as it contains approximately 35 million gallons of highly radioactive waste, much of it in a mobile form. Planned Infrastructure improvements must be funded to ensure facility conditions are maintained to continue safe storage of waste.

Evaporator Operation Constraints (2H PISA)

In January 2000, an accumulation of solids, including higher than expected quantities of uranium, was discovered in the 2H Evaporator pot. Although investigations indicate that the solids are critically safe, the evaporator was shut down due to the risk that continued operation could lead to conditions under which a criticality could be credible. A Potential Inadequacy in Safety Analysis (PISA) was declared. The resolution of the PISA resulted in delays in operating the other two evaporator systems for several months. The PISA will likely keep the 2H Evaporator shut down until October 2000. The reduced capacity for evaporation in the tank farms required modification of procedures, equipment, and processes to ensure safe storage and receipt of existing and new Canyon and DWPF waste. Resolution of the 2H PISA could require different strategies for handling and segregating waste among the three evaporators.

Introduction

Revision 11 of the High Level Waste System Plan documents the current operating strategy of the HLW System at SRS to receive, store, treat and dispose of high-level waste. The HLW System is a fully integrated operation. It involves safely storing high-level waste in underground storage tanks, removing, pre-treating, and vitrifying this high-level waste; and storing the vitrified waste until it can be permanently disposed of in a Federal Repository.

By the end of this fiscal year, over 900 vitrified waste canisters will have been produced. Two waste tanks were closed by the end of FY98. This will leave the Tank Farms with an estimated 35 million gallons of waste containing approximately 420 million curies of radioactivity to be disposed of over the next 20 to 30 years. Revision 11 of the HLW System Plan analyzes and compares the programmatic and funding requirements to support two cases, a Requirements Case, and a Target Case:

- **Requirements Case** – DWPF production of 250 canisters per year; Salt Processing startup in FY10.
- **Target Case** – DWPF production of 250 canisters per year in FY00, an average of 200 canisters per year in FY01-FY10 and 225 canisters per year in FY11-End of Program; Salt Waste Processing startup in FY10

The System Plan Requirements Case is the basis of the "Planning Case" in the FY02 "Paths to Closure" plan. The System Plan Target Case is the FY02 OYB Target Case. In the Target Case funding is reduced for waste removal, tank closure and canister production over the next 10 years. This is to support the Department's need to complete the high priority DNFSB Recommendations 94-1 and 2000-1 Nuclear Materials Stabilization at the site. The Target Case also results in a more evenly matched sludge and salt production processing completion date so that the number of "salt-only" canisters is essentially eliminated.

Other assumptions used in the development of this plan are detailed throughout the document.

State of the HLW System

The status of each key HLW facility is summarized below.

H-Tank Farm: The **2H Evaporator system** had a good year in its performance parameters by producing over 2,000,000 gallons of space gain for FY99. Late in FY99, the 2H system began to experience intermittent problems with the Pot Level and Specific Gravity instrumentation as well as with the evaporator pot lift rate. During the same time frame as the 2H system problems were beginning to occur, the Water Management team recommended that the 2H system be operated to maximize the volume reduction of the 2H system. This was accomplished by diverting the DWPF recycle waste stream away from the 2H system and into a Type IV tank. This plan maximized the space recovered from the waste in the 2H system by allowing the waste to be concentrated to a higher hydroxide level without being continually diluted by the receipt of fresh recycle. However, it also appears that this revised operating strategy also led to the formation of a sodium-aluminum-silica compound in the 2H vessel. The 2H system has essentially been shut down since the beginning of FY00 due to planned outages and several operational problems due to lift line pluggage and the discovery of the compound mentioned above. A Potential Inadequacy in Safety Analysis (PISA) was declared in January 2000 and HLW is currently working on many aspects of the PISA resolution. The 2H Evaporator system will require both chemical and mechanical cleaning. It is also expected that operational constraints will be placed on the system during future operations (See Issue 7.8).

The **3H Evaporator system** received DOE approval for operation in December 1999. The operation of the 3H Evaporator System was impacted by the PISA described above. Currently the initial feed for the 3H Evaporator System has been qualified with additional feed qualification being needed to allow the Evaporator System to continue operation throughout FY00. These actions are expected to be completed in time to support continued evaporator operations. In addition to the impacts of the PISA, the final preparations for radioactive operations continued. The 3H Evaporator is currently scheduled to initiate radioactive operations in early April after some equipment issues identified during startup testing are resolved. The 3H system is expected to carry the bulk of the evaporation load for FY00 and is vital to the success of supporting Sludge Batch 2.

The "Usable Space" (see Appendix B – Glossary, and Section 8.1.1 for a full definition of "Useable Space") in HTF has been reduced to approximately 1.1 million gallons due to the current 2H Evaporator issues. In order to maintain usable space in the Tank Farms until the Salt Processing Facility startup, the evaporators must evaporate dilute supernate (backlog) from Type III tanks. This is expected to recover approximately 1,500,000 – 2,000,000 gal of actual space over the period FY00-FY04.

F-Tank Farm: The **2F Evaporator system** had a good year in its performance parameters by producing over 675,000 gallons of space gain for FY99. In FY00, the 2F Evaporator system went into a major outage to install required TSR modifications to bring the 2F system into compliance with the newly implemented Technical Safety Requirements (TSR) for FTF. The planned outage was expected to last from October 99 until the mid-December time frame, but the outage was extended to respond to additional infrastructure failures (steam leaks, Specific Gravity instrument jumper failure, Inter-area Line (IAL) transfer jumper failure, etc.). The operation of the 2F Evaporator System was also impacted by the PISA described above. The 2F Evaporator resumed operation after feed qualification for the PISA in February 2000.

The “Usable Space” in FTF has been reduced to approximately 223 thousand gallons because of the IAL jumper failure and the extended shutdown of the 2F system.

Tank Closure: Tanks 17 and 20 operational closure is complete; these are the first two high level waste tanks to be closed in the United States. The Tank 16 annulus was sampled in FY98 and it was determined that further annulus cleaning will be required before final closure. Installation of the infrastructure to support removal of the sludge/zeolite heel from Tank 19 is in progress. Development of submersible mixers (manufactured by ITT Flygt) on a rotating mast is continuing prior to installation. The Tank 18/19 transfer/recycle system development was completed and deployment is in progress. Removal of the heel from Tank 19 is forecast to be complete in FY00. The first tank cluster will be closed in FY04 (Tanks 17-20). Based on work to date, it is evident that, prior to tank closure, some tanks may require further tank heel removal past the base case of bulk waste removal and spray water wash to meet residual waste limits.

Waste Removal: Construction of waste removal equipment is virtually complete on Tank 8. Design and construction of waste removal equipment continues on Tanks 7 and 11. Supporting services design and construction in both Tank Farms continues as well. Routing all signals and controls from Tanks 29-32, 35-37 and associated West Hill facilities to the 3H Evaporator (RHLWE) Control Room continues. Significant Lessons Learned obtained from Tank 8 project work are being factored into future waste removal tanks. Low funding levels in FY00 moved much of the construction scope for Tanks 7 and 11 into FY01. This consumed all schedule contingency for recovery from unexpected delays as were experienced on Tank 8 (tank riser interferences, high radiation rates, waste characterization issues, etc.).

Extended Sludge Processing (ESP): Sludge Batch 1A feed to DWPF was completed in September 1998. Tank 51 is currently feeding Sludge Batch 1B to DWPF. Preparations are in progress to enable Tank 40 to start washing Sludge Batch #2.

Salt Waste Processing: Processing at the In-Tank Precipitation (ITP) Facility was suspended because the facility could not cost effectively meet both the safety and production requirements for the High Level Waste System. A HLW salt solution processing alternative evaluation is currently underway. An extensive list of potential treatment options has been pared down to three alternatives. These alternatives are Small Tank Tetraphenylborate (TPB) Precipitation, Crystalline Silicotitanate (CST) Non-Elutable Ion Exchange, and Caustic Side Solvent Extraction. Science and Technology activities are continuing on these three alternatives with a final DOE technology selection expected in FY01.

Defense Waste Processing Facility (DWPF): Pouring problems experienced in early FY97 were corrected by the installation of replaceable pour spout inserts. The insert’s service life has been acceptable and insert replacement has been performed without complication. Since the pour spout of Melter #1 continues to be eroded, additional activities are underway to develop future insert designs. At the time of this System Plan (March 1), DWPF had poured 78 canisters in FY00, after a planned outage at the first of the fiscal year. Programs are underway to increase the production rate by adjusting melter feed Redox conditions and increasing the melter feed solids content. Processing of Sludge Batch 1B sludge began in October 1998 and has produced 314 canisters of vitrified waste (with a total expected 625 canisters from Batch 1B). Sludge Batch 1A produced 492 canisters of vitrified waste.

Glass Waste Storage Building (GWSB): At the time of this System Plan, 797 glass canisters are stored in GWSB #1. This represents approximately 37% of the available 2,159-canister capacity at GWSB #1. Activities to repair the shield plugs for approximately 450 presently unused canister storage locations (included in the GWSB #1 canister capacity value) are planned for FY02 and FY03.

Effluent Treatment Facility (ETF): In FY99, the ETF treated over 17 million gallons of low-level wastewater, resulting in 153,997 gallons of waste concentrate transferred for storage to Tank 50. For FY00 and beyond, the estimated annual volume of wastewater to be treated is 20 million gallons and the estimated waste concentrate produced is approximately 180,000 gallons per year.

Saltstone: In FY98, Saltstone completed processing approximately 300,000 gallons of Tank 50 waste inventory and entered an extended planned lay-up. This System Plan assumes that the ETF concentrate stored in Tank 50 can be treated using an off-site vendor starting in FY02. This will allow Tank 50 to be de-inventoried in preparation for its use as a HLW storage tank. If the use of an off-site vendor is successful, then Saltstone will remain in lay-up until the start of Salt Processing in 2010.

Consolidated Incinerator Facility (CIF): CIF began radioactive operations in April 1997. Since 1997, over 5,275 gallons of radioactive solvent have been incinerated. A decision was made to suspend CIF operations by the beginning of FY01. This will support both development of alternative solvent processing methods and the Department's need to provide funding to the higher priority DNFSB Recommendations 94-1 Nuclear Materials Stabilization Program in FY01. If no better solvent processing methods are determined, the restart of the CIF is expected in FY04 with full operation in FY05. If a more cost effective solvent processing method is developed, then it would be implemented. In this case, the High Level Waste Program will incorporate the required unit operations into the Salt Processing Facility to dispose of any benzene generated from the Salt Processing program.

1 Description of the HLW System Plan

This System Plan describes the two different strategies for the integrated operation of the HLW System. The first strategy is the Requirements Case, which provides excellent risk reduction by expediting waste removal from "high risk" tanks, processes an average of 250 canisters per year, and starts salt processing activities by mid 2010. This case will be the "Planning Case" in the April 2000 "Paths to Closure" submittal. Appendix H provides the detailed production planning information for the Requirements Case. The second strategy is the Target Case, which provides good risk reduction, processes an average of 200 canisters per year, and starts salt processing activities by mid 2010. This case is the "Target" Case in the April 2000 FY02 OYB submittal. Appendix I provides the detailed production planning information for the Target Case.

The HLW System planning bases are described in Sections 1 through 6. Key issues and assumptions are described in Section 7. The production plan and its associated Tank Farm space management strategy are described in Section 8. Sections 9 and 10 highlight technology development needs and potential future missions for the HLW System. The Appendices include supporting tables and figures. Appendix A provides a list of acronyms and Appendix B provides a glossary of terms. Appendix C is a listing of the HLW System Priorities, the basis upon which major funding decisions are made. Appendix D is a simplified HLW process flowsheet. Appendix E depicts the Approved FFA Waste Removal Plan and Schedule. These appendices should be particularly useful to those who are not familiar with this Plan. Appendix F provides perspective on changes in Tank Farm influents and effluents from 1954 to the present. Appendix G illustrates the High Level Waste Tank Usage and depicts the Tank Farm space availability. Appendix K briefly describes various components and processes of the HLW System.

One goal of the planning process is to continuously improve the HLW System Plan to better serve the needs of stakeholders. Revision 11 of this System Plan incorporates the results from several improvements in the planning process implemented since Revision 10 was issued:

- Interface meetings were established between HLW and NMS&S to improve communication of processing plans and their associated impacts on Tank Farm space and DWPF canister production. These meetings are held on a weekly basis between the working level planners and waste forecasters. Upper level management meets on a quarterly basis to discuss major planning assumptions and issues.
- **ProdMod** is the integrated linear programming computer simulation of the HLW System using Aspen Speedup® software. It was modified to enable planners to incorporate additional inter-tank transfers, evaporation of backlogged wastes, and flexibility in processing of DWPF recycle and ESP wash water. These are key activities in HLW production planning, especially in the years prior to Salt Processing.
- A FORTRAN 90 based **Expert System** was developed and interfaced with ProdMod to make it an intelligent simulation code. ProdMod is an extensive input data based simulation code involving many process operating rules and limitations. The objectives of the Expert System are to
  - Provide a reminder of simulation options and the default values used in the simulation
  - Check for input errors against set parameters
  - Check for violations of set operating or regulatory constraints
  - Guide planners by providing look-ahead information for simulation advancement
  - Check output against predicted results for key parameters.

  In addition to saving time during the planning development, the Expert System also improved the quality of ProdMod outputs.
- The **Space Management Model (SpaceMan)** is an interactive PC-based program, written in Visual Basic, used to predict tank farm storage space. SpaceMan realistically simulates tank farm processes using a manually inputted waste management plan. This program allows planners to simulate a variety of strategies to determine future space impacts.
- A **Glassmaker Model** was designed to give time independent results for the various sludge batch blends. While not as detailed or rigorous as the CPES model used in the past, it provides much of the sludge processing information required for development of the System Plan in a more timely manner. Its calculations have been shown to be consistent with earlier versions of the System Plan while remaining quick running and easy to use.
- Continued enhancements in reports and models have allowed greater quality control of the varying data inputs and outputs and improved the planning of the various activities in the HLW System.

It should also be noted that HLW personnel are also supporting activities that could lead to new missions for SRS. DOE-Material Disposition (MD) program activities include possible implementation of a can-in-canister program at DWPF and the Mixed Oxide (MOX) Fuel Facility for disposition of surplus plutonium. See Section 10 for further discussions on the impacts of potential new site missions on the High Level Waste Program.

2 Mission

The mission of the High Level Waste System is to:

- Safely store the existing inventory of DOE high level waste
- Support Nuclear Materials Stabilization and other site missions by providing tank space to receive new waste
- Volume reduce high level waste by evaporation
- Pretreat high level waste for subsequent treatment and disposal
- Immobilize the low level liquid waste resulting from HLW pre-treatment and dispose of it onsite as Saltstone grout
- Immobilize the high level liquid waste as vitrified glass, and store the glass canisters onsite until a Federal Repository is available
- Empty and close HLW tanks and support systems per regulatory-approved approach
- Ensure that risks to the environment and to human health and safety posed by high level waste operations are either eliminated or reduced to acceptable levels

That part of the HLW Mission that supports other Site Missions remains a high priority. Because of the Secretary of Energy's acceptance of DNFSB Recommendation 2000-1 (sub-recommendations 1 through 9), SRS's plan for implementation of remaining NMS&S commitments is being revised. HLW will support the resulting revised strategy and plan once it is approved by the Secretary.

Both the Requirements and Target Cases included in this System Plan support all aspects of the HLW Mission are shown in Appendices H.1 to H.9 and Appendices I.1 to I.9.

3 Purpose

The purpose of this System Plan is to document currently planned HLW operations. These operations begin with the receipt of fresh waste, continue with storage, volume reduction, and pretreatment of the waste, and end with the operation of the DWPF and Saltstone. The program will end when all HLW has been vitrified, all HLW facilities have been closed, and all glass canisters have been shipped to the Federal Repository. This document is a summary of the key planning bases, assumptions, limitations, strategy, and schedules for facility operations needed to support the FY02 outyear planning process. This System Plan will also be used as a base document for:

- Developing future budgets
- Adjusting individual project baselines to match projected funding
- Projecting the Site's ability to support the approved Federal Facilities Agreement (FFA) Waste Removal Plan and Schedule and the Site Treatment Plan requirements.

4 High Level Waste System Scope

Key HLW facilities and supporting projects are grouped by function in the "Path to Closure" and FY02 Outyear Budget documents as shown below. This includes deactivation and long term surveillance and maintenance of all facilities. The Effluent Treatment Facility, Saltstone Facility, and the Consolidated Incineration Facility are included because of the supporting roles they play for the HLW System.

- SR-HL01: H-Tank Farm
  H-Area Tank Farm
  2H Evaporator
  3H Evaporator (previously referred to as the Replacement High Level Waste Evaporator Project)
- SR-HL02: F-Tank Farm
  F-Area Tank Farm
  2F Evaporator
  F/H Interarea Line
- SR-HL03: Waste Removal Operations and Tank Closure
  Waste Removal Operations
  Waste Removal Demonstrations
  Tank Closure Projects
- SR-HL04: Waste Pretreatment
  Extended Sludge Processing
  DWPF Feed Storage
- SR-HL05: Vitrification
  Defense Waste Processing Facility Operations
  Replacement Melter Projects
  Failed Equipment Storage Vault Projects
- SR-HL06: Glass Waste Storage
  Glass Waste Storage Building Operations
  Glass Waste Storage Building #2 Construction
  Glass Waste Shipping Facility
- SR-HL07: Effluent Treatment Facility
- SR-HL08: Saltstone
  Saltstone Facility Operations
  Saltstone Vaults Operations
  Saltstone Vault Projects
- SR-HL09: Tank Farm Service Upgrades (Complete)
- SR-HL10: H-Tank Farm Storm Water System Upgrades
- SR-HL11: Tank Farm Support Services F Area
- SR-HL12: HLW Removal
  Waste Removal from Tanks
  Processing Facility Upgrades (including Vitrification)
  Space Management Upgrades
  Piping Upgrades (H-Tank Farm East Hill)
- SR-HL13: Salt Disposition
- SR-SW01: Consolidated Incineration Facility
- SR-FA24: High Level Waste Facility Disposition

The inter-relationships of these facilities and projects are shown in Appendix D, Simplified HLW Flowsheet Diagram.

5 Planning Methodology

Operation of the HLW System facilities is subject to a variety of programmatic, regulatory, and process constraints as described below.

5.1 Planning Oversight

Some uncertainty is inherent in this Plan. Actual operating experience in the new processes, emergent budget issues, changes to Canyon missions and production plans, evolution of Site Decontamination & Decommissioning initiatives, and other factors preclude execution of a “fixed” plan. Therefore, DOE Headquarters (DOE-HQ), DOE Savannah River (DOE-SR) and Westinghouse Savannah River Company (WSRC) personnel are continuously evaluating the uncertainties in this System Plan and incorporating changes to improve planning and scheduling confidence. WSRC refines and updates this System Plan in conjunction with facility operations planning and budget planning.

The **HLW Steering Committee** provides the highest level of oversight of the HLW System. This Committee consists of members from DOE-HQ, DOE-SR, and the WSRC HLW Division. The Committee meets periodically to formally review the status and operational plan for the HLW System. DOE-HQ, DOE-SR, and WSRC HLWD approve the HLW System Plan.

The **HLW Program Board** is a WSRC committee that provides oversight and approval of the HLW System Plan and its schedules. These form the schedule and cost “baseline” for the overall program. Maintenance of the baseline is controlled via a formal change control process.

The **Technical Oversight Steering Team (TOST)** is comprised of senior WSRC professionals and managers from HLW Engineering, the Savannah River Technology Center (SRTC), and HLW Program Management, and provides oversight for resolution of technical issues within the HLWD.

The weekly **HLW Interface Meeting** among HLWD Facility Managers and others ensures that near-term activities impacting multiple facilities are closely coordinated to maximize effective allocation of resources.

The **High Level Waste Management Technology Program Plan (TPP)** describes the integrated technology program plan for the SRS HLW System. The program is based upon the specific needs of the HLW System and is organized following system-engineering functions. Specific tasks, funding, deliverables, and milestones are presented for each fiscal year; the plan is updated and issued annually. For additional information on current and planned activities, refer to Section 9, Technology Development.

Waste Acceptance Criteria (WAC) are in place for all waste-receiving facilities. Influent waste streams must be compatible with existing equipment and processes, must remain within the safety envelope, and must meet downstream process requirements.

The **High Level Waste Management / Nuclear Materials Interface meetings** ensure clear communication of needs between NMS&S and HLW to improve communication of processing plans and their associated impacts on Tank Farm space and DWPF canister production. These meetings are held on a weekly basis between the working level planners and waste forecasters. Upper level management meets on a quarterly basis to discuss major planning assumptions and issues.

5.2 Modeling Tools

WSRC uses a suite of computer simulations to model the operation of the HLW System. Each model is designed to address different aspects of long range production planning. WSRC uses these models interactively to guide long-range production planning.

The **Waste Characterization System (WCS)** documents the composition of the waste in each of the 51 HLW tanks. Sludge, salt, and supernate are characterized separately. The data encompass 41 radionuclides, 38 chemical species, and 23 other waste characteristics, and come from a multitude of monthly reports, waste sampling results, Canyon process records, and solubility studies. The Waste Characterization System represents the best compilation of SRS HLW characterization to date, and provides a sound basis for production planning analyses. The data for use in this System Plan was the WCS datafile of January 14, 2000.

The **GlassMaker Model** is a program which takes its compositions from the WCS, processes the compositions for DWPF, and then runs the resulting compositions through the PCCS algorithms, with statistics, to determine if an acceptable glass blend can be made. The version of GlassMaker used for this System Plan treats sludge and supernate for each batch. It assumes an average salt composition. The model runs each batch, dilutes the supernate, washes the sludge, and then determines the glass acceptability for that batch of sludge. Since its purpose is to determine glass acceptability and other parameters associated with a batch, it is a time independent model. It was written to be an easy to use, quick running program so that different sludge batch blends can be tested expeditiously. For this revision of the System Plan, the Glassmaker Model was used to evaluate the sludge batch sequencing changes to determine if an acceptable glass blend is made by each sludge batch.

The **Production Model (ProdMod)** is a linear equation model that uses Speedup® software. The linear equations used in ProdMod enable it to calculate the entire program in monthly and annual increments, with an approximate one minute run time. This enables planners to quickly evaluate different operating scenarios while still tracking key parameters. ProdMod tracks three key waste constituents:

- Sodium, because it drives the sludge washing operation in ESP
- Potassium, because it determines the amount of precipitate produced by salt processing
- Cesium, because many source term limits are based on cesium concentrations.

ProdMod uses the Waste Characterization System as its source of waste data. The ProdMod data define the programmatic scope in the baseline.

The **Space Management Model (SpaceMan)** is a PC-based Visual Basic program used to track available tank space. Two input files are needed to run the program. The data file provides the chemistry source data from the WCS. The strategy for controlling tank farm space is provided by a separate management file. This file inputs

- tank farm activities, such as:
  - external receipts (from Canyons, RBOF, ETF, flush water, and inhibitor additions)
  - waste transfers
  - evaporation
  - waste removal (including salt dissolution and sludge removal)
  - ESP (including aluminum dissolution)
- tank status (fill limits, jet heights, closure, reuse, etc.)
- receipt chemistry.

The program automatically steps through each week and tracks available space, inventory movement, and tank chemistry. The model can eventually be set up to also track Salt Processing, DWPF canister production and Saltstone vault usage. The evaporation simulation (salt space generation and ETF overheads production) is based on current supernate thermodynamic models. The outputs include a graphical tank farm display depicting individual tanks grouped by system. Within each tank, supernate, saltcake, and sludge are depicted graphically by different colored regions whose sizes are adjusted to indicate the relative contents of each within the tank. Calculated inventory values are placed in output files to develop material balance tables and charts.

The **HLW System Plan Financial Model** is based on fixed and variable costs. Fixed costs are those costs required to keep a facility in a “hot standby” mode, in which the facility is fully manned with a trained workforce ready to resume production immediately. Variable costs are those costs that vary with production, including: raw materials, repetitive projects such as outfitting tanks with waste removal equipment, replacement glass melters, Failed Equipment Storage Vaults, Saltstone Vaults, some Capital Equipment, etc. Variable costs go to zero if production is zero. The Financial Model is used to determine the long-term cost impacts of accelerating or delaying HLW production schedules. The Financial Model data define the cost baseline for the program.

The WCS, GlassMaker, ProdMod, Spaceman, and the Financial Model were used to generate the production planning data contained in the Appendices H and I of this Plan.

Several additional models are available but were not used to provide input into this Plan.

The **Chemical Process Evaluation System (CPES)** is a steady-state model originally developed as a design document for DWPF. The strength of this model is the size of the database it can manage. The current version of CPES tracks 183 chemical compounds in 1,750 process streams connecting over 700 unit operations. Its output consists of a complete tabular material balance for all chemical compounds in each process stream. CPES models waste processing operations for each of the ten sludge batches. Sludge composition varies widely from tank to tank, so CPES uses tank-specific sludge composition data, as defined by WCS. Salt composition, however, is relatively uniform so CPES assumes all salt wastes are blended into an "average salt" composition. CPES reads waste composition data directly from the Waste Characterization System. This allows planners to easily determine how changes in waste composition data will impact sludge batches and subsequent processing in DWPF.

The **Product Composition Control System (PCCS)** has as its main role the on-line prediction of glass quality in DWPF. It is also used off-line to verify that the Tank Farm waste blends modeled by CPES will be processable in DWPF and will produce acceptable glass. PCCS examines glass property constraints, including liquidus temperature, viscosity, durability, homogeneity, solubility, alumina content, and frit content. PCCS also determines the optimum glass blend to maximize waste loading in glass thereby minimizing canister production for each sludge batch. ESP sludge washing and aluminum dissolution endpoints are established based on CPES and PCCS analyses.

The **HLW Integrated Flowsheet Model (HLWIFM)** is a non-linear, dynamic simulation, in the same Speedup® software as ProdMod, that addresses daily variability over a planning period of approximately 3 years. HLWIFM can model transient waste processing conditions (such as tank levels, temperatures, or curie content) against known processing constraints (such as safety parameters, source term limits, operations limits, and regulatory permit requirements).

To expedite modeling of different production planning scenarios, the individual facility modules of the HLWIFM can be run independently. The results of these facility-specific runs are available in seconds, not hours, and are used to optimize facility operations. They are also useful as "real-time" predictive and diagnostic tools while the facility is operating. Facility-specific models have been developed for ESP, the evaporators, and DWPF. HLWIFM also uses the Waste Characterization System as its source of waste data.

These three models have been superceded, for System Plan purposes, by ProdMod, SpaceMan, and GlassMaker because of the latter's flexibility and speed.

5.3 Regulatory Constraints

Numerous regulatory laws, constraints, and commitments impact HLW System planning. The most important are described below.

The SRS **Federal Facility Agreement (FFA)** was executed January 15, 1993 by DOE, the Environmental Protection Agency (EPA), and the South Carolina Department of Health and Environmental Control (SCDHEC). The FFA, which became effective August 16, 1993, provides standards for secondary containment, requirements for responding to leaks, and provisions for the removal from service of leaking or unsuitable HLW storage tanks. Tanks that do not meet the standards set by the FFA may be used for the continued storage of their current waste inventories, but must adhere to a schedule for removal from service and closure. A revised "F/H Area High Level Waste Removal Plan and Schedule (WRP&S)" was submitted to EPA and SCDHEC on January 15, 1998. The WRP&S provides start and end dates for the removal from service and operational closure of each non-compliant tank and commits SRS to remove from service and close the last non-compliant tank no later than FY22. The WRP&S also provides for the possibility that Tanks 4-8 could be used to store concentrated supernate after the completion of bulk waste removal. The reuse of Tanks 4-8 is not planned in this revision of the System Plan.

The WRP&S was approved by SCDHEC on February 26, 1998 and by EPA on June 22, 1998. The approved WRP&S is an enforceable commitment from DOE to SCDHEC and EPA. Refer to Appendix E to see the approved schedule.

The production plans for the Requirements and Target Cases as depicted in Appendix H & I of this Plan, meet this commitment. However, meeting the commitment will require renegotiation with SCDHEC to switch some individual tanks in the schedule. This minor modification is not expected to be a problem with the State.

The **National Environmental Policy Act (NEPA)** requires federal agencies to assess the potential environmental impacts of constructing and operating new facilities or modifying existing facilities. Four existing NEPA documents directly affect the HLW System and support the operating scenario described in this Plan:

- DWPF Supplemental Environmental Impact Statement (SEIS)
- Waste Management Environmental Impact Statement (EIS)
- Interim Management of Nuclear Materials (IMNM) Environmental Impact Statement
- Environmental Assessment (EA) for the Closure of the High Level Waste Tanks in F & H-Areas at the Savannah River Site

An EIS is currently being prepared specific to HLW tank closure. This EIS will provide DOE stakeholders and regulators an additional opportunity to provide input to the tank closure process, including alternatives. A Record of Decision (ROD) is expected in FY00.

A Supplemental EIS will be prepared in FY01 specific to the Alternative Salt Disposition project. This SEIS will provide DOE stakeholders and regulators an opportunity to provide input to the Alternative Salt Disposition process, including alternatives.

The **Site Treatment Plan (STP)** for SRS describes the development of treatment capacities and technologies for mixed wastes. This allows DOE, regulatory agencies, the States, and other stakeholders to efficiently plan mixed waste treatment and disposal by considering waste volumes and treatment capacities on a national scale. The STP identifies vitrification in DWPF as the preferred treatment option for treating SRS liquid high level waste. It identifies incineration followed by stabilization in the CIF as the preferred treatment option for many mixed wastes.

DWPF has met its STP commitments to submit permit applications, enter into contracts, initiate construction, conduct systems testing, commence operations, and submit a schedule for processing backlogged and currently generated mixed waste. SRS committed that:

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

The production plans for the Requirements and Target Cases meet this commitment.

CIF has met its STP commitments to submit permit applications, enter into contracts, initiate construction, conduct systems testing, and begin operations. The commitment to submit an LDR waste processing rate schedule was met on October 17, 1997. The schedule commits to a processing completion milestone and several intermediate milestones, based on mixed waste that was in RCRA permitted or interim status facilities as of September 30, 1997. Incinerable mixed waste received at RCRA storage facilities after that date is not included in the schedule, but this waste will be accumulated and burned in the appropriate CIF campaign (listed vs. characteristic). On September 18, 1998, CIF met the requirement to complete processing of 50% of the backlogged non-PUREX SRS mixed wastes by 4Q federal FY98. Additional near-term schedule commitments for CIF include:

> *"Submit RCRA Part B permit application or permit modification for pre-treatment of non-PUREX SRS mixed wastes by 1Q federal FY2002."*
>
> *"Complete processing of 50% of the backlogged PUREX waste by 4Q FY2009."*

Based on the decision to suspend operations of the CIF by the end of FY00, alternative methods for future solvent disposition will be evaluated and discussed with the state. If no better solvent processing methods are determined, the restart of the CIF is expected in FY04 with full operation in FY05. Since the next STP milestone on solvent processing is in FY09, there is adequate time available to support this commitment.

6 Planning Bases

6.1 Reference Date

The reference date for the mathematical modeling (ProdMod and SpaceMan) of this Plan is January 14, 2000. All other data is current as of March 1, 2000. Schedules, forecasted budget, milestones, cost estimates, and operational plans were current as of that date.

6.2 Funding

The funding required to support this Plan is shown in Appendix H.1 and Appendix I.1 for the Requirements and Target Cases respectively, by individual projects. Key milestones dates required to remove waste from storage, process it into glass or saltstone grout, and close HLW facilities shown in Table 6-A are supported by the budget as described in the Appendixes.

Table 6–A Key Milestones

Key Milestone	Rev 10 Planning Case	Rev 11 Requirements Case	Rev 11 Target Case
DWPF Sludge Production (in average canisters per year)			
• FY00	200	250	250
• FY01 to FY10	200	250	200
• FY11 to End of Program	200	250	225
Date by which the 9 “high risk” sludge tanks are emptied	FY10	FY09	FY14
Date by which all “high risk” tanks are emptied	FY17	FY16	FY16
Date Salt Processing Becomes Operational	FY10	FY10	FY10
Number of Salt-Only Canisters Produced	159	409	0
Total Number of Canisters Produced	5,732	6,044	5,649
Date by which waste processing is completed	FY26	FY22	FY23
Are all regulatory commitments met?	Yes	Yes	Yes
FY01 funding Above Budget Target ($ in millions)	N/A	$19	–
FY02 funding Above Budget Target ($ in millions)	N/A	$40	–
Estimated Life-Cycle Costs			
• Costs in escalated dollars ($ in billions)	$20.8	$18.1	$18.4
• Costs in constant 1999 dollars ($ in billions)	$14.1	$12.6	$12.7
• Tank 8 ready to start washing with Tank 40	7/00	8/00	8/00
• Tank 7 ready for sludge removal	7/02	4/02	7/02
• Tank 11 ready for sludge removal	12/01	8/01	2/05
• Begin GWSB #2 Design & Construction	10/02	10/01	6/02
• Complete repair of 450 GWSB #1 Plugs	FY03	FY03	FY04
• Begin GWSB #2 Radioactive Operations	FY07	FY05	FY07
• Complete closure of Tank 16	9/03	9/04	3/13
• Complete closure of Tank 19	3/03	3/02	3/02
• Complete closure of Tank 18	3/04	3/04	3/04
• Reuse Tank 49 for waste storage	FY03	9/00	9/00
• Reuse Tank 50 for waste storage	FY06	9/02	9/03
• Start shipping canisters to the Federal Repository	FY15	FY10	FY10
• Complete shipping canisters to Federal Repository	FY26	FY39	FY38
• Facility Deactivation Complete	FY28	FY40	FY39

7 Key Issues and Assumptions

Key issues affecting the HLW System are described below. Resolution of each of these issues will have a significant impact on the HLW System for years to come. Each issue has an assumed outcome. Assumptions are therefore listed for each key issue. Potential contingency actions are described, should the assumptions prove to be incorrect.

7.1 Funding Guidance

Issue: The HLW System is especially sensitive to funding levels in the near term (FY01-FY10). The funding levels described in the two cases are needed to ensure:

- Safe storage of High Level Waste
- Risk reduction progress by removing waste from high risk tanks
- Waste immobilization by operating the DWPF
- Selection, design, construction and startup of the Salt Processing Facility

Further reductions in funding levels would jeopardize one or several of the above activities. This would result in a delay in waste removal program and increase life cycle costs by an estimated $420 million dollars per year of delay incurred by the program (constant FY00 dollars).

Background: This Plan presents two funding scenarios:

- **Requirements Case** – DWPF production of 250 canisters per year; Salt Processing Facility startup in FY10.
- **Target Case** – DWPF production of 250 canisters per year in FY00, an average of 200 canisters per year in FY01-FY10 and 225 canisters per year in FY11-End of Program; Salt Processing Facility startup in FY10.

Assumptions: This Plan provides acceptable deliverables for both the Requirements and Target Case funding levels.

Contingency: If funding levels are reduced below the levels specified in the Target Case, the HLW System funding will go first to safe storage of waste, to risk reduction activities associated with removing waste from high risk tanks, DWPF operations and then to the Salt Processing Facility.

7.2 Age of the HLW Facilities

Issue: The material condition of many HLW facilities constructed from the early 1950s to the late 1970s is deteriorating.

Background: The following are examples:

- A transfer line secondary containment encasement in F-Area failed in one place and is leaking in several others. Because of this encasement failure, sixteen transfer lines to Tanks 1-8 have been taken out of service.
- Numerous carbon steel leak detection systems have failed and had to be repaired before transfers could be made.
- Routine repairs to service systems in the F and H-Area Tank Farms have escalated into weeks of unplanned downtime due to obsolete instrumentation and the poor condition of the service piping.

In many cases, waste cannot be transferred out of tanks unless temporary services are installed or emergency measures are taken. Aging facilities cause excessive unplanned downtime and addition of unplanned scope to existing projects or the need for new Line Item projects to ensure that the Tank Farm infrastructure will be able to support the HLW Program. It should be noted that the Tank Farm cannot be “shut down” as it contains approximately 35 million gallons of highly radioactive waste, much of which is in a mobile form.

Assumptions:
- An H-Area secondary containment encasement (similar in design and vintage to the failed F-Area encasement) will not fail.
- Sufficient funding will be allocated for maintenance of the Tank Farms, and planned Line Item projects will remain on schedule to help refurbish and preserve the Tank Farm infrastructure. These projects include:
  - Tank Farm Storm Water Upgrades — FY98-FY00
  - Tank Farm Support Services (FTF) — FY99-FY02
  - Piping Upgrades (HTF East Hill) — FY01-FY05 (Requirements Case)
FY02-FY06 (Target Case)
- Leak detection piping and systems will continue to be repaired as needed.

Contingencies:
- Accept a slowdown of the HLW Program and increased life cycle costs to reallocate funding to the Tank Farm infrastructure.
- Accept increased environmental risks as tank infrastructure systems age.
- Obtain additional funding.

7.3 Age of the HLW Tanks

Issue: SRS's 51 underground HLW storage tanks are intended for interim liquid waste storage only. The oldest of these tanks have already been in service for almost 50 years. Nine of these tanks have a leakage history. Continued storage of liquid waste in these tanks poses a potential threat to the environment.

Background: The first SRS HLW tanks were put into service in the early 1950s. Twenty-four of the 51 tanks are considered "old-style" (non-compliant) tanks and do not meet current requirements for secondary containment and leak detection. DOE has enforceable commitments to SCDHEC and the EPA to close these "old-style" tanks (see Appendix E) by FY22. Two of the tanks (Tanks 17 and 20) have already been closed. Many of the tanks are in or near the water table. Approximately 35 million gallons of high level waste are stored in the Tanks Farms, much of it in a mobile form.

Per this Plan, many of these tanks will be well over 50 years old before they are closed. In the last 2 years, two additional tank integrity issues have arisen with these tanks.

- Tank 15 has developed a type of leak site not previously seen: a crack running parallel to a weld seam, above the waste level, approximately 18 inches in length. This type of leak site will make waste removal from this tank much more difficult. If other tanks develop similar cracks, the risk of releases and the complexity and cost of future waste removal will be increased.
- Increased corrosion has been observed in several tank secondary pans. These secondary pans, which represent the last line of defense for this waste, already contain waste from previous leaks in the primary walls of the tanks.

Although SRS maintains an aggressive program to monitor the integrity of all waste tanks, these recent findings underscore the need to fund Tank Farm infrastructure projects and complete waste removal from these tanks as soon as possible.

Assumptions:
- Successful waste chemistry controls, temperature controls, and construction stress-relief methods will prevent new leak sites.
- Rigorous tank inspections will monitor known leak sites and detect any new leak sites, if they occur, so that appropriate compensatory actions can be taken.
- Resources will be available to continue to remove liquid waste from underground tanks, thereby significantly reducing the environmental threat posed by storage of liquid high level waste in underground tanks.

Contingency:
- Maintain emergency storage capacity in the Tank Farms to accommodate transfer of waste from a leaking tank, if a leak occurs.
- Accept increased environmental risks as tank systems age.
- Obtain additional funding.

7.4 Tank Farm Waste Storage Space

Issue: The Tank Farms' useable waste storage space is continuing to be consumed by delays in the start of salt processing, planned long term sludge-only DWPF processing, and continued receipts of Canyon wastes. If salt processing is delayed until FY10 and the waste generating facilities perform as planned, then the Tank Farm waste inventory will exceed the storage capacity unless additional modifications are implemented. Modification initiatives have been developed which will support the maintenance of adequate Tank Space until 2010 when the Salt Processing Facility becomes operational.

Background: All parts of the HLW System at SRS are operational except the salt processing plant. Work on salt processing was suspended in January 1998 because the facility could not cost effectively meet both the safety and production requirements for the High Level Waste System. Since January 1998, a rigorous systems evaluation was done on all available salt processing technologies and Research and Development for process selection is currently being completed. The selection process has narrowed the alternative technologies to Small Tank Tetraphenylborate (TPB) Precipitation, Crystalline Silicotitanate (CST) Non-Elutable Ion Exchange, and Caustic Side Solvent Extraction. The final selection of a processing alternative is expected in FY01. The current schedule for startup of the facility is projected for mid FY10.

It must be remembered that minimal space is gained from sludge removal, as it is a minor component of the total space in use in the Tank Farms. In addition, almost all of the sludge processed prior to FY10 is currently stored in non-compliant tanks. Salt and supernate removal is the only process that truly gains space in the Tank Farm. As a result, the Tank Farms must continue to process the significant DWPF recycle and ESP washing streams within existing space limitations. DWPF is expected to continue sludge-only operations until salt processing startup.

A HLW Space Management Team (Space Team) was chartered to recommend the best management practices for safe stewardship of HLW while maximizing available tank space. The Space Team issued its final report in August 1999, and the results of the report were updated, where appropriate, and incorporated into this revision of the System Plan.

At the time of this Plan, F-Tank Farm has approximately 200,000 gallons of useable space available, and H-Tank Farm has approximately 1,100,000 gallons of useable space available. Working inventory must be maintained in the Tank Farms to receive large volumes of new waste (*e.g.* ESP wash water) or to provide contingency space for unplanned evaporator outages.

Assumptions:

- The Canyon's waste stream volumes and the DWPF recycle volumes will be less than or equal to the forecast.
- The current 2H Evaporator issue will be resolved and the 2H and 2F Evaporators will operate as planned and achieve their space gain goals.
- The 3H Evaporator will begin radioactive operations in April 2000 and operate as planned.
- Significant reductions will be made in the volume of DWPF Recycle sent to the Tank Farms (recent actions have provided a 40% reduction in recycle volumes).
- The backlog of dilute supernate currently stored in H-Tank Farm Type III tanks can be successfully retrieved and evaporated as a means to recover space in the Tank Farms.
- Tanks 49 and 50 will undergo required modifications to allow their use for concentrated waste storage service.
- Tank 26 sludge will be moved into Batch 4 and the 2F Evaporator will be placed in standby.
- Tank 35 will be retrofitted to be a Salt Receipt tank for the 3H Evaporator System.
- An evaporator may be installed in the DWPF Salt Cell to process DWPF recycle if required.

Contingencies:

- Implement other recommended new strategies that increase available space.
- Salt processing may resume before FY10.

- HLW System attainment could be decreased, however, this would not meet the goal of reducing the risk in the "high risk" tanks as soon as possible.
- Planned Canyon programs could be slowed down until the Tank Farms are in a better position to support them.

7.5 Uncertainties in Tank Space Assumptions

Issue

The Tank Farm space management strategy is based on a set of key assumptions involving canister production rates, influent stream volumes, Tank Farm evaporator performance and space gain initiative implementation. Significant changes in any of these key assumptions will impact HLW's ability to successfully support planned processing commitments due to a lack of Tank Farm waste storage space.

Background:

The HLW Space Team was chartered to recommend the best management practices for safe stewardship of high level waste while maximizing available tank space. The Space Team issued its final report in August 1999. The results of the report are based on several assumptions that were applicable at the time. Since the report was issued, there have been changes or updates to several of the assumptions used by the Space Team.

For example, the Space Team report was based on an average DWPF canister production rate of 200 cans/yr while the Requirements Case in this revision of the System Plan is based on 250 cans/yr. The different DWPF canister production rates assumed for the Requirements Case is one factor that results in the implementation of a different Tank Farm space management strategy from that proposed by the Space Team. At a 250 can/yr production rate, the timing of ESP sludge preparation batches and the resulting washwater decants to the Tank Farm will be different. Therefore, the timing and need for the space gain initiatives required for the Rev. 11 Requirements and the Target Case have been individualized to meet the needs of these cases. Both of these strategies have changed from that proposed in the Rev 10 Update.

In addition, the impact on Tank Space from changes in Canyon waste forecasts involving existing missions or from potential new Canyon missions must be continually assessed. The Canyon forecasts have significantly increased in the past year as planned processing campaigns are better defined. At present the Canyon forecasts 6.2 million gallons of waste transfers over the next 6-8 years; last year this forecast was 3.0 million gallons.

The Space Team also selected acid evaporation at DWPF as the preferred process technology for eliminating the transfer of recycle to the Tank Farm. While this initiative is required in the Requirements Case, it carries uncertainties associated with being able to complete design, construction, and startup of the evaporator to achieve space savings by FY04 under current budget constraints. Another uncertainty is associated with how to handle the evaporator bottoms. It is now estimated that approximately 15% of the recycle stream must be returned to the Tank Farm. This stream is made up of constituents in the evaporator bottoms that can not be sent to the melter.

Because of aggressive facility efforts, significant recycle reduction ideas have been implemented at DWPF in FY00. If these recycle reduction efforts can be increased and maintained over the next several years, then it may preclude the need for installing an acid evaporator at an estimated cost of $25 – 35 million. In the Target Case, the Acid Evaporator modification will not be required.

The bottom line is that there will continue to be changes to assumptions made involving Tank Farm space management. Due to the uncertainties in assumptions, the Tank Farm space management strategy must continually be evaluated to respond to emerging issues and changing processing scenarios. The allocation of resources must continue to be balanced between reducing the risk from the continued storage of high level waste in underground tanks and the cost to implement space gain initiatives.

Assumptions:
- Waste minimization efforts involving Canyon waste stream volumes and the DWPF recycle volumes will be successful such that the actual volumes will be less than or equal to the forecast.
- Evaporators will operate as planned and achieve their space gain goals.
- Space Gain initiatives can be completed as forecast.

Contingencies:
- Implement other recommended new strategies that increase available space.
- Salt processing may resume before FY10.
- HLW System attainment could be decreased, however, this would not meet the goal of reducing the risk in the "high risk" tanks as soon as possible.
- Planned Canyon programs could be slowed down until the Tank Farms are in a better position to support them.

7.6 Return of Tank 49 to Waste Storage Service

Issue: If salt processing is delayed until FY10 and the waste generating facilities perform as planned, then the Tank Farm waste inventory will exceed the storage capacity in Type III tanks (currently designated for waste storage). The plan is to return Tank 49 to waste concentrate storage starting by the end of FY00. The disposition of benzene bearing solutions currently stored in Tank 49 has not been determined.

Background: Tank 49 was previously part of the ITP process where it was to be used as a precipitate feed tank for DWPF. It currently contains approximately 75 kgal of benzene bearing solution from ITP demonstration runs that must be removed prior to its return to waste storage service. Physical modifications to transfer lines must also be made. Tank 49 must be tied back into transfer lines to HDB-7 and ties to the Late Wash Facility must be disconnected.

Assumptions:
- Existing solution from demonstration runs in Tank 49 can be adequately dispositioned.
- Modifications required at the tank can be made.

Contingencies: Implement other recommended new strategies that increase available space.

7.7 Return of Tank 50 to Waste Storage Service

Issue: If salt processing is delayed until FY10 and the waste generating facilities perform as planned, then the Tank Farm waste inventory will exceed the storage capacity in Type III tanks (including returning Tank 49 to service in FY00). The plan is to add concentrated supernate to Tank 50 starting in FY03. Before using Tank 50 for waste storage, a new ETF concentrate storage location will be required. A method to process the current material in Tank 50 and the continuing stream from ETF must be provided.

Background: Tank 50 was used as a part of the ITP process where it stored the low activity filtrate stream for feed to the Saltstone Facility. It is currently used to receive and store ETF concentrate that will eventually be fed to Saltstone. Physical modifications will be required at Tank 50 to tie transfer lines back into HDB-7 and to disconnect transfer line tie-ins to ETF and Saltstone. Shielding upgrades must be made to the Tank 50 valve box and at slurry and transfer pump spray chambers. This allows Tank 50 to be used for concentrated supernate storage versus the current ETF bottoms storage.

In FY98, Saltstone processed approximately 300,000 gallons of Tank 50 waste inventory and entered an extended planned lay-up. This System Plan assumes that the ETF concentrate stored in Tank 50 can be treated using an off-site vendor starting in FY02. This will allow Tank 50 to be de-inventoried in preparation for its use as a HLW storage tank. If the use of an off-site vendor is successful, then Saltstone will remain in lay-up until the start of Salt Processing.

Since Tank 50 will be required for concentrated waste storage service, the use of a vendor for processing ETF concentrate must be continued until the startup of Salt Processing in FY10. At that time, the Saltstone Facility must be restarted to support the large volume filtrate stream from Salt Processing and the ETF concentrate can be sent to Saltstone. A new storage tank may be required to optimize processing with the projected low annual ETF concentrate stream (approximately 180 kgal/yr) until Salt Processing begins operation. A new operational strategy must be developed to balance ETF processing versus planned vendor processing of the concentrate.

Assumptions:

- ETF concentrate stored in Tank 50 can be treated using an off-site vendor starting in FY02.
- After processing the Tank 50 material, the off-site vendor will continue to process the ETF concentrate at a rate of approximately 180 kgal/yr.
- Physical modifications can be made to support concentrated waste storage in Tank 50 and the processing of ETF concentrate by an off-site vendor.

Contingencies:

- Implement other recommended new strategies that increase available space.
- Saltstone can be restarted in FY02 to process the existing Tank 50 waste. From FY03 until the startup of Salt Processing in FY10, Saltstone can be intermittently operated to support continued annual receipts of ETF concentrate.

7.8 Evaporator Operation Constraints (2H PISA)

Issue: The 2H Evaporator is currently shutdown because of an accumulation of solids in the evaporator pot. The solids contain uranium and sodium aluminosilicate, including higher than expected quantities of U235. Although preliminary investigations indicate that the solids are critically safe, there is a risk that continued operation of the evaporator could lead to conditions under which a criticality would be credible.

Background: During a planned outage in October 1999, visual inspection of the 2H Evaporator revealed solids buildup on evaporator internals and in the bottom cone area of the pot. Approximately 18 grams of material was obtained from the bottom cone area for analysis anticipating an end of CY00 chemical cleaning. The 2H Evaporator was restarted in December 1999. Erratic lift rates were experienced and the evaporator was shutdown in January 2000 when attempts to correct the lift rate were unsuccessful. In early January 2000, results from the sample revealed the material consists of sodium aluminosilicate and sodium diuranate (with an average total uranium content of 6.9 wt% and an average 2.3% enrichment). Based on the analysis results, a PISA was issued and all evaporator operations were suspended.

To ensure incoming waste streams from continuing DWPF and Canyon processing could be accepted without immediate tank space impacts, transfer sequences and priorities were changed. These included raising operating limits, reducing the DWPF recycle stream, accelerating Tank 39 organic PISA resolution, and implementing modifications and procedure changes to allow single wall tanks to accept DWPF recycle.

To resolve the 2H problem, immediate compensatory actions were taken. First, Site Criticality Committee concurrence was obtained that the current 2H configuration is safe. Second, multi-disciplinary teams were deployed to:

- Understand and address the chemistry
- Develop a cleaning technique for the evaporator pot
- Develop a strategy for future evaporator operation, including 2F and 3H
- Develop a strategy for tank space management during the resolution of the issue.

Third, an extensive sampling program was performed to characterize the problem.

Assumptions:

- 2H Evaporator operation questions will be resolved and the evaporator will restart by October 1, 2000.
- Action items regarding 2F and 3H Evaporators will be successfully resolved and they will be able to operate as needed during FY00.
- DWPF recycle and existing supernate containing DWPF recycle will be able to be evaporated as planned.

- Compensatory actions to handle incoming waste streams will result in minimal impact to waste generators.
- Tank Space management program will ensure sufficient tank space is available to continue processing feed for DWPF.

Contingencies: Implement process and equipment modifications that totally segregate high silicate streams (*e.g.* DWPF recycle) from the tank farm.

7.9 Tritiated Water

Issue: The WSRC self imposed administrative ETF release limit for tritium was reduced. It is now at a level that will challenge HLW, SFS, and NMS&S to control the effluent of tritium to ETF without adversely effecting normal operations in these facilities. To maintain adequate useable space in the Tank Farm, for the next few years this Plan relies on space gained from evaporation of backlogged waste that contains higher levels of tritium.

Background: The WSRC self imposed administrative ETF release limit was reduced from 45 curies/day to 5 curies/day of tritium to accommodate a processing concern encountered by ETF in September of 1998. The 5-curies/day limit was established based on historical data during a period that did not include the typical processing of high-heat backlog waste. This did not allow normal evaporator operation in F-Tank Farm because the overheads produced by the 2F Evaporator system processing high-heat waste exceeded the ETF release limit for tritium. The 2F Evaporator was forced into an outage for approximately 6 weeks. During this time a task team was assembled to analyze the problem and recommend solutions to the Senior Site ALARA committee. The team demonstrated that the 5 curie/day limit was not reasonable with respect to processing high-heat backlog waste or the waste expected from dispositioning of backlogged fuel assemblies by NMS&S. In follow up meetings with the ALARA committee, they agreed to raise the ETF tritium release limit to 30 curies/day. This level is still well below safe drinking water limits. However, planned future evaporation of backlogged waste in Tanks 30, 32, 35 and 39, new Canyon waste, and the NMS&S processing of backlogged fuel assemblies will most likely challenge the 30 curies/day tritium release limit.

Coordination of efforts between NMS&S, HLW and ETF will be required to successfully treat this waste stream without impacting day-to-day operations at these facilities.

Assumption: Operating schedules can be adjusted to "level load" the tritium effluent to ETF to an acceptable level.

Contingencies:

- HLW System attainment could be decreased.
- Planned Canyon programs could be slowed down until ETF is in a better position to support them.

7.10 Salt Processing Disposition and Resumption of Operations

Issue: DOE has not made a final decision on the process to treat HLW salt solutions. Conclusions and recommendations made in this Plan can be significantly impacted depending on the final alternative selected and its associated startup date.

Background: All parts of the HLW System at SRS are operational except the salt processing plant. Processing at the In-Tank Precipitation (ITP) Facility was suspended because the facility could not cost effectively meet both the safety and production requirements for the High Level Waste System. A HLW salt solution processing alternative evaluation is currently underway. An extensive list of potential treatment options has been pared down to three primary alternatives. These alternatives include Small Tank Tetraphenylborate (TPB) Precipitation, Crystalline Silicotitanate (CST) Non-Elutable Ion Exchange and Caustic Side Solvent Extraction. The current projected schedule for Salt Processing Facility operation is mid FY10. DWPF is expected to continue sludge-only operations until salt processing startup.

In the Requirements Case salt-only canisters will be produced for the last 2-3 years of the program. The production of salt-only canisters will require additional evaluation to ensure a glass can be made that meets requirements (durability, heat loading, etc.). Development of a glass formulation with new frit and/or new glass forming chemicals will be required. The potential impact of the salt-only canisters on the Glass Waste Storage Building must also be evaluated. In the Target Case, essentially no salt-only canisters will be produced.

Assumptions:

- This revision of the System Plan does not have the benefit of a final decision by DOE on the process technology to treat HLW salt solutions. Therefore, this Plan uses the values (salt solution feed volumes, precipitate feed rates, etc.) from the Small Tank Tetraphenylborate Precipitate Salt Disposition alternative. This Small Tank alternative is assumed to be representative of the three alternatives still under evaluation. Once a final decision is made on the preferred salt disposition process, a new revision of this Plan will be generated.
- Production of salt-only canisters will not impact processing plans.
- Funding will be available to support an accelerated schedule for construction and startup by mid-FY10.

Contingencies:

- Implement other recommended new strategies that increase available space.
- Salt processing may resume before FY10.
- HLW System attainment could be decreased, however, this would not meet the goal of reducing the risk in the “high risk” tanks as soon as possible.
- Planned Canyon programs could be slowed down until the Tank Farms are in a better position to support them.

7.11 Key HLW Processing Parameters Uncertainty

Issue: Subtle changes in a few key waste characteristics could dramatically impact HLW process planning and the overall length of the HLW Program.

Background: This Plan assumes that most of the aluminum in the sludge is in the form gibbsite, $Al(OH)_3$, which is soluble in a 3 molar NaOH solution, and can be removed by the aluminum dissolution process at ESP. However, some could be in the form of boehmite, AlO(OH), or aluminum silicates, which do not dissolve completely, and therefore would not be removed in ESP. This could impact processing in DWPF as well as the total number of canisters produced. This Plan assumes that 2 wt% insoluble solids are entrained in saltcake. If the actual amount is higher, then more canisters of glass will be produced. This Plan assumes that the accepted total potassium inventory in the Tank Farms is well defined. An increase in potassium will drive increases in total precipitate production.

This Plan also assumes the accepted weight percent solids in settled sludge are well known. An increase in the weight percent solids will result in more canisters of glass being produced. A change in the weight percent solids variable has already been seen in Sludge Batch 1A and resulted in a revision to the canister yield.

A Process Engineering group within HLW Engineering has been established to coordinate process interfaces and process chemistry internal to HLW and between HLW and NMS&S. This group will ensure that changes to key parameters (waste inventories and composition, modeling tool changes, modeling assumptions, etc.) that impact HLW system planning are agreed upon by all applicable parties before they are implemented. A primary purpose of this new team is to communicate key information so that all facilities are using the same data or assumptions for operating or planning activities.

: Waste sample analyses are being refined to obtain additional needed information without increasing the number of samples. Operating experience in facilities throughout the High Level Waste System will improve our understanding of the relationships among waste composition, waste characteristics, and waste processing. In particular, the upcoming sludge removal activities on Tank 8 and sludge washing of Batch 2 will allow a comparison of forecast versus actual inventory data for these tanks. Actual Sludge Batch 1A and 1B processing data has allowed us to better predict production information for future batches.

Assumptions:
- Sample results will confirm the waste composition and characteristics described above.
- Facility processes will be adjusted as necessary.
- Blending of feed to Salt Processing Facility and ESP will compensate for any transient (high or low) conditions in individual waste tanks.

Contingencies:
- Additional waste tank samples could be retrieved and analyzed.
- Additional processing data will provide better information for future System Plans.
- Modifications to some facilities could be required.
- The total number of canisters to be produced may increase or decrease.
- The overall High Level Waste program could be lengthened.

7.12 Maintaining Continuous Sludge Feed to DWPF

Issue: Funding constraints for previous years and continuing into FY01 and FY02 have required difficult decisions in the planned HLW operating strategy, particularly with regard to the process of DWPF feed preparation. Based on current funding guidance, the schedules to maintain continuous sludge feed to DWPF require just-in-time completion dates for Sludge Batches #3 (Tanks 7, 11) and #4 (Tanks 7, 15, 18, 19 and 26) for the Requirements Case. In the Target Case, it was also necessary to rebatch tanks for the sludge batches (Sludge Batch #3 [Tank 7 only] and #4 [Tanks 11, 18, 19 & 26]). Waste removal and feed preparation, given the state of legacy high level waste now in the tanks, is a first-of-a-kind process abundant with challenges and uncertainties.

Background: For work recently completed on Tank 8 in preparation for waste removal, there has been an extraordinary amount of emergent work related to the poor condition of the tank, tank-top equipment, and supporting services. There have been significant Lessons Learned obtained from Tank 8 preparation work that will be factored into future waste removal tanks, where possible. However, low funding levels in FY00 for Tanks 11 and 7 moved much of the construction scope into FY01. This leaves minimal schedule contingency time for recovery from unexpected delays as were experienced on Tank 8 (tank riser interferences, high radiation rates, waste characterization issues, etc.).

The increase in projected canister yield (428 cans to 625 cans) for Sludge Batch 1B has helped to offset the funding impacts on feed preparation. This increase in canister yield resulted from two factors:

- After slurry pump replacement, a larger amount of sludge solids existed in Tank 51 than was originally forecast
- It was possible to move a greater amount of sludge from Tank 42 to Tank 51 than was originally planned.

However, these projections have already been factored into the schedule used for this Plan and any unexpected delays in feed preparation will impact sludge feed availability.

Assumptions:
- Sludge Batches #1B and 2 will perform as projected.
- There will be no major, unexpected delays in future Sludge Batch feed preparation.
- WSRC will be able to improve subsequent Sludge Batch schedules to sustain a production rate at the available funding levels for both the Requirements and Target Cases.
- A melter outage is projected in FY02 and a DCS outage is projected in FY04 at DWPF.

Contingencies:
- The DWPF production rate could be reduced.
- An extended outage could be planned.

7.13 Potential Delays in Tank Closures (DOE Order 435.1 Lawsuit)

Issue: In January 2000, the Natural Resources Defense Council (NRDC) and the Snake River Alliance (SRA) petitioned the Ninth Circuit US Court of Appeals to review and set aside DOE Order 435.1. The petitioners claim the Order 435.1 is “arbitrary, capricious and contrary to law.” The petitioners also claim that DOE’s categorical exclusion finding for this Order under

National Environmental Policy Act is "arbitrary, capricious and contrary to law." The Court of Appeals review, and potential set aside, of Order 435.1 could delay closing HLW tanks as required by the Federal Facility Agreement.

Background: In July of 1999 DOE issued Order 435.1 "Radioactive Waste Management." Order 435.1 sets forth the requirements for handling all DOE radiological waste, including the residual waste heel that cannot be removed from HLW tanks after bulk waste removal. Before closing an SRS HLW tank, the residual heel that cannot be removed must be able to meet the 435.1 criteria of Waste Incidental to Reprocessing (WIR).

Under Order 435.1, waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not high-level waste. It is managed under DOE's regulatory authority in accordance with the requirements for transuranic waste or low-level waste, as appropriate.

When determining whether spent nuclear fuel reprocessing plant waste is managed as another waste type or as high-level waste, either the citation or the evaluation process is used:

- **Citation**: Waste incidental to reprocessing by citation includes spent nuclear fuel reprocessing plant wastes such as contaminated job wastes including laboratory items such as clothing, tools, and equipment. The waste heel remaining in HLW tanks clearly does not meet the Citation criteria.
- **Evaluation**: Waste incidental to reprocessing will be managed as low-level waste and meet the following criteria:
  - Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
  - Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and
  - Are to be incorporated in a solid physical form at a concentration that does not exceed concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*; or will meet alternative requirements for waste classification and characterization as DOE may authorize.

DOE is planning on developing, by 6/00, a Waste Incidental to Reprocessing Determination to satisfy the requirements in Order 435.1 for the waste heel remaining in Tank 19.

Assumptions: Closure will proceed as planned with no impact from this appeal.

Contingencies: If the Court of Appeals sets aside 435.1 then DOE could revert back to the previous Radioactive Waste Management Order (5820.2A) that preceded 435.1 and close the remaining tanks under NRC guidance.

Order 5820.2A had no provisions for evaluating the waste heel of a HLW tank in order to manage that heel as low level waste. However, before 435.1 issuance, DOE determined that the material remaining in Tanks 17 and 20, at closure, satisfied criteria for "incidental waste," since it met the NRC guidance available. That is, the waste heel remaining after waste removal:

(*a*) *"has been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical;*
(b) "will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR Part 61; and
(c) " will be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied."

7.14 Authorization Basis Document Upgrades

Issue: The effort to finalize the development and implementation of Authorization Basis (AB) documents that reflect all the requirements of DOE Orders 5480.22 and 5480.23 for F and H-Tank Farms and the WPT Facilities is currently unfunded.

Background: Bringing the F and H-Area Tank Farms and the WPT Facility into full compliance with DOE Orders 5480.22 and 5480.23 will require significant manpower resources, and may require capital upgrades to these facilities. Completion of analysis to the standards specified in DOE Order 5480.23 for the Tank Farms will require additional funding. In addition, equipment upgrades or new systems may be required to meet Evaluation Guides for reduction of risk in each facility. Additional hardware modifications and training, procedure, and surveillance revisions will be necessary to comply with DOE Order 5480.22.

In order to maximize the efficiency of these upgrades, WSRC is developing a proposal for the scope of a consolidated, Graded Approach SAR as well as Facility specific TSRs. The development effort will focus on those activities that provide the most benefit towards improvement of safety and Conduct of Operations in relation to the effort required, while maintaining compliance with the DOE Orders. The compliant SAR and TSRs previously prepared for the WPT Facility will be used as the basis for the SAR. Included in the scope of the effort are identification of further analytic needs, simplification of controls, reconciliation of Facility differences, elimination of non-operational precipitation processes, and simplification of the implementation effort.

AB upgrades will provide an improved safety basis for the Tank Farms and WPT operations. However, additional resources must be applied to develop and implement these AB upgrades due to analytic requirements and controls that are more stringent. The upgrades for the Tank Farms consist of the following:

a) Update of the hazards analysis is required to incorporate facility worker hazards not previously assessed. New analysis for facility worker hazards not previously analyzed and review of existing accident analysis are required. This is to ensure that all hazards to the public, facility workers, and the environment associated with facility operations have been identified and assessed for impact. This analysis ensures that safety functions are identified to prevent or mitigate the consequences of each accident. Completion of the hazards analysis is currently planned for FY00.

b) Derivation of controls is required to finalize the selection of systems, structures, and components (SSCs) controls or administrative controls to perform the safety functions that prevent or mitigate the accidents. Controls can be existing controls or, when existing controls are inadequate or overly burdensome, newly developed equipment designed to perform the safety function. Development of new equipment can represent a significant cost, due to both the stringent and exacting requirements associated with safety class or safety significant classification and the number of tanks involved.

   Associated with derivation of controls is the completion of uncertainty analysis. This analysis is conducted to ensure that instrumentation utilized for prevention and mitigation of accidents operate in compliance with assumptions in the accident analysis.

c) Final functional classification is required to ensure that the facility SSCs selected to prevent or mitigate the accidents are capable of performing their safety function when needed. For safety class and safety significant equipment, this effort is conducted using the Backfit process described in the S-4 Manual, Procedure ENG.12 (HLWMD Backfit Analysis Program). Necessary actions resulting from the backfit process can include replacement, modification, and/or testing of SSCs. In addition, the functional classification of SSCs as safety class or safety significant imposes an additional burden on the operation and maintenance of the equipment.

d) Procedures and training that reflect the revised AB must be developed. These efforts represent a large impact on resources.

Assumptions: AB upgrade and implementation will be deferred until sufficient funding is allocated.

Contingencies:
- WPT, F, and H-Tank Farm operations will continue under the revised SAR and TSRs (Interim ABs). This will continue until scope or resource availability is adjusted to facilitate implementation of all attributes necessary to achieve full implementation of DOE Orders 5480.22 and 5480.23 in all CST facilities.
- HLW System attainment could be slowed to make resources available to support the TSR program.

7.15 Control Systems Obsolescence

Issue: Many of the major process control computer systems in the HLW Division are nearing the end of their planned useful life. Some, especially the distributed control system at DWPF and HDB-8 which were installed 14 years ago, can be characterized as being technologically obsolete. Therefore, projects to replace the DCSs in DWPF, H and F Tank Farms and WPT are included in the funding requirements over the next five years.

Background: There are 52 Mission Essential computer systems in the High Level Waste Division. These include distributed control systems (DCSs), programmable logic controllers (PLCs), and other PC-based and minicomputer-based systems, as well as the network equipment used to link these systems. The systems most in need of replacement are the DWPF production DCS, the H-Area Diversion Box #8 DCS, the F Tank Farm DCS, the waste removal/replacement evaporator DCS, and the WPT HVAC PLC and DCS.

Of these systems, the most urgent is the DWPF DCS replacement. It was installed 14 years ago; vendor software support stopped five years ago; and vendor hardware support stopped 3 years ago. All current spares are refurbished used parts. Based on current operating trends, the last of the inventory of refurbished spares will be consumed by May FY02. This DCS controls all operations of the plant, including melter operations, pouring, valves opening/closing, pumps, transfers and ventilation. It will be replaced at a cost of approximately $15 million from FY01-FY03, with a planned six-month production outage in FY04. This outage may well occur sooner, based on current failure trends and the availability of spare parts beyond mid-FY02.

The vision for HLWD process controls is to have a single control system architecture deployed across the division. This architecture would be based upon open systems concepts and use commercial standards for both hardware and software. This combination of a single, consistent division architecture and the use of commercial standards will provide a common user interface between facilities, resulting in a more versatile and flexible workforce. It will also allow better implementation of new technology and process changes, will permit interconnectivity of control rooms, will improve information flow across all division facilities, and will reduce the life cycle costs of these systems.

Assumptions:
- Outages at each affected facility will be scheduled and staffed in order to accomplish the replacements and upgrades.
- Replacements and upgrades to existing facility systems will include replacing or upgrading the associated development and simulator systems.
- Control systems will be equipped with redundant computing components in order to prevent failure of a single component from jeopardizing the integrity of plant systems.
- Continuing training for support personnel will be planned and funded in order to maintain the staff's technical expertise.
- Control System modifications resulting from future missions will only require extensions, additions, or deletions to the control systems, and not wholesale replacements or upgrades.

Contingencies:
- Failure to adequately maintain the HLWD control systems will result in an overall cost increase to the division. This is due to increased maintenance and engineering costs as well as increasing the potential for production outages due to unplanned control systems failures. Facilities could be shut down until replacements and upgrades can be made.
- Engineering must develop the manual operating capability required to allow removal of automatic control during the replacements and upgrades.

8 Integrated Production Plan

8.1 Overview

The following integrated production plan supports the implementation of both the Requirements and Target Cases. However, note that successful implementation of this production plan is contingent upon:

- Availability of funding as shown in Appendix H.1 for the Requirements Case or Appendix I.1 for the Target Case
- Successful management of Tank Farm space
- Successful performance of waste removal projects in the Tank Farms
- Successful sludge batch preparation in ESP
- Successful implementation of the Salt Processing Facility with a startup in FY10.

The FFA commitment for closure of several individual tanks will need to be switched by agreement with SCDHEC. This will allow all of the Approved FFA Waste Removal Plan and Schedule commitments to be met.

This section provides a summary discussion of the key constituents of Tank Farm space. It is followed by a detailed description of the current Tank Farm space management strategy. Section 8.1.3 describes the effect of each influent and effluent stream in the Tank Farms, and its impact on Tank Farm operations. Sections 8.2 through 8.11 describe the production requirements for each HLW facility to support this Plan.

8.1.1 Tank Farm Waste Storage Space

The lack of tank space impacts the ability to receive influents from the Canyons and DWPF and to store salt concentrate from the evaporators. A review of some terms used to define tank space and a summary of current tank space conditions is outlined below.

Useable Tank Space (or Working Inventory): Influents and effluents are listed only as they impact the Type III Tanks that are used to store and evaporate HLW, herein referred to as the "Useable Tank Space." The Useable Tank Space has the following distinctives:

For planning purposes, the maximum capacity (**Tank Operating Limit**) of the Type III and Type IIIA tanks is assumed to be 1,270,620 gallons, which is 35,100 gallons less than the TSR limit of 1,305,720 gallons. The only exceptions to this are the 2F and 2H Evaporator feed tanks, Tanks 26 and 43, in which the Operating Limit is 1,263,600 gallons, due to the elevation of the evaporator feed pump motor.

The old-style (Types I, II, & IV) tanks (Tanks 1-24) are excluded because they do not meet current requirements for secondary containment and leak detection, with the exception of dilute waste handling in Tanks 21-24. The Tank Farm Industrial Wastewater Operating Permit does not allow waste to be added to tanks that currently leak or have leaked. Tanks 4-8 could potentially be used to store concentrated waste in the future, if permission was received from the regulators and no space were available in Type III tanks. However, some field modifications would be required before those tanks could be used. Therefore, they are not included in the "Useable Tank Space" at this time.

Tanks 48, 49, and 50 are excluded, at this time, primarily because unplanned additions of large waste volumes would alter the waste composition. This would possibly violate strict process chemistry controls. Tanks 49 and 50 are planned to store concentrated waste, but field modifications will be required and technical issues must be resolved before returning these tanks to waste storage service.

ESP Tank 51 is excluded from the Useable Tank Space calculation because unplanned additions of waste would alter the washed sludge composition, thus interrupting feed to DWPF while the waste is re-qualified. When Tank 40 begins processing sludge for Sludge Batch 2 in FY00, its volume will also be removed from the Useable Tank Space calculation.

As of March 1, 2000, the "Useable Tank Space" is the tank space available to support routine Tank Farm activities, such as inter-tank transfers and evaporator operations, and to store waste received by the Tank Farms. At the time of this Plan, the F and H-Tank Farms have a combined 1,300,000 gallons of Useable Tank Space as is illustrated in Table 8-A.

Table 8-A Useable Tank Space

	No Tanks	Volume (millions of gallons)		Comments
	51			Total number of tanks
Less	2			Tanks 17 & 20 Closed (filled with grout)
Equals	49	55.2		Total Maximum Capacity (TSR/OSR Limit)
	49	47.3		Total Working Capacity (Tank Operating Limit)
			18.0	*Total Stored Supernate*
			15.1	*Total Stored Salt*
			3.2	*Total Stored Sludge*
Less		36.3		Total Stored Waste (including process tanks 48,49,50,&51)
Equals		11.0		Total Working **Freeboard**
Less	24	4.2		Freeboard in Types I, II, and IV tanks (unavailable for reuse)
Less	4	2.9		Freeboard in Processing Tanks (Tanks 48,49,50,&51 – unavailable for reuse)
Less		2.6		Emergency Space (reserved in the event of a tank leak)
Equals	21	1.3		Total **Useable Space**
			0.2	*F Tank Farm Minimum Evaporator Requirement*
			0.4	*H Tank Farm Minimum Evaporator Requirement*
			0.1	*F Tank Farm Minimum Waste Receipt Requirement*
			0.1	*H Tank Farm Minimum Waste Receipt Requirement*
			0.5	*TF Min Waste Receipt required for ESP support*
Less		1.3		**Working Space**
Equals	21	0		**Available Space** (Useable Space less Working Space)

NOTE: See Appendix B for further tank space terminology definitions.

Sufficient space must be available in the Tank Farms to meet minimum SAR requirements and continue to support planned waste transfers from the Canyons and DWPF. To maintain sufficient space, HLW has begun evaporating approximately 5,000,000 gallons of backlogged, dilute supernate from Type III tanks. This is expected to recover approximately 2,000,000 gal of space over the period FY00-FY04. It must be noted that the Emergency Space and Useable Space (Working Space and Available Space) are not in one or two convenient tanks but the space is dispersed in tanks across the Tank Farms. A graphic representation of the tanks space in the various tanks is shown in Appendix G (High Level Waste Tank Usage).

8.1.2 Tank Farm Space Management Strategy

As discussed above, the current Useable Space in the Tank Farms is near what is considered to be the minimum to efficiently support planned processing. The amount of useable waste storage space in the Tank Farms is steadily being consumed by continued waste receipts, as is indicated by the following estimated new receipts for FY00:

- DWPF Recycle water 1,300,000 gallons in 250 receipts
- Sludge Wash Water 500,000 gallons
- Canyon Wastes 600,000 gallons in 460 receipts
- RBOF 150,000 gallons in 25 receipts.

These receipts are reduced by evaporation (the Tank Farm evaporation systems evaporate approximately 70 - 90% of these receipts depending on the influent source), but the negative impact on available tank storage space is significant. Furthermore, since early sludge removal is conducted from old style tanks, it does not result in an overall net gain in available space in the Type III tanks. In fact, due to the large amounts of sludge processing wash water returned to the Type III tanks, there is an actual overall net space loss in Type III tanks. This is especially true through FY10 when sludge is mainly being removed from high-risk tanks. The overall net waste inventory being stored will begin to be reduced only when salt processing is operational and the salt waste is removed from the tanks.

Based on the assumptions used in the development of this Plan, the Tank Farms will run out of available storage capacity in Type III tanks unless alternative storage options are implemented. To study available waste storage space in depth, a HLW Space Management Team (Space Team) was chartered. The Space Team performed a detailed systems engineering analysis and recommended the best management practices for safe stewardship of high level waste while maximizing available tank space. The Team issued a final report (WSRC-RP-99-00005) in August 1999. Updated results of this final report have been incorporated into this revision of the System Plan. The space management initiatives to be implemented are:

1. Continue to evaporate liquid waste, including the backlog of liquid waste that is waiting to be fully concentrated.
2. Convert Tank 49, previously identified as a Salt Processing Tank, back into a HLW Storage Tank.
3. Manage ETF bottoms without the use of Tank 50 as a temporary storage location and convert Tank 50 back into a HLW Storage Tank.
4. Reduce the DWPF Recycle Stream sent to the Tank Farm.
5. Implement identified small volume gain ideas to achieve small incremental storage volumes.
6. Move Tank 26 sludge into an earlier sludge batch and place the 2F Evaporator in standby.
7. If necessary, near the end of the period incrementally reduce the minimum emergency space (presently set at 2,600 kgal for the F and H Tank Farms) to the AB minimum requirement of 1,300 kgal.
8. Retrofit Tank 35 for use as a salt receipt tank for the 3H Evaporator System.
9. Install an Acid Evaporator to process DWPF Recycle to avoid sending it to the Tank Farms (only required for the Requirements Case).

These combined actions will adequately manage tank space and avoid the necessity of reusing old style tanks for storage capacity as has been assumed in Revisions 9 and 10 of the System Plan. The Tank Space Management strategy will continue to be evaluated, expanded upon, and updated with the development of each future revision of the HLW System Plan as assumptions are validated or revised and as new process information becomes available.

Each of the recommended space gain initiatives listed above is discussed in more detail below. Note that the timing or the need for some of the space gain initiatives is impacted by the processing requirements unique to each of the Requirements and Target Cases. A brief summary of any case specific space requirements is included.

<u>1. Evaporate Backlog Waste</u>

For the past several years, approximately 3.5 million gallons of waste has been stored in Tanks 30, 35, 39, and 42 in anticipation of providing feed to the Salt Processing Facility. Now that salt processing has been delayed, this stored waste (or "backlog waste") should be further evaporated to reduce its volume and thereby recover space in the Tank Farm. The Tank Farms are evaporating this backlog waste as part of their normal evaporator operations. Current plans are to evaporate all the currently stored backlog waste over the next two to four years.

The logistics of making the waste transfers required to support both evaporation of backlog waste and DWPF processing will be a major challenge for HLW. The number of annual Tank Farm transfers must increase significantly. For example, the planned FY00 tank-to-tank transfers to evaporate backlog waste and to prepare Sludge Batch 2 for processing are almost triple the number of transfers made over the last three years combined.

The principal risks for this idea relate to the ability of the evaporators and infrastructure to operate on such a demanding schedule. Evidence of this risk has been seen in FY00 where all evaporators have been impacted by the 2H Evaporator PISA (See Section 7.8). In addition, equipment problems discovered during the 3H Evaporator startup testing phase have delayed the start date for processing of radioactive waste from February to April. The successful startup of the 3H Evaporator in April and the timely resolution of the 2H PISA for the 2H Evaporator will allow HLW to process off the backlog waste. For both the Requirements and Target Cases, it is anticipated that the full space gain that can be achieved from backlog waste evaporation will take one to two years longer to complete than what was forecast by the Space Team. That is, space gain from backlog reduction will occur by FY03-04 versus FY02.

2. Recover Tank 49 for High Level Waste Storage

This idea requires Tank 49, which had previously been allocated as a salt processing tank, to be returned to the Tank Farms for HLW storage. However, Tank 49 currently stores approximately 77 kgal of waste solution, which contains benzene-producing material, from ITP demonstration runs. DNFSB 96-1 issues regarding this solution must be resolved before the tank can be used for waste storage. In addition, physical modifications to transfer lines must also be made to tie Tank 49 back into transfer lines to HDB-7 and to disconnect Tank 49 from its ties to the Late Wash Facility.

An aggressive schedule has been implemented to accelerate the return of Tank 49 to waste storage service. For both the Requirements and Target Cases, it is assumed that Tank 49 will be available to receive concentrated waste by the end of FY00. This is a full year earlier than was forecasted by the Space Team.

The principal risk associated with return of Tank 49 is that the forecasted tetraphenylborate intermediates depletion rate and subsequent benzene generation rate do not match the actual sample profiles. This could delay the currently forecasted date for the return of Tank 49 to HLW service. Pump runs on Tank 49 are being initiated at the time of this Plan's development that will provide the information required to resolve the benzene generation issue.

3. Recover Tank 50 for High Level Waste Storage

Tank 50 is presently used as a receipt tank for Effluent Treatment Facility (ETF) bottoms, an aqueous waste that is ready for final treatment and disposal as Saltstone or by alternative means. Both the Requirements and Target Cases described in this Plan assume that Tank 50 can be returned to HLW waste storage service by the end of FY02. This is 2 years earlier than was forecast by the Space Team. Returning Tank 50 to HLW service requires that the ETF bottoms stored in Tank 50 (an estimated 600 – 700 kgal by FY02) be treated using an off-site vendor in FY02. This is a change from Revision 10 of the System Plan, where Saltstone was going to be returned to operations in FY04 to process the Tank 50 waste.

Since Tank 50 will be required for concentrated waste storage service, the use of a vendor for processing newly generated ETF concentrate must be continued on a periodic basis until the startup of Salt Processing in FY10. At that time, the Saltstone Facility must be restarted to support the large volume filtrate stream from Salt Processing and the ETF concentrate can be sent to Saltstone. A new storage tank for ETF bottoms will be required to optimize processing of the projected low annually generated stream (approximately 180 kgal/yr) until Salt Processing begins operation. In addition to the new tank, some transfer line modifications and Tank 50 shielding modifications must be completed.

The principal risk associated with the Recovery of Tank 50 for HLW storage is that the new tank for ETF bottoms and other required modifications will not be completed by the end of FY02. This would require continuous processing of newly generated ETF concentrate by the vendor until the modifications were completed.

4. Implement Ideas to Reduce the Volume of DWPF Recycle

Several ideas have been identified that would reduce the volume of DWPF recycle waste sent to the Tank Farm. The DWPF recycle stream has a low salt concentration and can easily be evaporated. However, the inhibitors that must be added to this high volume stream to meet the Tank Farm WAC result in concentrate that eventually takes up space in the Tank Farm. Therefore, reductions in the total amount of DWPF recycle sent to the Tank Farm can result in space savings.

Since the issuance of the Space Team report, DWPF has been very proactive in implementing ideas to reduce the amount of recycle being sent to the Tank Farm. An Operations led facility task team took the initial list of Space Team ideas and expanded it to include several new innovative ideas. A major reduction effort was implemented in January 2000 to isolate the steam atomized scrubber steam from the melter offgas system. It is expected that this idea alone will result in an annual 700,000 gallon reduction in recycle being sent to the Tank Farm. Additional ideas associated with the frit transfer system and reductions is sample line flushes are projected to result in more FY00 water generation reductions. Through the efforts of this task team, it now anticipated that the annual recycle being sent to the Tank Farm will be reduced from approximately 2,200,000 gallons for a 250 can/yr production rate to approximately 1,300,00 gallons or less. With this type of reduction, the need for a DWPF acid evaporator to process recycle at DWPF is being assessed to determine if will be cost effective for handling the reduced recycle stream. The need for an acid evaporator is discussed in further detail below.

5. Small Volume Gain Ideas

The Space Team identified a list of ideas that have the potential to yield smaller increases in available space. The group of ideas can be broken down into two main categories. Some provide small volume gains ranging up to about 600 kgal. Others suggest better mechanisms (*e.g.* changing operating practices or developing better tracking indicators) that should be evaluated further. Even if the space gains from these ideas are small, they could result in better space forecasting to better manage the available space. If successfully implemented, the small volume gain ideas could also result in overall cost savings if they eliminate the need for other more costly space gain initiatives. The small volume ideas are counted on by both the Requirements and Target Cases in this Plan. They will be evaluated and implemented over the next several years to maximize available tank space.

The primary small volume gain ideas include:

- *Perform Aluminum Dissolution with High Hydroxide Waste*

  This idea proposes to use existing concentrated supernate that is high in hydroxide for aluminum dissolution rather than adding fresh sodium hydroxide. If successfully implemented, the loss of up to 600 kgal of available space is avoided by eliminating the addition of new salt and sodium hydroxide during the aluminum dissolution process.

- *Install Telescoping Transfer Jets (TTJ) in Selected Tanks*

  Transfer jets are used to move waste from tank to tank to support processing activities. Some of the fixed height transfer jets are set too high and will not allow complete removal of supernate to enable full evaporation of existing waste. Because of this condition, several tanks contain supernate that has not been fully concentrated. For example, the existing transfer jet in Tank 35 is at a level of 150 inches from the tank bottom. If a new TTJ were installed in Tank 35, up to an additional 250 kgal of space could be gained by evaporation of the additional supernate that could be removed from the tank.

  The principal risk associated with this idea is difficulty (cost, RadCon concerns, etc.) in the removal and disposal of an existing jet and in the subsequent installation of a new TTJ in the required riser. Instead of replacing the transfer jets, an alternative method of reclaiming this space is also being evaluated. Under this alternative method, "heavier" concentrated waste would be transferred into the tank displacing the existing "lighter" waste. The existing jet would then be used to remove this displaced "lighter" feed for further evaporation. This process would be repeated until the waste in the tank was fully concentrated.

- *Revise Tank Farm Waste Acceptance Criteria (WAC)*

  This idea proposes to revise the Tank Farm WAC to eliminate or modify practices that can affect space negatively, especially excess caustic additions and dilutions imposed on receipts from the Canyons and recycle from DWPF. The Tank Farm WAC requires sufficient caustic to be added to waste before it is transferred to assure the tank chemistry is not altered when the waste is added to the tank. Uncertainty related to splashing of waste on walls above the liquid level and the inability to determine how well the new waste mixes with existing waste in the tank has led to these stringent specifications. Improved monitoring of tank chemistry may allow the concentration of inhibitors to be reduced in waste sent to the Tank Farm.

6. Move Tank 26 Sludge into an Earlier Sludge Batch and Placing the 2F Evaporator in Standby

The Tank 26 sludge will be moved up into an earlier sludge batch. Moving Tank 26 up earlier in the batch sequencing results in improvements in tank space management prior to the startup of salt processing. An additional 280 kgal of tank space becomes available in FY04-06 after sludge is removed from Tank 26 and the tank is returned to waste storage service. In addition, by placing the 2F Evaporator System in standby the need for 200kgal of working space is eliminated.

This space gain initiative has been added since the issuance of the Space Team report. It will be implemented under both the Requirements and Target Cases.

7. Reduce Emergency Space to 1,300 kgal

The Space Team analyzed the long-standing practice of maintaining 1.3 million gallons of emergency space in the H-Area Tank Farm and the F-Area Tank Farm (2.6 million gallons total). The Liquid Radioactive Waste Handling Facilities Safety Analysis Report (LRWHF SAR), WSRC-SA-33, specifies a "defense-in-depth" emergency space value for the Tank Farm equal to the largest tank inventory (1.3 million gallons). The use of the Inter-Area Line (IAL) would be required to reduce the Emergency Space to the minimum value of 1.3 million gallons. The IAL is an underground transfer line between F and H-Tank Farms of approximately 2.2 miles in length.

This idea states that the minimum emergency space would be reduced incrementally from its current value of 2.6 million gallons, as required, to a level that could eventually drop to the Authorization Basis (AB) "defense-in-depth" value of 1.3 million gallons.

Though a viable idea, the Space Team recommended that this idea should only be implemented, if required, near the end of the period prior to Salt Processing. This is due to the challenges it presents to the operation of the Tank Farm. Several conditions must be assessed before this idea is implemented. A prerequisite for reducing the Emergency Space would be to qualify the IAL for emergency transfer readiness. Procedures must be written and some upgrades made to the IAL to assure it is always available. The frequency of use of the IAL will increase significantly over the next few years as sludge slurry is sent to the Extended Sludge Processing (ESP) Facility and as backlog waste and wash water are sent to the 2F Evaporator. Experience gained from these transfers will provide a higher confidence in HLW's ability to use the IAL for emergency transfers.

For both the Requirements and Target Cases in this Plan, maintenance of 1.3 million gallons of Emergency Space is assumed for each Tank Farm until major infrastructure projects are completed. The major infrastructure projects are Tank Farm Storm Water Upgrades, Tank Farm Support Services (F-Tank Farm) and Piping Upgrades (H-Tank Farm East Hill). In FY06, when Piping Upgrades is completed, the Emergency Space requirements will be reduced to a total of 1.3 million gallons between the two Tank Farms. The majority of this emergency space will be maintained in H-Tank Farm since most processing activities will be in H-Tank Farm.

8. Tank 35 Retrofitted to be a 3H Evaporator Salt Receipt Tank

Tank 35 will be retrofitted to be a 3H Evaporator Salt Receipt Tank in FY05 in the Requirements Case and potentially in early FY10 in the Target Case. This modification will ensure that the 3H Evaporator System can effectively minimize the space loss by efficiently evaporating necessary waste streams. The need of Tank 35 as a salt receipt tank is discussed further in Section 8.1.4 below.

9. Implement the Recycle Acid Evaporator at DWPF

If additional space gain is required, the DWPF recycle stream could be directed from the Tank Farm. The Space Team recommended that the recycle stream be eliminated from being sent to the Tank Farm by FY04.

The Space Team selected acid evaporation at DWPF as the preferred process technology for eliminating the transfer of recycle to the Tank Farm. The principal uncertainty associated with this idea is being able to complete design, construction and startup of the evaporator to achieve space savings by FY04 under current budget constraints. Another uncertainty is associated with how to handle the evaporator bottoms. It is now estimated that approximately 15% of the recycle stream must be returned to the Tank Farm. This "bleed" stream is made up of constituents in the evaporator bottoms that can not be sent to the melter.

As discussed in initiative 4, because of aggressive facility efforts significant recycle reduction ideas have been implemented at DWPF in FY00. If these recycle reduction efforts can be maintained over the next several years, it may preclude the need for installing an acid evaporator at an estimated cost of $25 – 35 million.

The Requirements Case assumes that the acid evaporator will be installed by FY04. At that time, only 15% of the recycle stream is projected to be sent to the Tank Farm. However, the Target Case assumes that the DWPF acid evaporator will not be required. It is assumed that FY00 recycle reduction efforts can be maintained. These aggressive recycle reductions in combination with a slower sludge processing rate (average of 200 cans/yr versus 250 cans/yr) provides enough Tank Farm space to manage until Salt Processing begins in FY10.

8.1.3 HLW System Material Balance

The Useable Tank Space charts shown in Appendices H.7 and I.7 (for the Requirements and Target Case respectively) were created from data generated by SpaceMan. The Tank Farm Material Balance, shown in Appendix H.3 for the Requirements Case and Appendix I.3 for the Target Case, reflects the influent and effluent streams figures produced by the space management model. Note that the balance sheets only reflect the volume of waste coming into the tank farms and the volume leaving the tank farms. They do not include lost space from saltcake creation during the evaporation process, and therefore, actual space recovery cannot be ascertained from these tables. Refer to Useable Space Charts for a forecasted space outlook. Available tank space is dependent on a balance between influents to the Tank Farms, evaporation of excess water, process timing, and effluents to DWPF, Saltstone, and the Effluent Treatment Facility. Management of the available space is critical during the next ten years due to the current low Useable Tank Space in the Tank Farms. The lack of tank space adversely affects the ability to receive influents from the Canyons and DWPF, and to store salt concentrate from the evaporators. A detailed discussion on forecasted influents and effluents and their impact on the HLW System is provided below.

Influents – F-Canyon Low Heat Waste (LHW) and High Heat Waste (HHW): Sand, Slag, and Crucible (SS&C) material has been dissolved and is being processed through the second plutonium cycle, creating approximately 80,000 gallons of waste. The Paths to Closure – SR Requirements Case without the Actinide Package & Storage Facility (APSF), September 1999 has been used to identify residues to be stabilized in F-Canyon and the time frame each campaign will occur. Waste volumes have been estimated for each campaign and are given below in chronological order of waste generation.

- EBR II and Mark-42 will be dissolved and processed, creating approximately 82,000 gallons of LHW and 38,000 gallons of HHW.
- Rocky Flats Scrub Alloy (RFSA) will be processed and generate approximately 64,000 gallons of LHW.
- Additional plutonium scrap materials, such as Pu alloy and fluorides, may be processed and generate approximately 8,000 gallons of LHW per dissolver batch.
- The Am/Cm project is expected to generate approximately 30,000 gallons of HHW.
- Outside Facilities operations (General Purpose evaporator and Lab Waste evaporator) will generate approximately 8,000 gallons of LHW per month.
- Generation of approximately 4,000 gallons of routine LHW and approximately 2,500 gallons of routine HHW is expected each month.
- Carbonate solutions containing a plutonium di-butyl phosphate (Pu/DBP) complex will generate approximately 90,000 gallons of either LHW or HHW.
- Deinventory flushes are forecasted to generate approximately 540,000 gallons of LHW and 30,000 gallons of HHW.
- Shutdown flushes are forecasted to generate 390,000 gallons of LHW.

Influents – H-Canyon Low Heat Waste (LHW) and High Heat Waste (HHW):

- Processing of Mark 16 and Mark 22 charges is scheduled to continue through December 2002. This will generate approximately 24,000 gallons of low heat waste per month through Oct. 1, 1999.
- Starting in May 2000, the Canyon will increase the number of dissolver charges processed monthly. This will cause waste generation rates to increase to 28,000 gallons/month.
- A Warm Canyon Process Vessel Vent (PVV) filter flush is scheduled for October/November 2000. It will generate approximately 20,000 gallons of relatively dilute waste to be transferred to the Tank Farm in November 2000.
- Anion exchange recovery of neptunium in HB-Line is being planned, but is not currently scheduled.
- Transfer of Pu-238 flush was completed in January 2000. Dilution necessitated due to Pu-238 produced a total of approximately 17,000 gallons of low heat waste.
- Transfer of low assay plutonium will begin in March 2000. Effort is being made to avoid dilution due to Pu-238 and ammonia generation thus reducing the volume to 15,000 gallons as compared to 45,000 gallons of low heat waste.
- Mixed scrap from HB-Line will generate about 4,000 gallons a month for 3 months starting October 2000.
- Beginning in October 2002, Sterling Forest Oxide will generate 13,650 gallons per month of low heat waste until December 2002.

- Unirradiated Off Spec Type II HEU Alloy will generate about 21,000 gallons per month starting January 2003 to June 2006.

Because of the Secretary of Energy's acceptance of DNFSB Recommendation 2000-1 (sub-recommendations 1 through 9), SRS's plan for implementation of remaining NMS&S commitments is being revised. DOE is working to have a revised plan ready for Secretarial approval by April 30, 2000. WSRC provided to DOE-SR at the end of February 2000, a Strategy and Resource Loaded Plan for Implementation of DNFSB Recommendation 94-1 which was based upon an assumed flat funding profile. DOE-SR has since requested a revision to that plan based upon increased funding levels. The "WSRC Strategy and Resource Loaded Plan for Implementation of DNFSB Recommendations 94-1 and 2000-1, Revision 1" pursuant to that request was issued March 29, 2000. Once agreement has been reached on the final plan to be approved by the Secretary, NMS&S will revise outyear waste forecasts accordingly.

Influents – DWPF Recycle: DWPF recycle volume will vary over the life of the facility. The volume of recycle generated reflects sludge-only canisters versus combined sludge and precipitate canisters, planned canister production rates, and the age of the facility. (As the facility ages, maintenance needs for contaminated equipment will increase, thereby increasing the amount of spent decontamination water generated.) Significant efforts have been implemented to reduce the amount of recycle sent to the Tank Farm. Based on these reduction efforts, DWPF plans on sending approximately 1,300,000 gallons/yr of DWPF recycle to the Tank Farms over the next several years. The Requirements Case takes into account plans to install an evaporator in the DWPF Salt Cell to process recycle entirely at DWPF. When implemented, only the resulting concentrated stream will be sent to the Tank Farm. In the Target Case, the installation of the evaporator is not required. The recycle algorithm has been updated to reflect recent facility operating experience, and is explained in Section 8.6.

Influents – Other: Miscellaneous influents are received into the Tank Farms from RBOF (approximately 155,000 gallons/year), the 299-H repair facility (approximately 12,000 gallons/year), rainwater from sumps (approximately 85,000 gallons/year), and internal additions such as flushes and transfer jet dilution (approximately 200,000 gallons/year). The volumes are based on historical information. For the purposes of this plan, it is assumed that 99.5% of this volume is recovered via evaporation.

Influents – Inhibited Water: Inhibited water additions include Tank Wash Water and ESP Wash Water.

> *Tank Wash Water:* The waste tank interiors of all tanks to be removed from service are water washed as part of the waste removal program. The annulus of each tank with a leakage history is also water washed. The volume of the tank interior wash is planned to be 140,000 gallons, which is a level of about 40 inches in most tanks. The annulus wash assumes two 25,000-gallon washes, which is a level of about 24 inches in the annulus for each wash. This Plan assumes that all tanks are water washed.
>
> *ESP Wash Water:* The ESP wash water volumes are based on GlassMaker modeling for each of the remaining sludge batches. The wash water for each batch is generated during the 9 to 21 month period immediately before the batch is fed to the DWPF. The wash water duration will vary from batch to batch depending on waste composition. No distinction is made between sludge wash water, aluminum dissolution waste, and the water used to slurry and transport the sludge to the ESP tanks. It is currently assumed that all of the ESP washwater will be evaporated. However, some washwater may be used for sludge removal or to dissolve salt. For more details on ESP, refer to Section 8.5.1.

Effluents – Evaporator Overheads: The 2F, 2H, and 3H (RHLWE) Evaporators reduce the volume of dilute, influent waste streams. In order to maintain available space in the Tank Farms during the extended Salt Processing evaluation outage, the evaporators have also begun to evaporate dilute supernate (backlog) from Type III tanks. This is expected to recover from 2,000,000 to 2,500,000 gallons of actual space over the period FY00-FY04. Reference to "evaporator space gain" for new Tank Farm influents is a misnomer, because evaporator operations can only minimize the effect of waste additions as saltcake, concentrated supernate (caustic liquor), and sludge accumulate. The only true source of Tank Farm space gain is to operate a Salt Processing facility, thereby processing the salt and supernate into an acceptable solid waste form (glass or grout). For more details on evaporator operations, refer to the "Evaporator Salt Inventory" section below, and Sections 8.2.2 and 8.3.2.

Effluents – Sludge to ESP: Removing sludge from Type III tanks provides the only space recovery from a sludge removal operation. A total of approximately 1,000,000 gallons will be recovered in both the Requirements and the Target Cases.

Effluents – Supernate to Salt Processing: Space gain occurs when concentrated supernate, unconcentrated supernate, or dissolved saltcake is fed to a Salt Processing facility. This Plan credits recovered space immediately when it is fed to the Salt Processing facility. The recovered space could be made available to store concentrated supernate from an active evaporator drop tank or any liquid waste, in the unlikely event of a tank leak. Although the salt processing technology has not been selected, for planning purposes this Plan assumes that space gain is achieved using Small Tank Precipitation. For more details on Salt Processing, refer to Section 8.5.2.

8.1.4 Evaporator Salt Inventory Management

The evaporators reduce the volume of the various waste streams that have been received in the Tank Farms. This is crucial to the success of HLW and Site Missions. The evaporators must keep current with waste generated by Canyon operations, DWPF recycle, ESP spent wash water, and HLW tank wash water.

Evaporator space gain is defined as the difference between evaporator feed and evaporator concentrate, corrected for flush water and chemical additions necessary to operate the evaporator system. Space gain is predicted based on evaporation of each waste stream, given its chemical constituents. The Spaceman model takes the influent stream forecasted volumes and their associated compositional data and models the impact on Tank Farm space. The evaporation simulation for the generation of salt, salt concentrate, and overheads production to ETF is based on current supernate thermodynamic models.

Salt receipt space in the Tank Farm is at a premium. The 2H Evaporator system has limited remaining salt receipt space in Tank 38. The 2F and 3H Evaporator systems have salt receipt space in only Tanks 46 and 30, respectively. In running the Spaceman model for the Requirements and Target Cases in this Plan, all efforts were made to maximize space gain by processing certain waste streams in selected evaporator systems to take advantage of the available salt receipt space. For example, all efforts were made to process all Canyon waste, which generates a high volume of salt when evaporated, in the 2F Evaporator system to take advantage of the salt receipt space in Tank 46.

Even with the optimization of processing certain influent streams in selected evaporators, the Spaceman modeling runs on the Requirements Case predicted that the 3H Evaporator system would run out of salt receipt space in FY05. By that time, it was assumed that some major modifications would have to be made to allow Tank 35 to be used as an evaporator receipt tank for the 3H system. The modifications would include the installation of a new gravity drain line (GDL) from 3H to Tank 35, a new backflush valve at Tank 35, and other associated equipment or facilities.

For the Target Case, the Spaceman model showed that the conversion of Tank 35 to a salt receipt tank was not required until FY09/10. Operating at a slower DWPF canister production rate allowed more time to process salt laden influent streams at the 2F Evaporator and resulted in better use of the Tank 46 salt space. Though the modifications are still assumed to be required at Tank 35, they are later in the program.

8.2 H-Tank Farm

The H-Tank Farm receives, stores, evaporates, and transfers high level waste.

8.2.1 H-Tank Farm Useable Space

The H-Tank Farm includes twelve old-style waste storage tanks, eleven new-style tanks, and three evaporator systems (two of which are operational). At the time of this Plan (March 1, 2000), H-Tank Farm has approximately 1,100,000 gallons of Useable space (or Working Inventory) available.

8.2.2 H-Tank Farm Evaporators

The **1H Evaporator** vessel has a failed tube bundle. There are no plans to restart this evaporator. Therefore, the condition in the Tank Farm Wastewater Operating Permit to remove the 1H Evaporator from active service by January 1, 1998 has been met.

The 1H system was chemically decontaminated in FY96. The evaporator cell, the interior of the evaporator vessel, the Concentrate Transfer System (CTS) cell, the CTS tank interior and the CTS loop line were cleaned using alternate caustic/acid flushes. This is similar to the method used for the 2H Evaporator vessel replacement. The 1H system is currently in lay-up mode.

The **2H Evaporator** system includes one feed tank (Tank 43) and two salt receipt tanks (Tanks 38 and 41). Tank 38 is the active tank; Tank 41 is full of salt. In past years the primary role of the 2H Evaporator was to evaporate the 221-H Canyon LHW stream and the DWPF recycle stream, both of which have been received in Tank 43 and evaporated. With the emergence of the 2H Evaporator PISA issue described in Section 7.8, the role of the 2H Evaporator is being reassessed. For the purposes of this plan, it is assumed that the 2H will only be used for processing DWPF recycle. Efforts are currently underway to have H-Canyon waste received into Tank 39. As required, the H-Canyon waste will be transferred out of Tank 39 for eventual evaporation by either the 3H or the 2F Evaporators.

Based on the status of 2H Evaporator PISA issue, this revision of the System Plan does not count on the 2H Evaporator resuming operations until the beginning of FY01. DWPF recycle will be received into Type IV tanks (Tanks 21-24) until 2H restarts. It should be noted that the receipt of DWPF recycle into Type IV tanks does not impact Tank Farm Usable Space since only Type III tanks are used in determining the Usable Space volume.

When restarted in FY01 the 2H Evaporator is forecast in this System Planto gain 1,200,000 to 2,000,000 gallons per year. In the Requirements Case, the 2H Evaporator will operate at the listed levels for the next several years (FY01 – FY04) until the time that the DWPF acid evaporator is operational. After FY04 the 2H is planned to remain in operation to process the reduced DWPF recycle stream that will continue to be received in the Tank Farm until the end of the program. The ability of the 2H Evaporator to meet these higher early year production rates was demonstrated in FY98 and FY99 when over 2,000,000 million gallons of space gain was recorded in each year.

In the Target Case, where the DWPF acid evaporator will not be installed, the 2H Evaporator will be counted on to process the DWPF recycle stream over the life of the program. Spaceman modeling does show some periods where the DWPF recycle must be processed in the 3H Evaporator system to fully recover the maximum space gain.

It should be noted that the 2H Evaporator has experienced several unplanned extended outages over the last few years (*i.e.* FY97 and FY00) that have impacted its ability to operate as planned. In FY98 and FY99, the 2H system experienced a high utility rate; however, in FY97 and again in the beginning of FY00 the 2H Evaporator system has encountered long, unplanned outages. The three outages described below are representative of unplanned events which impact HLW's ability to meet space gain goals.

In May 7, 1997, the 2H Evaporator was shut down in response to a Potential Inadequacy in Safety Analysis (PISA) regarding the source term in the evaporator vessel. Sample analyses of Tank 38 indicated a higher-than-expected quantity of sludge solids, which could only have come from Tank 43 and through the evaporator. Given this condition, the projected source term in the evaporator was calculated to exceed the SAR limit for offsite dose in the unlikely event of an evaporator explosion. During the subsequent outage, two major modifications took place. The Tank 43 feed pump eductor was raised well above the known height of sludge in Tank 43 to prevent further entrainment of sludge solids in evaporator feed. In addition, a safety class steam cut-off valve was installed to automatically stop steam feed to the tube bundle. The 2H Evaporator resumed operations on July 4, 1997, and ran well for 15 days.

On July 19, 1997, the 2H Evaporator was shut down because the gravity drain line (GDL) was plugged. Standard flushing techniques failed to clear the line. Remote video inspection of the GDL indicated that the plugged material was not crystallized salt. The material was sampled and analyzed at SRTC. The analysis showed that the deposit was high in silica and alumina content. Similar materials have been encountered in evaporator bottoms when feeds from tanks that received solid materials containing high silica content were evaporated. For example, Tanks 19F and 24H received zeolites from CRC operations and silica gel from early canyon operations. The higher silica content of this more recent feed is attributed to frit carryover from DWPF when waste from DWPF startup tests were transferred to the Tank Farm. Incorrect positioning of the feed line near the sludge layer in Tank 43 may also have contributed to higher than normal silica content in the feed to the 2H Evaporator. When the frit solids, aluminate, and caustic in the feed were combined and concentrated in the evaporator, conditions were likely set up to form the insoluble aluminosilicate found in the line. When the concentrate was sent to the cooler GDL, solids began to crystallize on the interior of the line. Evaporator operation under these conditions continued to deposit the solids until they finally plugged the line. A vendor with a 10,000-psi pressure wash system had to be brought in to clear the line. The 2H Evaporator resumed operations on September 2, 1997, and narrowly achieved its FY97 space gain goal of 1,600,000 gallons.

During a planned outage in October 1999, visual inspection of the 2H Evaporator revealed solids buildup on evaporator internals and in the bottom cone area of the pot. Approximately 18 grams of material was obtained from the bottom cone area for analysis anticipating an end of CY00 chemical cleaning. The 2H Evaporator was restarted in December 1999. Erratic lift rates were experienced and the evaporator was shutdown in January 2000 when attempts to correct the lift rate were unsuccessful. In early January 2000, results from the sample revealed the material consists of sodium aluminosilicate and sodium diuranate (averaging 6.9 wt% total uranium content of and 2.3% enrichment). Based on the analysis results, a PISA was issued and all evaporators were shutdown. To ensure incoming waste streams from continuing DWPF and Canyon processing could be accepted without immediate tank space impacts, transfer sequences and priorities were changed. These included raising operating limits, reducing the DWPF recycle stream, accelerating the Tank 39 organic PISA resolution and implementing modifications and procedure changes to allow additional single wall tanks to accept DWPF recycle. Because of the PISA, this plan does not count on the 2H Evaporator operating until the beginning of FY01.

These three unplanned, extended outages demonstrate the evaporator's critical role in maintaining a balance between Tank Farm influents and effluents. As Tank Farm space becomes even tighter, it will be even more difficult to continue to support DWPF and Canyon production if similar unplanned outages were to occur. The timely implementation of the space gain initiatives described in Section 8.1.2 are required to provide the flexibility for working through unplanned, extended evaporator outage periods.

The **3H Evaporator system** received DOE approval for operation in December 1999. Final preparations for radioactive operations continued throughout January and February 2000. The 3H is currently scheduled to initiate radioactive operations in April, after some equipment issues identified during startup testing are resolved. The 3H system is expected to carry the bulk of the evaporation load for FY00 and the outyears. In particular, its successful start of radioactive operations in April is instrumental to the ability of HLW to prepare Sludge Batch 2 and ensure a feed supply is maintained for DWPF operations.

With the emergence of the 2H Evaporator PISA issue described in Section 7.8, the role of all of the evaporators is being reassessed. For the purposes of this plan, it is assumed that the 3H will be used for the processing of:

- Backlog waste
- ESP wash water
- Canyon waste

Depending on the resolution of the 2H Evaporator PISA, the 3H may also eventually be used to process some DWPF recycle. In fact, for the Target Case, Spaceman modeling shows some periods where the DWPF recycle must be processed in the 3H Evaporator system to fully recover the maximum space gain.

8.2.3 H-Tank Farm Waste Removal Operations

Salt Removal

With the delay in Salt Processing, maintaining sludge feed to DWPF will be the focus for the next several years.

Sludge Removal

Per the Requirements Case, sludge from Tank 11 will be processed as part of Sludge Batch 3. Work on Tank 11 is already underway. The current schedule is as follows:

- In FY99, as-built drawings were developed, a waste removal design contract was awarded, most of the waste removal design work was completed, and construction D&R activities were initiated
- In FY00, the design will be completed and construction will ramp up
- In FY01, construction will be completed, all equipment tested and turned over to Operations, a graded Readiness Assessment completed, and waste removal operations initiated
- In FY02, sludge removal to Tank 51 for aluminum dissolution and sludge washing will be completed.

This schedule provides just-in-time support for planned DWPF production at 250 cans/year and easily supports the FFA closure date of September 2010. Low funding levels in FY00 moved much of the construction scope into FY01 and consumed all contingency time for recovery from unexpected delays as were experienced on Tank 8 (tank riser interferences, high radiation rates, waste characterization issues, etc.).

For the Target Case, where Tank 11 has been moved to Sludge Batch 4, sludge removal from Tank 11 can be moved out three years from the dates shown above.

Per the Requirements Case, sludge from Tank 15 will be processed as part of Sludge Batch 4.

- In FY01, walk-downs of actual tank conditions will be completed, a design TOPR will be developed, and a design contract will be awarded
- In FY02, design will be completed, construction bids will be received, a construction contract will be awarded, and construction will be started
- In FY03, construction and startup testing will be completed, the tank will be turned over to Operations
- In FY04, waste removal will be started to Tank 40 for aluminum dissolution and sludge washing.

This schedule provides just-in-time support for planned DWPF production and easily supports the FFA closure date of March 2013. Significant issues exist on Tank 15 including:

- Dealing with existing slurry pumps and transfer pumps which must be removed and disposed
- High radiation rates
- The fact that it is a dry sludge tank
- Evaluation of recent tank crack propagation impacts on waste removal strategies.

For the Target Case, where Tank 15 has been moved to Sludge Batch 5, sludge removal from Tank 15 can be moved out three to four years from the dates shown above.

For the Requirements Case, aluminum dissolution facilities on Tank 51 are required to be operational to pre-treat the sludge from Tank 11 starting in February 2002. Modifications include two new gang valves, two steam spargers, evaluation and potential modification to the H&V system, and revisions to the SAR.

- In FY00, design will be completed, procurements initiated, and evaluations will start
- In FY01, construction will be started
- In FY02, construction, startup testing, and turnover to Operations will be completed and aluminum dissolution operations will be initiated.

For the Target Case, where Tank 11 has been moved to Sludge Batch 4, aluminum dissolution will first be required in Tank 40 rather than in Tank 51. The need date for the aluminum dissolution facilities will also be moved out about two to three years from the dates shown above.

8.3 F-Tank Farm

The F-Tank Farm receives, stores, evaporates, and transfers high level waste.

8.3.1 F-Tank Farm Useable Space

The F-Tank Farm includes twelve old-style waste storage tanks, two of which are now closed; ten new-style tanks; and two evaporator systems (one of which is operational). At the time of this System Plan (March 1, 2000), F-Tank Farm has approximately 200,000 gallons of useable space available.

8.3.2 F-Tank Farm Evaporators

The **1F Evaporator** was shut down in 1988 because of high maintenance and lack of feed. There are no plans to restart this evaporator system. Some contaminated rainwater was pumped out of the 1F Evaporator cell in February 1998 and steam to the 1F system was permanently isolated in May 1998. However, at the time of this Plan, no chemical cleaning has been done and no decontamination and decommissioning activities have occurred.

In 1999 the **2F Evaporator** system achieved a space gain total of approximately 700,000 gallons. During the year, the 2F system experienced several planned and unplanned outages that varied from utility infrastructure problems to TSR implementation of key components. As described in Section 7.8 the 2F Evaporator operations were suspended while 2H PISA issues were resolved. The Evaporator System is back in normal operations at the time of this plan. The Requirements and Target Cases places the 2F Evaporator System in standby in FY03 and FY05 respectively.

Similar to what occurred with the 2H Evaporator, the 2F Evaporator has also experienced several extended unplanned outages over the last few years. On November 28, 1998, the 2F system was unexpectedly shut down because of high tritium concentrations in its overheads stream that is sent to ETF. The evaporator remained down for approximately six weeks while an interim solution was reached between HLW, ETF and ESH&QA (see Section 7.9). HLWD experience in operating HLW evaporators indicates that the average life expectancy of evaporator vessels is 10.5 years. The 2F Evaporator vessel will reach 10.5 years of service in April 2000. The plan is to operate the 2F Evaporator until failure, so a replacement outage is not specifically scheduled at this time. A new vessel is currently on order with an expected procurement completion date of May 2000. The new vessel will serve as a spare for either the 2F or the 2H Evaporator systems. The evaporator storage or disposal box is in the design phase.

8.3.3 F/H Interarea Transfer Line

The capability to transfer between F-Tank Farm and H-Tank Farm was restored in FY97. Several successful transfers have been made since then. Planned evaporation of H-Tank Farm backlogged HHW in the 2F System, and subsequent de-inventorying of the concentrated supernate from 2F into H-Tank Farm, will require numerous uses of the Interarea Transfer Line during the period FY00-FY04. Tank 8 sludge will also be transferred to Tank 40 via the Interarea Line in FY00. The Interarea Transfer Line will continue to be used over the life of the program to support waste removal and space management activities.

8.3.4 F-Tank Farm Waste Removal Operations

Salt Removal

With the delay in Salt Processing, all efforts for the next several years will be focused on maintaining sludge feed to DWPF.

Sludge Removal

The four slurry pumps were installed in Tank 8 in March 1999. Shaft binding was discovered when pump coupling was attempted in September 1999. Recently completed materials compatibility testing by SRTC has concluded that the binding was caused by corrosion of a thin tungsten-cobalt coating on the lower shaft section. The pumps will be used "as is." The shafts are hands–turned daily to prevent recurrence of binding. Hanford pumps have experienced similar problems. The 3H (RHLWE) feed pump, which was similar in design, had this coating milled off of its shaft and a 410 stainless steel sleeve installed to eliminate shaft binding on this pump.

At the time of this report, virtually all equipment modifications are complete. All startup testing is complete. All eleven systems have been turned over to Operations. The projected startup date is April 2000. The schedule slip from November 15, 1999 is attributed to:

- Slurry pump shaft problem resolution
- Numerous hardware backfits and procedure revision to comply with the new Tank Farm AB
- Development of a complicated slurry pump operations program to ensure that hydrogen potentially trapped in the sludge is released in a controlled fashion that does not challenge the AB
- Some unavailability of facility support for project activities due conflicts with other high priority programs within F Tank Farm.

The Tank 8 sludge will be moved to Tank 40 in two batches by September 2000 for washing as part of Sludge Batch 2. This schedule provides just-in-time support for planned DWPF production at 250 cans/year.

The Tank 19 heel removal technology has been selected via small and full scale testing. Three oscillating 50-hp submersible (Flygt) mixers will be used to suspend the sludge solids in the entire tank. Testing at Pacific Northwest National Laboratories (PNNL) indicated that a velocity greater than 1.6 ft/sec was required to suspend zeolite solids and greater than 1.0 ft/sec was required to suspend sludge solids. Full-scale tests at TNX indicate that three 50-hp submersible (Flygt) mixers can achieve these velocities throughout Tank 19. The equipment is currently being fabricated and tested. Installation in Tank 19 is scheduled from April to July 2000. After startup testing and a Graded Readiness Assessment are completed, heel removal will be initiated August 2000. A robotic crawler with water monitor will be deployed September 2000 to remove residual sludge if needed to meet the performance assessment. This schedule provides just-in-time support for tank closure by the FFA date of March 2003. Refer to Section 8.4.8 for details on Tank 19 closure plans.

The Tank 18 heel removal technology baseline includes replacing the three failed slurry pumps with three new slurry pumps with different discharge configurations. Preliminary evaluations are under way to determine if there is a promising alternative technology with a potential cost savings versus the baseline. Start of design and construction was deferred to FY01 due to the funding shortfall in FY00. This schedule will provide just-in-time support for tank closure by the FFA date of March 2004. Refer to Section 8.4.8 for details on Tank 18 closure plans.

For the Requirements Case, the sludge in Tank 7 will be combined with the sludge in Tank 11 to become Sludge Batch #3. Tank 7 sludge does not require aluminum dissolution. Sludge removal from Tank 7 must start May 2002 to maintain continuous feed to DWPF at a planned production rate of 250 cans/year.

- In FY00, Title II design will be completed, construction will be started, and the transfer pump will be installed
- In FY01, construction will continue
- In FY02, construction, startup testing, and turnover to Operations will be complete.

Sludge will be transferred to Tank 51 in late FY02. This schedule just barely supports planned DWPF production and easily supports the FFA closure date of September 2022.

For the Target Case, the dates for Tank 7 given above for design, construction and startup still apply. However, in the Target Case Batch 3 will only contain the sludge from Tank 7.

For the Requirements Case, Sludge from Tank 26 will be processed as part of Sludge Batch 4.

- In FY01, walk-downs will be completed, a design TOPR will be developed, a design contract will be awarded, and design will be started
- In FY02, design will be completed, construction bids will be received, a construction contract will be awarded, and construction will be started
- In FY03, construction will be completed
- In FY04, construction and startup testing will be completed, the tank will be turned over to Operations, and waste removal will be completed to Tank 40 for sludge washing.

This schedule provides just-in-time support for planned DWPF production.

For the Target Case, where the sludge processing rate has been reduced, sludge removal from Tank 26 can be moved out approximately 2 years from the dates shown above.

8.4 Waste Removal

8.4.1 Sludge Removal Technical Baseline

The sludge removal technical baseline is based on four standard 150 hp slurry pumps per sludge tank. The slurry pumps are installed in available risers such that the affected cleaning radius of each individual pump overlaps with the adjacent pumps to enable the entire tank to be slurried. The initial elevation of the pump suction is positioned just above the sludge layer. Water is added to the tank if there is not enough supernate to use as the slurry media. Operation of the slurry pumps will typically suspend all of the sludge that can be suspended at that slurry pump elevation within a few days. The slurry pumps are then lowered in 10" increments, more water is added if needed, and the next layer of sludge is suspended. This sequence of operations is repeated until the slurry pumps are at the lowest elevation, typically 10" or less above the tank floor. The transfer pump is then lowered to its lowest elevation, typically 6" or less above the tank floor. The sludge is now ready to be transferred out of the tank. Sludge removal in this manner is referred to as “bulk waste removal.”

Several additional attempts may be made to remove residual sludge by adding more water, slurrying and transferring. This is typically repeated until a point of diminishing returns is reached. This technique was successfully used on Tanks 16 and 17. Sludge was also removed from Tanks 15, 21, 22, and 42 with standard slurry pumps, however the sludge removal operation was stopped without making several attempts to remove the residual sludge due to the water additions required.

8.4.2 Sludge Removal Demonstrations

Two alternate sludge suspension technologies are being developed via the Tanks Focus Area: the Advanced Design Mixer Pump and the use of submersible (Flygt) mixers. SRS will be expected to support these demonstrations. See Section 9.2 under Technical Development for current work being done on alternative waste retrieval methods.

8.4.3 Salt Removal Technical Baseline

The salt removal technical baseline is based on three slurry pumps per salt tank. The slurry pumps are positioned just above the saltcake, and water is added to the tank. When the slurry pumps are operated, the boundary layer of salt solution in contact with the saltcake is displaced thus exposing the underlying saltcake to unsaturated water. When the bulk solution nears saturation, it is transferred to the salt processing facility. Then the slurry pumps are lowered and the process is repeated. This technique was successfully used on Tanks 17, 19, 20, and 24. Three slurry pumps for salt removal were selected as the project baseline in the early 1980s for four reasons:

- The salt removal rate was fast enough to support a production rate of 405 canisters/year
- The agitation provided by three slurry pumps was vigorous enough to also remove insoluble solids known to be in all salt tanks
- Economy of scale could be achieved by using the same pumps for salt and sludge removal
- Slurry pumps were considered to be cost effective at that time.

Since that time, the cost has increased due to the use of enhanced mechanical seals and slurry pump containment.

8.4.4 Salt Removal Demonstrations

Salt removal demonstrations in actual waste tanks have been postponed due to the delay in salt processing. See Section 9.2 under Technology Development for current work being done on alternative waste removal methods. Three less expensive alternative salt removal techniques were previously proposed, including Modified Density Gradient, a Single Slurry Pump, and a Water Jet.

8.4.5 Waste Removal Cost Baseline

Waste Removal project rebaselining for the cost of retrofitting salt and sludge tanks with waste removal equipment is complete. The Baseline Change Proposal is currently at DOE-HQ for approval. This significant effort provides up-to-date project cost information to use in the HLW Financial Model to determine annual funding requirements and Life Cycle Costs.

8.4.6 Waste Removal from Type I, II and IV Tanks

Four different designs, or “Types,” of carbon steel waste tanks are used to store liquid HLW at SRS, but only the Type III Tanks meet current requirements for leak detection and double containment as defined in the FFA. The Type I and Type II Tanks have inadequate secondary containment and leak detection capabilities, and the Type IV Tanks have no secondary containment at all. Although nine of the non-compliant HLW tanks have leaked in the past, the HLWD’s formal tank integrity monitoring program indicates that none of the known leak sites is currently active. Still, long term risk to the environment will be greatly reduced by removing the waste from these tanks and immobilizing the waste in a solid borosilicate glass or stabilizing it in a saltstone waste form.

Per this Plan, some of these tanks will be over 60 years old before they are closed. In the last 2 years, two additional tank integrity issues have arisen with these tanks:

- Tank 15 has developed a type of leak site not previously seen: a crack running parallel to a weld seam, above the waste level, approximately 18 inches in length. This type of leak site will make waste removal from this tank much more difficult. If other tanks develop similar leak sites, the risk of releases and the complexity and cost of future waste removal will be increased.
- Increased corrosion has been observed in several tank secondary pans. In several cases, these secondary pans, which represent the last lines of defense for this waste, already contain waste from previous leaks in the primary walls of the tanks.

Although SRS maintains an aggressive program to monitor the integrity of all waste tanks, these recent findings underscore the need to complete infrastructure upgrades and waste removal from these tanks as soon as possible.

8.4.7 Waste Removal Sequencing Considerations

The following generalized priorities are used to determine the current sequencing of waste removal from the HLW tanks:

1. Maintain emergency tank space per the Technical Safety Requirements (TSR)
2. Control tank chemistry, including radionuclide and fissile material inventory
3. Enable continued operation of the evaporators
4. Ensure blending of processed waste to meet salt processing, DWPF, and Saltstone feed criteria
5. Remove waste from tanks with a leakage history
6. Remove waste from tanks that do not meet FFA requirements
7. Provide continuous radioactive waste feed to DWPF
8. Maintain an acceptable precipitate balance within the salt processing facility
9. Remove waste from the remaining tanks

The principal goal of the regulatory drivers is to remove waste from the old-style tanks. In the Requirements Case, waste will be removed from all of the old-style tanks by 2016. However, once Salt Processing is operational salt waste must concurrently be removed from some of the Type III Tanks to support the cleanup of the older tanks. Concentrated supernate and/or salt removal from new tanks are required to maintain the evaporator systems on-line and to provide receipt space for large transfers of ESP washwater and DWPF recycle**.** Removal of concentrated supernate or salt from Type III Tanks 29, 30, 38, and 41 must receive priority over some of the non-compliant salt tanks to enable continued operation of the 2H and 3H Evaporator systems.

In an effort to address source term issues, particularly in the later batches, and to improve tank space management, several changes in source tanks making up Sludge Batches were made from what was assumed for Revision 10 of the System Plan. The re-sequenced batches were modeled using Glassmaker and are all projected to make acceptable glass. A summary of the major changes for the Requirements and Target Cases follows:

Requirements Case Sludge Batch Re-sequencing

The sludge removal sequencing for the Requirements Case is essentially the same as in HLW System Plan, Rev. 10. The overall sludge batch sequence is shown in Appendix H.5 and the major changes from Rev. 10 are:

- Tanks 4 and 26 switched batches. Tank 4 moved from Batch 4 to 6 and Tank 26 moved from Batch 6 to 4.

  Reason: Moving Tank 26 up earlier in the batch sequencing results in improvements in tank space management prior to the startup of salt processing. An additional 280 kgal of tank space becomes available in FY04-05 after sludge is removed from Tank 26 and the tank is returned to waste storage service.

- Tanks 21 and 22 have moved from Batch 5 to Batch 7.

  Reason: Tanks 21 and 22 will be maintained as potential receipt tanks for DWPF recycle or ESP washwater until the start of salt processing. These tanks contain minimal sludge (a total of 20,000 kg between both tanks).

- Tank 47 has been moved from Batch 7 to Batch 8.

  Reason: Tank 47 has a significant amount of salt (approximately 800 kgal) which must be removed before removing sludge. With the delay in Salt Processing, Tank 47 sludge should be delayed as late as possible.

Target Case Sludge Batch Re-sequencing

In the Target Case, sludge batches were re-sequenced to maximize risk reduction by emphasizing the removal of waste from old-style tanks while also meeting target level funding constraints. The overall sludge batch sequence is shown in Appendix I.5 and the major changes from the Requirements Case are:

- Tank 11 is moved from Batch 3 to Batch 4. All of Tank 7 is processed in Batch 3.

Reason: Required to allow maximum removal of sludge from an old-style tank while being constrained by projected early year funding constraints. Tank 7, which contains a significant amount of sludge, had previously been split between Batches 3 and 4. The same amount of sludge (approximately 412,000 kg) is still removed in Batch 3, although sludge removal is only performed on one tank.

- Tank 15 is displaced from Batch 4 by Tank 11 and moves to Batch 5.

  Reason: Required to establish proper size batches.

- Tank 13 is moved from Batch 5 to Batch 6. All of Tank 13 is processed in Batch 6.

  Reason: Required to establish proper size batches. This change allows Tank 13 to be processed in one batch instead of being split between two batches.

- Tanks 4 and 6 are moved from Batch 6 to Batch 7.

  Reason: Required to establish proper size batches.

- Tanks 21 and 22 have moved from Batch 7 to Batch 8.

  Reason: Places priority on removing sludge that is higher in curies. Tanks 21 and 22 contain minimal sludge (a total of 20,000 kg between both tanks).

8.4.8 Closure Program

The Savannah River Site has begun to close HLW tank systems. SRS closes HLW tank systems under the F/H Tank Farm Industrial Wastewater Operating Permit and South Carolina Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities." In addition, SRS recognizes that future RCRA/CERCLA remediation actions may be required to clean up contaminated soils and groundwater in the Tank Farms. Therefore, the SRS Tank Closure Program is structured to be consistent with the comparative analyses performed as part of a RCRA corrective measures study, and a CERCLA feasibility study under the FFA. See additional discussion on Tank Closure under Section 5.3 Regulatory Constraints – NEPA.

The performance objectives for HLW tank system closure are the groundwater protection standards applied at the point where groundwater discharges to the surface (seepline), and the surface water quality standards applied in the receiving stream. Closure options for each tank are evaluated to show conformance with the performance objectives as part of the overall evaluation.

In July of 1999 DOE issued Order 435.1 "Radioactive Waste Management." Order 435.1 sets forth the requirements for handling all DOE radiological waste, including the residual waste heel that cannot be removed from HLW tanks after bulk waste removal.

Waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not high-level waste, and is managed under DOE's regulatory authority in accordance with the requirements for transuranic waste or low-level waste, as appropriate. When determining whether spent nuclear fuel reprocessing plant wastes are managed as another waste type or as high-level waste, either the citation or the evaluation process is used:

1. **Citation**. Waste incidental to reprocessing by citation includes spent nuclear fuel reprocessing plant wastes such as, contaminated job wastes including laboratory items such as clothing, tools, and equipment.
2. **Evaluation**. Waste incidental to reprocessing will be managed as low-level waste and meet the following criteria:
   - Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
   - Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and
   - Are to be incorporated in a solid physical form at a concentration that does not exceed concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*; or will meet alternative requirements for waste classification and characterization as DOE may authorize.

DOE is planning on developing, by June 2000, a Waste Incidental to Reprocessing Determination to satisfy the requirements in Order 435.1 for the waste heel remaining in Tank 19.

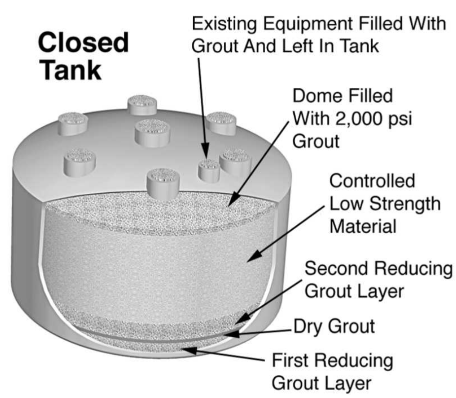
The general protocol for SRS tank system closure is as follows:

1. Bulk waste is removed and the tank is water washed.
2. Any waste remaining in the tank after water washing is considered residual waste and subject to a Waste Incidental to Reprocessing (WIR) Determination. The residual waste is characterized, and a method for stabilizing the residual contaminants is proposed. Based on work done to date, it is evident that some type of mechanical or chemical cleaning, using oxalic acid or some other more DWPF compatible chemical, will be required. This is necessary to reduce the waste heel to levels required to meet closure requirements. (See Sections 9.2 and 9.3 for technical development work on this subject).
3. The proposed closure configuration is subjected to fate and transport modeling to evaluate compliance with overall performance objectives as determined by applicable environmental regulations. Contributions from other nearby tanks and non-tank sources are also included in the calculations.
4. Specially designed containers to store, transport, and dispose of equipment are necessary to support equipment failures and equipment removal for tank closure. Each of these containers are required to pass an On-site Safety Assessment for the on-site transport of radioactive materials as required by RADTRANS2000 which incorporates the requirements of DOE Order 460.1A Packaging and Transportation Safety.
5. The portion of the performance objectives remaining after subtracting non-tank sources is apportioned among the tanks to determine individual, tank-specific performance objectives.
6. Detailed tank-specific closure modules are prepared for each tank system and submitted to SCDHEC for approval. SCDHEC approval is a prerequisite to starting emplacement of backfill material.

Equipment removed from tanks due to failure, obsolescence, or to support Waste Removal for tank closure must also be proven to be "incidental waste" prior to disposal. To support this, decontamination of equipment must be routinely performed prior to, upon, or after equipment removal. Enhanced decontamination efforts are expected to be necessary for equipment in idled tanks to ensure it can meet the disposal requirements for "incidental waste."

Grout backfill is used to perform three functions:

- A "reducing" grout is poured in the tank first to stabilize the residue. This grout has chemically reducing properties, which encourage some of the radioactive isotopes to remain insoluble and therefore less mobile. This reduces the migration of contaminated materials to the surrounding water systems.
- Controlled Low Strength Material (CLSM) is a specially formulated grout that fills the empty voids in the tank system thereby eliminating the chance for subsidence. Its mechanical properties are similar to compacted soil.
- In case institutional control is lost, an intruder barrier is provided by pouring a layer of relatively strong grout at the top of the tank or by crediting the reinforced concrete tank top. For the Type IV tanks a strong grout layer was poured to provide this added intruder protection. Different grout formulations continue to be tested to reduce cost and/or improve performance.



The Tank 17-20 cluster in F-Area was selected as the first set of tanks to be closed, for several reasons. Tanks 17-20 are old-style tanks, which will not be returned to service after waste removal. Very little waste remains in any of the four tanks (see below for more details). Tanks 19 and 20 have a history of groundwater in-leakage. In addition, these are Type IV tanks, which lack internal structures, thereby simplifying removal of sludge heels and emplacement of backfill material. Tanks 20 and 17 were closed in 1997.

Tank 20 was the first HLW Tank operationally closed at SRS. Bulk waste removal and water washing were completed in 1986. Ballast water was removed in July 1996. Photographic inspections of the tank interior revealed approximately 1,000 gallons of residual sludge on the bottom of the tank. The waste was characterized by process knowledge and sampling. SCDHEC approved the Tank 20 Closure Module on January 30, 1997. DOE-SR determined through their ongoing interactions with the NRC that the NRC had "no objection" to the closing of Tanks 20 and 17. WSRC began placing the reducing grout in Tank 20 on April 24, 1997, using an on-site continuous feed plant located near Tank 20. The reducing grout was placed in several stages. The first layer was placed in liquid form using multiple pour locations. Grout was alternately poured through six perimeter risers and one center riser. The dense grout lifted the waste sludge, which is less dense, off the tank bottom and spread it across the tank. The loose waste sludge was then immobilized by blowing in dry powdered grout. The dry particles hydrated, incorporating the water into the grout powder, and formed a hard mass. More liquid grout was poured from the center riser, forming a domed cap fully encapsulating the waste within the grout layers. Bleed water generation was kept to a minimum due to the special formulations of the backfill materials. Approximately 518 cubic yards (2 feet deep in tank) of reducing grout were used. This was followed by approximately 7,000 cubic yards of CLSM (approximately 32 feet deep). The entire filling operation was observed using a remotely operated video camera. The grouts and CLSM were shown to be very flowable while in the liquid state and were able to self-level and fully surround and enclose tank equipment. SCDHEC approved the Tank 20 closure on July 31, 1997.

Tank 17 was the second waste tank operationally closed at SRS. Bulk waste removal of 376,000 gallons of sludge and salt was completed in 1985. Approximately 280,000 gallons of tritiated water was transferred from Tank 17 to Tank 6 in March 1997, leaving a sludge heel of approximately 10,000 gallons. Submersible (Flygt) mixers (4 horsepower and 15 horsepower sizes) were used to suspend the sludge heel, and water brushes were used to sluice the suspended sludge toward diaphragm pumps for removal to Tank 18. Approximately 2,200 gallons of solids and 200 gallons of water remained in Tank 17 after sluicing. These waste solids were sampled; sample results confirmed that process knowledge estimates were reasonable. The reducing grout was placed in several layers. The first one-foot layer was placed in liquid form using multiple pour locations. When the grout was first introduced, some of the sludge was lifted off the tank bottom by the dense grout. Some intermixing occurred between the grout and the sludge. After the first one-foot layer, no visible sludge remained on the top of the grout. At this point, the remaining reducing grout was poured from the center riser to achieve a total of approximately 6 feet (1,330 cubic yards) of reducing grout. This was followed by approximately 28 feet (5,416 cubic yards) of CLSM, and approximately 11 feet (1,307 cubic yards) of 2,000 psi high strength grout. The Tank risers were filled with 28 cubic yards of 5,000-psi high strength grout. SCDHEC approved the Tank 17 closure on December 15, 1997.

Tank 19 bulk waste removal occurred in 1986 using two slurry pumps mounted in diametrically opposing risers. This equipment configuration created a “beachline” of sludge and zeolite (spent ion exchange media), roughly 18 inches high, running across the diameter of the tank bottom. The zeolite particles are large, making them difficult to remove with only two slurry pumps. Zeolite covers some piles of sludge. Waste samples, obtained with a modified, off-the-shelf sample tool (mud snapper) in 1996, revealed that most of the heel is soft and probably easily mobilized. However, very little zeolite was present in this sample. There is a concern that several thousand gallons of zeolite under the northeast riser may exist in a consolidated mass that could be difficult to slurry. The current plan for Tank 19 heel removal is to use three 50 horsepower submersible (Flygt) mixers currently being tested for that purpose. Because of the presence of zeolite in Tank 19, SRTC has enhanced a vendor’s remote crawler and is testing it for possible use in Tank 19. The residual waste and wash water from Tank 19 will be consolidated in Tank 18. The Tank 19 transfer pump riser (TPR) has been built and installation is in progress. The TPR, along with the two Tank 19 transfer pumps and the Tank 18 recycle pump, will allow the liquids used to suspend the Tank 19 sludge/zeolite for transfer to Tank 18, to be reused. This will greatly reduce the new liquid added to the tank farm inventory to empty Tank 19. The two pumps in Tank 19 will allow the rapid removal of the majority of the slurry, while also allowing the liquid heel to be reduced to less than 1". Tanks Focus Area funding is being used to support a significant portion of FY00 activities. Tank 19 closure is currently funded in FY02 and FY03. Closure in FY03 meets DOE’s FFA commitment to close Tank 19 by FY03.

Tank 18 will be the last tank closed in this cluster because Tanks 17, 19 and 20 can only transfer into Tank 18, and Tank 18 is the only one of the four that can transfer out to FDB-1. The tank currently contains about 42,000 gallons of sludge and 308,000 gallons of supernate. After the Tank 19 waste is transferred into Tank 18, the combined contents of Tanks 18 and 19 will be transferred to another tank. This tank is currently designated to be Tank 26 but transfer route and potential tank space issues must be resolved. Tank 18 will be closed in FY04. This meets DOE’s FFA commitment to close Tank 18 by March 2004.

Tank 16 was the subject of a rigorous waste removal, water washing, and acid washing demonstration in 1978-80. Waste removal from the primary tank is considered complete. However, large quantities of insoluble salts remain in the annulus. Some of the crystallized saltcake may have evolved into natro-devyne, a hard, insoluble compound. A sample tool was developed in the spring of 1998 and deployed in May 1998. Samples retrieved from the annulus were analyzed and preliminary fate and transport modeling revealed that further cleaning is required. Further work on Tank 16 is not currently funded for several years due to other priorities. The FFA closure commitment date is FY15.

8.5 HLW Pretreatment

8.5.1 Extended Sludge Processing (ESP)

General

The ESP facility performs two main functions. First, for some H-Area sludge, it uses high temperature caustic dissolution to remove excess aluminum in sludge, which improves glass viscosity and reduces the total number of canisters to be produced. Second, the aluminum-dissolved sludge is combined with remaining H-Area and F-Area sludge comprising the sludge batch and washed. The sludge is washed with water to remove excess alkali in order to make the sludge compatible with the vitrification process.

The planning basis for the ESP facility provides for single tank washes in either Tank 40 or Tank 51. Both tanks will be retrofitted with steam spargers so that either tank can be used for aluminum dissolution.

Total Projected Canister Production

For the Requirements Case, the current sludge inventory is estimated to produce about 5,635 canisters. In addition to the canisters associated with sludge processing, there will also be an estimated 409 canisters of salt-only glass made at the end of the program for an overall estimated total of 6,044 canisters produced. The 6,044 canister estimate is an increase from the 5,732 canisters estimated in the last revision of this Plan.

This increase is due to chemistry constraints precluding us from loading salt-only canisters to the precipitate levels assumed in Rev 10. Similar changes in the outyear estimates will occur as we continue to gain additional operating experience and improved understanding of the relationships among waste composition, waste characteristics, and waste processing.

For the Target Case, the current sludge inventory is estimated to produce about 5,649 canisters. The slight increase in canister production results from the re-sequencing of sludge batch source tanks for the Target Case. At this time, it is predicted that salt-only canisters will not be required for the Target Case. This assumption is based on the ability to resolve some currently existing technical constraints on precipitate loading in a canister.

Production Capacity

For planning purposes, sludge batch preparation is expected to require from 11 to 21 months. However, for ESP Batch 2 efforts are being made to accelerate the washing process to 9-10 months. Note this batch does not require aluminum dissolution. The feed preparation duration at ESP is typically broken down into the following major activities:

- Receive designated H-Area sludge
- Add chemicals for aluminum dissolution
- Perform aluminum dissolution, if required
- Allow to settle and decant aluminum loaded supernate
- Receive remaining sludge (primarily from F-Area but could include some remaining from H-Area)
- Perform wash and decant cycles. Repeat as necessary to reach proper waste composition. (4 to 7 cycles required)
- Sample washed sludge
- Qualify sludge by characterization of the sludge and produce glass in SRTC High Level Cells
- Batch Ready for feed to DWPF

The total duration is dependent primarily on the number of washes, though many other factors will also apply. The size of each batch is limited to approximately 600,000 to 800,000 gallons of equivalent 16 – 19 wt% solids. The remaining volume of the waste is needed for washwater and vapor space flammable vapor releases. Provided waste removal projects are completed to support ESP batches, ESP can produce approximately 600,000 – 700,000 gallons of sludge feed every two to three years for feed to DWPF.

Production Plan

Tank 51 is being used to store and transfer ESP Batch 1B sludge, which has been qualified to meet DWPF feed requirements. As of February 29, 2000, 315 canisters have been prepared from this batch. About 625 total canisters are projected from ESP batch 1B. The sludge concentration in the tank has slowly decreased over the past year and half since transfers from ESP Batch 1B began. The decrease in concentration is attributed to dilution from slurry and transfer pump bearing water and transfer line flushes back into the tank required after each transfer. Because of seismic qualification issues associated with the transfer jet, the supernate cannot be decanted from the tank. The dilution of sludge negatively affects DWPF ability to produce canisters since the sludge solids are lower in each ESP to DWPF transfer. These dilution impacts have larger implications as Tank 51 level decreases. Initiatives such as lowering of the transfer pump and operating the slurry pumps during the ESP to DWPF transfers are being evaluated to address the dilution issue.

Tank 42 is now used for storage of supernate that has been partially concentrated. Plans are to eventually transfer the Tank 42 supernate waste to an evaporator system for further concentration. The tank will then be used for long term concentrated waste storage until the start salt processing. Tank 42 is no longer available for ESP washing.

Tank 40 preparation is almost complete so the tank can be used for processing ESP Batch 2. Three of four slurry pumps have been installed. Slurry pump acceptance testing is underway. The concentrated supernate previously stored in Tank 40 has been transferred to Tank 42. The Tank already contains about 175,000 gallons of settled sludge that will become part of ESP Batch 2. In order to reduce the batch preparation schedule, a wash cycle for Tank 40 current contents is planned to be done prior to the transfer of the remaining sludge that makes up ESP Batch 2 from Tank 8 in F-area. Batch 2 preparation is planned on an accelerated schedule so that DWPF will not run out of feed. Delays have occurred in the Tank 8 sludge removal preparation schedule due to emergent issues (*e.g.* high radiation rates, tank riser interferences, and waste characterization). Though not included in this Plan, there is the potential that ESP Batch 2 may have to be split into two smaller batches (ESP Batch 2A, Tank 40 sludge, and ESP Batch 2B Tank 8 sludge).

8.5.2 Salt Processing

Of the 35 million gallons of high level waste in storage, approximately 3 million gallons are sludge waste and 32 million gallons are salt waste. The sludge waste, which is insoluble and settles to the bottom of a waste tank, generally contains insoluble radioactive elements including strontium, plutonium, americium, and curium in the form of metal hydroxides. The salt waste, which is soluble and is dissolved in the liquid rather than settling to the bottom of the waste tanks, contains most of the soluble radioactive element cesium. The salt supernate and dissolved salt cake removed from the waste storage tanks will be processed to remove the radioactive cesium. The cesium contains approximately 99.99% of the radioactivity in the salt waste but is only a small fraction of the total previous volume. Since cesium is the only part of salt waste that is high-level waste, it is the only part that must be transferred to DWPF for vitrification and ultimate storage in a Federal Repository. The remaining salt solution, now without radioactive cesium, is classified as low-level waste. This decontaminated salt solution, although it contains less than 0.01% of the previous radioactivity, is the bulk of the previous volume. It is sent to the Saltstone Facility for safe, on-site disposal.

Systems Engineering Evaluation

Processing at the In-Tank Precipitation (ITP) Facility was suspended because the facility could not cost effectively meet both the safety and production requirements for the High Level Waste System. A HLW salt solution processing alternative evaluation is currently underway. An extensive list of potential treatment options has been pared down to three primary alternatives. These alternatives include Small Tank Tetraphenylborate (TPB) Precipitation, Crystalline Silicotitanate (CST) Non-Elutable Ion Exchange and Caustic Side Solvent Extraction.

- **Small Tank Tetraphenylborate Precipitation**
  The Small Tank TPB facility uses chemical precipitation/adsorption and filtration to separate Cs-137, Sr-90 and Pu from salt solution into a low-volume, high radioactivity waste stream known as "precipitate," and a high-volume, low radioactivity waste stream known as "filtrate." The precipitate is washed to reduce the nitrite concentration from 0.4 M NO_2 to 0.01 M NO_2. The lower NO_2 concentration reduces the formation of attainment limiting, high boiling organic compounds in the DWPF melter feed preparation ventilation system to safe and manageable levels. The filtrate is combined with ETF evaporator concentrate and then solidified and disposed as Saltstone grout.
- **CST Non-Elutable Ion Exchange**
  The CST Non-Elutable Ion Exchange process uses adsorption filtration to remove the Sr-90, U, and Pu from the waste using monosodium titanate (MST). It then removes the Cs-137 by adsorption on crystalline silicotitanate (CST). The decontaminated salt solution is then combined with ETF

evaporator concentrate, solidified and disposed as Saltstone grout. The adsorption media (both CST and MST) are transferred to DWPF for incorporation into the glass.

- **Caustic Side Solvent Extraction**
  In solvent extraction (liquid-liquid), a sparingly soluble diluent material carries an extractant that will complex with cesium ions in the caustic solution. The separated cesium can then be stripped back into an aqueous phase for transfer back to DWPF.

Science and Technology activities are continuing on these three alternatives with a final DOE technology selection expected in FY01. For the purpose of this Plan, the documented values (salt solution feed volumes, precipitate feed rates, etc.) from the Small Tank Tetraphenylborate Precipitate process were used for modeling of the HLW System. Once a final decision is made on the preferred salt disposition process, a new revision of the HLW System Plan will be generated.

It is critical to resolve the salt processing flow sheet as quickly as possible. The DWPF vitrification specifications allow for sludge-only canisters and for combined salt-sludge canisters. This is because certain sludge constituents are required chemically to make high quality glass. Additionally, when a combination salt-sludge batch is being processed, the treated salt waste dissolves into the molten glass, creating minimum additional volume. Therefore, the total number canister made is minimized if salt is combined with sludge. However, to produce precipitate-only canisters, special chemicals, or "sludge simulant," must be added to replace the sludge. This would increase costs and create more canisters. The Requirements Case includes a period of 2-3 years where an estimated 409 salt-only canisters are made. Studies to develop a cesium only (*i.e.* salt-only) glass formulation may reduce the number of salt-only canisters produced.

<u>Production Capacity</u>

The salt solution removal rate (at an average of 6.44 M Na^+) is projected to be a long-term average of 6,000,000 gallons annually, based on logistical constraints imposed by the infrastructure of the Tank Farms.

A projected maximum of 6,000,000 gallons of salt solution are made available every year from the Tank Farm. However, the DWPF forecasts that the melter must be replaced every 2-3 years, which requires a six-month outage. The salt processing alternative processes have included 60 days of product storage capacity in design basis flowsheets. This storage allows all of the options to operate 2.17 years out of every 2.5 years, making the required capacity to 6,900,000 gallons of 6.44M salt solution on an annualized basis to match the waste removal capability.

Therefore, the instantaneous salt solution processing rate for all three salt processing alternatives is 13.1 gpm at 100% attainment, corresponding to 17.5 gpm at 75% attainment.

Small Tank Tetraphenylborate Precipitation has the capability to hydrolyze all the precipitate it produces, as the current bases. This is a change from the last System Plan basis. Therefore, Small Tank Tetraphenylborate Precipitation can support the Requirements Case coupled canister production rate of 250 per year. This is also true of the other options highlighted above.

For the Requirements Case, coupling Small Tank Tetraphenylborate Precipitation to DWPF starting with Sludge Batch 6 in FY10 will allow processing of about approximately 70% of the total HLW salt and supernate. The remaining salt will produce hydrolyzed (free of organic) product from the Salt Processing Facility which can be processed in DWPF at a rate of 150 canisters per year. The precipitate hydrolysis product loading is limited by glass property constraints (durability, in this case) to about 20 wt% on an oxide basis. Note that the 150 canisters per year of salt-only operations differs from the 60 canisters per year used in Revision 10. The earlier plan based the loading limit on thermal output of the canisters and had not considered glass property constraints.

At this time, it is expected that salt-only canisters will not be required for the Target Case. This assumption is based on the ability to resolve some currently existing technical constraints on precipitate loading in a canister. In particular, issues associated with glass property durability constraints must be resolved. These technical constraints may be eliminated by one or a combination of the following: more extensive sludge washing, a change in frit loading, or experimental work extending the range of acceptable salt loading. If these technical constraints can not be alleviated, then the production of salt-only canisters will be required.

8.6 Defense Waste Processing Facility (DWPF)

DWPF is currently in "sludge-only" Radioactive Operations. At the time of this, DWPF has poured 797 canisters (64 in FY96, 169 in FY97, 250 in FY98, 236 in FY99, and 78 in FY00 through March 1.). This represents completion of approximately 13% of the total number of canisters to be produced over the life of the facility.

Production Capacity

DWPF operation was initiated in FY96. In FY96, FY97, and the majority of FY98, substantial shakedown runs and learning experience was gained. However, since DWPF has now operated for approximately four years in a full sludge only production mode, it is appropriate to update the production capacity based on the knowledge of the plant behavior versus the initial design capacity calculations.

For reference, Research and Development (R&D) work conducted in the late 1970s and early 1980s indicated that the average instantaneous pour rate for the DWPF melter should be 228 lbs./hr. This was based on scale up calculations from data derived from the small R&D melters with a specific chemistry. The melt rate is controlled by several key chemical and physical properties of the liquid high level waste and the molten vitrified waste:

- Glass oxidation state
- Molten vitrified waste viscosity
- Melter feed solids content
- Melter vapor space temperature as defined in the Safety Authorization Basis
- Quantities of combustibles in the melter feed

A limited study was also performed in 1989 that estimated the DWPF plant attainment to be approximately 75%, including melter outages.

Therefore, the initial design capacity for the facility was based on the following:

$$\frac{228\ \text{lbs. glass}}{\text{hr}} \times \frac{\text{canister}}{3{,}705\ \text{lbs. glass}} \times \frac{24\ \text{hr}}{\text{day}} \times \frac{365.25\ \text{day}}{\text{yr.}} \times 75\%\ \text{attainment} = \frac{405\ \text{canisters}}{\text{yr.}}$$

However, based on the production capability that has been accomplished for Batch 1A and for Batch 1B, it does not appear that this type of production capability will be accomplished without modifications being implemented. The limitations being experienced in production are primarily related to:

- the higher oxidation state of the sludge feed relative to the original test data and its impact on production
- foaming of the melter cold cap
- pressure surging of the off gas system
- lowering of the melter vapor space temperature

These limitations result in a lower production rate.

Based on the first two macro-batches of feed processed in the DWPF, the following production capacity has been accomplished to date:

Batch 1A Results (5/25/98 to 9/15/98)

$$\frac{161\ \text{lbs. glass}}{\text{hr}} \times \frac{\text{canister}}{3{,}800\ \text{lbs. glass}} \times \frac{24\ \text{hr}}{\text{day}} \times \frac{365.25\ \text{day}}{\text{yr.}} \times 68.0\%\ \text{attainment} = \frac{253\ \text{canisters}}{\text{yr.}}$$

Batch 1B Results (12/3/98 to 3/30/99)

$$\frac{146\ \text{lbs. glass}}{\text{hr}} \times \frac{\text{canister}}{3{,}800\ \text{lbs. glass}} \times \frac{24\ \text{hr}}{\text{day}} \times \frac{365.25\ \text{day}}{\text{yr.}} \times 77.1\%\ \text{attainment} = \frac{260\ \text{canisters}}{\text{yr.}}$$

The melt pour rates of 161 and 146 lbs. of glass per hour for Batch 1A and 1B, respectively, were obtained by evaluating a stable period of operating time (dates shown above) and is considered representative of the macro-batch.

As you will note above, the pounds of glass per hour that was poured during Batch 1A was greater than is currently being poured in Batch 1B. This is caused by the differing chemical composition of the two batches. For example, Batch 1B feed is more viscous than Batch 1A feed and is therefore predicted to have a lower melt rate based on development data.

During the overall mission of the HLW Program, the chemical composition of the feed batches will change each time a new sludge batch is processed. The average pour rate in Batch 1A and 1B ranged from 146 to 161 lbs. of glass per hour. The feed composition of these two batches is relatively consistent with the future batches remaining to be processed. Therefore, we predict the average pour rate for the future batches to be approximately 155 lbs. of glass per hr. The attainment percentage in Batch 1A and 1B ranged from 68.0% to 77.1% attainment. As you will note, as we have become more knowledgeable of plant operations and implemented improvements (*e.g.*, improved cold cap management, SRAT Lab aliquotting, etc.), this percentage has increased. Based on this learning curve, we predict that in the future an attainment percentage of as high as 83% can be maintained (not including melter outages). Therefore, based on our current knowledge of DWPF operations, we currently predict the following production capacity for the facility during full production years after successful implementation of production improvement initiatives.

$$\frac{155\text{ lbs. glass}}{\text{hr}} \times \frac{\text{canister}}{3{,}800\text{ lbs. glass}} \times \frac{24\text{ hr}}{\text{day}} \times \frac{365.25\text{ day}}{\text{yr.}} \times 83\%\text{ attainment} = \frac{297\text{ canisters}}{\text{yr.}}$$

The production rate above, however, does not include any deduction from the attainment percentage to incorporate a melter change out that will be necessary at certain times in the processing at DWPF. To date, DWPF has not experienced a melter failure and therefore, there is no plant experience to improve the assumed timeframes for predicting melter failures or a melter outage.

DWPF is pursuing initiatives to improve production capacity. The programs associated with a more reducing feed and its impact on Technical Safety Requirement flammability limits and melter vapor space kinetics should provide an increase in the melt rate. Sample analytical time requirements are not expected to present a near term restriction for Sludge Only operation, but could impact production at higher melt rates.

The effect of expected outages on canister production for major outages such as melter and DCS replacement has been depicted in Appendix H.9 and I.9. The current melter has operated well past its expected life, chiefly due to lower quantities of noble metals in the initial sludge batches. Based on the higher noble metal content of subsequent sludge batches, however, the forecast melter life will remain at an estimated 2-3 years. Since melter failures can not be predicted precisely, the timing of outages shown in Appendix H.9 and I.9 is considered typical of what will be experienced over the next 10 years. In addition, a major outage for replacing the obsolete DCS at DWPF is scheduled for FY04, if not earlier. The cumulative effect of these major outages will require the following sustained production rates in order to maintain the goal average production rates for the years FY02 through FY10:

	Average Production Rate for FY02-FY10 Canisters/year	Required Sustained Production Rate for FY02-FY10 Canisters/year
Requirements Case (Appendix H.9)	250	315
Target Case (Appendix I.9)	200	250

<u>Melter Pour Spout Inserts</u>

Melter pour spout inserts continue to perform well and support DWPF canister production rates by virtually eliminating problems with glass "wicking." A replaceable insert is installed remotely in the melter pour spout. Its function is to provide a clean, sharp "knife edge." The knife-edge is the last surface that the molten glass contacts before it free falls through the bellows and into the canister. Glass pouring eroded the original melter pour spout knife-edge, leaving a rounded surface that caused the glass pour stream to waver. This caused the glass to contact, cool, and solidify on the inside surfaces of the lower pour spout and bellows liner. This greatly reduced DWPF attainment, because melter feeding and pouring had to be interrupted while the glass was removed from the affected surfaces. However, the fresh, sharp edge provided by each new insert allows the glass to flow smoothly and drop cleanly through the bellows and into the canister. The first melter pour spout insert was installed in May 1997. Operating experience shows that each insert lasts for approximately 60 canisters, before it must be removed and replaced.

Production Plan

DWPF is currently processing Sludge Batch #1B from Tank 51. The last feed from Sludge Batch 1A was received in September with the completion of processing in October 1998. Sludge Batch 1B is expected to last until April 2001 based on a 250 can/year production rate. For additional information on preparation of future sludge batches, refer to Appendix H.5, Sludge Processing.

Several facility modifications were implemented to support production improvements:

- The DWPF sludge-only flowsheet was revised to eliminate the addition of simulated precipitate hydrolysis aqueous (PHA) in FY98. This improved the Sludge Receipt and Adjustment Tank (SRAT) batch preparation time by 40%, eliminated the need to prepare and sample the batches of simulated PHA, and reduced the volume of recycle generated by 11,000 gallons per SRAT batch cycle. This reduced the volume of recycle transferred to the Tank Farm. This improvement continues to support high production rates at minimum water generation.
- The Slurry Mix Evaporator (SME) operating sequence was modified to increase productivity. The spent decon frit and wash water resulting from canister decontamination is recycled to the SME for incorporation in subsequent glass batches. Previously, canister decontamination was a time-limiting item in melter feed preparation, because the SME could only accommodate spent decon frit and wash water at a rate of two canisters per day. However, under the new operating sequence, the SME can now accept up to 6 canisters' worth of spent decon frit and wash water per day. This improvement required no facility modifications. It continues to operate successfully.
- The dilute nitric acid decon system, presently in use in the Remote Equipment Decon Cell (REDC) and the Contact Decon Maintenance Cell (CDMC), has been augmented by a carbon dioxide (dry ice) pellet system. This system assists equipment decontamination in these two cells by generating streams of high-pressure air bearing the CO_2 pellets. Initial testing has been successful. Implementation of this system would reduce one source of aqueous waste in DWPF, because the spent CO_2 pellets will sublime (phase change directly from solid to gas). This helps reduce the volume of decontamination related recycle waste being returned to the Tank Farms, thereby reducing the burden on Tank Farm Evaporators and storage space.
- Mock-up testing of laboratory aliquotting has been completed and the method implemented for the SRAT related analysis. Side by side testing is underway for SME aliquotting samples. Initial results are very encouraging. Successful implementation will increase DWPF analytical Lab capacity.
- Several additional facility modifications were completed to prepare DWPF for processing of Batch 1B sludge. The Melter Feed Tank interlocks were upgraded and seismically qualified to ensure that, in the event of an earthquake, feeding to the melter will stop. Motor Control Centers for Zone 1, 2, and 3 Ventilation were seismically qualified to ensure that, following an earthquake, forced air ventilation into the Vitrification building can be shut down while exhaust fans continue to operate. This will maintain negative pressure inside the Vitrification Building, thereby reducing the risk of an unfiltered release of radioactive material. A safety class air purge supply to the Slurry Mix Evaporator Condensate Tank (SMECT) was added to maintain a dilute vapor space. This will prevent the SMECT vapor space from reaching the lower flammability limit in the event of a solids carryover from the Sludge Receipt and Adjustment Tank (SRAT) or the Slurry Mix Evaporator (SME), which could result in hydrogen generation.

Since startup, yearly production rates have varied as follows:

FY96	64 canisters (actual)
FY97	169 canisters (actual)
FY98	250 canisters (actual)
FY99	236 canisters (actual)
FY00	250 canisters planned (78 poured to date)

The higher curie content of Sludge Batch 2 will require the safety class nitrogen missile-shielding project to be completed before this sludge batch can be processed in DWPF. This modification is needed to maintain compliance with the DWPF safety analysis.

DWPF will continue sludge-only processing until precipitate feed is available from the salt processing facility. At the time of this Plan, the salt processing flowsheet remains under evaluation. This System Plan assumes that salt processing will resume in FY10.

With the delay in the start of salt processing to FY10, the Requirements Case shows that the processing of salt-only canisters will be required after all the sludge waste has been processed. The production of salt-only canisters will require additional evaluation to ensure a glass can be made that meets requirements (durability, heat loading, etc.). Development of a glass formulation with new frit, glass forming chemicals, or simulated sludge will be required.

The DWPF production rate is impacted in future years by two major factors. First, it is desirable to feed sludge and salt streams at a rate that allows the two inventories to be depleted around the same time. This is achieved in the Target Case of this Plan. However, as seen in the Requirements Case, maintaining a 250 canister per year sludge only feed rate results in a period of salt-only production at the end of the program. Second, sufficient Waste Removal funding must be provided to maintain or exceed the planned DWPF production rate of 250 canister per year. Waste Removal must be funded so that modifications can be made to support the removal of sludge or salt from waste storage tanks.

Replacement Control Systems

The current distributed control system (DCS) at DWPF is over 14 years old. The system is approaching the end of its useful life. Therefore, plans have been initiated to procure and install a new system by FY04 consistent with funding availability. See Section 7.15 for more details on this issue.

Replacement Melters

Ongoing vitrification operations will require periodic melter replacement. SRTC predicts that noble metals deposition (causing the electrodes to short-circuit) may be the most likely cause of melter failure. Other possible causes of melter failure include the failure of non-replaceable heaters in the riser, pour spout, and vapor space. SRTC also predicts that melter life expectancy will average about two years. The melter presently in service (melter #1) has been in operation for 5.5 years (4 years radioactive — 1.5 years simulated). Noble metal content of the feed during this period has been very low (<10% of design basis). Replacement melter projects are planned accordingly. Melter replacement outages are expected to last approximately 6 months.

Melter #1 is in service. It began operating in June 1994, was used for DWPF startup testing, and is currently in radioactive service. At the time of this Plan, Melter #1 has already reached 275% of its nominal two-year life expectancy. The long service life of Melter #1 may be attributed, at least in part, to the low noble metals content of Sludge Batch #1A. The noble metals content of Sludge Batch #1B is higher. Melter #1 will remain in service as long as it operates normally.

Melter #2 is on site. Construction modifications are complete, and the melter itself is ready to install, pending modification to the Dome Heater Bussbars based on the failure of cooling water tubes on Melter #1. Some modifications to the Melter #1 Storage Box and the Failed Equipment Storage Vault crane are being evaluated, but are currently unfunded. Plans and procedures to conduct the melter outage are task ready, should Melter #1 fail. However, because Melter #1 will be allowed to operate until failure, the Melter #2 replacement outage is not specifically scheduled at this time.

The **Melter #3** vessel, frame, and most major components are on site. Assembly began, but is currently on hold. The melter refractory has been installed, dried, and laid up inside the 105-P Reactor building. The subcontract for assembly of the pour spout is on hold; SRS now plans to do the final modifications in-house, based on lessons learned from Melter #1 pouring experience. Thermocouples will be ordered, pending availability of funding. Once all components are on site, final assembly of Melter #3 is expected to take 6 months. Assuming funding is available when needed, overall lead time for a replacement melter project, from project inception through actual installation in the DWPF, is about 5 years.

Failed Equipment Storage Vaults

Failed Equipment Storage Vaults (FESVs) are repetitive projects required to sustain ongoing DWPF operations. Failed melters and other large failed DWPF equipment, which are too contaminated to dispose in the site's Burial Ground, will be contained in engineered boxes and temporarily stored in the DWPF FESVs. Each FESV can store one failed melter. Over the life of the HLW program, approximately 10 FESVs will be needed. FESVs

#1-2 are already operational in DWPF. Additional FESVs line items are scheduled on a just-in-time basis. The need dates for FESV #3-6 and successive pairs of vaults are evaluated on an ongoing basis.

Recycle Handling

As part of normal operations, DWPF generates an aqueous recycle waste stream originating from three sources in the DWPF process: the primary (or back-up) Melter Off-Gas Condensate Tank, the Slurry Mix Evaporator Condensate Tank, and the Decon Waste Treatment Tank. These streams are collected in the Recycle Collection Tank (RCT) for transfer to the Tank Farm. The contents of the RCT are adjusted with corrosion inhibitors prior to transfer.

Melter Off-Gas Condensate Tank (OGCT): The melter is not designed to accommodate thermal cycling. Once it has been brought up to temperature, it remains heated — containing a molten glass pool — even when waste feeding and glass pouring are temporarily suspended. Because the melter will always contain molten glass, the melter ventilation system must also remain operational. Several components of the melter off-gas system, including the offgas film cooler and the steam atomized scrubbers, use steam to cool and decontaminate the offgas before release to the Vitrification building exhaust system. Together, these components generate an aqueous waste stream that is collected in the primary (or back-up) OGCT. Currently the steam-atomized scrubbers are not required to be operational due to the lower than design basis source term of Sludge Batch 1B.

During melter feeding and pouring, additional recycle volume is generated. The slurry feed into the melter is 45-55 wt% water, which flashes to steam upon entering the melter. This portion of the recycle stream is directly proportional to DWPF attainment rate; at higher attainment rates, feeding and pouring are increased, so recycle volume increases.

Slurry Mix Evaporator Condensate Tank (SMECT): The SMECT collects contaminated condensate from the Slurry Mix Evaporator (SME), the Sludge Receipt and Adjustment Tank (SRAT), and the Formic Acid Vent Condenser. The amount of aqueous waste produced by the SME and the SRAT is determined by waste processing rates and the solids content of the feed streams. In general, at higher attainment rates, more recycle waste will be produced.

Decon Waste Treatment Tank (DWTT): Contaminated aqueous waste from equipment decontamination operations is collected in the DWTT. The DWTT Contents are pumped to the Recycle Collection Tank for subsequent recycling to the Tank Farm This flow is variable, and depends upon the frequency of decontamination operations.

Recycle Collection Tank (RCT): The primary (and backup) OGCT, the SMECT, the DWTT, and the DWPF Analytical Laboratory sample waste streams are collected in the RCT, which has a working capacity of 8,200 gallons. DWPF has no other capacity to store the recycle stream.

Transfer to H-Tank Farm: To support DWPF production, recycle transfers to the Tank Farm must occur routinely. The normal HLW System configuration for these transfers uses the S to H-Area inter-area line to the Low Point Pump Pit, then to the HDB-8 Complex, through HDB-7, and finally to Tank 43, which feeds the 2H Evaporator. The same route can also be used to transfer recycle into Tank 38 when necessary. A route through HDB-8 and HDB-5 also exists, which allows the DWPF recycle to be transferred to Tank 22 or, as an alternate, Tank 21. This will provide additional flexibility for the Tank Farms to accept DWPF recycle when Tank 43 is unavailable.

With the current 2H PISA issue, DWPF recycle is currently being received into Tank 21 only. Modifications are underway to allow recycle to also be received into Tank 24, once Tank 21 is filled. This use of Type IV tanks allows HLW to continue DWPF operations until the 2H Evaporator is returned to service.

Recycle Forecast

DWPF Engineering has developed an algorithm for predicting recycle generation rate. The algorithm is derived from recent operating experience, including demonstrated or anticipated results of ongoing efforts to reduce recycle volume; adjustments for coupled feed operation; planned program activities, and increasing waste generation from decontamination operations as DWPF equipment ages.

From October 1, 1999 through January 22, 2000, the recycle liquid generation rate matched the forecasted algorithm of:

DWPF Recycle = 5,700 * (# of cans/year) + 768,000 gallons

This incorporated a projected 150,000 gallon reduction from observed FY99 volume.

Beginning January 22, 2000, the Melter Steam Atomized Scrubber flows were shut off, resulting in a fixed flowrate reduction and a revised algorithm:

DWPF Recycle = 5,700 * (# of cans/year) + 143,000 gallons

Beginning in March 2000, procedural and equipment modifications to reduce the amount of water needed to convey the frit slurry to the SME are expected to result in a recycle liquid generation rate of:

DWPF Recycle = 4,520 * (# of cans/year) + 143,000 gallons

Note that even at zero attainment, some recycle waste continues to be generated.

Organic Waste Storage Tank (OWST)

Under the current recommended salt processing flowsheet (small tank precipitation), washed precipitate transferred to DWPF will contain cesium tetraphenylborate and potassium tetraphenylborate. DWPF will use a precipitate hydrolysis process to destroy the tetraphenylborate, because tetraphenylborate cannot be processed through the melter. The precipitate hydrolysis process will yield a side stream nominally referred to as "benzene," although it also contains approximately 15% other aromatic organic compounds and very low levels of radioactivity. The benzene will be:

- steam-stripped in the Precipitate Reactor (PR)
- further decontaminated in the Organic Evaporator (OE)
- sampled in the Organic Evaporator Condensate Tank (OECT) then
- transferred outside the Vitrification building to the Organic Waste Storage Tank (OWST) via a welded, stainless steel overhead line.

The OWST is a double-shell aboveground tank located southwest of the Vitrification Building in S-Area. The primary tank is constructed of 304L stainless steel, and has a capacity of 150,000 gallons. A floating roof inside the primary tank reduces evaporation of the organic liquid. The roof begins to float when the tank inventory reaches approximately 13,800 gallons. Therefore, a minimum heel of 13,800 gallons of benzene, once established, will always be maintained to limit benzene emissions. The vapor space between the floating roof and the fixed roof is padded with nitrogen gas, and ventilated through a HEPA filter. The secondary tank is constructed of carbon steel, and includes a leak detection system.

Essentially all benzene generated during cold chemical runs has been removed from the OWST. Although it is considered empty for RCRA purposes, the OWST still contains a very small quantity (about 15 gallons) of benzene and continues to be operated under RCRA and SAR requirements.

Mercury Disposal

The sludge contains mercury, which must be removed prior to vitrification. The recovered mercury is returned to the Separations facilities for re-use in their processes per a Memorandum of Understanding that became effective February 1, 1999.

8.7 Glass Waste Storage

The canisters of vitrified HLW glass produced by DWPF are stored on-site in dedicated interim storage buildings called **Glass Waste Storage Buildings** (GWSBs).

GWSB #1 consists of a below-grade seismically qualified concrete vault that contains support frames for vertical storage of 2,286 canisters. The storage vault is equipped with forced ventilation cooling to remove radioactive decay heat from the canisters. A standard steel-frame building encloses the operating area directly above the storage vault. A 5-foot thick concrete floor separates the storage vault from the operating area. The **Shielded Canister Transporter (SCT)** moves one canister at a time from the Vitrification Building to the Glass Waste Storage Building. It drives into the operating area, removes the shielding plug of a pre-selected storage location, lowers the canister into the storage vault, and replaces the shielding plug.

Of the 2,286 canister storage positions nominally available, 572 positions are currently unusable because the plugs are out of round relative to the floor liner. This poses the problem of potentially jamming a plug during removal or replacement. Of the 572, DWPF Engineering estimates that 450 plugs can be repaired. In addition, five positions are occupied by test canisters strategically located to monitor for possible corrosion. After the 450 plugs are repaired, GWSB #1 will have a working capacity of 2,159 usable storage locations. Funding is planned in FY02 and FY03 to repair these plugs.

GWSB #1 is currently in Radioactive Operation. At the time of this Plan, GWSB #1 was storing 761 radioactive canisters. If DWPF production proceeds at a rate of 250 canisters/year and the 450 presently unusable positions are recovered, GWSB #1 will reach capacity in FY05, as shown in Appendix H.6.

The project to design and construct GWSB #2 was previously planned to begin in FY02 with funding over a five-year period. The project schedule for GWSB #2 (as shown in the GWSB #2 Conceptual Design Report (CDR)) will not support an average DWPF canister production rate of 250 canisters per year. The planning basis for DWPF canister production was previously 200 canisters per year, which was used in the development of the CDR. Therefore, project funding prior to FY02 (to complete detailed design for GWSB #2 and prepare a procurement sub-contract package for release) will be necessary to support a 250 canister per year production basis for the GWSB #2 project.

The current design basis for GWSB #2 (Phase 1) has four individual storage vault compartments (2286 total storage positions) similar to GWSB #1. The design of Phase 1 will include provisions for additional vaults to be constructed later if the Federal Repository does not open by FY15. Note that if the repository does open in FY15, additional on-site storage will be required. This is because the shipment rate assumption (205 per year max) is lower than the assumed production rate (250 per year for the Requirements Case and 225 per year after Salt Processing startup in the Target Case).

Assuming the Federal Repository will be ready to receive canisters in FY10 at an initial first year rate of 105 canisters (increasing to a steady rate of about 205 canisters for the next and subsequent years) and a canister shipping facility has been constructed and is operational at DWPF, both GWSBs would be emptied and available for decommissioning in FY39 for both the Requirements and Target Cases.

In parallel with the development of the GWSB #2 project, an above-ground, modular storage concept for HLW canisters is being evaluated. The concept involves leasing concrete storage casks which utilize the existing inventory of SRS depleted uranium oxide to enhance the shielding capability of standard concrete. The casks and cask transporter would be provided as leased services obtained under a subcontract. The facility would be responsible to provide a cask interface facility, the cask storage pad, and access roadways for the SCT and the cask transporter. The cask interface facility would accept canisters delivered by the SCT, load the canisters into the storage cask, close the cask, and make it accessible to the cask transporter for transport to the storage pad.

A WSRC management decision point has been identified in December 2002 to determine whether to proceed with the GWSB #2 project or the aboveground modular storage concept. The requested prototypic casks and supporting testing documentation from the potential cask vendor must be available to support the December 2002 project decision milestone.

8.8 HLW Disposal

HLW — consisting of glass filled canisters, failed melters, and non-routine HLW — is destined for permanent disposal in a deep geological repository. To support disposal of these items, the following must continue to be pursued:

- Site approval for the permanent geological repository
- DOE/DOT approved transport routes for HLW
- DOE approval to ship HLW from SRS
- Transportation/storage containers for the HLW
- Canister handling facility
- Continued funding to support safe storage of canisters, failed DWPF melters, and non-routine HLW

8.9 Effluent Treatment Facility (ETF)

The ETF treats the low-level aqueous wastes from the F and H-Canyons and the F and H-Tank Farms. The ETF provides enhanced environmental control over the previous practice of discharging liquid directly to seepage basins. Additional waste streams from Environmental Restoration and CIF are treated. After treatment at ETF, the wastewater is discharged to a permitted outfall at Upper Three Runs Creek.

Production Capacity: The ETF Facility includes process waste water collection tanks, treated water tanks, and basins to collect contaminated cooling water and storm water run-off. Treatment processes include pH adjustment, filtration, organic removal, reverse osmosis, mercury removal, and ion exchange. Recent operating experience indicates that average throughput is approximately 80 gpm, with a peak rate of 120 gpm for short periods.

Production Plan: ETF plans to treat 20,000,000 gallons of wastewater in FY00. At the time of this Plan, the facility has treated about 4.6 million gallons (FYTD). ETF Concentrate is currently transferred to Tank 50 for storage prior to disposal in the Saltstone Facility or by alternative means.

8.10 Saltstone Facility

The Saltstone Facility treats and disposes the Salt Waste Processing filtrate stream and the ETF concentrate stream. The two low-level radioactive waste streams are treated by mixing the wastes with cement, flyash, and slag. The resulting grout is disposed by pumping it to engineered concrete vaults and allowing it to cure. The solidified waste form is known as saltstone.

Production Capacity: The Saltstone facility is normally staffed with one ten-hour shift per day, four days per week. About seven hours each day are available for salt solution processing at an instantaneous rate of up to 110 gpm. The other three hours each day are required for startup preparations in the morning and process shutdown at the end of the day. The plant utility is assumed to be 50% based on experience to date. Therefore, when feed is available, Saltstone can average approximately23,100 gallons of salt solution processed per day or approximately4,805,000 gallons of salt solution processed per year. This may be increased by modifying the shift schedule to allow more hours per day or days per week.

Production Plan: Since Salt Waste Processing began its re-evaluation of technology alternatives, only ETF concentrate has been available to Saltstone for processing. The waste inventory in Tank 50, approximately 300,000 gallons, was processed in FY98. In FY99, the Saltstone Facility was placed in a partial lay-up mode. Partial lay-up reduces facility costs while minimizing potential deterioration of the plant, thereby minimizing the cost to resume operations in the future.

Tank 50 is presently used as a receipt tank for Effluent Treatment Facility (ETF) bottoms, an aqueous waste that is ready for final treatment and disposal as Saltstone or by alternative means. Both the Requirements and Target Cases described in this System Plan assume that Tank 50 can be returned to HLW waste storage service by the end of FY02. This is 2 years earlier than was forecast by the Space Team. Returning Tank 50 to HLW service requires that the ETF bottoms stored in Tank 50 (an estimated 600 – 700 kgal by FY02) be treated using an off-site vendor beginning in FY02. This is a change from Revision 10 of the System Plan, where Saltstone was going to be returned to operations in FY04 to process the Tank 50 waste.

Since Tank 50 will be required for concentrated waste storage service, the use of a vendor for processing newly generated ETF concentrate must be continued on a periodic basis until the startup of Salt Processing in FY10. At that time, the Saltstone Facility must be restarted to support the large volume filtrate stream from Salt Processing and the ETF concentrate can be sent to Saltstone.

The future salt processing flowsheet is not known; therefore, the production requirements for Saltstone are not known. This System Plan assumes salt processing will resume in FY10, and that the process will generate decontaminated salt solution similar to that planned for ITP. This System Plan assumes Saltstone will alter its staffing plan to support production level through a two-shift operation, if necessary.

Vaults: Saltstone operations require periodic construction of additional vaults, capping of filled vault cells and construction of permanent vault roofs. The required schedule for these repetitive projects is dependent upon the salt processing production plan. Each vault cell can hold 242,500 cubic feet of saltstone grout, or approximately

1 million gallons of salt solution. The construction and startup of new vaults supports planned Salt Processing production rates on a just-in-time basis.

Currently, construction of **Vault #1** is complete. Vault #1 has six cells, three of which are now filled and capped. A Rolling Weather Protection Cover (RWPC) protects the cell that is being filled.

Vault #4 grout filling will resume in FY10 (one cell out of twelve is filled), in lieu of filling Vault #1. Eleven of Vault #4's twelve cells are available for grout disposal (Cell A was filled in 1989 when 10,032 Naval Fuels waste drums were disposed and grouted in place.) Construction of the Vault #4 permanent roof was completed in January 1997. The permanent roof provides several advantages over the RWPC:

- the cells can be filled to height of approximately 25 feet
- more than one cell can be filled at a time
- disposal of the RWPC as radioactive waste is eliminated.

The design for **Vault #2** is complete. Like Vault #4, Vault #2 has been designed with twelve cells. However, the Vault #2 design differs somewhat from the Vault #4 design in that it includes a permanent roof as an inherent part of the vault design and construction. The Vault #2 design is considered the prototype for future Saltstone vaults, if SRS chooses to continue building this type of disposal unit. However, to maximize budget efficiencies, this System Plan assumes that 6-cell vaults will be used until a better planning basis is available.

Saltstone Vault Alternatives: The high cost of building replacement vaults has been identified as a potential area for cost reduction. The "Saltstone Vault Alternatives Study" identified grout disposal in a Z-Area landfill as a possible option. The subsequent "Pre-Conceptual Design Study for Z-Area Saltstone Waste Disposal Alternatives," dated October 1996, briefly described the design and construction of Geosynthetic Lined Waste Disposal Cells, which would be similar to municipal landfills. Based upon pre-conceptual design information, a cost comparison concluded that the landfill option could provide cost savings. However, feasibility studies of this option are on hold pending outcome of the Salt Waste Processing technology alternative study and scheduled resumption of salt processing.

8.11 Consolidated Incineration Facility (CIF)

The Consolidated Incineration Facility (CIF) treats and reduces the volume of incinerable hazardous, low-level radioactive and mixed SRS wastes. CIF conducted its Trial Burn in April 1997, and is awaiting the issuance by SCDHEC of a RCRA Permit modification to incorporate the results from the Trial Burn. In the interim, CIF is able to operate under its existing RCRA permit.

A decision was made recently to suspend CIF operations by the beginning of FY01. This will support both development of alternative solvent processing methods and the Department's need to provide funding to the higher priority DNFSB Recommendations 94-1 Nuclear Materials Stabilization Program in FY01. If no better solvent processing methods are determined, the restart of the CIF is expected in FY04 with full operation in FY05. If a more cost-effective solvent processing method is developed, then it will be implemented. In this case, the High Level Waste Program will incorporate the required unit operations into the Salt Processing Facility to dispose of any benzene generated from the Salt Processing program.

9 Technology Development

Since 1996, DOE's Office of Science and Technology (S&T), EM-50, has provided technical support and co-funding to sites in the complex to develop and integrate technologies to accelerate cleanup of legacy waste. Several national focus areas are chartered to provide this support and the Tanks Focus Area (TFA) is specifically chartered to support the weapons complex high level waste programs. The SRS Site Technology Coordination Group (STCG) provides assistance to the site operating divisions in developing technology planning to support the DOE "Path To Closure" mission.

As part of this mission, the HLW division has successfully executed several key activities supported by the TFA. These activities include:

- Closure of Tanks 17 and 20
- Development and demonstration of several types of new waste retrieval tools that are expected to be deployed in Tank 19 and, possibly, future tanks
- Development and testing of a new generation of slurry pumps
- Deployment of a fluidic sampler in Tank 48 and Tank 40.
- Deployment of a fluidic mixer pump in F Pump Tank 1

The HLW division has ongoing activities and future planning in the following areas:

- Waste Pretreatment
- Waste Retrieval
- Tank Closure
- Vitrification
- Safety

A Technology Program Plan and development proposal has been prepared and submitted to the TFA as technology needs in each of these areas for FY01 and out years. A brief description of these plans and proposals are provided below.

9.1 Waste Pretreatment Technology

As was described earlier in the System Plan, the original baseline Salt Processing Facility could not simultaneously meet both production and safety requirements. Over the next several years, a solid science and technology underpinning will be developed to make the final process selection and provide the data required for process scale up and design.

Science and technology (S&T) roadmaps have been developed to document the planning for three candidate salt processing technologies (small tank tetraphenylborate precipitation, crystalline silicotitanate ion exchange, and caustic-side solvent extraction). Ongoing and planned R&D is structured to execute the S&T roadmaps.

Several initiatives are underway to reduce the flow of the DWPF recycle stream that enters the tank farm. Several changes are being made this year in the DWPF flowsheet to reduce recycle. A task team is evaluating a number of alternative longer-term changes to the flowsheet to further reduce or eliminate the recycle stream.

9.2 Waste Retrieval

Planning and execution of waste retrieval is an ongoing activity within HLW.

In the previous and current fiscal years, several waste retrieval tools have been in development and testing to support retrieval and tank closure. These tools include:

- Submersible (Flygt) mixers as low cost alternatives to slurry pumps
- Weight % solids instruments to monitor sludge suspension efficiency
- Pitbull waste removal pumps capable of removing waste within approximately one inch of the tank bottom
- A remotable tank bottom crawler and water spray system for tank cleaning.

SRS expects to initially deploy these tools this fiscal year to support planned waste removal activities in Tank 19 and evaluate for subsequent deployment in future tank retrieval.

Transfer of tank cleaning technology from the Russian nuclear program is currently underway. The Russians have been very successful using chemical cleaning technology. Application of this technology for caustic sludge looks encouraging based on preliminary results. This technology has the potential for addressing cleanout of tanks having interior obstructions that would interfere with mechanical cleaning.

A long life fluidic mixer pump was installed in FY99 in F-Area Pump Tank 1 (FPT-1). This mixer pump was developed by AEA Technologies and tested in their facilities as part of an EM-50 program to transfer British technology. Fabrication and installation of the pump was partially funded by the EM-50 Accelerated Site Technology Deployment (ASTD). This pump is scheduled to begin hot operations by 9/00. Additional mixer pumps of similar design will be considered for the four canyon waste receipt pump tanks after operation and evaluation of the FPT-1 mixer.

A fluidic sampler similar to the design of the Tank 48 sampler is currently being deployed as a sludge sampler for Tank 40. A sampler originally planned for TPB slurry in Tank 49 is available for modification to support extended sludge processing in Tank 51.

Pipeline blockage detection and removal systems are planned and under development in cooperation with TFA, Florida International University (FIU), and the National Energy Technology Laboratory (NETL). A test facility has been developed at FIU to test several industrial prototype systems. Successful detection and blockage removal systems will be prestaged for deployment in the complex in case of a pipeline blockage.

The development of remotable systems to decontaminate and disassemble contaminated process equipment in the Tank Farm and DWPF is currently underway. At present disposal of large pumps, jumpers, etc., is expensive and requires large burial boxes.

9.3 Tank Closure

The lessons learned during closure of Tank 17 and 20 are being used in the planning for future tank closures. The reducing grout formulation is being modified to improve performance and reduce cost. Performance Assessments for the composition of future candidate tanks indicate that technetium will be the radionuclide that will dominate the extent and cost of tank cleaning to meet closure criteria. This problem extends across the DOE complex and a comprehensive program is being initiated in FY00 to develop technology to better remove, bind up, or immobilize technetium.

9.4 Vitrification

With sludge batches 1A and 1B, waste loading in DWPF glass is limited to about 26% waste oxides. A 2% increase in waste loading offers the potential for life cycle cost reduction equivalent to a year's DWPF production. R&D is underway to reduce the uncertainty bands on processing constraints that will provide an expanded operating window allowing both flexibility and increased waste loading. Data is now available to reduce uncertainty in the liquidus constraint. This data has been incorporated into preliminary statistical models and work is in progress to validate model predictions with experimental glass melter tests.

DWPF has been operating for a number of years and opportunities have been identified for improvements in the process and glass melter design. The glass melter is one of the most expensive and complicated components in DWPF. Although the melter has exceeded its two-year design life, improvements in pour spout design and enhancements to accommodate future feeds are desirable. Recent problems with pour stream control have been solved with replaceable pour spout inserts. However, an improved overall design is needed to better accommodate erosion and corrosion. In addition, the present melter has operated at lower melt rates than were initially planned. The DWPF melter was designed before the potential for electrode shorting by an accumulation of noble metals was recognized. Although the melter is currently operating with low noble metal concentrations, a more noble-metal tolerant melter with higher melt rate capacity may be needed for future operation. A cooperative R&D program is planned and underway at FIU and at Clemson University to address some of the design issues for the next generation of melters.

Once filled, DWPF glass canisters are stored in Glass Waste Storage Building #1 (GWSB). Depending on DWPF canister production rates in the Requirements or Target Cases, this first GWSB is scheduled to be filled in the FY05-06 timeframe. A second GWSB will be constructed to be available once GWSB I is filled. An alternative to the glass canister storage technology has been proposed. This technology uses storage modules fabricated from a composite of concrete and depleted uranium aggregate. These proposed storage modules provide the required shielding and structural integrity for outdoor surface storage of glass canisters. This technology is currently under evaluation as a potential cost saving initiative.

9.5 Safety

The Tank Farm presently employs paper HEPA filters in the ventilation systems of the high level waste tanks. These paper filters become blinded by water vapor and have service life of about two years. Replacement of these filters involves occupational exposure and significantly contributes to the solid wastes generated by the Tank Farm. Moreover, a loaded paper filter represents a significant source term in the event a fire was to occur. The extent of loading is not known inasmuch as the trapped particulates are alpha emitters and cannot be easily monitored in their self-shielded filter geometry. A cooperative program is underway between SRS, TFA, and NETL to develop permanent washable HEPA filters using sintered metal or ceramic filter media. A prototype filter is being fabricated and laboratory tests will be initiated this year. Deployment of a filter system on skid units that will support waste removal is planned for FY01.

Several remote sensing and monitoring probes are under development in cooperation with TFA and the Characterization Monitoring and Sensing Technology (CMST) Cross Cut Area:

- A weight percent solids probe to monitor high weight percent solids is also being developed to define the end point of sludge suspension during sludge removal. Deployment is expected in Tank 19.
- A combined corrosion probe and corrosion species probe is being developed using Hanford technology. Initial deployment is expected in FY00. The probe offers the potential to reduce operator exposure during normal sampling. It will also help in the management of our tank space by enabling a reduction in caustic added to tanks to maintain corrosion control.

10 Support for Future Missions

A number of new programs are currently being evaluated or developed. Many of these programs have the potential to impact HLWD operations in the future. At the time of this Plan, there has been no decision to incorporate any of these programs into the baseline; therefore, none are included in the current Plan. They are addressed in this System Plan for information only.

10.1 Can-In-Canister Plutonium Disposal

With the end of the Cold War, the U.S. has declared a surplus of weapons-grade plutonium. Up to 50 metric tons of U.S. weapons-grade plutonium may be dispositioned via a process aptly titled "can-in-canister", pending a joint agreement with Russia which is currently being negotiated. At the time of this Plan, the preferred option is to construct a facility at SRS, probably within the existing F-Area, to convert the plutonium to a ceramic form. The plutonium ceramic would be placed in small stainless steel cans, measuring approximately 21" high and approximately 3" in diameter. These small cans would be positioned in racks inside a full-size DWPF canister. HLW glass would then be poured into the DWPF canister as usual. The presence of the HLW glass would act as a deterrent to the unauthorized retrieval of the weapons-grade plutonium. The filled canisters would then be stored in the Glass Waste Storage Building, pending transfer to the Federal Repository for long-term storage. This process was successfully tested at DWPF in 1996 (prior to the start of Radioactive Operations) using a simulated plutonium glass inside the small cans. The process was successfully tested again in 1999 at Clemson University with simulated Pu ceramic cans, prototypic magazines and racks, and a stirred melter that is equivalent to the melter at DWPF. Results for both tests indicated that the HLW glass flowed around the cans without creating any significant void spaces, and cooled without forming many crystals. This option would require cesium from salt processing at DWPF to provide the appropriate radiation levels to deter unauthorized retrieval of the plutonium. The salt processing will not be available until mid FY10 in the Requirements Case. Although no additional HLW glass would be produced, the plutonium ceramic, cans, and racks would occupy space that would have been filled with glass. Disposal of all 50 metric tons of plutonium would result in approximately 210 additional DWPF canisters. However, because this mission is still under development, these additional canisters are not included in the System Plan at this time.

10.2 U-233 Processing

Oak Ridge and Idaho have significant quantities of U-233. Options will be evaluated to determine the optimum disposition of this material. Options involving SRS include:

- Dissolving the U-233 in the Canyons, diluting the U-233 with depleted uranium and sending the waste to the HLW tanks
- Dissolving the U-233 in the Canyons, adding neutron poisons, and sending the waste to HLW tanks already containing depleted uranium to reduce the additional glass logs generated by DWPF
- Separating Th-229 for future medical use
- Packaging breeder reactor fuel pellets in DWPF canisters similar to the plutonium can-in-canister proposal

All of these options will result in the production of additional DWPF canisters. An MD EIS for this program is currently unfunded. Because this mission is still under development, these additional canisters are not included in the System Plan at this time.

10.3 Pit Manufacturing

Savannah River Site is currently being considered for the large-scale pit manufacturing mission, which will augment the small lots facility currently under construction at LANL. This proposed facility will process return pits to make feedstock, cast the pit halves, and machine and assemble the components into war reserve certified pits. Project start-up would occur in the 2015 time frame. The facility would generate a maximum of approx. 33,600 gal./yr. of high level waste. It has not been determined if the high level waste would be treated as a part of the system described in this System Plan or be converted to a Waste Isolation Pilot Plant (WIPP) compatible disposal form. No additional canisters are included in this revision of the System Plan pending a definitive proposal to include this waste into the HLW waste stream.

10.4 Am-Cm Vitrification

Approximately 3,600 gallons of solution containing isotopes of americium (Am) and curium (Cm) are stored in F-Canyon Tank 17.1. These isotopes were recovered during plutonium-242 production campaigns in the mid- and late-1970s. The continued storage of these isotopes was identified as an item of primary concern in the Defense Nuclear Facility Safety Board's (DNFSB) Recommendation 94-1. No operating SRS facilities can presently be used to stabilize this material for safe interim storage and transportation to the heavy isotopes program at the Oak Ridge National Laboratory (ORNL). An analysis of several alternatives resulted in the recommendation to stabilize the Am-Cm solution in a high-lanthanide glass. The Multi-Purpose Processing Facility (MPPF) in the F-Canyon will be used for the vitrification process. Pretreatment operations will be performed in existing canyon vessels to separate actinides and lanthanides from other impurities (primarily iron, aluminum, and sodium) prior to the vitrification operation.

The pretreatment and vitrification processes will produce limited quantities of liquid waste when operations begin. Due to the short duration of this campaign (producing approximately 350 kg of glass over a 1 year period), the impact of this additional waste stream on F-Canyon operations is expected to be minimal. Material balance calculations on the final flowsheets suggest that total waste volume from the pretreatment and vitrification operations should be less than approximately 30,000 gallons. This volume will be treated through the traditional F-Canyon waste processing system (neutralized and evaporated), reducing the volume, and discharged to the F-Tank Farm. Operations are currently planned for the 2004-2005 timeframe, according to a February 2000 rebaseline.

10.5 Other Potential Nuclear Materials Stabilization & Storage Missions

In addition to processing nuclear materials required to satisfy the DNFSB 94-1 and 2000-1 Recommendations, there is potential that the SRS Canyon facilities may be used for processing of other selected DOE Complex surplus materials. These streams include various Pu and HEU oxides, scrap and residue materials as identified in the NMS&S Strategic Management Implementation Plan – Visionary Roadmap. Many of these potential new missions are in the NEPA documentation development stage. Preliminary waste estimates have been developed for each of these potential missions. An additional 1.5 to 2.0 million gallons of waste could be sent to the Tank Farms between FY03 and FY11 if all potential streams on the Visionary Roadmap are processed at SRS. HLW and NMS&S are working closely to ensure Tank Farm space impacts are taken into account as a major factor in determining if these materials will be processed at SRS.

These new potential mission streams are not currently included in this Plan. Status of new NMS&S missions will continue to be tracked and incorporated into future System Plan revisions, as appropriate.

10.6 Receipt of West Valley Canisters

The West Valley Demonstration Project (WVDP) in New York State began producing vitrified waste glass canisters in July 1996. Through FY99 the entire WVDP high level liquid waste inventory was immobilized in approximately 300 glass canisters. Currently, these canisters are being stored in a modified process building cell on the West Valley Site, pending availability of the Federal Repository in FY15. However, final decontamination and decommissioning of all WVDP facilities is expected to be complete by FY05, ten years before the Repository will be available. Initially it appeared that some cost savings could be achieved if the WVDP canisters were shipped and stored at the DWPF GWSB #1. Shipment of 100 WVDP canisters per year to DWPF was proposed to begin in FY02 and finish by FY04. However, further analysis cast doubt on the cost savings so that, in late FY98, it was decided not to pursue shipments to SRS at this time. Interim storage in New York State is the present proposal prior to final shipment to the Federal Repository. Until the Record of Decision is formalized, there remains a possibility of shipment to SRS.

Appendix A - Acronyms

2000-1	DNFSB Recommendation 2000-1, Stabilization and Storage of Nuclear Materials (covers many of the materials under Rec. 94-1)
94-1	DNFSB Recommendation 94-1, Improved Schedule for Remediation in DNF Complex
ACP	Accelerating Cleanup Plan
ADS	Activity Data Sheet
ALARA	As Low As Reasonably Achievable
AOP	Annual Operating Plan
ASTD	Accelerated Site Technology Deployment
BA	Budget Authority
BCP	Baseline Change Proposal
BDAT	Best Demonstrated Available Technology
BIO	Basis for Interim Operations
BO	Budget Outlay
CAB	Citizen's Advisory Board
CDMC	Contact Decontamination Maintenance Cell (DWPF)
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
Ci	Curies
CIF	Consolidated Incinerator Facility
Ci/gal	Curies per gallon
CFR	Code of Federal Regulation
CLFL	Composite Lower Flammability Limit
CLSM	Controlled Low Strength Material
CMST	Characterization Monitoring & Sensing Technology
CPES	Chemical Process Evaluation System
CRC	Cesium Removal Column
CST	Crystalline Silicotitanate
CTS	Concentrate Transfer System
CY	Calendar Year (January through December)
DB	Diversion Box (e.g. HDB-8 – H Area Diversion Box #8)
DBP	di-butyl phosphate
DCS	Distributed Control System
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOE-MD	DOE – Material Disposition
D&R	Dismantle & Removal
DWPF	Defense Waste Processing Facility
DWTT	Decon Waste Treatment Tank
EA	Environmental Assessment
EIS	Environmental Impact Statement
EM	Environmental Restoration and Waste Management, usually as a suffix to DOE
EPA	Environmental Protection Agency
ESH&QA	Environmental Safety, Health, and Quality Assurance Divsion
ESP	Extended Sludge Processing
ETF	Effluent Treatment Facility
FESV	Failed Equipment Storage Vault (DWPF)
FFA	Federal Facility Agreement
FIU	Florida International University
FY	Fiscal Year (October through September)
FYTD	Fiscal Year To Date
GDL	Gravity Drain Line
GS/PS	General Service / Production Service
GWSB	Glass Waste Storage Building
HEU	Highly Enriched Uranium
HHW	High Heat Waste
HLW	High Level Waste
HLWIFM	High Level Waste Integrated Flowsheet Model
HLWD	High Level Waste Division
HQ	Headquarters, usually as a suffix to DOE
HVAC	Heating, Ventilation, & Air Conditioning
INMM	Integrated Nuclear Material Management
ITP	In-Tank Precipitation
kgal	Kilo-gallons = 1,000 gallons
LCO	Limiting Condition of Operation
LHW	Low Heat Waste
LI	Line Item
LIMS	Laboratory Information Management System
LLW	Low Level Waste
MD	Material Disposition
MOX	Mixed Oxide (Fuel)
MPPF	Multi-Purpose Processing Facility
MST	Monosodium Titanate
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NMS&S	Nuclear Materials Stabilization and Storage Division
NRC	Nuclear Regulatory Commission
OE	Organic Evaporator (DWPF)
OECT	Organic Evaporator Concentrate Tank (DWPF)
OGCT	Off-Gas Condensate Tank (DWPF)
ORNL	Oak Ridge National Laboratory
ORR	Operational Readiness Review
OWST	Organic Waste Storage Tank (DWPF)
OYB	Out Year Budget
PCCS	Product Composition Control System
PCO	Process Controls of Operation
PHA	Precipitate Hydrolysis Aqueous
PIMS	Process Information Management System
PISA	Potential Inadequacy in Safety Analysis
PLC	Programmable Logic Controller
PNNL	Pacific Northwest National Laboratory
PR	Precipitate Reactor (DWPF)
ProdMod	Production Model computer program
PTC	Path To Closure

Appendix A - Acronyms

PUREX	Plutonium Recovery and Extraction
PVV	Process Vessel Vent
QA	Quality Assurance
R&D	Research and Development
RBOF	Receiving Basin for Off-site Fuels
RCRA	Resource Conservation and Recovery Act
RCT	Recycle Collection Tank (DWPF)
REDC	Remote Equipment Decontamination Cell (DWPF)
RHLWE	Replacement High Level Waste Evaporator (3H Evaporator)
RK	Rotary Kiln (CIF)
ROD	Record Of Decision
RWPC	Rolling Weather Protection Cover (Saltstone)
SAP	Statistical Analysis Program
SAR	Safety Analysis Report
SCC	Secondary Combustion Chamber (CIF)
SCDHEC	South Carolina Department of Health and Environmental Control
SCT	Shielded Canister Transporter
SEIS	Supplemental Environmental Impact Statement
SFD	Spent Fuel Division
SGF	Space Gain Factor
SME	Slurry Mix Evaporator (DWPF)
SMECT	Slurry Mix Evaporator Condensate Tank (DWPF)
SpaceMan	Space Management Computer Model
SR	Savannah River - usually a suffix to DOE
SRAT	Sludge Receipt and Adjustment Tank (DWPF)
SRS	Savannah River Site
SRTC	Savannah River Technology Center
SS/SC	Safety Significant / Safety Class
SSC	Systems, Structures, and Components
S&T	DOE's Office of Science & Technology
STP	Site Treatment Plan
STPB	Sodium Tetraphenylborate
TEC	Total Estimated Cost
TFA	Tank Focus Area
Tk	Tank
TOPR	Task Order Proposal Request
TOST	Technical Oversight Steering Team
TPB	Tetraphenylborate
TPP	Technology Program Plan
TPR	Transfer Pump Riser
TSR	Technical Safety Requirement
WAC	Waste Acceptance Criteria
WCS	Waste Characterization System
WIPP	Waste Isolation Pilot Plan
WIR	Waste Incidental to Reprocessing
WMS	Works Management System
WRP&S	Waste Removal Plan and Schedule
WSRC	Westinghouse Savannah River Company
WVDP	West Valley Demonstration Plant
WW	Wash Water
Y2K	Year 2000 (as in computer compliance)

Appendix B – Glossary

General

HLW:

"**H**igh **L**evel **W**aste" is the term used for "the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation." [From DOE Order 435.1]. The waste storage tanks at SRS include strontium-90, cesium-137, plutonium-238, plutonium-239, plutonium-241, and various uranium isotopes. Due to the intense radiation fields, all waste storage tanks are built underground and all process work is done under radiological conditions, which can mean being done remotely or with proper shielding. The radiation field for direct exposure to this waste could be as high as 50 rem/hr (which in 6 minutes would exceed Federal yearly limits for a nuclear industry worker).

HLW System

The HLW System refers to the integrated series of facilities at SRS that convert HLW waste into glass. The system includes the facilities for storage, waste removal, pre-treatment, processing, and disposal.

HLW System Plan

This is the detailed planning document that describes the HLW System operations through the end of the program. The plan uses sophisticated computer models to schedule production, track chemical and radioactive materials, and model process flows.

Salt and Sludge

HLW stored in tanks can generally be characterized as being either "salt" or "sludge."

Salt Waste containing radioactive elements that are **dissolved in the waste liquid**. This generally contains cesium and trace amounts of other soluble radioactive elements.

Sludge Waste containing **insoluble** radioactive elements that have settled to the bottom of waste tanks. This generally contains strontium, plutonium, and uranium as metal hydroxides. The salt waste can be further characterized as being –

supernate	liquid containing dissolved radioactive salts in normal solution
concentrated supernate	supernate that has had liquid removed by evaporation
salt cake	waste that has crystallized out of solution.

A single tank can contain sludge, supernate and salt cake, although an effort is made to segregate the sludge and salt by tank. During waste removal, water is added to waste tanks and agitated by 45-foot-long slurry pumps to dilute or re-dissolve salts if it is a salt tank or to suspend the sludge if it is a sludge tank. The resulting liquid slurry is pumped out of the tanks and transferred to pre-treatment.

Salt Processing:

During salt processing, the highly radioactive constituents (especially cesium) of the salt waste are separated out of solution and sent to DWPF for vitrification. The remaining liquid is "salt solution" (now without its highly radioactive constituents) which is low-level waste and can be safely sent to the Saltstone Facility for on-site treatment and disposal. Salt processing greatly reduces the volume of waste to be vitrified and sent for permanent disposal in a Federal repository.

Vitrified Glass

In a process called "vitrification" the HLW is blended with glass frit and melted at 2,100 degrees Fahrenheit to form a borosilicate glass. Once HLW is immobilized within the structure of the glass, it cannot dissolve out of the glass and migrate into the environment. Vitrification greatly reduces the environmental risk of HLW and converts it into a safe form for permanent disposal.

Appendix B – Glossary

Tank Space Terms

Freeboard

The empty space in a HLW storage tank. Freeboard is the total tank volume (at its operating limit) minus the volume of waste currently in the tank. Freeboard space is not necessarily available to be filled with new waste. A portion of freeboard may be reserved for tank farm emergency space, evaporator working space, or tank farm transfer space. Any empty space in a tank retired from service or otherwise not available to receive new waste is not considered freeboard.

Total HLW Freeboard

The sum of the freeboard in all of the HLW tanks.

Emergency Space

The freeboard that must be maintained in reserve in Type III/IIIA Tanks at all times in the unlikely event that a leak in a tank requires immediate transfer of waste from that leaking tank to this reserve space. The amount of emergency space that is reserved is set by regulatory commitments, is documented in TSRs, and is currently set at 370” (1.3 million gallons) in each Tank Farm (a total of 2.6 million gallons).

Working Space

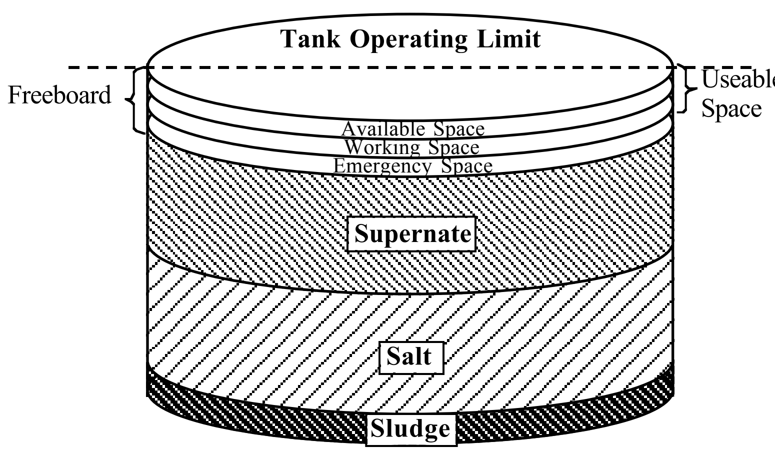
The minimum amount of freeboard required for normal tank farm operations, including waste receipts and evaporator operations. The amount of working space is determined by engineering estimates and operating experience. Working space is currently set at 200 kgals per evaporator system and 100 kgals per area for waste receipts (this translates to 500 kgals for H-Area and 300 kgals for F-Area). When the total amount of usable space in the Tank Farms approaches this Working Space minimum, then operating flexibility is significantly limited.

Available Space

The freeboard that can be used for receipt of incoming waste. Available space is calculated as total Freeboard less Emergency Space and Working Space.

Useable Space (Working Inventory)

The combination of working space and available space. This is the space the tank farms use on a routine basis. With adequate Useable Space, the tank farms have the flexibility to respond to unplanned outages, receive unplanned influent streams and fully support waste processing activities including DWPF recycle water and ESP wash water (where large receipts of wash water are received into the Tank Farm over a short duration).



Backlog Waste

Unconcentrated supernate. This supernate from past operations waiting to be concentrated and volume-reduced by evaporation. The tank farm evaporator systems are working off this backlog of unconcentrated waste as quickly as possible.

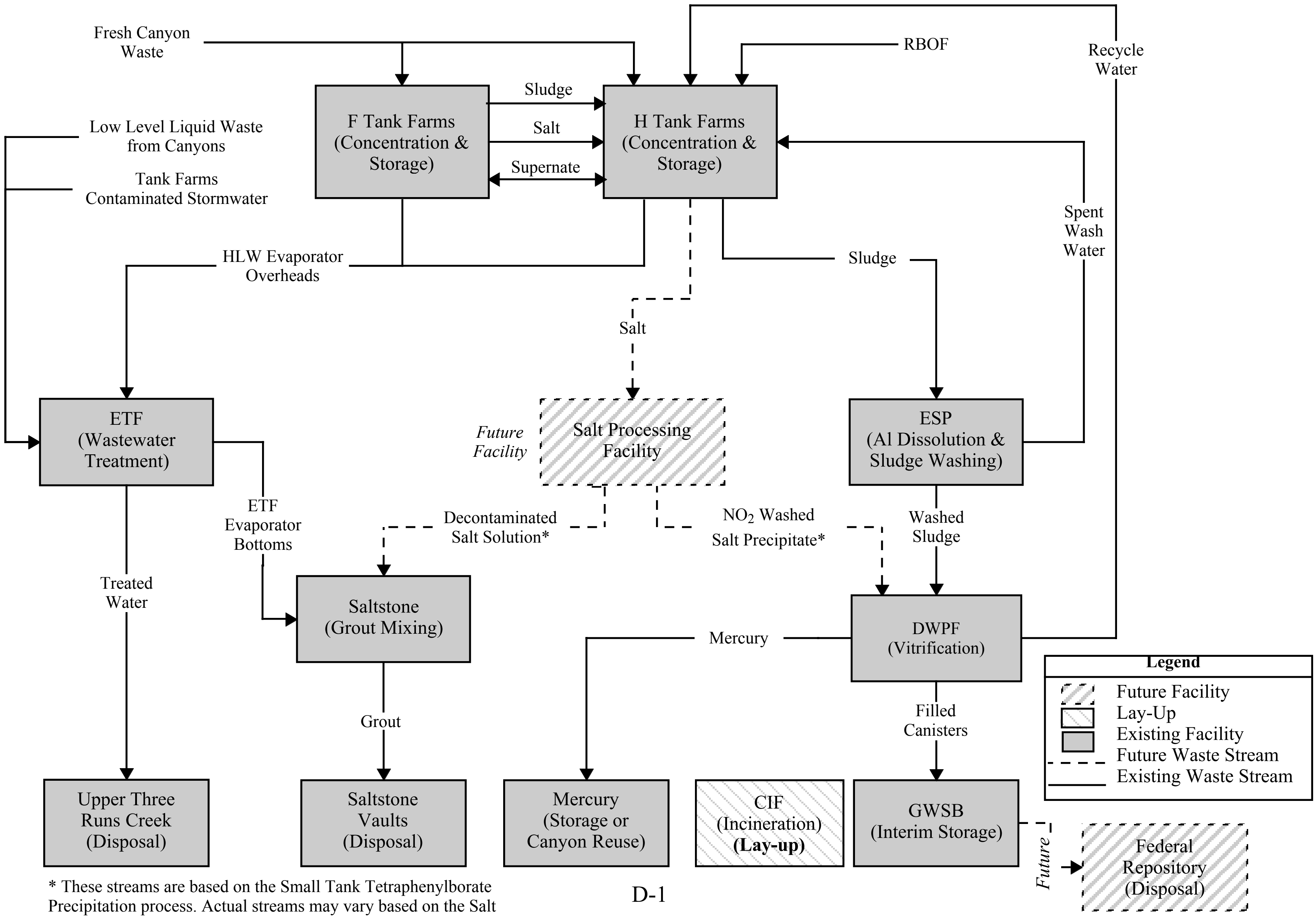
Concentrated Liquor

Supernate that has been evaporated to a specific gravity of 1.45 or greater, thus reducing its volume and minimizing the tank farm space it uses.

Appendix C - HLW System Priorities

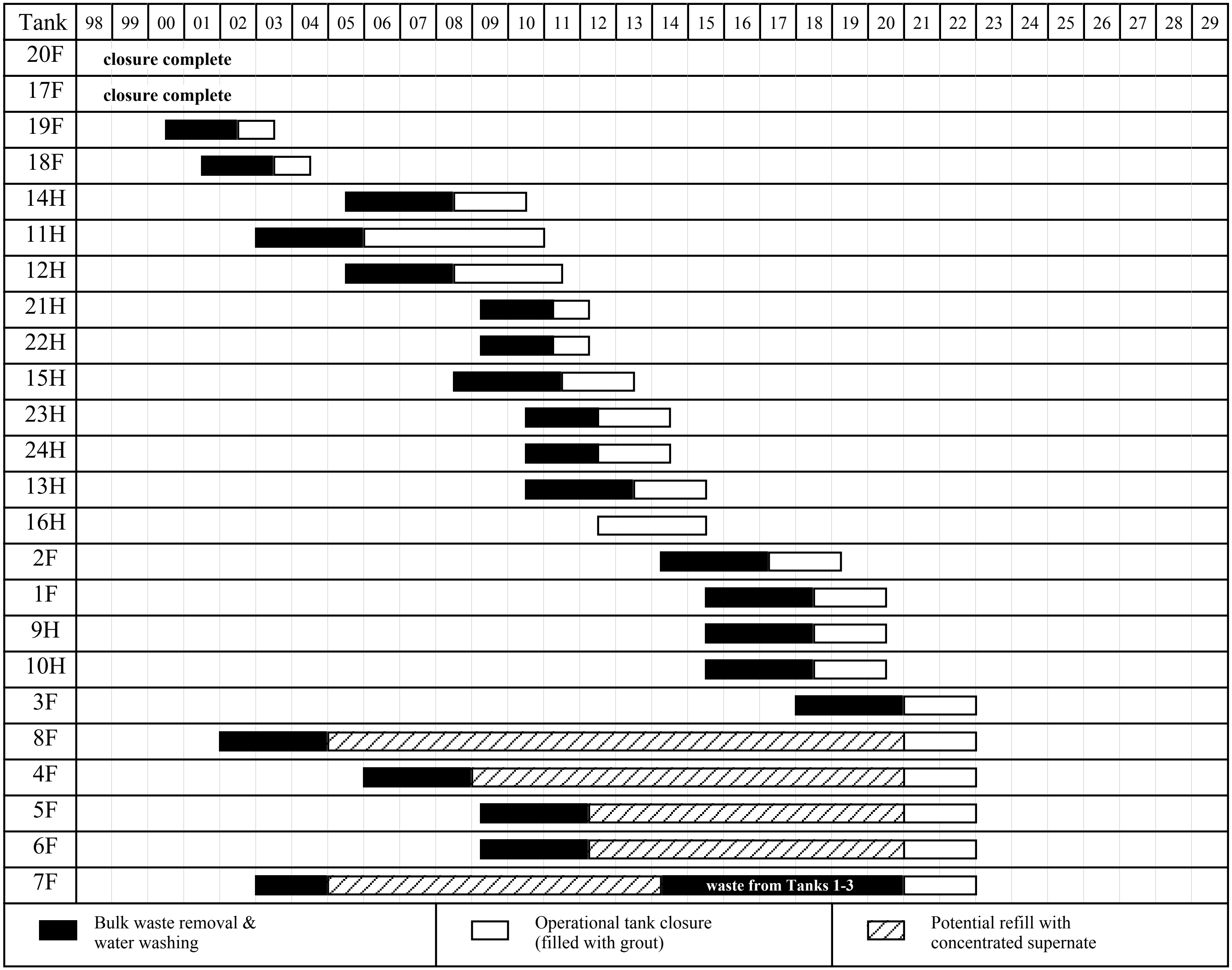
1. Maintain operating facilities in a safe and production-ready condition:
   - 1a. Safeguard health and safety of workers and public
   - 1b. Continue stewardship of current waste inventories
   - 1c. Implement improvement programs/projects critical to 1a and 1b
2. Support critical Site missions (i.e., DNFSB 94-1):
   - 2a. Operate Evaporators and Tank Farms as required to provide receipt space for Canyon waste and DWPF Recycle
   - 2b. Operate ETF to support Canyons, Tank Farms and Evaporators
3. Reduce the risk of High Level Waste Storage by removing curies from "high risk" non-compliant tanks.
4. Near-term compliance with the Site Treatment Plan
   - 4a. Provide DWPF materials and analytical support to produce forecast number of canisters
   - 4b. Operate evaporators and Tank Farms to provide receipt space for DWPF recycle
   - 4c. Operate ESP to provide Tank 51 (Batch 1B) sludge feed to DWPF
   - 4d. Prepare Tank 8 and Tank 40 sludge (Batch 2) feed to DWPF
   - 4e. Prepare Tank 40 equipment for sludge processing
   - 4f. Start up the 3H Evaporator to evaporate ESP wash water generated during Batch 2 processing
5. Salt Processing
   - 5a. Support the Salt Processing alternative selection process
6. Mid-term strategy to support Canyon missions and DWPF production:
   - 6a. Implement Tank Farm Space Management initiatives
   - 6b. Prepare Tank 49 as a concentrated waste storage tank
   - 6c. Evaporate backlog supernate to create space in the Tank Farms
   - 6d. Prepare Tank 50 as a concentrated waste storage tank
   - 6e. Prepare future sludge batches (Batches 3-4) to maintain continuity of DWPF operations
7. Comply with the approved FFA Waste Removal Plan and Schedule (*i.e.*, empty and close all old-style tanks by 2022)
   - 7a. Support Tank 19 closure to meet commitment date of FY03
   - 7b. Support Tank 18 closure to meet commitment date of FY04
8. Support Salt Processing
   - 8a. Support the Salt Processing alternative selection process including R&D initiatives
   - 8b. Support Salt Processing design activities on selected alternative
   - 8c. Support Salt Processing construction activities on selected alternative
   - 8d. Support Salt Processing startup activities on selected alternative
9. Long-term strategy to ensure continuity of DWPF operations, with both sludge and salt:
   - 9a. Continue sludge processing to maintain continuity of DWPF operations (Batch 5-9)
   - 9b. Install aluminum dissolution equipment on Tank 40 & 51
   - 9c. Retrofit Tank 35 as a 3H Evaporator Salt Tank
   - 9d. Complete design, construction and startup of Salt Processing facility
10. Develop new technologies that have a strong potential to reduce cost
11. Accelerate operation of the HLW System and thereby reduce program duration and life cycle cost
12. Develop and implement tank and facility closure methods
13. Perform engineering, technical and planning activities that reduce programmatic risk

Appendix D - Simplified HLW System Flowsheet (Small Tank TPB Precipitation)



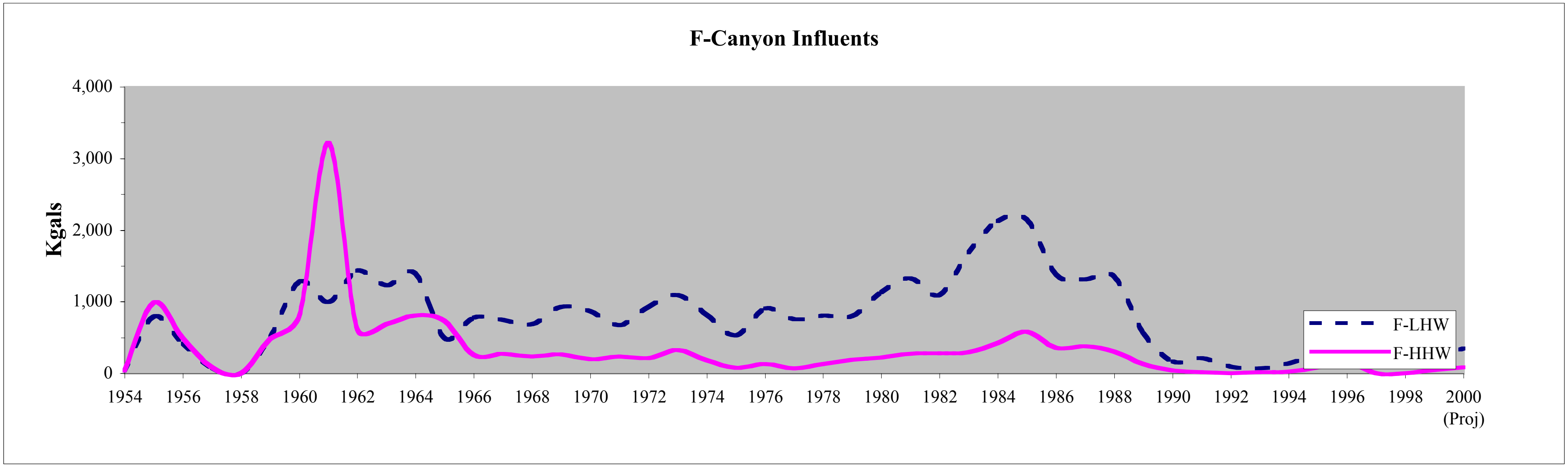
* These streams are based on the Small Tank Tetraphenylborate Precipitation process. Actual streams may vary based on the Salt Processing alternative chosen.

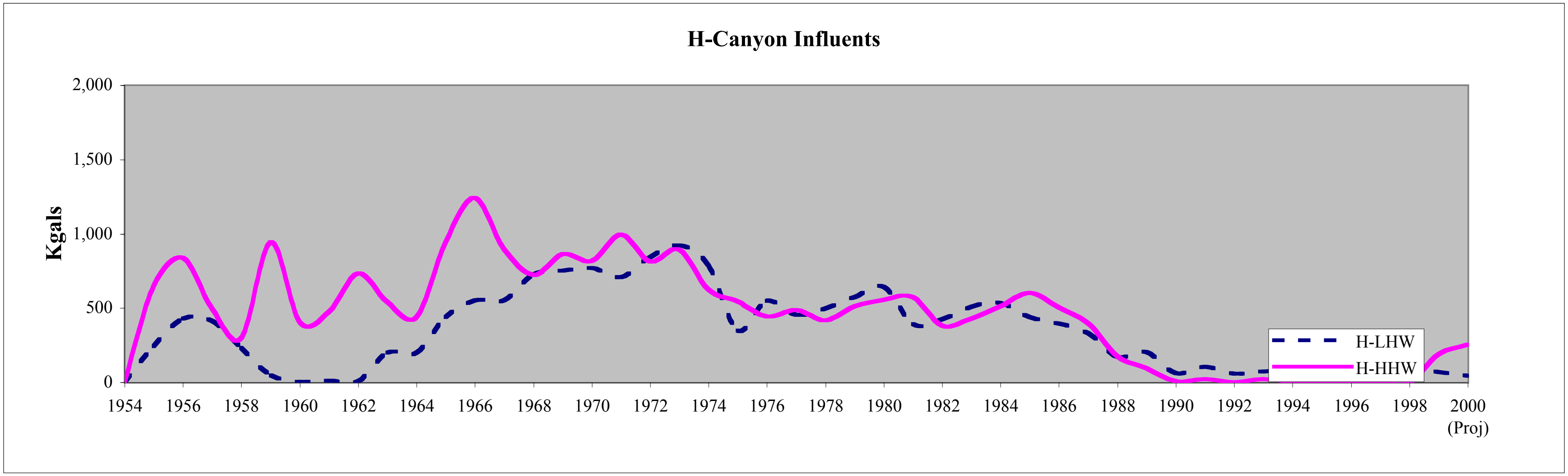
Appendix E - Approved FFA Waste Removal Plan & Schedule



Appendix F - Historical Tank Farm Influents and Effluents

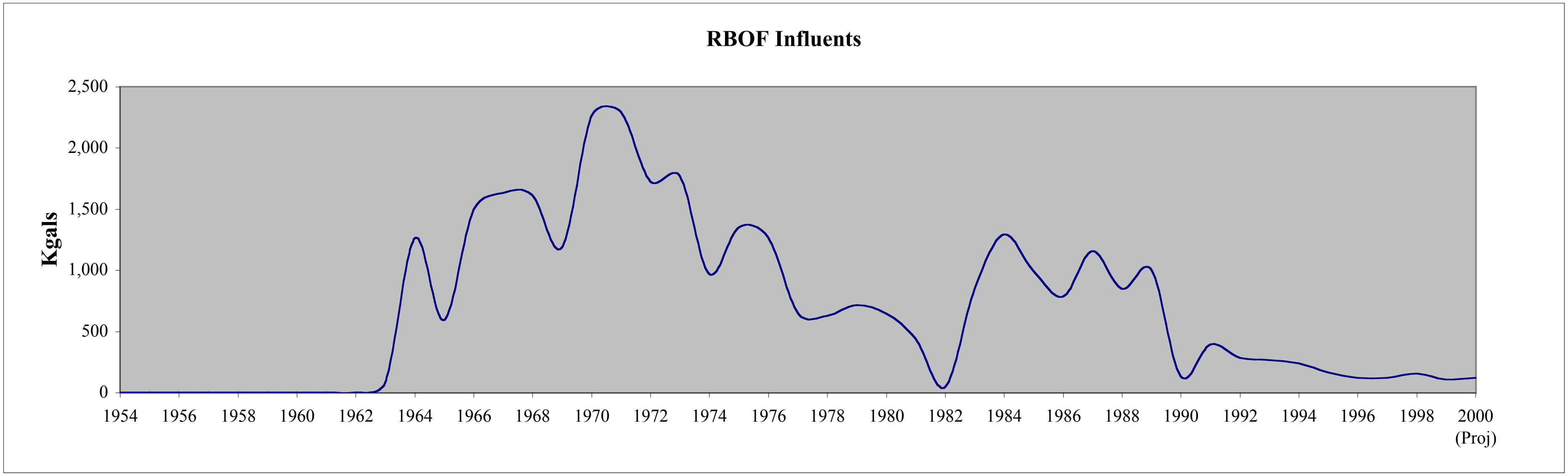
Calendar Year Basis

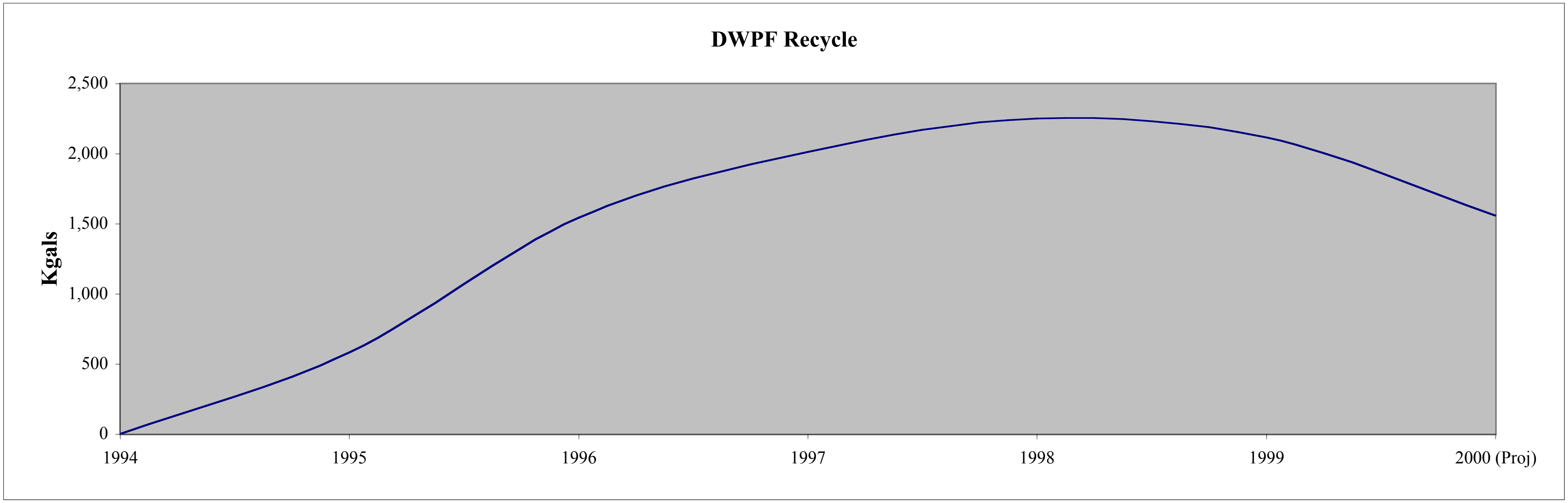




Appendix F - Historical Tank Farm Influents and Effluents

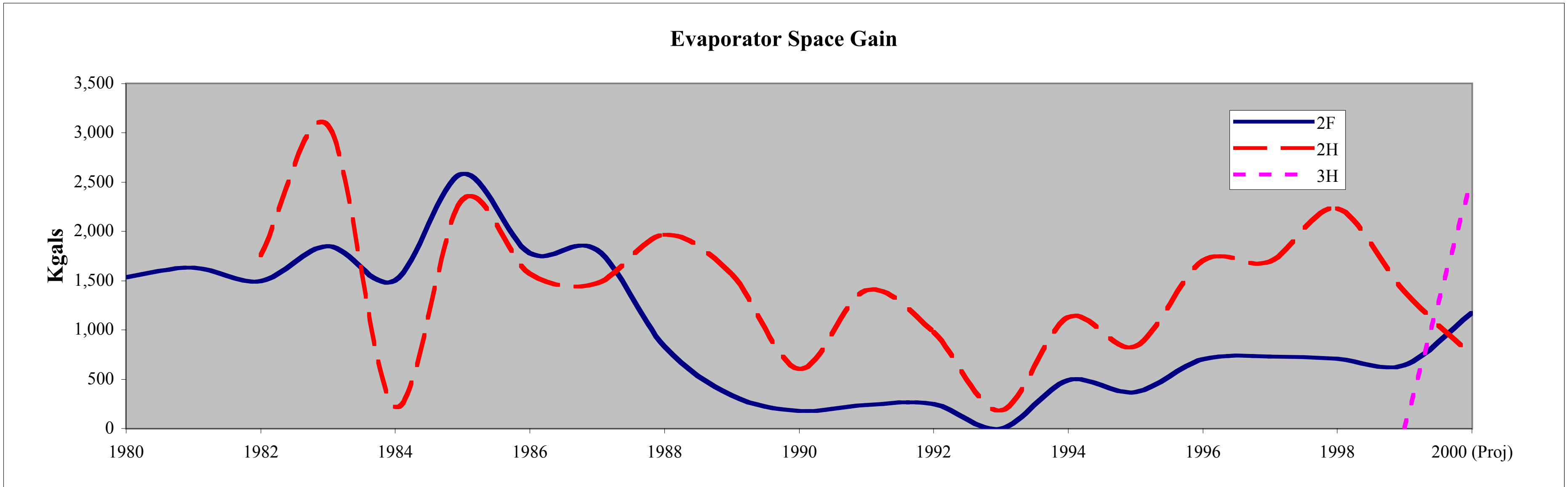
Calendar Year Basis

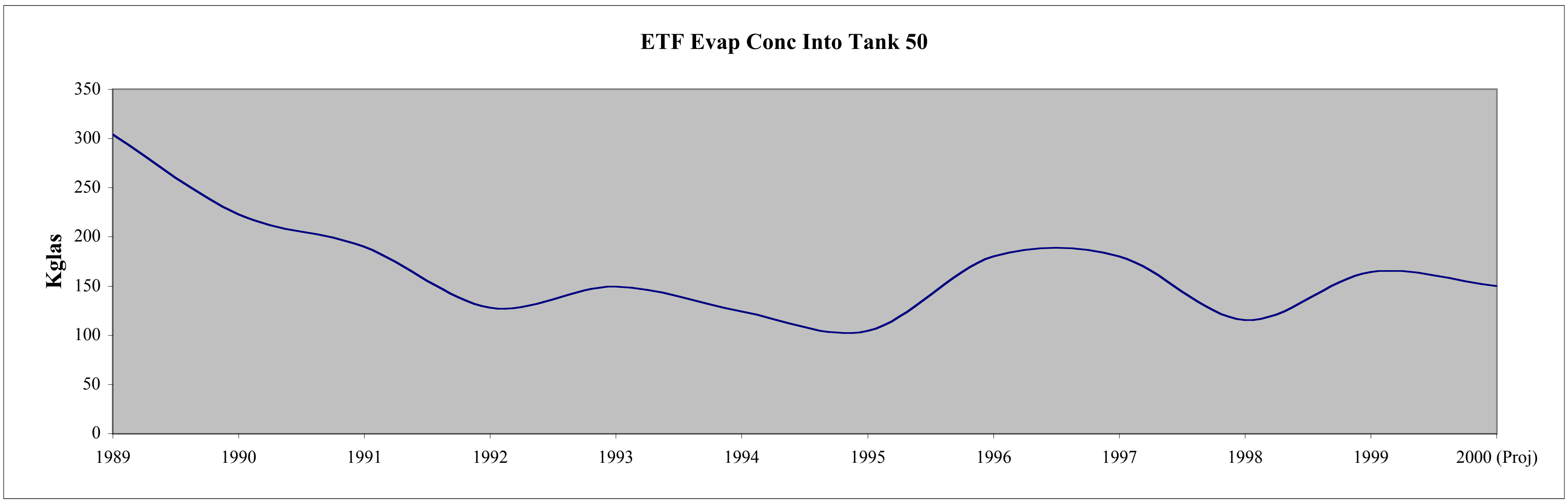




Appendix F - Historical Tank Farm Influents and Effluents

Calendar Year Basis





Appendix G - High Level Waste Tank Usage

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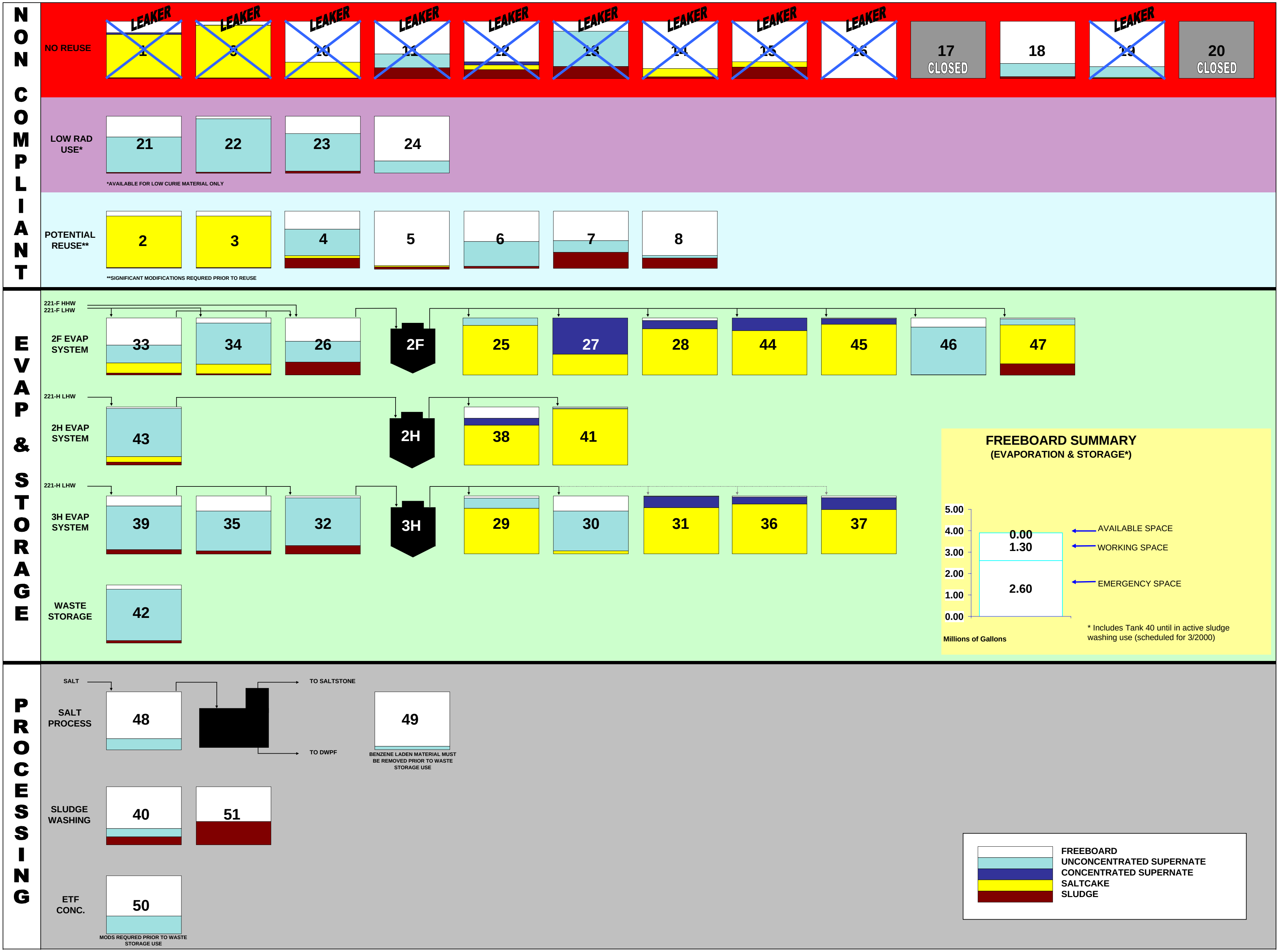


Appendix H.1 Funding (Requirements Case)

Budget Authority in Escalated Dollars

Project Title	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
HL-01 H Tank Farm															
H Tank Farm Operations	85,371	88,247	87,699	92,968	99,743	99,341	100,384	102,294	105,056	107,892	110,064	112,275	115,306	114,116	110,305
LI: Replacement Evaporator	12,835	3,414	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-01 Total	98,205	91,661	87,699	92,968	99,743	99,341	100,384	102,294	105,056	107,892	110,064	112,275	115,306	114,116	110,305
HL-02 F Tank Farm	58,928	59,315	58,751	60,475	65,005	61,539	63,200	64,905	66,657	68,456	69,563	71,441	71,806	73,744	75,735
HL-03 Waste Removal & Tank Closures															
WR Ops w/ Demo Projects	1,108	5,838	5,787	6,025	9,398	9,651	9,912	10,180	10,454	10,737	11,027	23,482	30,950	29,036	19,937
WR: Tank Closure	124	39	1,402	3,159	16,857	25,431	6,281	1,866	-	8,182	9,432	16,318	17,544	42,009	47,339
HL-03 Total	1,232	5,877	7,190	9,185	26,255	35,082	16,193	12,045	10,454	18,918	20,458	39,800	48,494	71,045	67,276
HL-04 Feed Preparations & Sludge Operations	53,328	54,155	53,035	62,371	65,576	70,759	70,963	71,173	73,095	75,069	77,095	79,177	72,085	74,031	76,030
HL-05 Vitrification															
Vitrification Ops	127,626	122,346	119,885	130,861	137,310	135,809	143,183	148,594	147,405	154,631	159,802	165,195	164,067	171,853	179,817
Failed Equip. Storage Vaults	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-05 Total	127,626	122,346	119,885	130,861	137,310	135,809	143,183	148,594	147,405	154,631	159,802	165,195	164,067	171,853	179,817
HL-06 Glass Waste Storage	436	626	427	7,399	22,783	39,430	18,346	1,001	4,654	12,228	18,295	8,120	2,288	2,350	2,413
HL-13 Salt Disposition															
Salt Disposition Ops	15,620	14,066	16,000	5,001	1	1	1	1	1	1	1	47,328	84,425	89,412	85,768
LI: Salt Alternative	-	-	-	29,539	84,461	135,000	150,000	150,000	150,000	144,000	99,000	58,000	-	-	-
HL-07 Total	15,620	14,066	16,000	34,540	84,462	135,001	150,001	150,001	150,001	144,001	99,001	105,328	84,425	89,412	85,768
HL-09 LI: Tk Fm Services Upgrade I	1,632	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-10 LI: Storm Water Upgrades	2,508	3,433	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-11 LI: Tk Fm Services Upgrade II	838	3,339	8,858	6,304	-	-	-	-	-	-	-	-	-	-	-
HL-12 LI: Waste Removal															
LI: WR from Tanks	24,739	22,009	37,476	48,197	66,023	50,341	33,437	24,471	45,784	56,971	82,942	54,656	50,085	42,579	43,776
LI: Vit Upgrades	12	928	-	-	-	13,544	13,910	14,285	14,671	15,067	11,606	17,878	12,241	18,857	19,366
LI: Pipe, Evaps & Infrastructure	-	-	-	984	5,999	11,145	11,471	4,531	-	-	-	-	-	-	-
HL-12 Total	24,751	22,937	37,476	49,181	72,022	75,029	58,817	43,287	60,455	72,038	94,548	72,534	62,326	61,436	63,142
FA-24 Facility Decontamination and Decommissioning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HLW TOTAL	**385,103**	**377,756**	**389,320**	**453,283**	**573,155**	**651,989**	**621,088**	**593,302**	**617,777**	**653,233**	**648,826**	**653,869**	**620,797**	**657,987**	**660,487**
Solid Waste Facilities															
CIF	23,745	22,990	2,000	2,000	2,000	34,745	35,485	28,523	26,356	34,703	30,380	32,322	29,858	31,045	37,375
ETF	16,510	15,993	16,304	18,815	18,214	22,001	22,095	22,883	18,234	22,219	18,346	19,509	19,350	22,140	30,776
SS	1,594	999	1,099	1,444	1,483	1,523	1,564	1,606	1,650	1,694	28,812	39,382	46,152	47,153	68,862
SW TOTAL	**41,850**	**39,982**	**19,402**	**22,259**	**21,697**	**58,270**	**59,144**	**53,012**	**46,239**	**58,616**	**77,538**	**91,213**	**95,360**	**100,338**	**137,013**
Life Cycle Cost	**426,952**	**417,738**	**408,722**	**475,542**	**594,853**	**710,258**	**680,232**	**646,314**	**664,017**	**711,849**	**726,364**	**745,082**	**716,156**	**758,325**	**797,500**

Appendix H.1 Funding (Requirements Case)

Budget Authority in Escalated Dollars

Project Title	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
HL-01 H Tank Farm															
H Tank Farm Operations	113,283	116,342	118,022	114,792	117,892	121,074	122,719	126,032	127,721	109,758	83,402	55,441	-	-	-
LI: Replacement Evaporator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-01 Total	113,283	116,342	118,022	114,792	117,892	121,074	122,719	126,032	127,721	109,758	83,402	55,441	-	-	-
HL-02 F Tank Farm	68,856	69,292	68,809	70,667	71,633	59,417	44,955	42,831	27,042	-	-	-	-	-	-
HL-03 Waste Removal & Tank Closures															
WR Ops w/ Demo Projects	20,475	21,028	21,596	22,179	22,778	8,150	8,370	8,596	-	-	-	-	-	-	-
WR: Tank Closure	6,196	21,488	49,106	44,034	25,074	64,443	36,098	43,051	53,271	130,287	77,753	16,367	-	-	-
HL-03 Total	26,671	42,517	70,702	66,213	47,851	72,593	44,468	51,647	53,271	130,287	77,753	16,367	-	-	-
HL-04 Feed Preparations & Sludge Operations	78,083	80,191	82,356	84,580	86,863	89,208	64,132	65,864	40,585	4,168	-	-	-	-	-
HL-05 Vitrification															
Vitrification Ops	177,081	186,210	193,672	197,368	198,423	205,201	212,229	199,782	95,781	0	0	0	0	-	-
Failed Equip. Storage Vaults	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-05 Total	177,081	186,210	193,672	197,368	198,423	205,201	212,229	199,782	95,781	0	0	0	0	-	-
HL-06 Glass Waste Storage	2,479	2,545	2,614	2,685	2,757	2,832	2,908	2,987	3,067	3,150	3,235	3,323	3,412	3,504	3,599
HL-13 Salt Disposition															
Salt Disposition Ops	91,756	85,645	88,065	89,890	92,998	95,159	97,728	89,430	49,271	-	-	-	-	-	-
LI: Salt Alternative	-	-	-	47,263	64,719	49,850	-	-	-	-	-	-	-	-	-
HL-07 Total	91,756	85,645	88,065	137,154	157,717	145,009	97,728	89,430	49,271	-	-	-	-	-	-
HL-09 LI: Tk Fm Services Upgrade I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-10 LI: Storm Water Upgrades	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-11 LI: Tk Fm Services Upgrade II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-12 LI: Waste Removal															
LI: WR from Tanks	41,977	60,229	61,054	57,244	65,450	58,142	44,123	33,364	23,852	38,733	-	-	-	-	-
LI: Vit Upgrades	19,889	13,617	13,985	-	-	-	-	-	-	-	-	-	-	-	-
LI: Pipe, Evaps & Infrastructure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-12 Total	61,866	73,846	75,039	57,244	65,450	58,142	44,123	33,364	23,852	38,733	-	-	-	-	-
FA-24 Facility Decontamination and Decommissioning	-	42,757	35,927	-	-	-	-	-	146,755	258,142	94,269	-	-	-	-
HLW TOTAL	**620,073**	**699,344**	**735,207**	**730,701**	**748,586**	**753,477**	**633,261**	**611,936**	**567,345**	**544,239**	**258,659**	**75,130**	**3,413**	**3,504**	**3,599**
Solid Waste Facilities															
CIF	32,165	33,811	38,031	34,311	42,203	39,781	37,088	38,880	41,390	46,001	41,125	48,676	42,832	46,773	55,737
ETF	22,404	22,490	27,618	22,705	29,828	23,947	25,637	38,087	27,799	26,640	-	-	-	-	-
SS	49,655	50,995	52,372	53,786	57,874	56,730	58,262	59,835	61,597	65,870	-	-	-	-	-
SW TOTAL	**104,224**	**107,296**	**118,022**	**110,802**	**129,904**	**120,458**	**120,986**	**136,802**	**130,786**	**138,510**	**41,125**	**48,676**	**42,832**	**46,773**	**55,737**
Life Cycle Cost	**724,297**	**806,640**	**853,229**	**841,503**	**878,491**	**873,935**	**754,247**	**748,738**	**698,130**	**682,749**	**299,784**	**123,806**	**46,245**	**50,277**	**59,335**

Appendix H.1 Funding (Requirements Case)

Budget Authority in Escalated Dollars

Project Title	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40		Cumulative FY99-End
HL-01 H Tank Farm														
H Tank Farm Operations	-	-	-	-	-	-	-	-	-	-	-	-		2,857,537
LI: Replacement Evaporator	-	-	-	-	-	-	-	-	-	-	-	-		16,249
HL-01 Total	-	-	-	-	-	-	-	-	-	-	-	-		2,873,786
HL-02 F Tank Farm	-	-	-	-	-	-	-	-	-	-	-	-		1,513,021
HL-03 Waste Removal & Tank Closures		-	-	-	-	-	-	-	-	-	-	-		
WR Ops w/ Demo Projects	-	-	-	-	-	-	-	-	-	-	-	-		326,693
WR: Tank Closure	-	-	-	-	-	-	-	-	-	-	-	-		763,151
HL-03 Total	-	-	-	-	-	-	-	-	-	-	-	-		1,089,844
HL-04 Feed Preparations & Sludge Operations	-	-	-	-	-	-	-	-	-	-	-	-		1,703,971
HL-05 Vitrification		-	-	-	-	-	-	-	-	-	-	-		
Vitrification Ops	-	-	-	-	-	-	-	-	-	-	-	-		3,874,130
Failed Equip. Storage Vaults	-	-	-	-	-	-	-	-	-	-	-	-		-
HL-05 Total	-	-	-	-	-	-	-	-	-	-	-	-		3,874,130
HL-06 Glass Waste Storage	3,696	2,847	2,924	3,003	3,084	3,167	3,253	3,340	3,431	3,523	3,618	-		221,779
HL-13 Salt Disposition		-	-	-	-	-	-	-	-	-	-	-		
Salt Disposition Ops	-	-	-	-	-	-	-	-	-	-	-	-		1,137,567
LI: Salt Alternative	-	-	-	-	-	-	-	-	-	-	-	-		1,161,833
HL-07 Total	-	-	-	-	-	-	-	-	-	-	-	-		2,299,400
HL-09 LI: Tk Fm Services Upgrade I	-	-	-	-	-	-	-	-	-	-	-	-		1,632
HL-10 LI: Storm Water Upgrades	-	-	-	-	-	-	-	-	-	-	-	-		5,941
HL-11 LI: Tk Fm Services Upgrade II	-	-	-	-	-	-	-	-	-	-	-	-		19,339
HL-12 LI: Waste Removal		-	-	-	-	-	-	-	-	-	-	-		
LI: WR from Tanks	-	-	-	-	-	-	-	-	-	-	-	-		1,167,653
LI: Vit Upgrades	-	-	-	-	-	-	-	-	-	-	-	-		199,857
LI: Pipe, Evaps & Infrastructure	-	-	-	-	-	-	-	-	-	-	-	-		34,130
HL-12 Total	-	-	-	-	-	-	-	-	-	-	-	-		1,401,640
FA-24 Facility Decontamination and Decommissioning	-	-	-	-	-	-	-	-	-	-	-	18,915		596,765
HLW TOTAL	**3,696**	**2,847**	**2,924**	**3,003**	**3,084**	**3,167**	**3,253**	**3,340**	**3,431**	**3,523**	**3,618**	**18,915**	**-**	**15,601,247**
Solid Waste Facilities														
CIF	47,527	48,253	-	-	-	-	-	-	-	-	-	-		1,088,109
ETF	-	-	-	-	-	-	-	-	-	-	-	-		570,544
SS	-	-	-	-	-	-	-	-	-	-	-	-		811,992
SW TOTAL	**47,527**	**48,253**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**2,470,645**
Life Cycle Cost	**51,223**	**51,100**	**2,924**	**3,003**	**3,084**	**3,167**	**3,253**	**3,340**	**3,431**	**3,523**	**3,618**	**18,915**	**-**	**18,071,892**

Appendix H.1 Funding (Requirements Case)

Budget Authority in Constant Dollars

Project Title	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
HL-01 H Tank Farm															
H Tank Farm Operations	85,371	85,181	81,710	84,342	88,109	85,447	84,075	83,422	83,421	83,421	82,863	82,305	82,305	79,314	74,650
LI: Replacement Evaporator	12,835	3,295	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-01 Total	98,205	88,476	81,710	84,342	88,109	85,447	84,075	83,422	83,421	83,421	82,863	82,305	82,305	79,314	74,650
HL-02 F Tank Farm	58,928	57,254	54,739	54,864	57,423	52,932	52,931	52,931	52,930	52,930	52,372	52,371	51,255	51,255	51,254
HL-03 Waste Removal & Tank Closures															
WR Ops w/ Demo Projects	1,108	5,635	5,392	5,466	8,301	8,301	8,301	8,301	8,301	8,301	8,301	17,214	22,092	20,181	13,493
WR: Tank Closure	124	37	1,307	2,866	14,891	21,874	5,261	1,522	0	6,326	7,101	11,962	12,523	29,198	32,037
HL-03 Total	1,232	5,673	6,699	8,333	23,192	30,175	13,562	9,823	8,301	14,628	15,402	29,176	34,615	49,379	45,530
HL-04 Feed Preparations & Sludge Operations	53,328	52,273	49,413	56,584	57,928	60,862	59,434	58,042	58,042	58,042	58,042	58,042	51,454	51,454	51,454
HL-05 Vitrification															
Vitrification Ops	127,626	118,095	111,698	118,719	121,294	116,814	119,920	121,180	117,050	119,559	120,309	121,099	117,111	119,444	121,693
Failed Equip. Storage Vaults	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-05 Total	127,626	118,095	111,698	118,719	121,294	116,814	119,920	121,180	117,050	119,559	120,309	121,099	117,111	119,444	121,693
HL-06 Glass Waste Storage	436	605	398	6,712	20,125	33,915	15,365	817	3,696	9,455	13,774	5,952	1,633	1,633	1,633
HL-13 Salt Disposition															
Salt Disposition Ops	15,620	13,578	14,907	4,537	1	1	1	1	1	1	1	34,695	60,262	62,144	58,045
LI: Salt Alternative	0	0	0	26,798	74,610	116,119	125,629	122,326	119,110	111,340	74,534	42,518	0	0	0
HL-07 Total	15,620	13,578	14,907	31,335	74,610	116,120	125,630	122,327	119,111	111,340	74,534	77,213	60,262	62,144	58,045
HL-09 LI: Tk Fm Services Upgrade I	1,632	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-10 LI: Storm Water Upgrades	2,508	3,314	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-11 LI: Tk Fm Services Upgrade II	838	3,223	8,253	5,719	0	0	0	0	0	0	0	0	0	0	0
HL-12 LI: Waste Removal															
LI: WR from Tanks	24,739	21,244	34,917	43,725	58,322	43,300	28,004	19,956	36,355	44,049	62,444	40,067	35,751	29,594	29,626
LI: Vit Upgrades	12	896	0	0	0	11,650	11,650	11,650	11,650	11,650	8,737	13,106	8,737	13,106	13,106
LI: Pipe, Evaps & Infrastructure	0	0	0	893	5,299	9,586	9,607	3,695	0	0	0	0	0	0	0
HL-12 Total	24,751	22,140	34,917	44,618	63,622	64,536	49,261	35,301	48,005	55,699	71,182	53,173	44,488	42,700	42,732
FA-24 Facility Decontamination and Decommissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HLW TOTAL	**385,103**	**364,629**	**362,733**	**411,225**	**506,305**	**560,801**	**520,178**	**483,842**	**490,557**	**505,075**	**488,478**	**479,333**	**443,124**	**457,323**	**446,992**
Solid Waste Facilities															
CIF	23,745	22,191	1,863	1,814	1,767	29,886	29,719	23,261	20,928	26,832	22,872	23,694	21,312	21,577	25,294
ETF	16,510	15,437	15,190	17,069	16,090	18,924	18,505	18,661	14,479	17,179	13,812	14,301	13,812	15,388	20,828
SS	1,594	964	1,024	1,310	1,310	1,310	1,310	1,310	1,310	1,310	21,691	28,870	32,943	32,773	46,603
SW TOTAL	41,850	38,593	18,077	20,194	19,167	50,120	49,534	43,232	36,717	45,322	58,376	66,866	68,068	69,738	92,725
Life Cycle Cost	**426,952**	**403,222**	**380,811**	**431,418**	**525,471**	**610,922**	**569,712**	**527,075**	**527,275**	**550,396**	**546,853**	**546,199**	**511,192**	**527,061**	**539,717**

Appendix H.1 Funding (Requirements Case)

Budget Authority in Constant Dollars

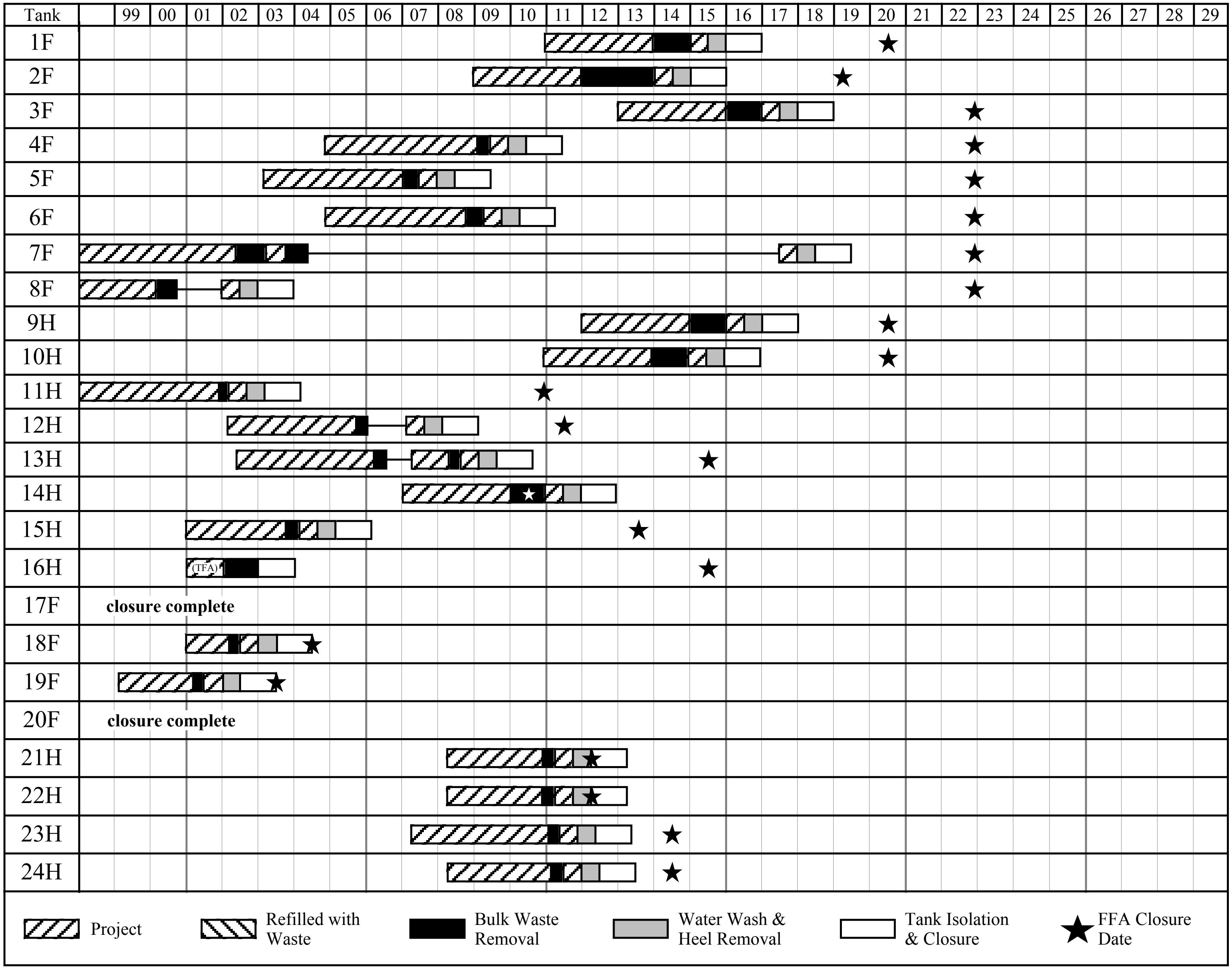
Project Title	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
HL-01 H Tank Farm															
H Tank Farm Operations	74,650	74,650	73,737	69,834	69,834	69,834	68,921	68,921	68,008	56,907	42,106	27,253	0	0	0
LI: Replacement Evaporator	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-01 Total	74,650	74,650	73,737	69,834	69,834	69,834	68,921	68,921	68,008	56,907	42,106	27,253	0	0	0
HL-02 F Tank Farm	45,374	44,461	42,990	42,990	42,432	34,271	25,247	23,422	14,399	0	0	0	0	0	0
HL-03 Waste Removal & Tank Closures															
WR Ops w/ Demo Projects	13,493	13,493	13,493	13,493	13,493	4,701	4,701	4,701	0	0	0	0	0	0	0
WR: Tank Closure	4,083	13,788	30,680	26,788	14,852	37,170	20,273	23,543	28,366	67,551	39,253	8,045	0	0	0
HL-03 Total	17,575	27,280	44,173	40,281	28,345	41,870	24,974	28,243	28,366	67,551	39,253	8,045	0	0	0
HL-04 Feed Preparations & Sludge Operations	51,454	51,454	51,454	51,454	51,454	51,454	36,018	36,018	21,611	2,161	0	0	0	0	0
HL-05 Vitrification															
Vitrification Ops	116,691	119,481	121,002	120,069	117,537	118,357	119,192	109,252	51,001	0	0	0	0	0	0
Failed Equip. Storage Vaults	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-05 Total	116,691	119,481	121,002	120,069	117,537	118,357	119,192	109,252	51,001	0	0	0	0	0	0
HL-06 Glass Waste Storage	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633
HL-13 Salt Disposition															
Salt Disposition Ops	60,464	54,953	55,021	54,685	55,088	54,886	54,886	48,905	26,236	0	0	0	0	0	0
LI: Salt Alternative	0	0	0	28,753	38,337	28,753	0	0	0	0	0	0	0	0	0
HL-07 Total	60,464	54,953	55,021	83,437	93,425	83,639	54,886	48,905	26,236	0	0	0	0	0	0
HL-09 LI: Tk Fm Services Upgrade I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-10 LI: Storm Water Upgrades	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-11 LI: Tk Fm Services Upgrade II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-12 LI: Waste Removal															
LI: WR from Tanks	27,662	38,645	38,145	34,824	38,770	33,536	24,780	18,245	12,701	20,082	0	0	0	0	0
LI: Vit Upgrades	13,106	8,737	8,737	0	0	0	0	0	0	0	0	0	0	0	0
LI: Pipe, Evaps & Infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-12 Total	40,768	47,383	46,883	34,824	38,770	33,536	24,780	18,245	12,701	20,082	0	0	0	0	0
FA-24 Facility Decontamination and Decommissioning	0	27,435	22,447	0	0	0	0	0	78,144	133,841	47,591	0	0	0	0
HLW TOTAL	**408,609**	**448,730**	**459,339**	**444,522**	**443,430**	**434,593**	**355,652**	**334,640**	**302,098**	**282,176**	**130,584**	**36,932**	**1,633**	**1,633**	**1,633**
Solid Waste Facilities															
CIF	21,196	21,695	23,761	20,873	24,999	22,945	20,829	21,262	22,039	23,850	20,762	23,928	20,502	21,799	25,294
ETF	14,763	14,430	17,255	13,812	17,669	13,812	14,398	20,828	14,802	13,812	0	0	0	0	0
SS	32,721	32,721	32,721	32,721	34,282	32,721	32,721	32,721	32,799	34,152	0	0	0	0	0
SW TOTAL	68,680	68,846	73,737	67,406	76,950	69,478	67,948	74,811	69,640	71,815	20,762	23,928	20,502	21,799	25,294
Life Cycle Cost	**477,289**	**517,576**	**533,076**	**511,928**	**520,379**	**504,071**	**423,600**	**409,450**	**371,739**	**353,991**	**151,345**	**60,860**	**22,135**	**23,433**	**26,927**

Appendix H.1 Funding (Requirements Case)

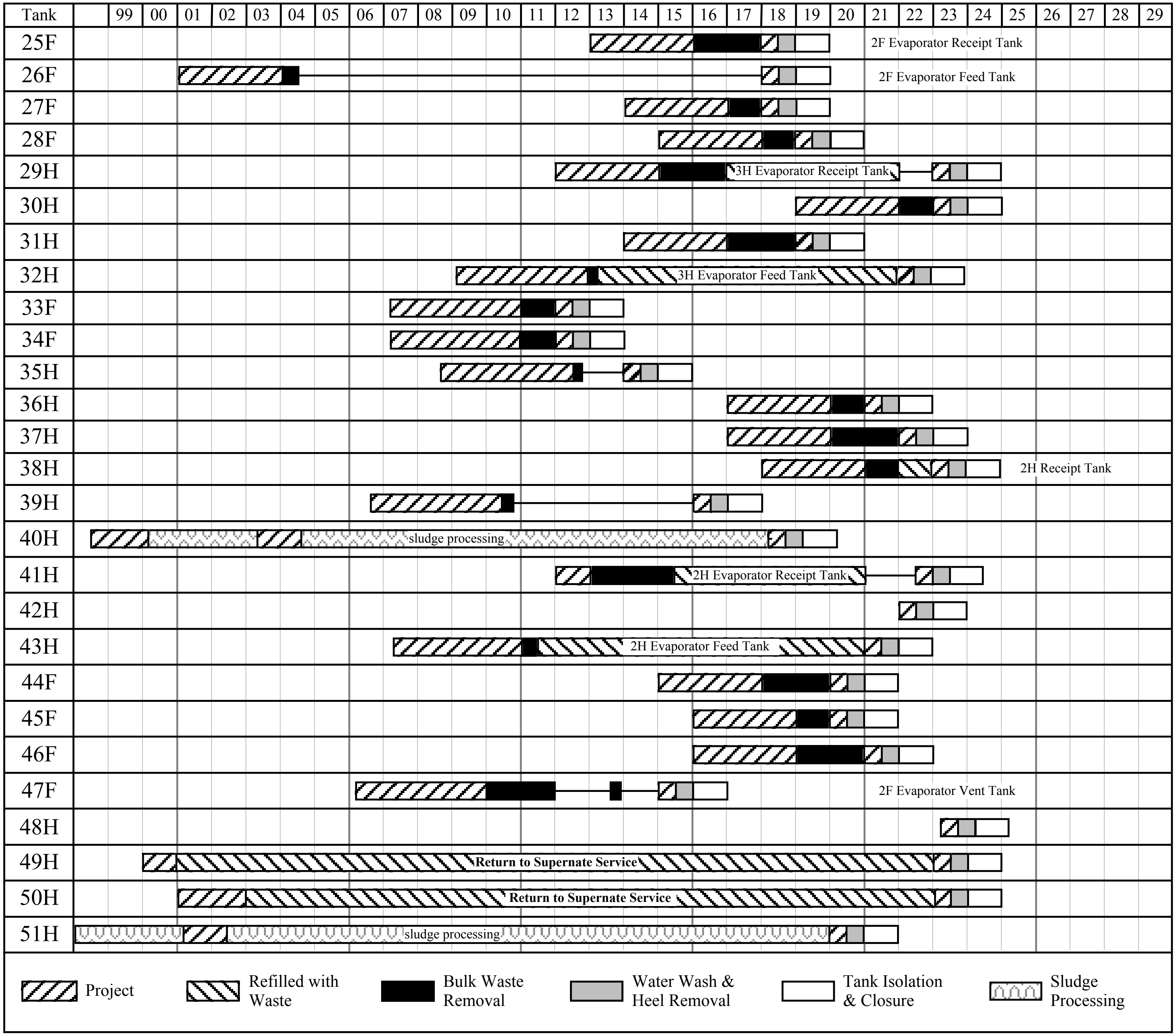
Budget Authority in Constant Dollars

Project Title	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	Cumulative FY99-End
HL-01 H Tank Farm													
H Tank Farm Operations	0	0	0	0	0	0	0	0	0	0	0	0	2,010,591
LI: Replacement Evaporator	0	0	0	0	0	0	0	0	0	0	0	0	16,130
HL-01 Total	0	0	0	0	0	0	0	0	0	0	0	0	2,026,721
HL-02 F Tank Farm	0	0	0	0	0	0	0	0	0	0	0	0	1,121,955
HL-03 Waste Removal & Tank Closures													
WR Ops w/ Demo Projects	0	0	0	0	0	0	0	0	0	0	0	0	230,256
WR: Tank Closure	0	0	0	0	0	0	0	0	0	0	0	0	461,421
HL-03 Total	0	0	0	0	0	0	0	0	0	0	0	0	691,678
HL-04 Feed Preparations & Sludge Operations	0	0	0	0	0	0	0	0	0	0	0	0	1,238,927
HL-05 Vitrification													
Vitrification Ops	0	0	0	0	0	0	0	0	0	0	0	0	2,784,191
Failed Equip. Storage Vaults	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-05 Total	0	0	0	0	0	0	0	0	0	0	0	0	2,784,191
HL-06 Glass Waste Storage	1,633	1,225	1,225	1,225	1,225	1,225	1,225	1,225	1,225	1,225	1,225	0	154,531
HL-13 Salt Disposition													
Salt Disposition Ops	0	0	0	0	0	0	0	0	0	0	0	0	728,916
LI: Salt Alternative	0	0	0	0	0	0	0	0	0	0	0	0	908,826
HL-07 Total	0	0	0	0	0	0	0	0	0	0	0	0	1,637,742
HL-09 LI: Tk Fm Services Upgrade I	0	0	0	0	0	0	0	0	0	0	0	0	1,632
HL-10 LI: Storm Water Upgrades	0	0	0	0	0	0	0	0	0	0	0	0	5,822
HL-11 LI: Tk Fm Services Upgrade II	0	0	0	0	0	0	0	0	0	0	0	0	18,033
HL-12 LI: Waste Removal													
LI: WR from Tanks	0	0	0	0	0	0	0	0	0	0	0	0	839,484
LI: Vit Upgrades	0	0	0	0	0	0	0	0	0	0	0	0	146,531
LI: Pipe, Evaps & Infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	29,081
HL-12 Total	0	0	0	0	0	0	0	0	0	0	0	0	1,015,096
FA-24 Facility Decontamination and Decommissioning	0	0	0	0	0	0	0	0	0	0	0	6,235	315,692
HLW TOTAL	**1,633**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**6,235**	**11,012,020**
Solid Waste Facilities													
CIF	21,001	20,762	0	0	0	0	0	0	0	0	0	0	674,254
ETF	0	0	0	0	0	0	0	0	0	0	0	0	401,771
SS	0	0	0	0	0	0	0	0	0	0	0	0	505,912
SW TOTAL	21,001	20,762	0	0	0	0	0	0	0	0	0	0	1,581,936
Life Cycle Cost	**22,635**	**21,987**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**1,225**	**6,235**	**12,593,956**

Appendix H.2 Waste Removal Schedule (Requirements Case)



Appendix H.2 Waste Removal Schedule (Requirements Case)



Appendix H.3 - Material Balance (Requirements Case)

End of Month/Year	Influents (gallons) F Canyon LHW	F Canyon HHW	F-Can Total	H Canyon LHW	H Canyon HHW	H-Can Total	DWPF Recycle	Other	Inhibited Water	Total In	Effluents (gallons) Evaporator Overheads FTF Evaps	HTF Evaps	Total	Type III Sludge to ESP	Type III Supernate to Salt Proc	Total Out
Jan 2000	22,000	1,250	23,250	-	2,500	2,500	130,464	11,250	-	167,464			-	-	-	-
Feb 2000	44,000	8,500	52,500	-	10,000	10,000	120,575	37,667	-	220,742	42,417	-	42,417	-	-	42,417
Mar 2000	43,000	2,500	45,500	-	10,000	10,000	97,923	37,667	-	191,090	80,273	101,535	181,808	-	-	181,808
Apr 2000	12,000	2,500	14,500	-	5,000	5,000	97,923	37,667	400,000	555,090	79,120	157,091	236,211	-	-	236,211
May 2000	17,000	5,500	22,500	4,442	23,887	28,329	97,923	37,667	-	186,419	-	153,093	153,093	-	-	153,093
Jun 2000	25,000	2,500	27,500	4,442	23,887	28,329	97,923	37,667	-	191,419	-	120,847	120,847	-	-	120,847
Jul 2000	17,000	21,252	38,252	4,442	23,887	28,329	97,923	37,667	-	202,171	58,062	84,891	142,953	-	-	142,953
Aug 2000	17,000	5,500	22,500	4,442	23,887	28,329	97,923	37,667	-	186,419	93,336	337,727	431,063	-	-	431,063
Sep 2000	43,125	21,251	64,376	7,493	23,887	31,380	97,923	37,667	-	231,346	-	196,649	196,649	-	-	196,649
FY00	240,125	70,753	310,878	25,261	146,935	172,196	936,500	312,583	400,000	2,132,157	353,208	1,151,832	1,505,040	-	-	1,505,040
Oct 2000	12,000	2,500	14,500	6,592	35,387	41,979	97,923	37,667	500,000	692,069	-	564,486	564,486	-	-	564,486
Nov 2000	40,125	5,499	45,624	6,592	35,387	41,979	97,923	37,667	400,000	623,193	-	380,813	380,813	-	-	380,813
Dec 2000	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	400,000	611,069	156,673	560,533	717,206	-	-	717,206
Jan 2001	28,000	2,500	30,500	6,592	35,387	41,979	97,923	37,667	-	208,069	33,950	532,187	566,137	-	-	566,137
Feb 2001	28,000	5,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	54,659	261,646	316,305	-	-	316,305
Mar 2001	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	151,574	389,371	540,945	-	-	540,945
Apr 2001	28,000	2,500	30,500	6,592	35,387	41,979	97,923	37,667	170,441	378,510	123,262	410,690	533,952	-	-	533,952
May 2001	28,000	5,500	33,500	6,592	55,387	61,979	97,923	37,667	-	231,069	60,215	275,134	335,349	-	-	335,349
Jun 2001	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	49,773	303,757	353,530	-	-	353,530
Jul 2001	28,000	2,500	30,500	6,592	35,387	41,979	97,923	37,667	-	208,069	52,309	273,167	325,476	-	-	325,476
Aug 2001	28,000	5,500	33,500	6,592	35,387	41,979	97,923	37,667	240,000	451,069	116,260	213,536	329,796	-	-	329,796
Sep 2001	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	86,766	292,109	378,875	-	-	378,875
FY01	344,125	41,999	386,124	79,104	444,644	523,748	1,175,076	452,000	1,710,441	4,247,389	885,441	4,457,427	5,342,868	-	-	5,342,868
Oct 2001	28,000	2,500	30,500	6,592	55,387	61,979	97,923	37,667	-	228,069	57,593	210,703	268,296	-	-	268,296
Nov 2001	28,000	5,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	67,224	225,071	292,295	-	-	292,295
Dec 2001	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	31,131	206,354	237,485	-	-	237,485
Jan 2002	28,000	2,500	30,500	6,592	35,387	41,979	97,922	37,667	-	208,068	17,021	151,073	168,094	-	-	168,094
Feb 2002	28,000	5,500	33,500	6,592	35,387	41,979	97,923	37,667	75,000	286,069	9,184	252,982	262,166	-	-	262,166
Mar 2002	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	357,557	568,626	176,316	259,260	435,576	-	-	435,576
Apr 2002	28,000	2,500	30,500	6,592	35,387	41,979	97,923	37,667	-	208,069	157,069	120,243	277,312	-	-	277,312
May 2002	28,000	5,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	86,896	27,529	114,425	-	-	114,425
Jun 2002	31,000	2,500	33,500	6,592	35,387	41,979	97,923	37,667	-	211,069	36,817	154,401	191,218	-	-	191,218
Jul 2002	28,000	2,500	30,500	6,592	35,387	41,979	97,923	37,667	-	208,069	149,692	160,310	310,002	-	-	310,002
Aug 2002	20,000	5,500	25,500	6,592	35,387	41,979	97,923	37,667	-	203,069	-	124,030	124,030	-	-	124,030
Sep 2002	23,000	2,500	25,500	6,592	35,387	41,979	97,923	37,667	-	203,069	115,422	178,075	293,497	-	-	293,497
FY02	332,000	42,000	374,000	79,104	444,644	523,748	1,175,075	452,000	432,557	2,957,380	904,365	2,070,035	2,974,400	-	-	2,974,400

Appendix H.3 - Material Balance (Requirements Case)

End of Month/Year	Influents (gallons) F Canyon LHW	F Canyon HHW	F-Can Total	H Canyon LHW	H Canyon HHW	H-Can Total	DWPF Recycle	Other	Inhibited Water	Total In	Effluents (gallons) Evaporator Overheads FTF Evaps	HTF Evaps	Total	Type III Sludge to ESP	Type III Supernate to Salt Proc	Total Out
Oct 2002	20,000	4,500	24,500	6,592	55,387	61,979	97,923	37,667	365,113	587,182	82,161	136,287	218,448	-	-	218,448
Nov 2002	20,000	7,500	27,500	6,592	35,387	41,979	97,923	37,667	706,414	911,483	64,528	543,017	607,545	-	-	607,545
Dec 2002	23,000	4,500	27,500	6,592	35,387	41,979	97,923	37,667	400,000	605,069	62,192	582,581	644,773	-	-	644,773
Jan 2003	20,000	4,500	24,500	3,545	19,141	22,686	97,923	37,667	400,000	582,776	53,773	540,452	594,225	-	-	594,225
Feb 2003	12,000	7,500	19,500	3,545	39,141	42,686	97,923	37,667	-	197,776	39,191	553,799	592,990	-	-	592,990
Mar 2003	15,000	4,500	19,500	3,545	19,141	22,686	97,923	37,667	400,000	577,776	6,777	578,088	584,865	-	-	584,865
Apr 2003	30,000	5,500	35,500	3,545	19,141	22,686	97,923	37,667	-	193,776	-	392,679	392,679	-	-	392,679
May 2003	18,000	3,000	21,000	3,545	19,141	22,686	97,923	37,667	-	179,276	-	327,113	327,113	-	-	327,113
Jun 2003	18,000	3,000	21,000	3,545	19,141	22,686	97,923	37,667	500,000	679,276	217,438	378,276	595,714	-	-	595,714
Jul 2003	18,000	3,000	21,000	3,545	19,141	22,686	97,923	37,667	-	179,276	-	159,833	159,833	-	-	159,833
Aug 2003	18,000	3,000	21,000	3,545	19,141	22,686	97,923	37,667	120,000	299,276	-	203,960	203,960	-	-	203,960
Sep 2003	18,000	18,000	36,000	3,545	19,141	22,686	97,923	37,667	-	194,276	-	123,196	123,196	-	-	123,196
FY03	230,000	68,500	298,500	51,681	318,430	370,111	1,175,076	452,000	2,891,527	5,187,214	526,060	4,519,285	5,045,345	-	-	5,045,345
FY04	246,000	51,000	297,000	40,221	256,579	296,800	58,752	452,000	-	1,104,552	-	2,468,305	2,468,305	281,000	-	2,749,305
FY05	246,000	14,000	260,000	39,456	252,208	291,664	55,080	452,000	1,998,498	3,057,242	-	4,352,697	4,352,697	-	-	4,352,697
FY06	120,000	-	120,000	29,592	207,282	236,874	56,304	452,000	245,887	1,111,065	-	2,346,373	2,346,373	-	-	2,346,373
FY07	120,000	-	120,000	-	50,016	50,016	55,080	452,000	1,632,168	2,309,264	-	2,949,904	2,949,904	-	-	2,949,904
FY08	120,000	-	120,000	-	50,016	50,016	56,304	452,000	513,000	1,191,320	-	2,316,910	2,316,910	-	-	2,316,910
FY09	120,000	-	120,000	-	50,016	50,016	58,752	452,000	1,185,125	1,865,893	-	2,233,724	2,233,724	-	-	2,233,724
FY10	120,000	-	120,000	-	50,016	50,016	58,752	452,000	914,000	1,594,768	-	3,046,009	3,046,009	-	1,259,000	4,305,009
FY11	-	-	-	-	-	-	58,752	452,000	190,000	700,752	-	665,714	665,714	-	3,226,000	3,891,714
FY12	-	-	-	-	-	-	58,752	452,000	2,093,000	2,603,752	-	2,473,564	2,473,564	259,000	2,543,000	5,275,564
FY13	-	-	-	-	-	-	58,752	452,000	-	510,752	-	485,214	485,214	182,871	2,042,000	2,710,085
FY14	-	-	-	-	-	-	58,752	452,000	2,728,000	3,238,752	-	3,076,814	3,076,814	312,584	937,000	4,326,398
FY15	-	-	-	-	-	-	58,752	452,000	736,000	1,246,752	-	1,184,414	1,184,414	-	1,305,000	2,489,414
FY16	-	-	-	-	-	-	58,752	452,000	330,000	840,752	-	798,714	798,714	-	1,406,000	2,204,714
FY17	-	-	-	-	-	-	58,752	452,000	1,323,000	1,833,752	-	1,742,064	1,742,064	13,575	2,544,000	4,299,639
FY18	-	-	-	-	-	-	58,752	452,000	560,000	1,070,752	-	1,017,214	1,017,214	-	2,332,000	3,349,214
FY19	-	-	-	-	-	-	58,752	452,000	280,000	790,752	-	751,214	751,214	-	2,406,000	3,157,214
FY20	-	-	-	-	-	-	58,752	452,000	420,000	930,752	-	884,214	884,214	-	2,355,000	3,239,214
FY21	-	-	-	-	-	-	58,752	452,000	420,000	930,752	-	884,214	884,214	-	2,241,000	3,125,214
FY22	-	-	-	-	-	-	58,752	452,000	1,120,000	1,630,752	-	1,549,214	1,549,214	-	892,000	2,441,214

Appendix H.4 - Salt Solution Processing (Requirement Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY10	10/1/09	14	153	ds	413	160	261	73.3	4,046	90	7,321	7.54	4
		30	280	cs	280								
		32	320	cs	320								
		33	190	cs	190								
		34	300	cs	300								
		38	100	cs	100								
		47	129	cs	129								
		47	93	ds	250								
				dw	1,040								
	Type III Tank space gain		1,412	total	3,022								
FY11	10/1/10	27	115	cs	115	313	512	49.8	8,141	180	14,728	15.65	4, 1 and 2
		32	497	cs	497								
		33	222	ds	600								
		34	619	cs	619								
		34	208	ds	561								
		39	477	cs	477								
		43	745	cs	745								
		47	343	ds	925								
				dw	1,537								
	Type III Tank space gain		3,226	total	6,076								
FY12	10/1/11	2	148	ds	400	341	556	45.4	8,060	180	14,585	23.69	2 and 3
		32	70	cs	70								
		35	1,127	cs	1,127								
		38	50	cs	50								
		47	416	ds	1,122								
		49	1,028	cs	1,028								
				dw	2,232								
	Type III Tank space gain		2,691	total	6,029								

Appendix H.4 - Salt Solution Processing (Requirement Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY13	10/1/12	2	377	ds	1,018	280	459	71.2	8,031	180	14,533	31.71	3 and 5
		27	75	cs	75								
		29	221	cs	221								
		30	250	cs	250								
		38	50	cs	50								
		41	15	cs	15								
		41	537	ds	1,450								
		50	1,271	cs	1,271								
				dw	1,631								
	Type III Tank space gain		2,419	total	5,981								
FY14	10/1/13	1	19	cs	19	316	517	35.2	8,036	180	14,542	39.72	5, 6 and 7
		1	470	ds	1,270								
		10	209	ds	563								
		27	485	cs	485								
		30	500	cs	500								
		38	150	cs	150								
		41	500	ds	1,350								
				dw	1,664								
	Type III Tank space gain		1,635	total	6,001								
FY15	10/1/14	9	527	ds	1,423	234	385	61.5	8,148	180	14,741	47.85	7and 8
		26	200	cs	200								
		27	133	cs	133								
		29	630	ds	1,700								
		30	300	cs	300								
		38	100	cs	100								
		39	300	cs	300								
		41	169	ds	457								
				dw	1,434								
	Type III Tank space gain		1,832	total	6,047								
FY16	10/1/15	3	525	ds	1,418	235	387	54.9	8,017	180	14,509	55.85	8 and 9
		25	165	cs	165								
		25	716	ds	1,932								
		26	400	cs	400								
		29	350	ds	946								
		30	300	cs	300								
				dw	790								
	Type III Tank space gain		1,931	total	5,951								

Appendix H.4 - Salt Solution Processing (Requirement Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY17	10/1/16	25	370	ds	1,000	230	379	70.1	8,119	180	14,689	63.95	9, 10 and 11
		26	200	cs	200								
		27	454	ds	1,225								
		28	186	cs	186								
		31	254	cs	254								
		31	630	ds	1,700								
		46	450	cs	450								
				dw	1,009								
	Type III Tank space gain		2,544	total	6,024								
FY18	10/1/17	28	1,011	ds	2,730	236	387	18.7	8,022	180	14,518	71.95	11 and 12
		30	250	cs	250								
		31	364	ds	983								
		44	281	cs	281								
		44	426	ds	1,150								
				dw	561								
	Type III Tank space gain		2,332	total	5,955								
FY19	10/1/18	36	80	cs	80	233	382	37.9	8,141	180	14,728	80.07	12, 13 and 14
		44	543	ds	1,467								
		45	128	cs	128								
		45	1,107	ds	2,990								
		46	362	cs	362								
		46	185	ds	500								
				dw	514								
	Type III Tank space gain		2,406	total	6,041								
FY20	10/1/19	36	74	cs	74	233	383	64.8	8,076	180	14,613	88.12	14 and 15
		36	1,072	ds	2,895								
		37	259	cs	259								
		37	222	ds	600								
		42	600	cs	600								
		46	127	ds	344								
				dw	1,222								
	Type III Tank space gain		2,355	total	5,994								

Appendix H.4 - Salt Solution Processing (Requirement Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY21	10/1/20	37	731	ds	1,974	144	241	59.9	8,180	180	14,797	96.28	15 and 16
		38	149	cs	149								
		38	704	ds	1,900								
		42	657	cs	657								
				dw	1,350								
	Type III Tank space gain		2,241	total	6,030								
FY22	10/1/21	30	491	cs	491	91	149	32.3	3,107	180	5,818	99.49	16 and 17
		30	65	ds	175								
		38	164	ds	444								
		41	172	cs	172								
				dw	1,024								
	Type III Tank space gain		892	total	2,306								

Notes:
* Space gain refers to Type III tanks only and is equal to cs + ds (prior to dissolution)
* Assume 2.7 gallons of Inhibited Water is required to dissolve 1 gallon of saltcake.
* cs = concentrated supernate
* ds = dissolved salt cake
* dw = dilution water to bring salt feed to 6.44 [Na+] for feed to Salt Processing, additional dilution to 4.7 [Na+] is performed at the Salt Processing Facility.
* NaTPB = sodium tetraphenylborate
* ppt = precipitate feed stream produced at Salt Processing Facility for feed to DWPF
* Precipitate Cesium Ci/gal has not been adjusted for decay
* With a permanent roof, each cell measures 98.5 x 98.5 x 25 feet = 242,500 cu ft, and holds 1,814 kgal grout, or 1,025 kgal feed.
* Existing Vault #1 has 6 cells, of which 3.5 are already filled. Vault #4 has 12 cells, of which 1 is already filled. All new vaults will have six cells each.
* Vault # fill sequence is assumed to be 4, 1, 2, 3, 5, 6, 7, … etc.

Appendix H.5 – Sludge Processing (Requirements Case)

	Waste Removal		ESP Pretreatment									DWPF Vitrification						
A Sludge Batch	B Source Tanks	C Sludge Content (kg)	D Alum. Rem'd (wt %)	E Alum. Dis. Start Date	F Wash Start Date	G Feed Prep Total Dur. (months)	H Total ESP Water Vol. (kgal)	I Na (wt% dry)	J Hg (wt% dry)	K Total Solids (wt%)	L Pretreated Volume (kgal)	M Feed Volume (kgal)	N Start Feed	O Canister Yield	P Feed Duration (years)	Q Finish Feed	R Feed Tank	S Waste Loading (wt %)
1A	51	na	na	na	na	na	na	8.80		16.4	491	491	3/1/96	492	2.75	8/30/98	51	25.0
												-140	(Tk 51 heel @ 40 ")					
												351						
1B	42	420,861	na	na	na	na	na	7.77	0.30	16.5	460	460	10/1/98	625	2.56	4/20/01	51	25.0
	total	420,861											(Tk 51 heel @ 40 ")					
2	8	182,451	na	na	8/20/00	9	1,848	9.81	0.30	16.0	639	639	4/20/01	552	2.21	7/5/03	40	28.0
	40	179,098										-140	(Includes 1/2 of Tk 51 heel w/ Tk 40 heel @ 40 ")					
	total	361,549										499						
3	7 (70%)	288,957			11/4/02	18	3,011	10.30	1.30	16.0	731	731	7/5/03	570	2.28	10/15/05	51	29.0
	11	124,380	75	2/3/02														
	total	413,337																
4	26	154,896			11/14/04	22	3,177	11.61	1.30	16.0	828	828	10/15/05	624	2.50	4/13/08	40	30.0
	7 (30%)	123,839																
	15	165,818	75	1/14/04														
	18	21,110																
	19	2,794																
	total	468,457																
5	5	57,630			5/14/07	22	2,921	10.67	2.60	16.0	732	732	4/13/08	551	2.20	6/26/10	51	32.5
	12	189,715																
	13 (40%)	167,025	75	7/13/06														
	total	414,370																
6	13 (60%)	250,537		na	2/24/09	16	2,344	10.79	1.90	16.0	627	627	6/26/10	599	2.40	11/17/12	40	29.0
	4	65,477																
	6	38,708																
	total	354,722																
7	21	6,393			10/18/11	13	2,000	9.60	1.90	16.0	636	636	11/17/12	546	2.18	1/23/15	51	32.0
	22	13,265		na														
	23	59,110																
	33	62,401																
	34	77,119																
	39	89,474																
	43	51,940																
	total	359,702																
8	32	195,586	75	4/24/13	2/22/14	22	3,327	10.89	5.00	16.0	835	835	1/23/15	606	2.42	6/26/17	40	31.5
	35	138,956																
	47	137,763																
	total	472,305																

Appendix H.5 – Sludge Processing (Requirements Case)

Waste Removal			ESP Pretreatment									DWPF Vitrification						
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Sludge Batch	Source Tanks	Sludge Content (kg)	Alum. Rem'd (wt %)	Alum. Dis. Start Date	Wash Start Date	Feed Prep Total Dur. (months)	Total ESP Water Vol. (kgal)	Na (wt% dry)	Hg (wt% dry)	Total Solids (wt%)	Pretreated Volume (kgal)	Feed Volume (kgal)	Start Feed	Canister Yield	Feed Duration (years)	Finish Feed	Feed Tank	Waste Loading (wt %)
9	ESP Heels (Tks 40,42,51)	158,377			8/25/16	10	1,464	9.98	3.10	16.0	667	667	6/26/17	470	1.88	5/13/19	51	30.0
	Other Insoluble Solids	219,000																
	total	377,377																
Totals		3,265,303					20,092					5,531		5,635	23			

Notes:

General: Above sludge processing table based on the following yearly canister production values: FY00-End of Program 250 cans/yr.

A) Each Sludge Batch must be individually tested and confirmed to meet waste qualification specifications

B) Sludge in these tanks will comprise the batch. Note: The sludge from Tanks 18&19 is now shown in Batch 4, however these tanks will be cleaned out earlier, with the sludge planned to be moved to Tk 26, to support FFA dates for Tanks 18 & 19.

C) Amount of sludge from each source tank in the batch obtained from WCS data base

D) Amount of aluminum removed from HM sludge (typically H-Area HHW sludge). To make qualified glass, aluminum dissolution is only performed on the tanks indicated (i.e. the tank that the Al dissolution start date is shown next to)

E) Aluminum dissolution start date for H-Area sludge in batch. Note: Tank requiring Al dissolution must be in ESP tank 1 mo. prior to this date to allow for settling and decant of transfer water.

F) Start date of when ESP decants begin. After all sludge is received, water washing will begin of combined H- & F-Area sludge to obtain proper alkali composition of the sludge slurry.

G) Total planned duration of aluminum dissolution, washing, sampling, test glass production, and associated decants

H) Total volume of sludge transfer water, aluminum dissolution and wash water decants

I) Amount of total Na in washed sludge (dry basis)

J) Amount of total Hg in washed sludge (dry basis)

K) Total solids (soluble and insoluble) in washed sludge

L) Volume of sludge at given wt% total solids before heel effects (Batch 1B is actual. Batch 2 and beyond are based on ratio of batch sludge kg values converted to gallons and adjusted from an estimated 25 wt% solids to 16 wt% solids)

M) Volume of sludge available for feed after adding or subtracting pump heel

N) Start feed date based on depletion of previous batch down to pump heel

O) Estimated number of canisters produced given the pretreatment as shown. Numbers are actual for Batch 1A and estimated for remaining batches. Coupled Salt and Sludge Feed assumed to start with Batch 6. Total shown at the bottom does not include Salt Only cans made in the last years of the program.

P) Column O divided by the planned canister production during the period in which the batch is vitrified

Q) Column N plus column P. Finish Feed means when the last transfer of feed is sent from the Feed Tank. The last canister for the batch will be poured later. The DWPF has approximately 25 canisters of feed in process. Therefore 25 more canisters will be produced from the batch after the last feed is sent to DWPF.

R) Batch feed tank

S) Weight % of glass comprised of sludge oxides.

Appendix H.6 - Canister Storage (Requirements Case)

End of Year	SRS Cans Produced		SRS Cans In GWSB #1 (2,159 max)			SRS Cans In GWSB #2 (2286)			SRS Cans Shipped to Repository		Net Cans Stored
	Yearly	Cum.	Added	Shipped	Cum.	Added	Shipped	Cum.	Each Year	Cumulative	At SRS
1996	64	64	64		64						64
1997	169	233	169		233						233
1998	250	483	250		483						483
1999	236	719	236		719						719
2000	250	969	250		969						969
2001	250	1,219	250		1,219						1,219
2002	250	1,469	250		1,469						1,469
2003	250	1,719	250		1,719						1,719
2004	250	1,969	250		1,969						1,969
2005	250	2,219	190		2,159	60		60			2,219
2006	250	2,469	0		2,159	250		310			2,469
2007	250	2,719			2,159	250		560			2,719
2008	250	2,969			2,159	250		810			2,969
2009	250	3,219			2,159	250		1,060			3,219
2010	250	3,469		(105)	2,054	250		1,310	105	105	3,364
2011	250	3,719		(205)	1,849	250		1,560	205	310	3,409
2012	250	3,969		(205)	1,644	250		1,810	205	515	3,454
2013	250	4,219		(205)	1,439	250		2,060	205	720	3,499
2014	250	4,469	24	(205)	1,258	226	0	2,286	205	925	3,544
2015	250	4,719	250	0	1,508	0	(205)	2,081	205	1,130	3,589
2016	250	4,969	250	0	1,758	0	(205)	1,876	205	1,335	3,634
2017	250	5,219	250	0	2,008	0	(205)	1,671	205	1,540	3,679
2018	250	5,469	151	0	2,159	99	(205)	1,565	205	1,745	3,724
2019	217	5,686	0	(205)	1,954	217	0	1,782	205	1,950	3,736
2020	150	5,836	150	0	2,104	0	(205)	1,577	205	2,155	3,681
2021	150	5,986	0	0	2,104	150	(205)	1,522	205	2,360	3,626
2022	58	6,044	0	0	2,104	58	(205)	1,375	205	2,565	3,479
2023	0	6,044	0	0	2,104		(205)	1,170	205	2,770	3,274
2024	0	6,044	0	0	2,104	0	(205)	965	205	2,975	3,069
2025	0	6,044		0	2,104	0	(205)	760	205	3,180	2,864
2026	0	6,044		0	2,104	0	(205)	555	205	3,385	2,659
2027	0	6,044		0	2,104	0	(205)	350	205	3,590	2,454
2028	0	6,044		0	2,104	0	(205)	145	205	3,795	2,249
2029	0	6,044		(60)	2,044	0	(145)	0	205	4,000	2,044
2030	0	6,044		(205)	1,839	0	0	0	205	4,205	1,839

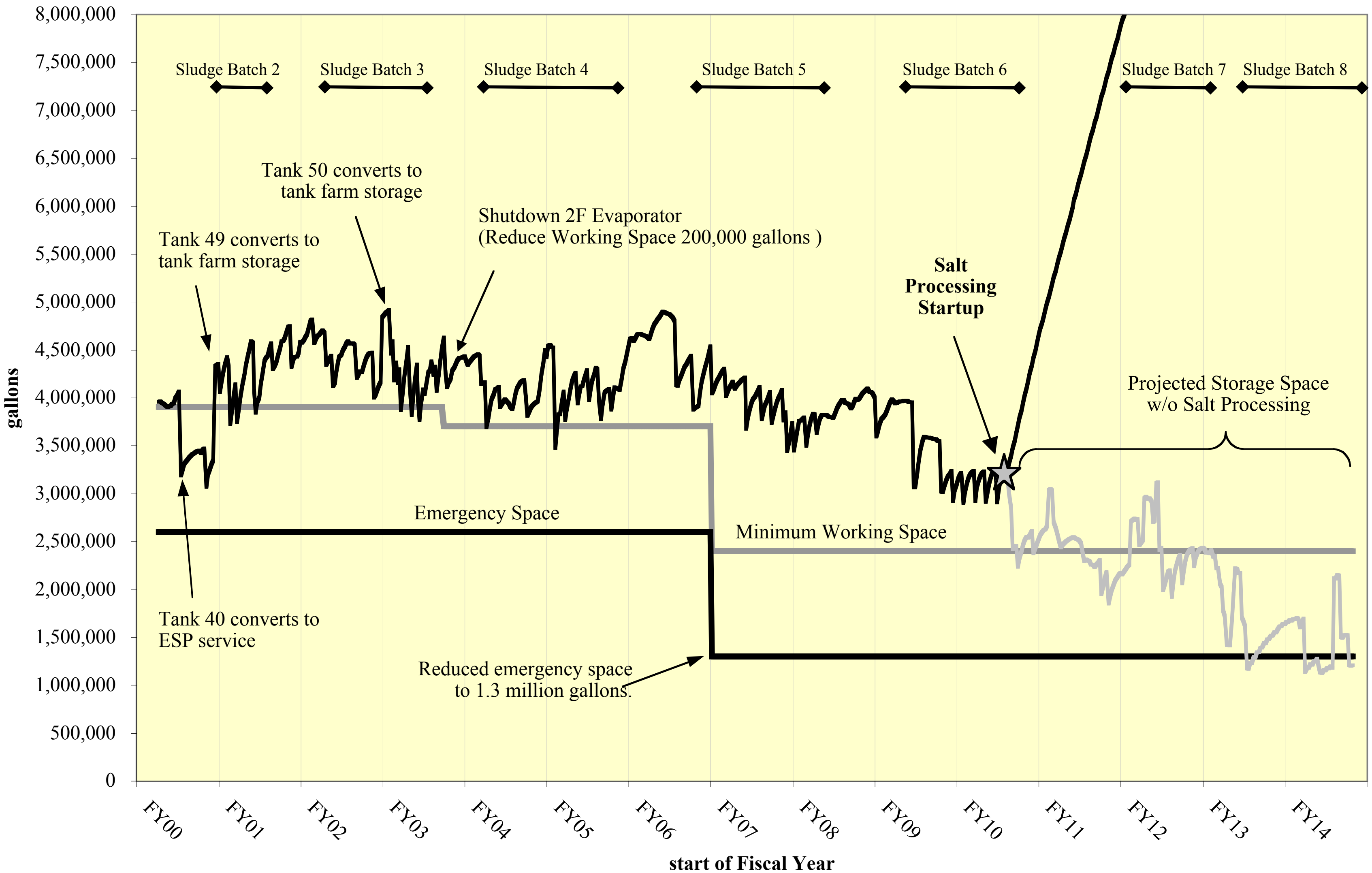
Appendix H.6 - Canister Storage (Requirements Case)

End of Year	SRS Cans Produced		SRS Cans In GWSB #1 (2,159 max)			SRS Cans In GWSB #2 (2286)			SRS Cans Shipped to Repository		Net Cans Stored
Year	Yearly	Cum.	Added	Shipped	Cum.	Added	Shipped	Cum.	Each Year	Cumulative	At SRS
2031	0	6,044		(205)	1,634	0	0	0	205	4,410	1,634
2032	0	6,044		(205)	1,429	0	0	0	205	4,615	1,429
2033	0	6,044		(205)	1,224	0	0	0	205	4,820	1,224
2034	0	6,044		(205)	1,019	0	0	0	205	5,025	1,019
2035	0	6,044		(205)	814	0	0	0	205	5,230	814
2036	0	6,044		(205)	609	0	0	0	205	5,435	609
2037	0	6,044		(205)	404	0	0	0	205	5,640	404
2038	0	6,044		(205)	199	0	0	0	205	5,845	199
2039	0	6,044		(199)	0	0	0	0	199	6,044	(0)

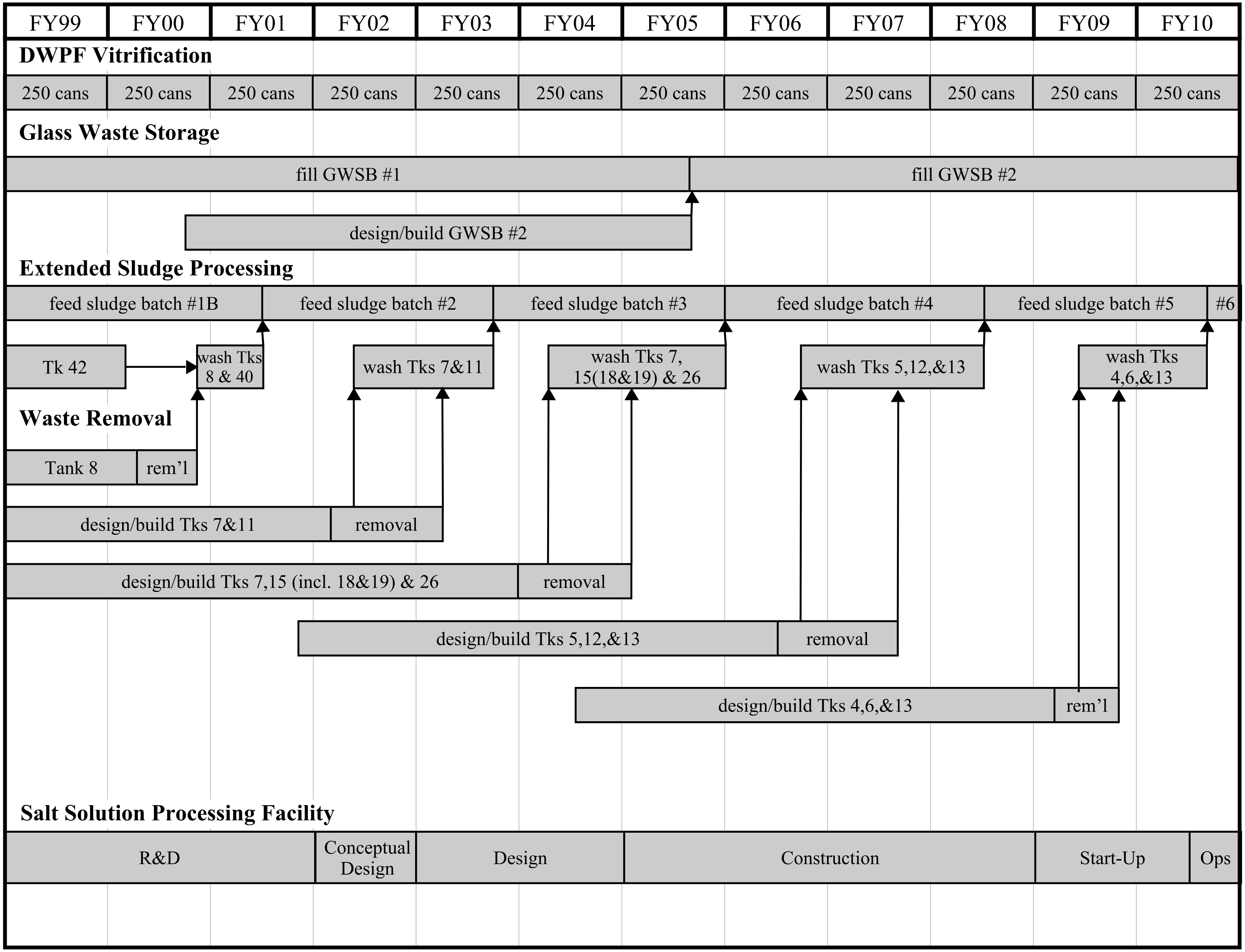
Notes:

1) GWSB #1 filling began in May 1996. It has 2,286 canister storage locations, less 122 unuseable locations for which a repair technique has not been identified, less 5 positions being used for storage of non-radioactive test canisters = 2,159 usable storage locations. However, of the 2,159 usable positions, 450 locations are unuseable and will need repair/replacement plugs per an existing plan before they will be available for use.
2) GWSB#1 is expected to reach maximum capacity in FY05. Therefore, GWSB#2 must be ready to start operations in FY05.
3) This System Plan assumes that canisters can be transported to the Federal Repository starting in FY10 at a rate of 105 canisters in FY10 and 205 canisters/yr, thereafter, until the end of the program.
4) A canister load-out facility will be required to move the canisters from the GWSB's to a railcar. Assume one year for design (FY07) and three years for construction (FY08-10).
5) GWSB#1 will be emptied and available for D&D in FY39.
6) GWSB#2 will be emptied and available for D&D in FY29.
7) This System Plan does not include possible can-in-canister disposition of excess plutonium.

Appendix H.7 Useable Tank Space (Requirements Case)



Appendix H.8 - Level 1 Schedule (Requirements Case)

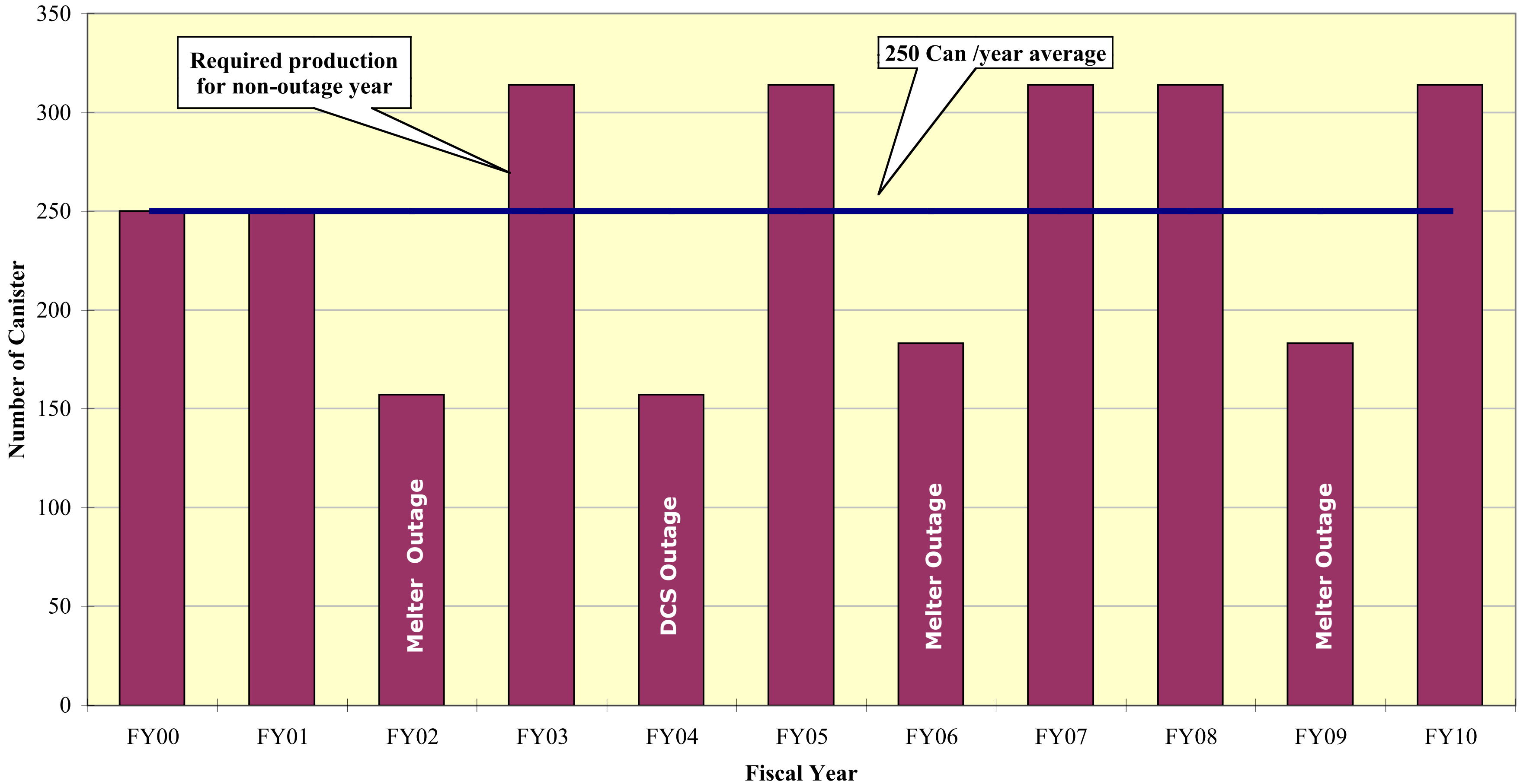


Appendix H.9 Canister Production Rate (Requirements Case)

Annual Production Rate

required to meet 250 canister per year average over time

(Outages shown are used for planning purposes.
Actual outage timing will vary dependent on facility conditions.)



Appendix I.1 - Funding (Target Case)

Budget Authority in Escalated Dollars

Project Title	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14
HL-01 H Tank Farm																
H Tank Farm Operations	85,371	88,247	87,687	91,249	98,014	102,320	103,285	104,321	107,138	110,030	113,001	115,291	117,622	119,995	121,587	120,331
LI: Replacement Evaporator	12,835	3,414	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-01 Total	98,205	91,661	87,687	91,249	98,014	102,320	103,285	104,321	107,138	110,030	113,001	115,291	117,622	119,995	121,587	120,331
HL-02 F Tank Farm	58,928	59,315	58,798	60,523	65,054	62,158	63,835	65,558	67,328	69,145	71,011	72,167	74,115	75,313	77,346	79,433
HL-03 Waste Removal & Tank Closures																
WR Ops w/ Demo Projects	1,108	5,838	3,064	5,743	6,083	9,496	9,752	10,015	10,286	10,563	10,849	16,218	29,211	27,250	18,103	18,592
WR: Tank Closure	124	39	1,416	3,159	12,161	8,320	-	-	-	15,530	463	4,544	20,100	11,574	29,959	21,285
HL-03 Total	1,232	5,877	4,479	8,902	18,244	17,816	9,752	10,015	10,286	26,094	11,312	20,762	49,311	38,824	48,062	39,877
HL-04 Feed Preparations & Sludge Operations	53,328	54,155	53,036	55,110	65,578	70,760	70,965	71,175	73,097	75,070	77,097	79,179	72,086	74,033	76,032	78,085
HL-05 Vitrification																
Vitrification Ops	127,626	122,346	117,757	128,675	136,773	133,503	140,816	146,163	144,908	152,067	157,168	162,490	162,346	170,086	178,002	175,217
Failed Equip. Storage Vaults	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-05 Total	127,626	122,346	117,757	128,675	136,773	133,503	140,816	146,163	144,908	152,067	157,168	162,490	162,346	170,086	178,002	175,217
HL-06 Glass Waste Storage	436	626	427	1,572	14,353	23,399	27,269	23,365	4,644	12,217	18,284	8,097	2,265	2,326	2,389	2,453
HL-13 Salt Disposition																
Salt Disposition Ops	15,620	14,066	16,000	5,000	-	-	-	-	-	-	-	47,602	84,425	89,508	85,868	91,960
LI: Salt Alternative	-	-	-	29,539	84,461	135,000	150,000	150,000	150,000	144,000	99,000	58,000	-	-	-	-
HL-13 Total	15,620	14,066	16,000	34,539	84,461	135,000	150,000	150,000	150,000	144,000	99,000	105,602	84,425	89,508	85,868	91,960
HL-09 LI: Tk Fm Services Upgrade I	1,632	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-10 LI: Storm Water Upgrades	2,508	3,433	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-11 LI: Tk Fm Services Upgrade II	838	3,339	8,900	6,304	-	-	-	-	-	-	-	-	-	-	-	-
HL-12 LI: Waste Removal																
LI: WR from Tanks	24,739	22,009	23,467	26,179	17,465	20,407	21,008	29,911	46,245	43,307	68,395	48,492	58,487	72,661	61,266	69,321
LI: Vit Upgrades	12	928	-	-	-	-	13,910	14,285	14,671	15,067	15,474	11,919	18,361	12,571	19,366	19,889
LI: Pipe, Evaps & Infrastructure	-	-	-	992	5,999	11,145	11,471	4,719	-	-	-	-	-	-	-	-
HL-12 Total	24,751	22,937	23,467	27,171	23,464	31,552	46,389	48,916	60,916	58,374	83,870	60,411	76,848	85,232	80,632	89,210
FA-24 Facility Decontamination and Decommissioning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HLW TOTAL	**385,103**	**377,756**	**370,551**	**414,045**	**505,941**	**576,508**	**612,311**	**619,514**	**618,316**	**646,997**	**630,742**	**623,999**	**639,018**	**655,317**	**669,916**	**676,566**
Solid Waste Facilities																
CIF	23,745	22,990	2,000	2,000	2,000	34,745	35,485	28,523	26,356	34,703	30,380	32,322	29,858	31,045	37,375	32,165
ETF	16,510	15,993	16,304	18,815	18,214	22,001	22,095	22,883	18,234	22,219	18,346	19,509	19,350	22,140	30,776	22,404
SS	1,594	999	1,099	1,444	1,483	1,523	1,564	1,606	1,650	1,694	28,812	39,382	46,152	47,153	68,862	49,655
SW TOTAL	**41,850**	**39,982**	**19,402**	**22,259**	**21,697**	**58,270**	**59,144**	**53,012**	**46,239**	**58,616**	**77,538**	**91,213**	**95,360**	**100,338**	**137,013**	**104,224**
Life Cycle Cost	**426,952**	**417,738**	**389,953**	**436,304**	**527,638**	**634,778**	**671,454**	**672,526**	**664,555**	**705,614**	**708,280**	**715,212**	**734,378**	**755,655**	**806,929**	**780,789**

Appendix I.1 - Funding (Target Case)

Budget Authority in Escalated Dollars

Project Title	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
HL-01 H Tank Farm																
H Tank Farm Operations	123,580	126,023	123,010	118,458	121,656	123,316	124,977	126,637	110,405	54,648	-	-	-	-	-	-
LI: Replacement Evaporator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-01 Total	123,580	126,023	123,010	118,458	121,656	123,316	124,977	126,637	110,405	54,648	-	-	-	-	-	-
HL-02 F Tank Farm	79,839	78,749	80,874	72,189	59,988	55,651	53,816	38,323	0	0	-	-	-	-	-	-
HL-03 Waste Removal & Tank Closures																
WR Ops w/ Demo Projects	19,093	19,609	20,138	20,682	21,241	21,814	7,807	4,009	-	-	-	-	-	-	-	-
WR: Tank Closure	29,573	48,714	76,973	69,614	56,034	35,160	37,921	71,887	80,072	132,771	19,638	-	-	-	-	-
HL-03 Total	48,666	68,323	97,112	90,296	77,275	56,974	45,728	75,895	80,072	132,771	19,638	-	-	-	-	-
HL-04 Feed Preparations & Sludge Operations	80,193	82,358	84,582	86,865	89,211	91,619	94,093	96,634	16,540	-	-	-	-	-	-	-
HL-05 Vitrification																
Vitrification Ops	184,296	191,706	195,348	196,349	205,008	215,629	206,452	206,006	34,703	0	0	0	-	-	-	-
Failed Equip. Storage Vaults	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-05 Total	184,296	191,706	195,348	196,349	205,008	215,629	206,452	206,006	34,703	0	0	0	-	-	-	-
HL-06 Glass Waste Storage	2,520	2,588	2,658	2,729	2,803	2,879	2,956	3,036	3,118	3,202	3,289	3,378	3,469	3,563	2,744	2,818
HL-13 Salt Disposition																
Salt Disposition Ops	85,645	87,419	89,780	92,771	94,460	97,609	87,587	50,280	-	-	-	-	-	-	-	-
LI: Salt Alternative	-	-	47,263	64,719	49,850	-	-	-	-	-	-	-	-	-	-	-
HL-13 Total	85,645	87,419	137,043	157,490	144,310	97,609	87,587	50,280	-	-	-	-	-	-	-	-
HL-09 LI: Tk Fm Services Upgrade I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-10 LI: Storm Water Upgrades	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-11 LI: Tk Fm Services Upgrade II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-12 LI: Waste Removal																
LI: WR from Tanks	82,292	80,888	82,647	62,676	58,226	43,213	35,049	18,082	28,254	27,521	-	-	-	-	-	-
LI: Vit Upgrades	20,426	13,985	14,363	-	-	-	-	-	-	-	-	-	-	-	-	-
LI: Pipe, Evaps & Infrastructure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HL-12 Total	102,718	94,873	97,010	62,676	58,226	43,213	35,049	18,082	28,254	27,521	-	-	-	-	-	-
FA-24 Facility Decontamination and Decommissioning	42,757	35,927	-	-	-	-	-	53,077	242,508	209,129	-	-	-	-	-	-
HLW TOTAL	**750,213**	**767,967**	**817,636**	**787,053**	**758,477**	**686,890**	**650,658**	**667,972**	**515,600**	**427,273**	**22,928**	**3,378**	**3,469**	**3,563**	**2,744**	**2,818**
Solid Waste Facilities																
CIF	33,811	38,031	34,311	42,203	39,781	37,088	38,880	41,390	46,001	41,125	48,676	42,832	46,773	55,737	47,527	48,253
ETF	22,490	27,618	22,705	29,828	23,947	25,637	38,087	27,799	26,640	-	-	-	-	-	-	-
SS	50,995	52,372	53,786	57,874	56,730	58,262	59,835	61,597	65,870	-	-	-	-	-	-	-
SW TOTAL	**107,296**	**118,022**	**110,802**	**129,904**	**120,458**	**120,986**	**136,802**	**130,786**	**138,510**	**41,125**	**48,676**	**42,832**	**46,773**	**55,737**	**47,527**	**48,253**
Life Cycle Cost	**857,509**	**885,988**	**928,438**	**916,958**	**878,935**	**807,876**	**787,460**	**798,757**	**654,111**	**468,398**	**71,603**	**46,210**	**50,242**	**59,299**	**50,271**	**51,072**

Appendix I.1 - Funding (Target Case)

Budget Authority in Escalated Dollars

Project Title	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	Cumulative FY99-End
HL-01 H Tank Farm											
H Tank Farm Operations	-	-	-	-	-	-	-	-	-	-	2,838,199
LI: Replacement Evaporator	-	-	-	-	-	-	-	-	-	-	16,249
HL-01 Total	-	-	-	-	-	-	-	-	-	-	2,854,447
HL-02 F Tank Farm	-	-	-	-	-	-	-	-	-	-	1,599,455
HL-03 Waste Removal & Tank Closures											
WR Ops w/ Demo Projects	-	-	-	-	-	-	-	-	-	-	326,563
WR: Tank Closure	-	-	-	-	-	-	-	-	-	-	787,032
HL-03 Total	-	-	-	-	-	-	-	-	-	-	1,113,594
HL-04 Feed Preparations & Sludge Operations	-	-	-	-	-	-	-	-	-	-	1,820,881
HL-05 Vitrification											
Vitrification Ops	-	-	-	-	-	-	-	-	-	-	3,991,440
Failed Equip. Storage Vaults	-	-	-	-	-	-	-	-	-	-	-
HL-05 Total	-	-	-	-	-	-	-	-	-	-	3,991,440
HL-06 Glass Waste Storage	2,894	2,972	3,053	3,135	3,220	3,307	3,396	3,488	3,582		220,921
HL-13 Salt Disposition											
Salt Disposition Ops	-	-	-	-	-	-	-	-	-	-	1,135,600
LI: Salt Alternative	-	-	-	-	-	-	-	-	-	-	1,161,833
HL-13 Total	-	-	-	-	-	-	-	-	-	-	2,297,433
HL-09 LI: Tk Fm Services Upgrade I	-	-	-	-	-	-	-	-	-	-	1,632
HL-10 LI: Storm Water Upgrades	-	-	-	-	-	-	-	-	-	-	5,941
HL-11 LI: Tk Fm Services Upgrade II	-	-	-	-	-	-	-	-	-	-	19,381
HL-12 LI: Waste Removal											
LI: WR from Tanks	-	-	-	-	-	-	-	-	-	-	1,172,208
LI: Vit Upgrades	-	-	-	-	-	-	-	-	-	-	205,227
LI: Pipe, Evaps & Infrastructure	-	-	-	-	-	-	-	-	-	-	34,326
HL-12 Total	-	-	-	-	-	-	-	-	-	-	1,411,761
FA-24 Facility Decontamination and Decommissioning	-	-	-	-	-	-	-	-	17,934	-	601,333
HLW TOTAL	**2,894**	**2,972**	**3,053**	**3,135**	**3,220**	**3,307**	**3,396**	**3,488**	**21,516**	**- -**	**15,938,219**
Solid Waste Facilities											
CIF	-	-	-	-	-	-	-	-	-	-	1,088,109
ETF	-	-	-	-	-	-	-	-	-	-	570,544
SS	-	-	-	-	-	-	-	-	-	-	811,992
SW TOTAL	-	-	-	-	-	-	-	-	-	-	**2,470,645**
Life Cycle Cost	**2,894**	**2,972**	**3,053**	**3,135**	**3,220**	**3,307**	**3,396**	**3,488**	**21,516**	**- -**	**18,408,864**

Appendix I.1 - Funding (Target Case)

Budget Authority in Constant FY99 Year Dollars

Project Title	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14
HL-01 H Tank Farm																
H Tank Farm Operations	85,371	85,181	81,699	82,783	86,582	88,010	86,504	85,075	85,075	85,074	85,074	84,516	83,959	83,401	82,285	79,294
LI: Replacement Evaporator	12,835	3,295	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-01 Total	98,205	88,476	81,699	82,783	86,582	88,010	86,504	85,075	85,075	85,074	85,074	84,516	83,959	83,401	82,285	79,294
HL-02 F Tank Farm	58,928	57,254	54,783	54,907	57,467	53,464	53,464	53,463	53,463	53,462	53,462	52,903	52,903	52,345	52,344	52,344
HL-03 Waste Removal & Tank Closures																
WR Ops w/ Demo Projects	1,108	5,635	2,855	5,210	5,373	8,167	8,167	8,167	8,167	8,167	8,167	11,889	20,851	18,940	12,251	12,251
WR: Tank Closure	124	37	1,319	2,866	10,743	7,157	0	0	0	12,008	349	3,331	14,347	8,044	20,275	14,026
HL-03 Total	1,232	5,673	4,174	8,076	16,116	15,324	8,167	8,167	8,167	20,175	8,516	15,220	35,198	26,984	32,526	26,278
HL-04 Feed Preparations & Sludge Operations	53,328	52,273	49,414	49,997	57,929	60,864	59,435	58,044	58,044	58,044	58,044	58,044	51,455	51,455	51,455	51,455
HL-05 Vitrification																
Vitrification Ops	127,626	118,095	109,715	116,736	120,820	114,831	117,937	119,197	115,067	117,577	118,326	119,117	115,883	118,215	120,465	115,463
Failed Equip. Storage Vaults	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-05 Total	127,626	118,095	109,715	116,736	120,820	114,831	117,937	119,197	115,067	117,577	118,326	119,117	115,883	118,215	120,465	115,463
HL-06 Glass Waste Storage	436	605	398	1,426	12,679	20,127	22,839	19,054	3,688	9,446	13,765	5,936	1,617	1,617	1,617	1,617
HL-13 Salt Disposition																
Salt Disposition Ops	15,620	13,578	14,907	4,536	0	0	0	0	0	0	0	34,896	60,262	62,211	58,112	60,598
LI: Salt Alternative	0	0	0	26,798	74,610	116,119	125,629	122,326	119,110	111,340	74,534	42,518	0	0	0	0
HL-13 Total	15,620	13,578	14,907	31,335	74,610	116,119	125,629	122,326	119,110	111,340	74,534	77,414	60,262	62,211	58,112	60,598
HL-09 LI: Tk Fm Services Upgrade I	1,632	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-10 LI: Storm Water Upgrades	2,508	3,314	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-11 LI: Tk Fm Services Upgrade II	838	3,223	8,293	5,719	0	0	0	0	0	0	0	0	0	0	0	0
HL-12 LI: Waste Removal																
LI: WR from Tanks	24,739	21,244	21,864	23,750	15,428	17,553	17,595	24,393	36,722	33,485	51,493	35,548	41,748	50,502	41,462	45,680
LI: Vit Upgrades	12	896	0	0	0	0	11,650	11,650	11,650	11,650	11,650	8,737	13,106	8,737	13,106	13,106
LI: Pipe, Evaps & Infrastructure	0	0	0	900	5,299	9,586	9,607	3,849	0	0	0	0	0	0	0	0
HL-12 Total	24,751	22,140	21,864	24,650	20,727	27,139	38,852	39,891	48,372	45,135	63,142	44,286	54,854	59,239	54,568	58,787
FA-24 Facility Decontamination and Decommissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HLW TOTAL	**385,103**	**364,629**	**345,246**	**375,628**	**446,930**	**495,878**	**512,827**	**505,218**	**490,985**	**500,253**	**474,863**	**457,436**	**456,131**	**455,467**	**453,373**	**445,836**
Solid Waste Facilities																
CIF	23,745	22,191	1,863	1,814	1,767	29,886	29,719	23,261	20,928	26,832	22,872	23,694	21,312	21,577	25,294	21,196
ETF	16,510	15,437	15,190	17,069	16,090	18,924	18,505	18,661	14,479	17,179	13,812	14,301	13,812	15,388	20,828	14,763
SS	1,594	964	1,024	1,310	1,310	1,310	1,310	1,310	1,310	1,310	21,691	28,870	32,943	32,773	46,603	32,721
SW TOTAL	41,850	38,593	18,077	20,194	19,167	50,120	49,534	43,232	36,717	45,322	58,376	66,866	68,068	69,738	92,725	68,680
Life Cycle Cost	**426,952**	**403,222**	**363,323**	**395,821**	**466,097**	**545,998**	**562,361**	**548,450**	**527,702**	**545,575**	**533,239**	**524,302**	**524,198**	**525,206**	**546,098**	**514,516**

Appendix I.1 - Funding (Target Case)

Budget Authority in Constant FY99 Year Dollars

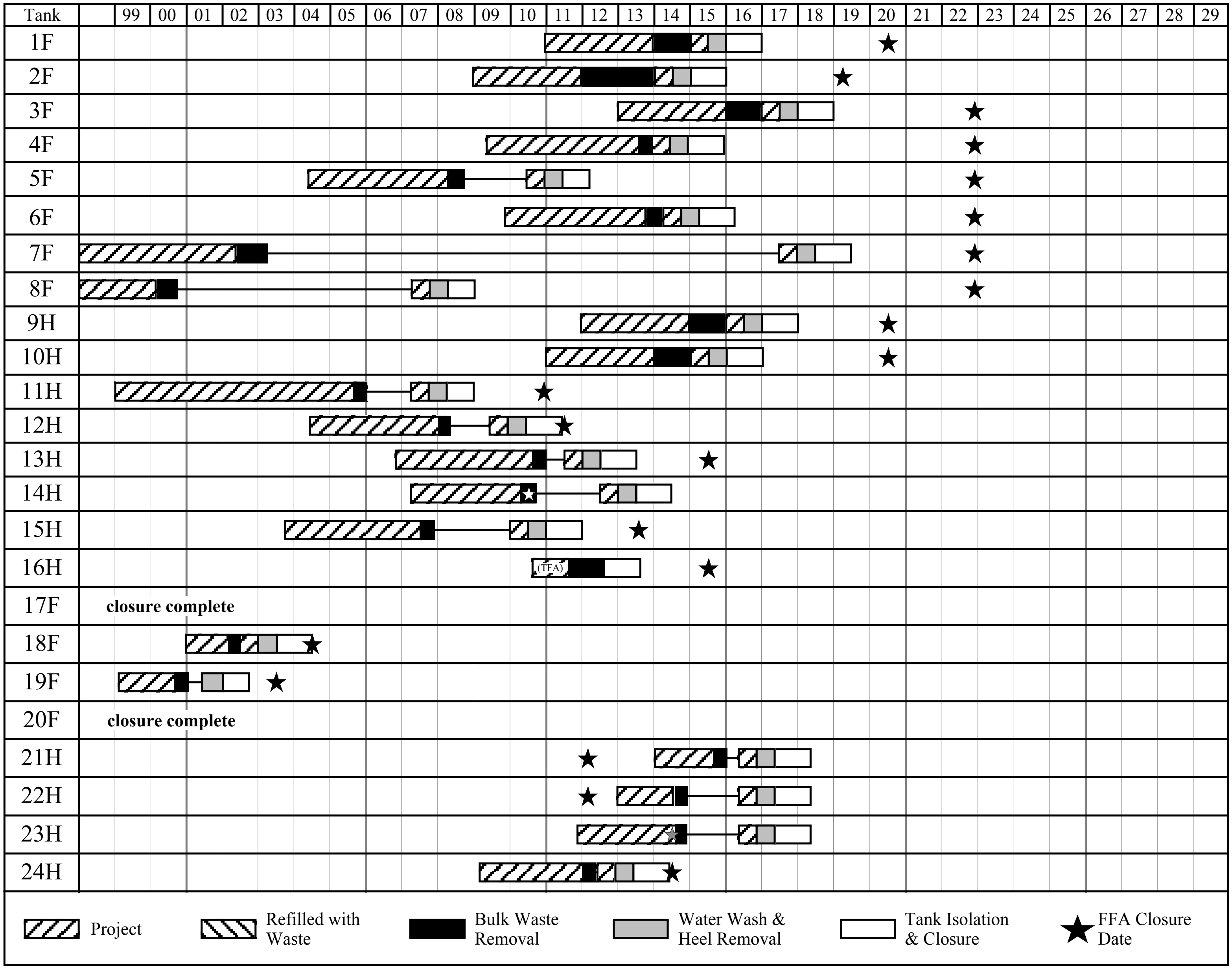
Project Title	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
HL-01 H Tank Farm																
H Tank Farm Operations	79,294	78,736	74,833	70,169	70,169	69,257	68,344	67,431	57,243	27,589	0	0	0	0	0	0
LI: Replacement Evaporator	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-01 Total	79,294	78,736	74,833	70,169	70,169	69,257	68,344	67,431	57,243	27,589	0	0	0	0	0	0
HL-02 F Tank Farm	51,228	49,200	49,200	42,762	34,600	31,254	29,429	20,406	0	0	0	0	0	0	0	0
HL-03 Waste Removal & Tank Closures																
WR Ops w/ Demo Projects	12,251	12,251	12,251	12,251	12,251	12,251	4,269	2,135	0	0	0	0	0	0	0	0
WR: Tank Closure	18,975	30,435	46,827	41,236	32,320	19,747	20,737	38,278	41,516	67,029	9,654	0	0	0	0	0
HL-03 Total	31,226	42,686	59,078	53,487	44,571	31,998	25,006	40,412	41,516	67,029	9,654	0	0	0	0	0
HL-04 Feed Preparations & Sludge Operations	51,455	51,455	51,455	51,455	51,455	51,455	51,455	51,455	8,576	0	0	0	0	0	0	0
HL-05 Vitrification																
Vitrification Ops	118,252	119,773	118,840	116,309	118,245	121,102	112,899	109,693	17,993	0	0	0	0	0	0	0
Failed Equip. Storage Vaults	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-05 Total	118,252	119,773	118,840	116,309	118,245	121,102	112,899	109,693	17,993	0	0	0	0	0	0	0
HL-06 Glass Waste Storage	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,617	1,213	1,213
HL-13 Salt Disposition																
Salt Disposition Ops	54,953	54,617	54,617	54,953	54,483	54,819	47,897	26,773	0	0	0	0	0	0	0	0
LI: Salt Alternative	0	0	28,753	38,337	28,753	0	0	0	0	0	0	0	0	0	0	0
HL-13 Total	54,953	54,617	83,370	93,290	83,236	54,819	47,897	26,773	0	0	0	0	0	0	0	0
HL-09 LI: Tk Fm Services Upgrade I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-10 LI: Storm Water Upgrades	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-11 LI: Tk Fm Services Upgrade II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-12 LI: Waste Removal																
LI: WR from Tanks	52,802	50,537	50,278	37,127	33,584	24,269	19,167	9,629	14,649	13,894	0	0	0	0	0	0
LI: Vit Upgrades	13,106	8,737	8,737	0	0	0	0	0	0	0	0	0	0	0	0	0
LI: Pipe, Evaps & Infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HL-12 Total	65,909	59,274	59,016	37,127	33,584	24,269	19,167	9,629	14,649	13,894	0	0	0	0	0	0
FA-24 Facility Decontamination and Decommissioning	27,435	22,447	0	0	0	0	0	28,262	125,735	105,578	0	0	0	0	0	0
HLW TOTAL	**481,370**	**479,807**	**497,409**	**466,216**	**437,477**	**385,771**	**355,815**	**355,680**	**267,328**	**215,708**	**11,271**	**1,617**	**1,617**	**1,617**	**1,213**	**1,213**
Solid Waste Facilities																
CIF	21,695	23,761	20,873	24,999	22,945	20,829	21,262	22,039	23,850	20,762	23,928	20,502	21,799	25,294	21,001	20,762
ETF	14,430	17,255	13,812	17,669	13,812	14,398	20,828	14,802	13,812	0	0	0	0	0	0	0
SS	32,721	32,721	32,721	34,282	32,721	32,721	32,721	32,799	34,152	0	0	0	0	0	0	0
SW TOTAL	68,846	73,737	67,406	76,950	69,478	67,948	74,811	69,640	71,815	20,762	23,928	20,502	21,799	25,294	21,001	20,762
Life Cycle Cost	**550,216**	**553,544**	**564,815**	**543,166**	**506,955**	**453,719**	**430,626**	**425,320**	**339,142**	**236,470**	**35,198**	**22,119**	**23,416**	**26,911**	**22,214**	**21,974**

Appendix I.1 - Funding (Target Case)

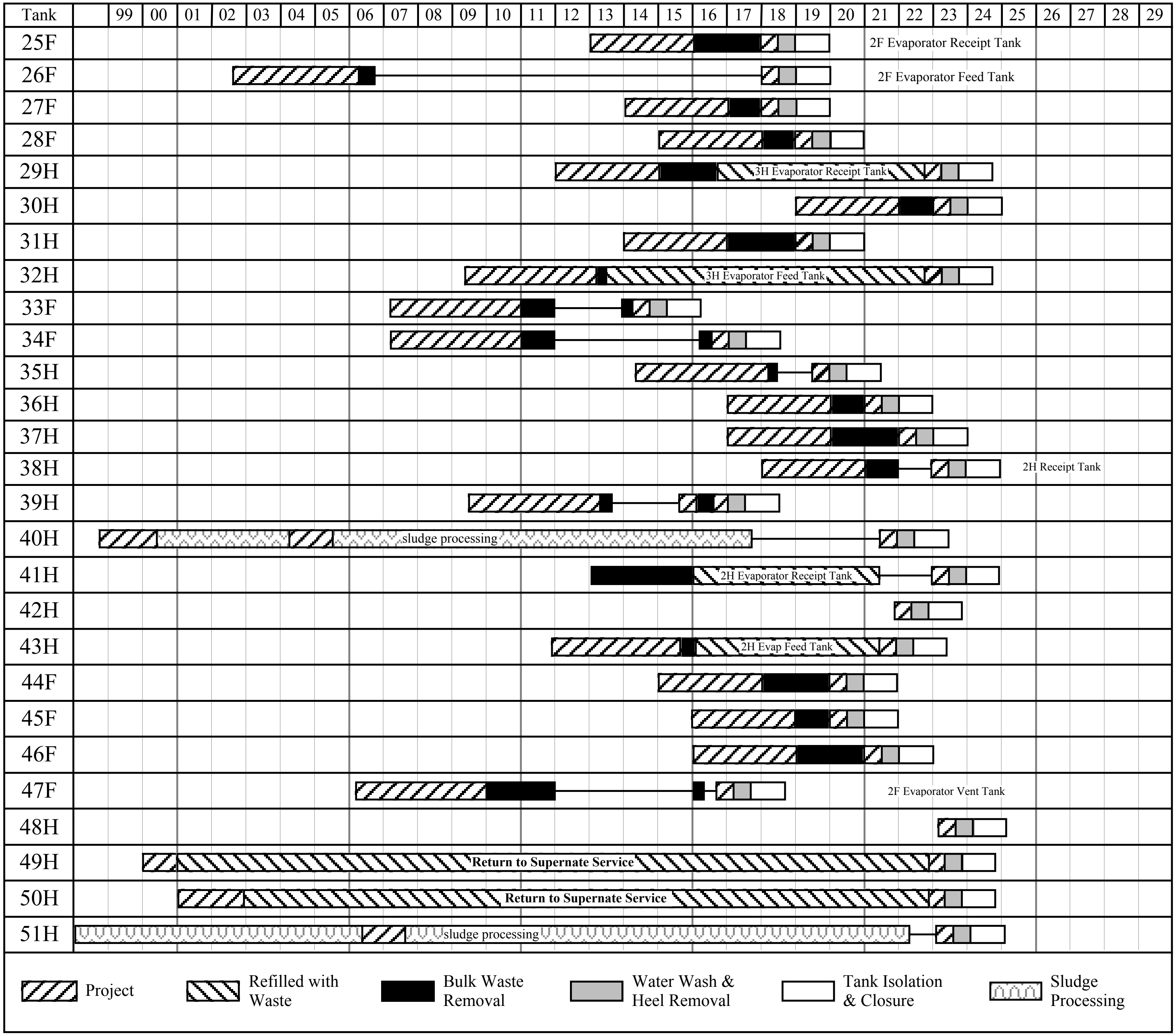
Budget Authority in Constant FY99 Year Dollars

Project Title	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	Cumulative FY99-End
HL-01 H Tank Farm											
H Tank Farm Operations	0	0	0	0	0	0	0	0	0	0	2,012,947
LI: Replacement Evaporator	0	0	0	0	0	0	0	0	0	0	16,130
HL-01 Total	0	0	0	0	0	0	0	0	0	0	2,029,077
HL-02 F Tank Farm	0	0	0	0	0	0	0	0	0	0	1,175,036
HL-03 Waste Removal & Tank Closures											
WR Ops w/ Demo Projects	0	0	0	0	0	0	0	0	0	0	225,279
WR: Tank Closure	0	0	0	0	0	0	0	0	0	0	461,380
HL-03 Total	0	0	0	0	0	0	0	0	0	0	686,659
HL-04 Feed Preparations & Sludge Operations	0	0	0	0	0	0	0	0	0	0	1,299,498
HL-05 Vitrification											
Vitrification Ops	0	0	0	0	0	0	0	0	0	0	2,838,175
Failed Equip. Storage Vaults	0	0	0	0	0	0	0	0	0	0	0
HL-05 Total	0	0	0	0	0	0	0	0	0	0	2,838,175
HL-06 Glass Waste Storage	1,213	1,213	1,213	1,213	1,213	1,213	1,213	1,213	1,213	0	152,838
HL-13 Salt Disposition											
Salt Disposition Ops	0	0	0	0	0	0	0	0	0	0	727,835
LI: Salt Alternative	0	0	0	0	0	0	0	0	0	0	908,826
HL-13 Total	0	0	0	0	0	0	0	0	0	0	1,636,661
HL-09 LI: Tk Fm Services Upgrade I	0	0	0	0	0	0	0	0	0	0	1,632
HL-10 LI: Storm Water Upgrades	0	0	0	0	0	0	0	0	0	0	5,822
HL-11 LI: Tk Fm Services Upgrade II	0	0	0	0	0	0	0	0	0	0	18,073
HL-12 LI: Waste Removal											
LI: WR from Tanks	0	0	0	0	0	0	0	0	0	0	809,140
LI: Vit Upgrades	0	0	0	0	0	0	0	0	0	0	146,531
LI: Pipe, Evaps & Infrastructure	0	0	0	0	0	0	0	0	0	0	29,241
HL-12 Total	0	0	0	0	0	0	0	0	0	0	984,913
FA-24 Facility Decontamination and Decommissioning	0	0	0	0	0	0	0	0	6,071	0	315,529
HLW TOTAL	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**7,284**	**0**	**11,143,912**
Solid Waste Facilities											
CIF	0	0	0	0	0	0	0	0	0	0	674,254
ETF	0	0	0	0	0	0	0	0	0	0	401,771
SS	0	0	0	0	0	0	0	0	0	0	505,912
SW TOTAL	0	0	0	0	0	0	0	0	0	0	1,581,936
Life Cycle Cost	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**1,213**	**7,284**	**0**	**12,725,848**

Appendix I.2 Waste Removal Schedule (Target Case)



Appendix I.2 Waste Removal Schedule (Target Case)



Appendix I.3 - Material Balance (Target Case)

End of Month/Year	Influents (gallons)										Effluents (gallons)					
	F Canyon			H Canyon							Evaporator Overheads			Type III Sludge to ESP	Type III Supernate to Salt Proc	
	LHW	HHW	F-Can Total	LHW	HHW	H-Can Total	DWPF Recycle	Other	Inhibited Water	Total In	FTF Evaps	HTF Evaps	Total			Total Out
Jan 2000	22,000	1,250	23,250	-	2,500	2,500	126,178	11,250	-	163,178	-	-	-	-	-	-
Feb 2000	44,000	8,500	52,500	-	10,000	10,000	120,575	37,667	-	220,742	42,417	-	42,417	-	-	42,417
Mar 2000	43,000	2,500	45,500	-	10,000	10,000	106,083	37,667	-	199,250	80,273	101,535	181,808	-	-	181,808
Apr 2000	12,000	2,500	14,500	-	5,000	5,000	106,083	37,667	400,000	563,250	79,120	157,091	236,211	-	-	236,211
May 2000	17,000	5,500	22,500	4,442	23,887	28,329	106,083	37,667	-	194,579	-	153,093	153,093	-	-	153,093
Jun 2000	25,000	2,500	27,500	4,442	23,887	28,329	106,083	37,667	-	199,579	-	120,847	120,847	-	-	120,847
Jul 2000	17,000	21,252	38,252	4,442	23,887	28,329	106,083	37,667	-	210,331	58,060	84,892	142,952	-	-	142,952
Aug 2000	17,000	5,500	22,500	4,442	23,887	28,329	106,083	37,667	-	194,579	96,348	295,914	392,262	-	-	392,262
Sep 2000	43,125	21,251	64,376	7,493	23,887	31,380	106,083	37,667	-	239,506	-	220,705	220,705	-	-	220,705
FY00	240,125	70,753	310,878	25,261	146,935	172,196	989,334	312,583	400,000	2,184,991	356,218	1,134,076	1,490,294	-	-	1,490,294
Oct 2000	12,000	2,500	14,500	6,592	35,387	41,979	106,083	37,667	500,000	700,229	-	464,996	464,996	-	-	464,996
Nov 2000	40,125	5,499	45,624	6,592	35,387	41,979	106,083	37,667	400,000	631,353	-	453,695	453,695	-	-	453,695
Dec 2000	31,000	2,500	33,500	6,592	35,387	41,979	106,083	37,667	400,000	619,229	107,156	493,847	601,003	-	-	601,003
Jan 2001	28,000	2,500	30,500	6,592	35,387	41,979	106,083	37,667	-	216,229	168,492	584,546	753,038	-	-	753,038
Feb 2001	28,000	5,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	109,551	342,276	451,827	-	-	451,827
Mar 2001	31,000	2,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	64,224	335,094	399,318	-	-	399,318
Apr 2001	28,000	2,500	30,500	6,592	35,387	41,979	106,083	37,667	-	216,229	37,755	421,804	459,559	-	-	459,559
May 2001	28,000	5,500	33,500	6,592	55,387	61,979	106,083	37,667	-	239,229	25,336	250,289	275,625	-	-	275,625
Jun 2001	31,000	2,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	5,361	100,334	105,695	-	-	105,695
Jul 2001	28,000	2,500	30,500	6,592	35,387	41,979	106,083	37,667	-	216,229	59,614	227,618	287,232	-	-	287,232
Aug 2001	28,000	5,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	42,337	42,337	197,703	-	-	197,703
Sep 2001	31,000	2,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	32,924	228,691	261,615	-	-	261,615
FY01	344,125	41,999	386,124	79,104	444,644	523,748	1,272,996	452,000	1,300,000	3,934,868	652,750	3,945,525	4,711,304	-	-	4,711,304
Oct 2001	28,000	2,500	30,500	6,592	55,387	61,979	106,083	37,667	-	236,229	26,203	291,836	318,039	-	-	318,039
Nov 2001	28,000	5,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	11,433	141,171	152,604	-	-	152,604
Dec 2001	31,000	2,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	28,105	169,081	197,186	-	-	197,186
Jan 2002	28,000	2,500	30,500	6,592	35,387	41,979	106,083	37,667	-	216,229	80,703	255,374	336,077	-	-	336,077
Feb 2002	28,000	5,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	45,403	243,309	288,712	-	-	288,712
Mar 2002	31,000	2,500	33,500	6,592	35,387	41,979	106,083	37,667	-	219,229	39,872	206,511	246,383	-	-	246,383
Apr 2002	28,000	2,500	30,500	6,592	35,387	41,979	-	37,667	-	110,146	128,610	157,940	286,550	-	-	286,550
May 2002	28,000	5,500	33,500	6,592	35,387	41,979	-	37,667	-	113,146	24,967	130,808	155,775	-	-	155,775
Jun 2002	31,000	2,500	33,500	6,592	35,387	41,979	-	37,667	-	113,146	135,308	269,133	404,441	-	-	404,441
Jul 2002	28,000	2,500	30,500	6,592	35,387	41,979	-	37,667	-	110,146	134,632	176,564	311,196	-	-	311,196
Aug 2002	20,000	5,500	25,500	6,592	35,387	41,979	-	37,667	-	105,146	93,763	220,187	313,950	-	-	313,950
Sep 2002	23,000	2,500	25,500	6,592	35,387	41,979	-	37,667	357,557	462,703	50,585	183,184	233,769	-	-	233,769
FY02	332,000	42,000	374,000	79,104	444,644	523,748	636,498	452,000	357,557	2,343,803	799,584	2,445,102	3,244,686	-	-	3,244,686

Appendix I.3 - Material Balance (Target Case)

	Influents (gallons)										Effluents (gallons)					
	F Canyon			H Canyon							Evaporator Overheads					
End of Month/Year	LHW	HHW	F-Can Total	LHW	HHW	H-Can Total	DWPF Recycle	Other	Inhibited Water	Total In	FTF Evaps	HTF Evaps	Total	Type III Sludge to ESP	Type III Supernate to Salt Proc	Total Out
Oct 2002	20,000	4,500	24,500	6,592	55,387	61,979	106,083	37,667	-	230,229	73,174	89,007	162,181	-	-	162,181
Nov 2002	20,000	7,500	27,500	6,592	35,387	41,979	106,083	37,667	-	213,229	116,375	169,076	285,451	-	-	285,451
Dec 2002	23,000	4,500	27,500	6,592	35,387	41,979	106,083	37,667	-	213,229	82,204	168,149	250,353	-	-	250,353
Jan 2003	20,000	4,500	24,500	3,545	19,141	22,686	106,083	37,667	-	190,936	67,729	135,380	203,109	-	-	203,109
Feb 2003	12,000	7,500	19,500	3,545	39,141	42,686	106,083	37,667	600,000	805,936	68,540	102,100	170,640	-	-	170,640
Mar 2003	15,000	4,500	19,500	3,545	19,141	22,686	106,083	37,667	-	185,936	51,375	382,350	433,725	-	-	433,725
Apr 2003	30,000	5,500	35,500	3,545	19,141	22,686	106,083	37,667	175,000	376,936	10,963	56,821	67,784	-	-	67,784
May 2003	18,000	3,000	21,000	3,545	19,141	22,686	106,083	37,667	585,000	772,436	38,709	496,471	535,180	-	-	535,180
Jun 2003	18,000	3,000	21,000	3,545	19,141	22,686	106,083	37,667	400,000	587,436	33,093	623,696	656,789	-	-	656,789
Jul 2003	18,000	3,000	21,000	3,545	19,141	22,686	106,083	37,667	-	187,436	64,182	673,830	738,012	-	-	738,012
Aug 2003	18,000	3,000	21,000	3,545	19,141	22,686	106,083	37,667	400,000	587,436	32,884	533,827	566,711	-	-	566,711
Sep 2003	18,000	18,000	36,000	3,545	19,141	22,686	106,083	37,667	133,000	335,436	71,521	530,105	601,626	-	-	601,626
FY03	230,000	68,500	298,500	51,681	318,430	370,111	1,272,996	452,000	2,293,000	4,686,607	710,749	3,960,816	4,671,565	-	-	4,671,565
FY04	246,000	51,000	297,000	40,221	256,579	296,800	707,994	452,000	-	1,753,794	772,026	2,916,665	3,688,691	-	-	3,688,691
FY05	246,000	14,000	260,000	39,456	252,208	291,664	1,025,188	452,000	240,812	2,269,664	246,782	3,150,154	3,396,936	-	-	3,396,936
FY06	120,000	-	120,000	29,592	207,282	236,874	1,047,000	452,000	379,151	2,235,025	-	3,092,323	3,092,323	281,000	-	3,373,323
FY07	120,000	-	120,000	-	50,016	50,016	1,046,513	452,000	1,654,519	3,323,048	-	3,607,500	3,607,500	-	-	3,607,500
FY08	120,000	-	120,000	-	50,016	50,016	1,047,000	452,000	586,112	2,255,128	-	2,859,966	2,859,966	-	-	2,859,966
FY09	120,000	-	120,000	-	50,016	50,016	1,047,000	452,000	1,433,055	3,102,071	-	4,012,058	4,012,058	-	-	4,012,058
FY10	120,000	-	120,000	-	50,016	50,016	1,047,000	452,000	-	1,669,016	-	2,467,108	2,467,108	-	1,259,000	3,726,108
FY11	-	-	-	-	-	-	1,047,000	452,000	3,164,000	4,663,000	-	4,429,850	4,429,850	-	3,226,000	7,655,850
FY12	-	-	-	-	-	-	1,047,000	452,000	190,000	1,689,000	-	1,604,550	1,604,550	-	2,543,000	4,147,550
FY13	-	-	-	-	-	-	1,047,000	452,000	190,000	1,689,000	-	1,604,550	1,604,550	-	2,042,000	3,646,550
FY14	-	-	-	-	-	-	1,047,000	452,000	2,810,000	4,309,000	-	4,093,550	4,093,550	259,000	937,000	5,289,550
FY15	-	-	-	-	-	-	1,047,000	452,000	790,000	2,289,000	-	2,174,550	2,174,550	-	1,280,000	3,454,550
FY16	-	-	-	-	-	-	1,047,000	452,000	1,517,000	3,016,000	-	2,865,200	2,865,200	121,000	1,406,000	4,392,200
FY17	-	-	-	-	-	-	1,047,000	452,000	2,149,000	3,648,000	-	3,465,600	3,465,600	273,000	2,544,000	6,282,600
FY18	-	-	-	-	-	-	1,047,000	452,000	420,000	1,919,000	-	1,823,050	1,823,050	-	2,332,000	4,155,050
FY19	-	-	-	-	-	-	1,047,000	452,000	752,000	2,251,000	-	2,138,450	2,138,450	64,584	2,336,000	4,539,034
FY20	-	-	-	-	-	-	1,047,000	452,000	1,842,000	3,341,000	-	3,173,950	3,173,950	-	2,355,000	5,528,950
FY21	-	-	-	-	-	-	1,047,000	452,000	420,000	1,919,000	-	1,823,050	1,823,050	-	2,115,000	3,938,050
FY22	-	-	-	-	-	-	1,047,000	452,000	420,000	1,919,000	-	1,823,050	1,823,050	-	1,008,000	2,831,050

Appendix I.4 - Salt Solution Processing (Target Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY10	10/1/09	14	153	ds	413	163	266	74.4	4,134	90	7,476	7.62	4
		30	280	cs	280								
		32	320	cs	320								
		33	190	cs	190								
		34	300	cs	300								
		38	100	cs	100								
		47	129	cs	129								
		47	93	ds	250								
				dw	1,105								
	Type III Tank space gain		1,412	total	3,087								
FY11	10/1/10	27	115	cs	115	313	512	50.1	8,163	180	14,767	15.76	4, 1 and 2
		32	497	cs	497								
		33	222	ds	600								
		34	619	cs	619								
		34	208	ds	561								
		39	477	cs	477								
		43	745	cs	745								
		47	343	ds	925								
				dw	1,554								
	Type III Tank space gain		3,226	total	6,093								
FY12	10/1/11	2	148	ds	400	342	558	46.0	8,138	180	14,723	23.88	2 and 3
		32	70	cs	70								
		35	1,127	cs	1,127								
		38	50	cs	50								
		47	416	ds	1,122								
		49	1,028	cs	1,028								
				dw	2,289								
	Type III Tank space gain		2,691	total	6,086								

Appendix I.4 - Salt Solution Processing (Target Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY13	10/1/12	2	377	ds	1,018	281	460	75.6	8,037	180	14,544	31.90	3 and 5
		27	75	cs	75								
		29	221	cs	221								
		30	250	cs	250								
		38	50	cs	50								
		41	15	cs	15								
		41	537	ds	1,450								
		50	1,271	cs	1,271								
				dw	1,636								
	Type III Tank space gain		2,419	total	5,986								
FY14	10/1/13	1	19	cs	19	318	519	33.4	8,105	180	14,664	39.98	5, 6 and 7
		1	470	ds	1,270								
		10	209	ds	563								
		27	485	cs	485								
		30	500	cs	500								
		38	150	cs	150								
		41	500	ds	1,350								
				dw	1,714								
	Type III Tank space gain		1,635	total	6,051								
FY15	10/1/14	9	527	ds	1,423	234	385	64.2	8,043	180	14,555	48.00	7and 8
		26	200	cs	200								
		27	133	cs	133								
		29	630	ds	1,700								
		30	300	cs	300								
		38	75	cs	75								
		39	300	cs	300								
		41	169	ds	457								
				dw	1,382								
	Type III Tank space gain		1,807	total	5,970								

Appendix I.4 - Salt Solution Processing (Target Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY16	10/1/15	3	525	ds	1,418	229	377	49.0	7,873	180	14,254	55.86	8 and 9
		25	165	cs	165								
		25	716	ds	1,932								
		26	400	cs	400								
		29	350	ds	946								
		30	300	cs	300								
				dw	683								
	Type III Tank space gain		1,931	total	5,844								
FY17	10/1/16	25	370	ds	1,000	229	377	70.4	8,116	180	14,684	63.96	9, 10 and 11
		26	200	cs	200								
		27	454	ds	1,225								
		28	186	cs	186								
		31	254	cs	254								
		31	630	ds	1,700								
		46	450	cs	450								
				dw	1,006								
	Type III Tank space gain		2,544	total	6,021								
FY18	10/1/17	28	1,011	ds	2,730	234	384	14.5	7,977	180	14,438	71.92	11and 12
		30	250	cs	250								
		31	364	ds	983								
		44	281	cs	281								
		44	426	ds	1,150								
				dw	528								
	Type III Tank space gain		2,332	total	5,922								
FY19	10/1/18	36	80	cs	80	227	374	34.3	7,968	180	14,422	79.87	12 and 13
		44	543	ds	1,467								
		45	128	cs	128								
		45	1,107	ds	2,990								
		46	292	cs	292								
		46	185	ds	500								
				dw	455								
	Type III Tank space gain		2,336	total	5,912								

Appendix I.4 - Salt Solution Processing (Target Case)

SALT SOLUTION PROCESSING FACILITY									SALTSTONE FACILITY				
Fiscal Year	FY Start Date	Source Tank	Waste Removed (Kgal)	Feed Type	Salt Feed to Salt Processing (Kgal)	NaTPB Req'd (Kgal)	10 wt% ppt Feed to DWPF (Kgal)	Ppt Cs Conc (Ci/gal)	Salt Processing Filtrate to Grout (Kgal)	ETF Feed to Grout (Kgal)	Grout Produced (Kgal)	Cum Vault Cells Filled	Active Grout Vault #'s
FY20	10/1/19	36	74	cs	74	232	381	66.1	8,085	180	14,629	87.93	13, 14 and 15
		36	1,072	ds	2,895								
		37	259	cs	259								
		37	222	ds	600								
		42	600	cs	600								
		46	127	ds	344								
				dw	1,227								
	Type III Tank space gain		2,355	total	5,999								
FY21	10/1/20	37	731	ds	1,974	129	216	68.8	7,541	180	13,666	95.46	15 and 16
		38	23	cs	23								
		38	704	ds	1,900								
		42	657	cs	657								
				dw	1,003								
	Type III Tank space gain		2,115	total	5,557								
FY22	10/1/21	30	619	cs	619	99	163	11.6	3,149	180	5,892	98.71	16 and 17
		30	65	ds	175								
		38	164	ds	444								
		41	160	cs	160								
				dw	943								
	Type III Tank space gain		1,008	total	2,341								

Notes:
* Space gain refers to Type III tanks only and is equal to cs + ds (prior to dissolution)
* Assume 2.7 gallons of Inhibited Water is required to dissolve 1 gallon of saltcake.
* cs = concentrated supernate
* ds = dissolved salt cake
* dw = dilution water to bring salt feed to 6.44 [Na+] for feed to Salt Processing, additional dilution to 4.7 [Na+] is performed at the Salt Processing Facility.
* NaTPB = sodium tetraphenylborate
* ppt = precipitate feed stream produced at Salt Processing Facility for feed to DWPF
* Precipitate Cesium Ci/gal has not been adjusted for decay
* With a permanent roof, each cell measures 98.5 x 98.5 x 25 feet = 242,500 cu ft, and holds 1,814 kgal grout, or 1,025 kgal feed.
* Existing Vault #1 has 6 cells, of which 3.5 are already filled. Vault #4 has 12 cells, of which 1 is already filled. All new vaults will have six cells each.
* Vault # fill sequence is assumed to be 4, 1, 2, 3, 5, 6, 7, … etc.

Appendix I.5 – Sludge Processing (Target Case)

	Waste Removal		ESP Pretreatment									DWPF Vitrification							
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Sludge Batch	Source Tanks	Sludge Content (kg)	Alum. Rem'd (wt %)	Alum. Dis. Start Date	Wash Start Date	Feed Prep Total Dur. (months)	Total ESP Water Vol. (kgal)	Na (wt% dry)	Hg (wt% dry)	Total Solids (wt%)	Pretreated Volume (kgal)	Feed Volume (kgal)	Start Feed	Canister Yield	Feed Duration (years)	Finish Feed	Feed Tank	Waste Loading (wt %)
1A	51		na	na	na	na	na	8.80		16.4	491	491	3/1/96	492	2.75	8/30/98	51	25.0
												-140	(Tk 51 heel @ 40 ")					
												351						
1B	42	420,861	na	na	na	na	na	7.77	0.30	16.5	460	460	10/1/98	625	2.56	4/20/01	51	25.0
	total	420,861											(Tk 51 heel @ 40 ")					
2	8	182,451	na	na	8/20/00	9	2,247	9.82	0.30	16.0	639	639	4/20/01	517	2.72	1/8/04	40	28.0
	40	179,098										-140	(Includes 40 cans from Tk 51 heel w/Tk 40 heel @40")					
	total	361,549										499						
3	7	412,337			3/10/03	11	2,734	9.99	0.10	16.0	729	729	1/8/04	655	3.56	7/29/07	51	29.5
	total	412,337																
4	26	154,896			9/28/06	21	2,235	12.30	1.70	16.0	494	494	7/29/07	409	2.05	8/13/09	40	29.0
	11	124,380	75	11/27/05														
	18	21,110																
	19	2,794																
	total	279,276																
5	5	57,630			10/13/08	21	2,890	12.00	3.10	16.0	730	730	8/13/09	477	2.25	11/11/11	51	34.5
	12	189,715																
	15	165,818	75	12/14/07														
	total	413,163																
6	13	417,600			10/11/10	14	2,974	9.98	2.60	16.0	738	738	11/11/11	753	3.35	3/16/15	40	25.5
	total	417,600																
7	4	65,477			12/15/13	16	2,661	13.30	3.50	16.0	703	703	3/16/15	522	2.32	7/10/17	51	36.0
	6	38,708																
	32	195,586																
	33	62,401																
	39(40%)	35,790																
	total	397,962																
8	23	59,110			7/10/16	13	2,215	10.10	1.40	16.0	706	706	7/10/17	671	2.98	7/3/20	40	26.5
	34	77,119																
	21	6,393																
	22	13,265																
	39(60%)	53,684																
	43	51,940																
	47	137,763																
	total	399,274																

Appendix I.5 – Sludge Processing (Target Case)

	Waste Removal		ESP Pretreatment									DWPF Vitrification						
A Sludge Batch	B Source Tanks	C Sludge Content (kg)	D Alum. Rem'd (wt %)	E Alum. Dis. Start Date	F Wash Start Date	G Feed Prep Total Dur. (months)	H Total ESP Water Vol. (kgal)	I Na (wt% dry)	J Hg (wt% dry)	K Total Solids (wt%)	L Pretreated Volume (kgal)	M Feed Volume (kgal)	N Start Feed	O Canister Yield	P Feed Duration (years)	Q Finish Feed	R Feed Tank	S Waste Loading (wt %)
9	ESP Heels (Tks 40,42,51)	158,377			9/2/19	11	1,877	11.60	4.50	16.0	913	913	7/3/20	528	2.35	11/6/22	51	33.0
	35	138,956																
	Other Insoluble Solids	219,000																
	total	516,333																
Totals		3,618,355					19,833							5,649	27			

Notes:

General: Above based on the following yearly canister production values: FY00-01 250 cans/yr, FY02 125 cans/yr, FY03 250 cans/yr,FY04 125 cans/yr,FY05-FY10 200 cans/yr, FY11-End 225 cans/yr.

A) Each Sludge Batch must be individually tested and confirmed to meet waste qualification spedicfications

B) Sludge in these tanks will comprise the batch. Note: The sludge from Tanks 18&19 is now shown in Batch 4, however these tanks will be cleaned out earlier, with the sludge planned to be moved to Tk 26, to support FFA dates for Tanks 18 & 19.

C) Amount of sludge from each source tank in the batch obtained from WCS data base

D) Amount of aluminum removed from HM sludge (typically H-Area HHW sludge). To make qualified glass, aluminum dissolution is only performed on the tanks indicated (i.e. the tank that the Al dissolution start date is shown against).

E) Aluminum dissolution start date for H-Area sludge in batch. Note: Tank requiring Al dissolution must be in ESP tank 1 mo. prior to this date to allow for settling and decant of transfer water.

F) Start date of when ESP decants will begin. After all sludge is received, water washing will begin for combined H- & F-Area sludge to obtain proper alkali composition of the sludge slurry.

G) Total planned duration of aluminum dissolution, washing, sampling, test glass production, and associated decants

H) Total volume of sludge transfer water, aluminum dissolution and wash water decants

I) Amount of total Na in washed sludge (dry basis)

J) Amount of total Hg in washed sludge (dry basis)

K) Total solids (soluble and insoluble) in washed sludge

L) Volume of sludge at given wt% total solids before heel effects (Batch 1B is actual. Batch 2 and beyond are based on ratio of batch sludge kg values converted to gallons and adjusted from an estimated 25 wt% solids to 16 wt% solids)

M) Volume of sludge available for feed after adding or subtracting pump heel

N) Start feed date based on depletion of previous batch down to pump heel

O) Estimated number of canisters produced given the pretreatment as shown. Numbers are actual for Batch 1A and estimated for remaining batches. Coupled Salt and Sludge Feed assumed to start with Batch 5.

P) Column O divided by the planned canister production during the period in which the batch is vitrified. See production note under General Section above.

Q) Column N plus column P. Finish Feed means when the last transfer of feed is sent from the Feed Tank. The last canister for the batch will be poured later. The DWPF has approximately 25 canisters of feed in process. Therefore 25 more canisters will be produced from the batch after the last feed is sent to DWPF.

R) Batch feed tank

S) Weight % of glass comprised of sludge oxides.

Appendix I.6 - Canister Storage (Target Case)

End of Year	SRS Cans Produced		SRS Cans In GWSB #1 (2,159 max)			SRS Cans In GWSB #2 (2286)			SRS Cans Shipped to Repository		Net Cans Stored At SRS
	Yearly	Cum.	Added	Shipped	Cum.	Added	Shipped	Cum.	Each Year	Cumulative	
1996	64	64	64		64						64
1997	169	233	169		233						233
1998	250	483	250		483						483
1999	236	719	236		719						719
2000	250	969	250		969						969
2001	250	1,219	250		1,219						1,219
2002	125	1,344	125		1,344						1,344
2003	250	1,594	250		1,594						1,594
2004	125	1,719	125		1,719						1,719
2005	200	1,919	200		1,919	0		0			1,919
2006	200	2,119	200		2,119	0		0			2,119
2007	200	2,319	40		2,159	160		160			2,319
2008	200	2,519			2,159	200		360			2,519
2009	200	2,719			2,159	200		560			2,719
2010	200	2,919		(105)	2,054	200		760	105	105	2,814
2011	225	3,144		(205)	1,849	225		985	205	310	2,834
2012	225	3,369		(205)	1,644	225		1,210	205	515	2,854
2013	225	3,594		(205)	1,439	225		1,435	205	720	2,874
2014	225	3,819		(205)	1,234	225	0	1,660	205	925	2,894
2015	225	4,044		(205)	1,029	225	0	1,885	205	1,130	2,914
2016	225	4,269		(205)	824	225	0	2,110	205	1,335	2,934
2017	225	4,494		(125)	699	225	(80)	2,255	205	1,540	2,954
2018	225	4,719	225	0	924	0	(205)	2,050	205	1,745	2,974
2019	225	4,944	225	0	1,149	0	(205)	1,845	205	1,950	2,994
2020	225	5,169	225	0	1,374	0	(205)	1,640	205	2,155	3,014
2021	225	5,394	225	0	1,599	0	(205)	1,435	205	2,360	3,034
2022	225	5,619	225	0	1,824	0	(205)	1,230	205	2,565	3,054
2023	30	5,649	30	0	1,854	0	(205)	1,025	205	2,770	2,879
2024	0	5,649	0	0	1,854	0	(205)	820	205	2,975	2,674
2025	0	5,649		0	1,854	0	(205)	615	205	3,180	2,469
2026	0	5,649		0	1,854	0	(205)	410	205	3,385	2,264
2027	0	5,649		0	1,854	0	(205)	205	205	3,590	2,059
2028	0	5,649		0	1,854	0	(205)	0	205	3,795	1,854
2029	0	5,649		(205)	1,649	0	0	0	205	4,000	1,649
2030	0	5,649		(205)	1,444	0	0	0	205	4,205	1,444

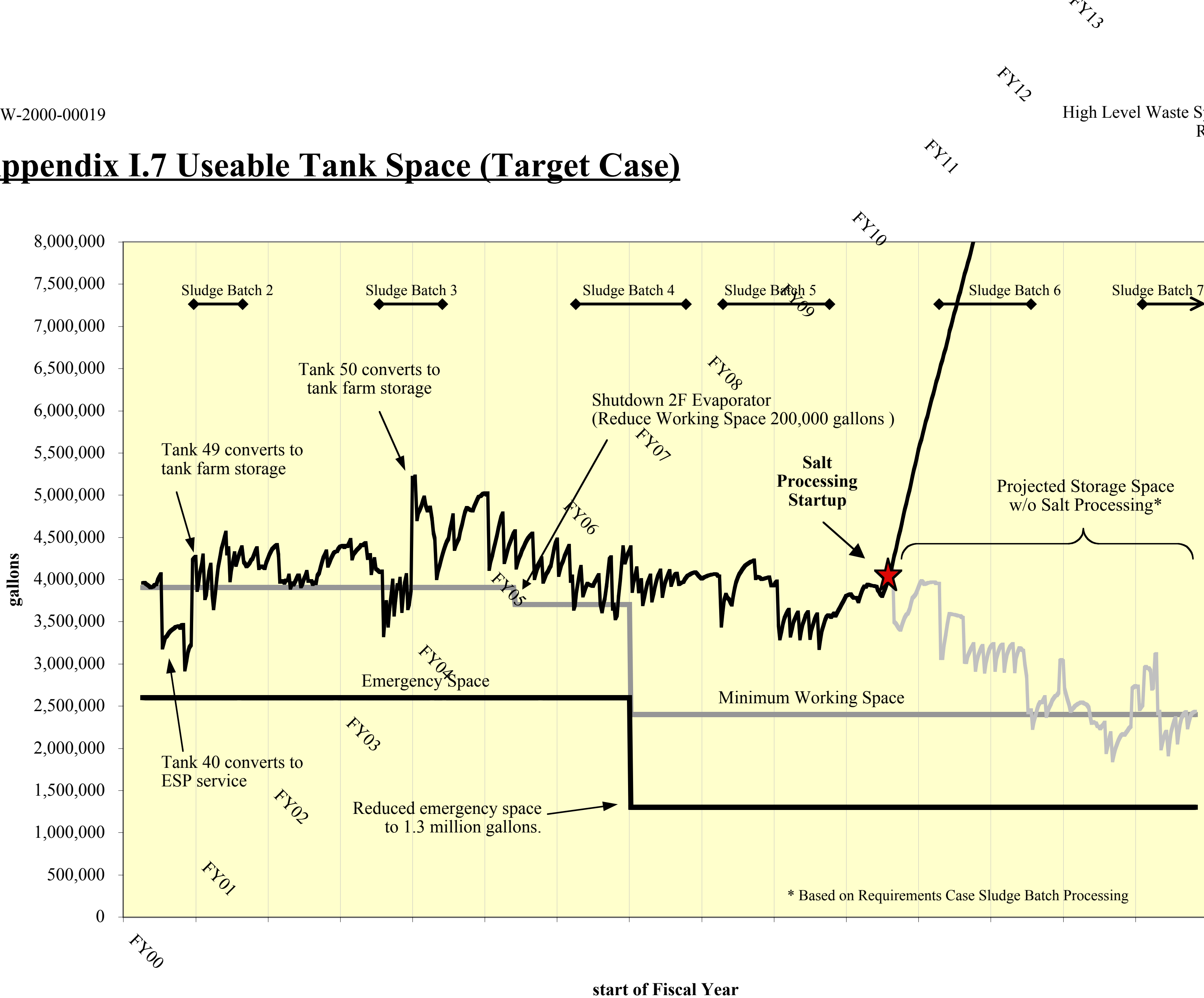
Appendix I.6 - Canister Storage (Target Case)

End of Year	SRS Cans Produced		SRS Cans In GWSB #1 (2,159 max)			SRS Cans In GWSB #2 (2286)			SRS Cans Shipped to Repository		Net Cans Stored At SRS
	Yearly	Cum.	Added	Shipped	Cum.	Added	Shipped	Cum.	Each Year	Cumulative	
2031	0	5,649		(205)	1,239	0	0	0	205	4,410	1,239
2032	0	5,649		(205)	1,034	0	0	0	205	4,615	1,034
2033	0	5,649		(205)	829	0	0	0	205	4,820	829
2034	0	5,649		(205)	624	0	0	0	205	5,025	624
2035	0	5,649		(205)	419	0	0	0	205	5,230	419
2036	0	5,649		(205)	214	0	0	0	205	5,435	214
2037	0	5,649		(205)	9	0	0	0	205	5,640	9
2038	0	5,649		(9)	0	0	0	0	9	5,649	0
2039	0	5,649		0	0	0	0	0	0	5,649	0

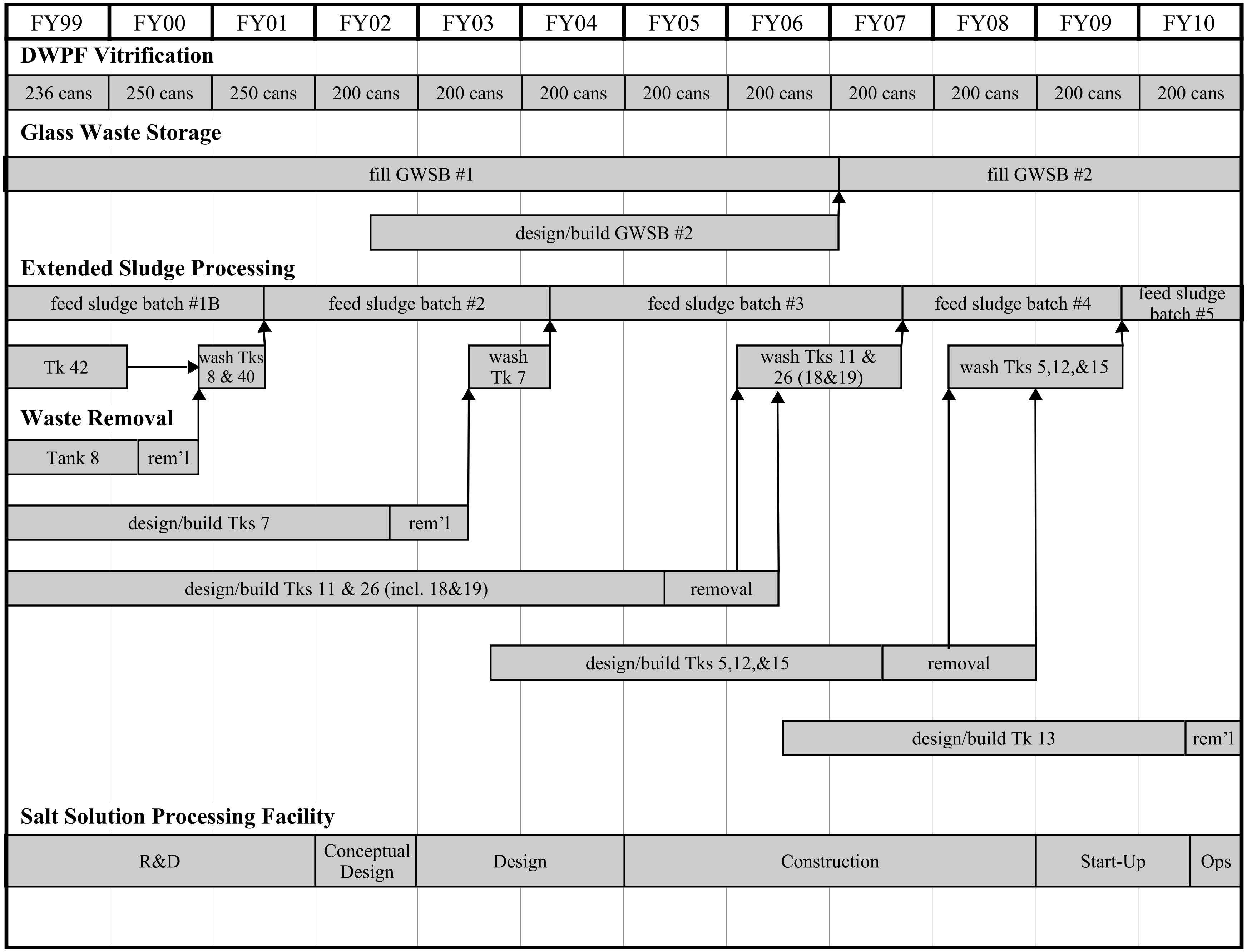
Notes:

1) GWSB #1 filling began in May 1996. It has 2,286 canister storage locations, less 122 unuseable locations for which a repair technique has not been identified, less 5 positions being used for storage of non-radioactive test canisters = 2,159 usable storage locations. However, of the 2,159 usable positions, 450 locations are unuseable and will need repair/replacement plugs per an existing plan before they will be available for use.
2) GWSB#1 is expected to reach maximum capacity in FY07. Therefore, GWSB#2 must be ready to start operations in FY07.
3) This System Plan assumes that canisters can be transported to the Federal Repository starting in FY10 at a rate of 105 canisters in FY10 and 205 canisters/yr, thereafter, until the end of the program.
4) A canister load-out facility will be required to move the canisters from the GWSB's to a railcar. Assume one year for design (FY07) and three years for construction (FY08-10).
5) GWSB#1 will be emptied and available for D&D in FY38.
6) GWSB#2 will be emptied and available for D&D in FY28.
7) This System Plan does not include possible can-in-canister disposition of excess plutonium.

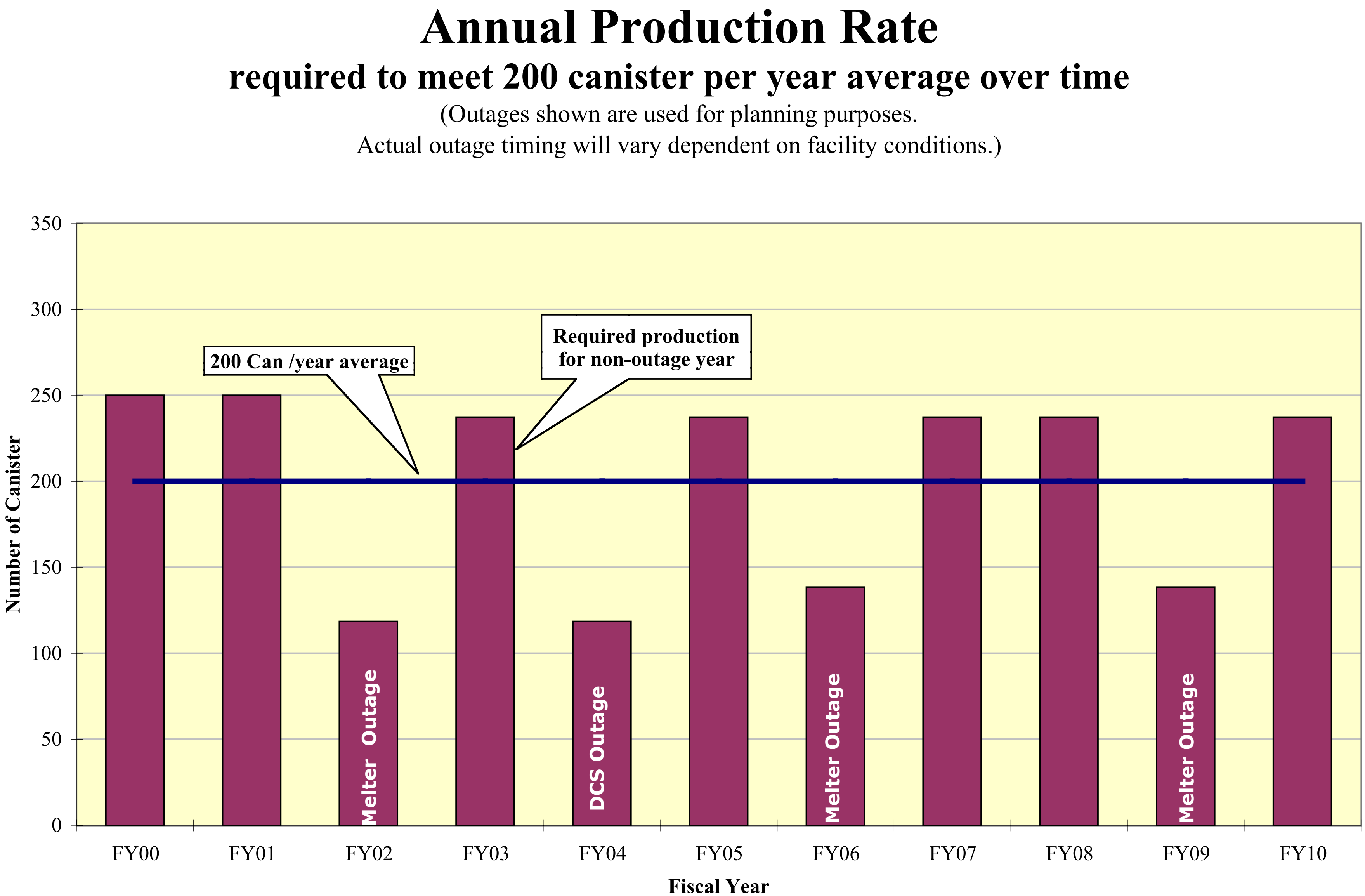
Appendix I.7 Useable Tank Space (Target Case)



Appendix I.8 - Level 1 Schedule (Target Case)



Appendix I.9 Canister Production Rate (Target)

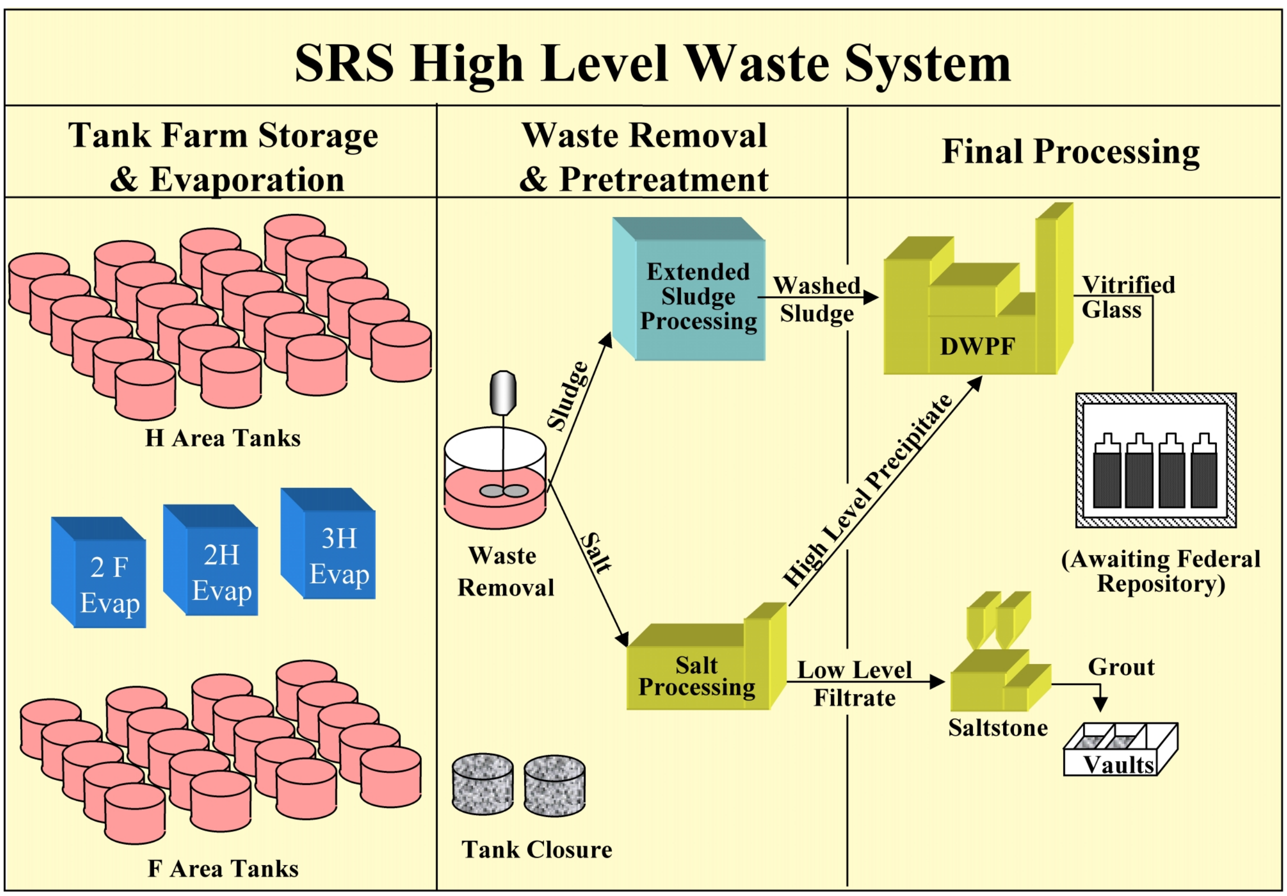


Appendix K – HLW System Description

Background

The Savannah River Site (SRS) in South Carolina is a 300-square-mile Department of Energy (DOE) complex that has produced nuclear materials for national defense, research, and medical programs since it became operational in 1951. As a waste by-product of this production, there are approximately 35 million gallons of liquid, high-level radioactive waste currently stored in 49 underground waste storage tanks. Continued, long-term storage of these liquid, high-level wastes in underground tanks poses an environmental risk. Therefore, the High Level Waste Division at SRS has, since FY96, been removing waste from tanks; pre-treating it; vitrifying it; and pouring the vitrified waste into canisters for long-term disposal. By the end of FY00, over 900 canisters of waste will have been vitrified. The canisters vitrified to date have all contained sludge waste. Salt waste processing is still being developed.

The High Level Waste System is the integrated series of facilities at SRS that convert waste stored in the tanks into glass. This system includes facilities for storage, evaporation, waste removal, pre-treatment, vitrification, and disposal. These facilities are shown in the sketch below and are briefly described in the text that follows.



Appendix K – HLW System Description

Tank Storage

The 35 million gallons of liquid, high-level radioactive waste at SRS are stored in 49 underground waste storage and processing tanks. In addition, there are two waste storage tanks that have been emptied and closed, making a total of 51 original tanks. The waste storage tanks are located in two separate "tank farms," one in H-Area and the other in F-Area. The stored waste contains 420 million curies of radioactivity.

There are four types of underground waste storage tanks at SRS. The Type I and Type II tanks are described as being "high risk" because they do not meet current secondary containment and leak detection standards, sit near or at the water table, and together store 5.6 million gallons of waste and 152 million curies of radioactivity. Removing waste from these tanks as soon as possible is important, given the environmental risks posed by continuing to store HLW in these aging tanks.

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

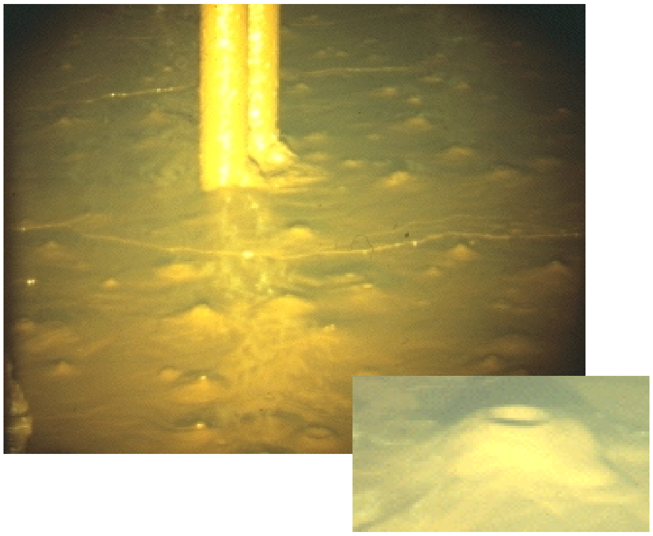
The age and condition of the 16 Type I and II waste storage tanks at SRS is of increasing concern. They were placed in service between 1954 and 1964. Over the years, nine of these tanks have leaked waste from the primary tank into the secondary pan. In one case, some waste leaked from the secondary pan into the environment.

Overhead View of H Tank Farm showing the tops of three tanks. Each tank is approximately 90 feet across and can contain over one million gallons of waste.

Recently, a new kind of leak site, a horizontal crack approximately 18 inches in length, was found on one Type II tank, Tank 15. This leak site was discovered by SRS's extensive tank-integrity monitoring program. SRS has not determined the cause of this crack, although it may indicate that a new mechanism is affecting tank wall integrity. In addition, increased corrosion is being seen in several tank secondary containment pans. These findings underscore the urgency to remove waste from these tanks as soon as possible.

The waste stored in SRS tanks is broadly characterized as either "sludge waste" or "salt waste." Sludge waste is insoluble and settles to the bottom of a waste tank, typically beneath a layer of liquid supernate. Sludge generally contains the radioactive elements strontium, plutonium, and uranium in the form of metal hydroxides. Sludge is only 9% of the SRS waste volume (3 million gallons) but is 57% of the waste radioactivity (240 million curies).

Appendix K – HLW System Description



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

Salt waste is soluble and is dissolved in the liquid. Salt generally contains the radioactive element cesium and trace amounts of other soluble radioactive elements in the form of dissolved salts. Salt waste is 91% of the SRS waste volume (32 million gallons) and 43% of waste radioactivity (180 million curies). Salt waste can be further described as being “supernate” (in normal solution), “concentrated supernate” (after evaporation has removed some of the liquid) or “saltcake” (previously dissolved salts that have now crystallized out of solution). A single waste tank can contain sludge, supernate, and salt cake; although an effort is made to segregate sludge and salt in different tanks.

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

Volume Reduction — Evaporation

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 approximately 100 million gallons of high-level liquid waste, of which 65 million gallons have been evaporated, leaving the 35 million gallons being stored in the 49 storage tanks. The System Plan carefully tracks the projected available tank space to ensure that the tank farms do not become “water logged,” a term meaning that all of usable tank space has been filled. A portion of tank space must be reserved for emergency transfers and for working space within the tanks. Waste receipts and transfers are normal tank farm activities as the tank farms receive new waste from the F and H Separations Canyons, stabilization and de-inventory programs, recycle water from DWPF processing, and wash water from Waste Pre-treatment. The tank farms also make routine transfers to and from tanks and evaporators. Currently, there is a backlog of approximately 5.5 million gallons of waste that has not been evaporated. Once this backlogged waste has been evaporated, the working capacity of the tank farms will be steadily reduced each year until salt processing becomes operational.

The two evaporator systems currently operating at SRS are the 2H and 2F systems. A third system, the 3H Evaporator is scheduled for full operation in spring of FY00.

Waste Removal & Tank Closure

Waste Removal from Tanks

During waste removal, water is added to waste tanks and agitated by slurry pumps. If the tank contains salt, this agitation dilutes the concentrated salt or re-dissolves the salt cake. If the tank contains sludge, this agitation suspends

Appendix K – HLW System Description

the insoluble sludge particles. In either case, the resulting liquid slurry is then pumped out of the tanks and transferred to waste pre-treatment tanks.

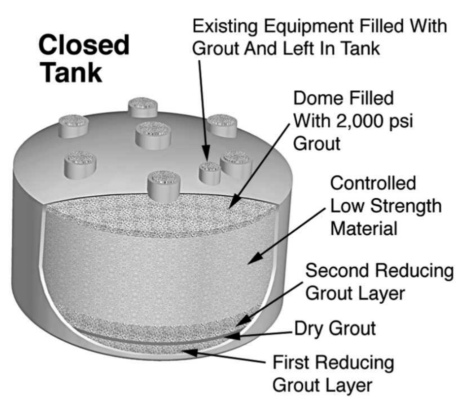
During waste removal, water is added to waste tanks and agitated by slurry pumps. If the tank contains salt, this water and agitation dilutes the concentrated salt or re-dissolves the salt cake. If the tank contains sludge, this water and agitation suspends the insoluble sludge particles. In either case, the resulting liquid slurry, which now contains the dissolved salt or suspended sludge, can be pumped out of the tanks and transferred to waste pre-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 equipment entries into High Level Waste Tanks.

Waste removal is a multi-year process. First, each waste tank must be retrofitted with 45-foot long slurry and transfer pumps, steel infrastructure to support the pumps, and various service upgrades (power, water, air, 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. Bulk waste removal normally takes between six to twelve months, with the pumps being left in place for later heel removal.

Tank Closure

Once bulk waste has been removed from a tank, a series of activities are needed to prepare it for closure. Tank closure involves heel removal and water washing, isolation, and filling with grout. Heel removal and water washing are used to remove the residual waste "heel" in the tank (the last several inches at the bottom). Spray nozzles wash down the tank sides and bottom, and specialized equipment removes this residual waste. The tank is then isolated by cutting and capping all service lines (power, steam, water, and air) and sealing all tank risers and openings. Finally, the tank is filled with layers of grout, which bind up any remaining waste, leaving the tank safe for long-term surveillance and maintenance. The schedule for waste removal and tank closure is part of the Federal Facility Agreement (FFA) between DOE, the Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC).



Appendix K – HLW System Description

Pre-Treatment

Salt Processing: To separate Salt Waste into its High-level and Low-level Radioactive Components

During salt processing, radioactive cesium and trace amounts of strontium and plutonium are separated from the salt supernate and dissolved salt cake that has been removed from waste storage tanks. This separated waste is highly radioactive because it contains almost all the radioactivity of the original salt waste but only a small fraction of the original volume. It is high-level waste that must be vitrified at DWPF. The remaining waste, now without its highly radioactive components, contains only a small fraction of the original radioactivity but the bulk of the volume. It is low-level waste called "salt solution" that can be safely disposed, on site, at the Saltstone Facility. Separating salt waste into its high-level and low-level components greatly reduces the amount of waste that must be vitrified into glass canisters, in turn greatly reducing the capacity and costs of the Federal Repository being built to dispose of the HLW glass canisters.

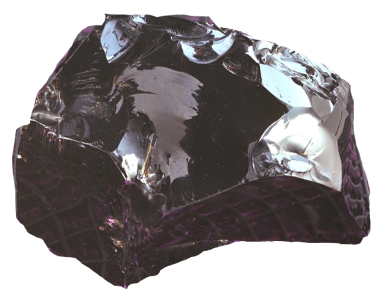
Salt processing at SRS has been suspended pending the resolution of technical issues with the original ITP salt processing facility. The Record of Decision for selecting an alternative salt processing technology is scheduled for FY01, with construction of a salt processing facility scheduled to be completed by FY10.

Sludge Processing: To Produce "Washed Sludge"

Sludge is "washed" to reduce the amount of non-radioactive aluminum and soluble salts remaining in the sludge. This ensures that the waste meets DWPF Waste Acceptance Criteria and Federal Repository requirements as well as reducing the overall volume of high-level waste to be vitrified. The processed sludge is called "washed sludge" and is sent to DWPF. During sludge processing, large volumes of wash water are generated and must be returned to the tank farms where it is volume-reduced by evaporation. Over the life of the waste removal program, the sludge currently stored in a number of tanks at SRS will be blended into a total of ten separate sludge "batches" to be processed and fed to DWPF for vitrification.

Final Processing

DWPF Vitrification

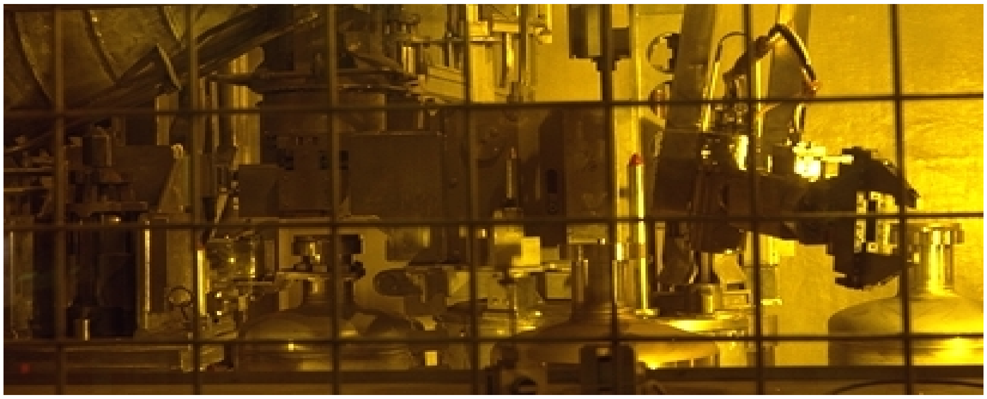


Sample of Vitrified Radioactive Glass

Final processing for the highly radioactive washed sludge and salt waste occurs at the DWPF facility. In a complex sequence of carefully controlled chemical reactions, this waste is blended with glass frit and melted at 2100 degrees Fahrenheit to vitrify it into a borosilicate glass form. The resulting molten glass is poured into 10-foot-tall, 2-foot-diameter, stainless steel canisters. As the filled canisters cool, the molten glass solidifies, immobilizing the radioactive waste within the glass structure. The vitrified waste will remain radioactive for thousands of years. After the canisters have cooled, they are permanently sealed and the external surfaces are decontaminated to meet US Department of Transportation requirements. The canisters are then ready to be stored on an interim basis on-site in the Glass Waste Storage Building, pending shipment to a Federal Repository for permanent disposal.

DWPF Canisters being received
(prior to being filled with Radioactive Glass)

Appendix K – HLW System Description



View through protective shielding of DWPF Melter Cell showing a canister being filled.

DWPF has been fully operational since FY96. By the end of FY00, it will have filled over 900 canisters. The 35 million gallons of liquid waste in the SRS tank farms are projected to produce approximately 5,700-6,000 canisters of vitrified glass. SRS is expected to complete vitrifying the existing waste by FY23.

Glass Waste Storage Building (GWSB)

Once the DWPF vitrification facility has filled, sealed and decontaminated the canisters, a Shielded Canister Transporter (SCT) moves the highly radioactive canisters from DWPF to GWSB #1 for interim storage. GWSB #1 is a standard, steel-frame building with a below-ground seismically-qualified concrete vault with vertical storage positions for 2,159 canisters. A five-foot thick concrete floor separates the storage vault from the operating area above ground. A second storage building, GWSB #2, will be constructed when GWSB #1 is filled to capacity. When the Federal Repository is opened (currently scheduled for FY10), all canisters will begin shipping with the last canisters' shipment scheduled for FY39.

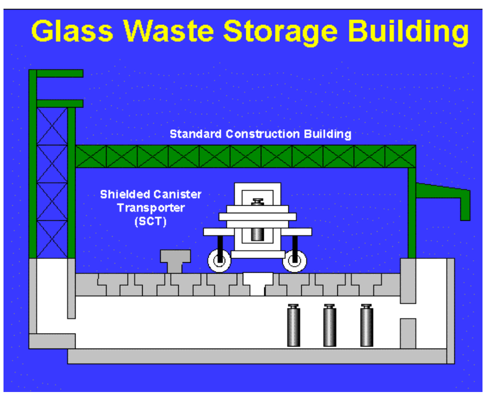


Diagram of Glass Waste Storage Building

The Shielded Canister Transporter (SCT) moves highly radioactive canisters from DWPF to the GWSB. The SCT removes a round shield plug from the floor, lowers the canister into a vertical storage position, and replaces the shield plug.

Glass Waste Storage Building (left) and Vitrification Building (right)
(Note the transporter leaving the open door of the Vitrification Building)

Appendix K – HLW System Description

Saltstone: On-site Disposal of Low-Level Waste

Final processing for the low-level "salt solution" that results from salt processing occurs at the Saltstone Facility. In the Saltstone process, this low-level waste is mixed with cement, flyash, and slag to form a grout that can be safely and permanently disposed in on-site vaults. The grout mixture is transferred to disposal vaults where it hardens into "saltstone," a non-hazardous solid. The vaults are constructed on a "just-in-time" basis, in coordination with salt processing production rates.

View of Saltstone Facility: Processing Facility in foreground, two vaults in rear.

Distribution List

DOE–HQ
Erickson, R.E. (Ralph), EM-32
Fisher, K.W. (Kurt), EM-42
Picha, K.G. (Kenneth), EM-35

DOE–SR
Aleman, S.M. (Suzanne), 703-H
Anderson, C.E. (Charlie), 703-F
Baez, A.N. (Alejendro), 703-A
Barber`, D.A. (Don), 703-H
Blanco, S.M. (Soni), 704-S
Everatt, C.A. (Carl), 704-S
Glenn, Jr, M.S. (Sam), 703-F
Gnann, H.B. (Howard), 704-S
Gutmann, T.S. (Tom), 704-S
Hansen, C.A. (Charles), 703-F
Ling, L.T. (Larry), 703-H
McCullough, Jr, J.W. (Jim), 704-3N
Pearson, W.D. (Bill)(21), 704-S
Schepens, R.J. (Roy), 704-S
Solomon, D.J. (Debbie), 704-S
Spader, W.F. (Bill), 704-S
Yarborough, R.M. (Rob), 704-S

DNFSB
Davis, R.T. (Todd), 719-14A
Ogg, D.G. (Dan)(3), 719-14A

WSRC–Sr.Staff
Becker, D.L. (Dan), 703-A
Buggy, J.J. (Joe), 703-A
Grefenstette, P.D. (Paul), 703-A
Jones, C.B. (Clay), 703-A
Pedde, R.A. (Bob), 703-A

HLWD–Staff
Campbell, P.D. (Dean), 705-A
Cwalina, A.M. (Andy), 703-H
Hay, J.B. (Joanne), 703-H
Morin, J.P. (Jerry), 703-H
Padezanin, III, T. (Ted), 703-H
Piccolo, S.F. (Steve), 703-H
Poulson, W.G. (Bill), 703-H

HLW–Pgm Mgmt
Caldwell, T.B. (Tommy), 703-H
Cathey, S.S. (Susan), 703-H
Chew, D.P. (David), 703-H
Mahoney, M.J. (Mark), 703-H
Way, K.B. (Kelly), 703-H
Wilson, W.A. (Walter), 703-H
Wise, F.E. (Frank), 703-H

HLW–Controller
Collins, M. (Mal), 703-H
Harris, T.A. (Tony), 704-67S
Ross, T.D. (Tim), 742-9G
Wiker, L.W. (Larry), 703-H

HLW–WPT
Borders, M.N. (Mike), 704-56H
Clark, Jr, W.C. (Wyatt), 704-56H
Long, B.E. (Bruce), 241-197H

HLW–WD
Wells, K.R. (Ken), 210-S
Wilson, J.W. (Jim), 704-S

HLW–CST
Barnes, J.L. (Jeff), 241-109F
Buxton, M.D. (Marybeth), 241-2H
Coleman, D.H. (David), 241-110F
Davis, Jr, W.T. (Will), 707-H
Davis, N.R. (Neil), 703-H
Green, M.J. (Michael), 742-14G
Herbert, J.E. (Jim), 241-108F
Johnson, M.D. (Mike), 703-H
Lampley, C.G. (Charles), 704-26F
Nickell, C.G. (Charles), 707-H
Runnels, R.A. (Rick), 707-H
Sherburne, D.C. (David), 241-100F
Stevens, P.H. (Pete), 703-H

HLW–SWP
Adams, R.A. (Bob), 704-3N
Hinds, Jr, R.N. (Bob), 704-3N

HLW–Maint
Handfinger, H.M. (Harvey), 704-71S
Hauer, K.A. (Kim), 241-100F
Lawson, Jr, L.G. (Gordon), 704-71S
Lucas, T.J. (Ted), 210-S
Mohammadi, M.N. (Rod), 704-71S
Rodwell, P.O. (Phil), 742-6G
Wilson, R.W. (Robert), 704-71S

HLW–Train & Proc
Chandler, T.E. (Tim), 766-H
Thompson, D.G. (Dennis), 766-H

HLW–QA
Carlson, M.K. (Mike), 704-S
Darden, K.O. (Ken), 704-S
Kuhn, R.J. (Ron), 703-H

HLWE
Allen, V.P. (Trish), 703-H
Bates, W.F. (Bill), 707-H
Beaumier, G.R. (Glenn), 707-H
Brandon, R.W. (Bob), 742-13G
Broaden, D.A. (Dave), 703-H
Burk, D.R. (Doug), 704-S
Campbell, R.M. (Ron), 703-H
Carter, J.T. (Joe), 704-3N
Cauthen, G.L. (Gary), 704-56H
Chapman, N.F. (Noel), 210-S
Cloninger, J.M. (Mack), 704-S
d'Entremont, P.D. (Paul), 703-H
Dewes, J.N. (John), 703-H
Dickert, V.G. (Ginger), 703-H
Edwards, Jr, R.E. (Richard), 704-25S
Elder, H.H. (Hank), 704-196N
Fowler, J.R. (John), 704-196N
Fowler, R.C. (Rick), 704-196N
Gillam, J.M. (Jeff), 704-27S
Hayes, Jr, C.R. (Chuck), 703-H
Hester, Jr, J.R. (Bob), 703-H
Jacobs, R.A (Roy), 704-3N
Johnson, G.M. (Gary), 742-4G
Jones, D.W. (Dan), 703-H
Jones, J.F. (Janet), 742-13G
Kerley, W.D. (Bill), 704-S
Kidd, M.S. (Mike), 742-13G
Lee, E.D. (Ernie), 241-152H
Lewis, B.L. (Brenda), 703-H
Lex, T.J. (Tom), 703-H
Liner, K.R. (Keith), 704-15S
Little, D.B. (David), 704-25S
Martin, B.A. (Bruce), 742-4G
Martin, D.J. (Dave), 703-H
Miller, M.S. (Marshall), 704-56H
Monahon, T.M. (Tom), 703-H
Newman, J.L. (Jeff)(11), 703-H
Norton, M.R. (Mike), 704-27S
Occhipinti, J.E. (John), 704-27S
Ortaldo, J.F. (Joe), 704-S
Ortner, T.L. (Terry), 704-56H
Owen, J.E. (John), 704-30S
Pike, J.A. (Jeff), 704-196N
Ray, J.W. (Jeff), 704-35S
Rueter, K.J. (Ken), 704-3N
Rutland, P.L. (Paul), 704-196N
Saldivar, Jr, E. (Eloy), 742-4G
Salizzoni, R.L. (Rich), 707-H
Saunders, S.A. (Scott), 742-4G
Schwamberger, R. (Bob), 241-100F
Sessions, J.R. (John)(4), 704-196N
Shapiro, B.J. (Bonnie), 703-H
Smith, P.K. (PK), 703-H
Subosits, S.B. (Steve), 704-196N
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