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OFFICE OF RIVER PROTECTION
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

14-WSC-0047

OCT 31 2014

Ms. Jane A. Hedges, Program Manager
Nuclear Waste Program
Washington State
Department of Ecology
3100 Port of Benton Blvd
Richland, Washington 99354

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Ms. Hedges:

U.S. DEPARTMENT OF ENERGY, OFFICE OF RIVER PROTECTION SUBMITTAL OF ORP-11242, *RIVER PROTECTION PROJECT SYSTEM PLAN*, REV. 7 IN COMPLETION OF HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER MILESTONE M-062-40D

References:

1. RPP-56408, *Selected Scenarios for the River Protection Project System Plan, Revision 7*, Rev. 0, Washington River Protection Solutions LLC, dated December 2013.

2. ORP letter K.W. Smith and J.A. Hedges, Ecology, to D.A. Faulk, EPA, "Completion of Hanford Federal Facility Agreement and Consent Order Milestone M-062-40C, to Select a Minimum of Three Scenarios and Partial Completion of Milestone M-062-40," 13-TPD-0070, dated December 12, 2013.

3. Federal Facility Agreement and Consent Order Change Control Form, originated by T.W. Fletcher, U.S. Department of Energy, Office of River Protection, Richland, Washington, M-62-13-02, dated October 24, 2013.

The U.S. Department of Energy (DOE), Office of River Protection (ORP) is submitting the enclosed ORP-11242, *River Protection Project System Plan*, Rev. 7, issued on October 31, 2014 (hereinafter, referred to as SP7), pursuant to the requirements of *Hanford Federal Facility Agreement And Consent Order* (HFFACO) Milestone M-062-40D.

Milestone M-062-40D requires, in part, that the DOE "Submit a System Plan to Ecology…" and that the System Plan be submitted, "Beginning October 31, 2011, and every three years thereafter…" This letter documents the submittal of SP7 to Ecology by October 31, 2014. Appendix D of SP7 demonstrates how the System Plan meets the additional requirements of Milestone M-062-40.

The SP7 describes the disposition of all tank waste managed by ORP, including the retrieval of all tanks not addressed by the Consent Decree and the completion of the treatment mission. In comparison to System Plans previously submitted by DOE, both prior to and after implementation of HFFACO Milestone M-062-40, this SP7 is unique in that a current baseline

M-062-40D, 1222507

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was not evaluated. The five presented cases in SP7 are all what-if cases with outcomes based on key assumptions selected by the Washington State Department of Ecology (Ecology). Results from the five cases were compared to the success criteria defined in Appendix B for each case.

Initial discussions, regarding SP7 between Ecology and ORP began on June 10, 2013 (Reference 1). On October 24, 2013, ORP notified Ecology of the decision to not select or define scenarios for SP7 (Reference 3).

Ecology selected and defined five what-if scenarios to be evaluated for SP7. During the selection of scenarios, Ecology reviewed, accepted, and approved the *Model Starting Assumptions for System Plan 7* and later developed case-specific detail assumptions and distinguishing features for all five cases (References 1 and 2).

SP7 presents the analysis and results of Ecology's selected and defined cases and comparative lifecycle cost analysis.

If you have any questions, please contact DaBrisha Smith at (509) 376-4306.

Kevin W. Smith
Manager FOR

Attachment

cc w/attach:
Administrative Record
WRPS Correspondence Control

cc w/o attach:
S. Harris, CTUIR
J.J. Lyon, Ecology
J.D. McDonald, Ecology
N.H. Uziemblo, Ecology
C.L. Whalen, Ecology
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G. Bohnee, NPT
K. Niles, ODOE
L.E. Thompson, WRPS
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T.L. Waldo, WRPS
R. Jim, YN
Environmental Portal, LMSI

ATTACHMENT

14-WSC-0047

ORP-11242

RIVER PROTECTION PROJECT SYSTEM PLAN

REV. 7

Date Received for Clearance Process (MM/DD/YYYY)
11/03/2014

INFORMATION CLEARANCE FORM

A. Information Category

- [ ] Abstract
- [ ] Journal Article
- [ ] Summary
- [ ] Internet
- [ ] Visual Aid
- [ ] Software
- [ ] Full Paper
- [x] Report
- [ ] Other N/A

B. Document Number ORP-11242 Revision 7

C. Title
River Protection Project System Plan

D. Proposed Internet Address N/A

E. Required Information (MANDATORY)

1. Is document potentially Classified? (●) No ( ) Yes

Ben J. Harp
Manager Required (Print and Sign)

If Yes N/A
ADC Required (Print and Sign) ( ) No ( ) Yes Classified

2. Official Use Only (●) No ( ) Yes Exemption No. ____
3. Export Controlled Information (●) No ( ) Yes OUO Exemption No. 3
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5. Applied Technology (●) No ( ) Yes OUO Exemption No. 5
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H. Information Owner/Author/Requestor
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Approval by Direct Report to President (Speech/Articles Only) N/A
(Print and Sign)

I. Reviewers

	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	[x]	Scott D. Stubblebine		(Y) / N
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DOE	[ ]	DOE-ORP:See signature page		Y / N
Other	[x]	Brian A. Harkins	11/5/14	(Y) / N
Other	[ ]			Y / N
Other	[ ]			Y / N

J. Comments

Information Clearance Approval
APPROVED
By GE Bratton at 2:23 pm, Nov 05, 2014

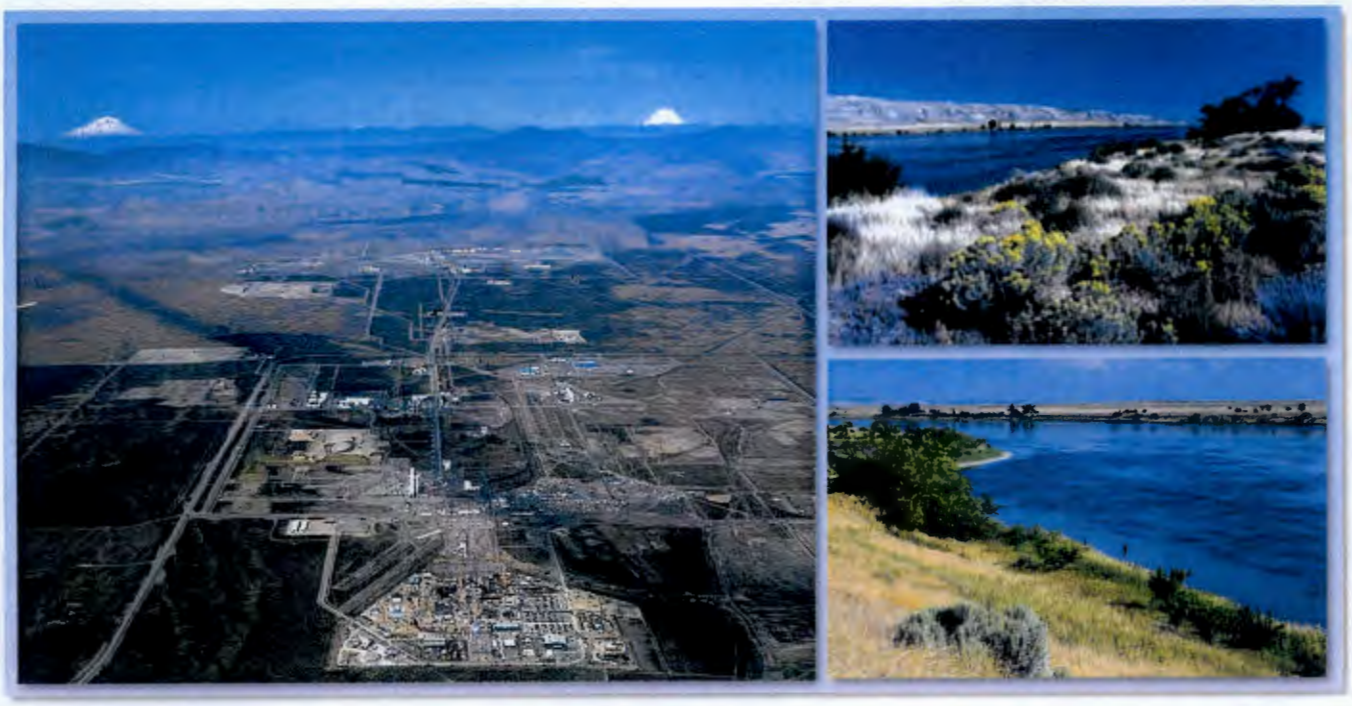
Approved for Public Release; Further Dissemination Unlimited

If Additional Comments, Please Attach Separate Sheet

A-6001-401 (REV 5)

ORP-11242
Revision 7

RIVER PROTECTION PROJECT SYSTEM PLAN



Retrieve and Treat Hanford's Tank Waste and
Close the Tank Farms to Protect the Columbia River

River Protection Project System Plan

Date Published:
October 2014

P.O. Box 450
Richland, Washington 99352

APPROVED
By GE Bratton at 2:24 pm, Nov 05, 2014

Release Approval | Date

**Approved for Public Release;
Further Dissemination Unlimited**

DISCLAIMERS

Some of the activities described herein may be subject to the analysis required by the National Environmental Policy Act, 42 USC §4321, et seq. They are included within this document for planning purposes only, not for decisional purposes.

System Plan, Rev. 7 is being submitted in accordance with *Hanford Federal Facility Agreement and Consent Order* (HFFACO, Ecology et al. 1989) milestone M-062-40 and describes the disposition of all tank waste managed by the U.S. Department of Energy (DOE), Office of River Protection (ORP), including the retrieval of tanks not addressed by the Consent Decree in State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (E.D. WA, October 25, 2010) and the completion of the treatment mission as depicted in the five scenarios selected by Washington State Department of Ecology (Ecology). These five scenarios were selected and defined solely by Ecology without modification by DOE. ORP elected to not select or define scenarios for evaluation in System Plan, Rev. 7. In comparison to System Plans previously submitted by DOE both prior to and after implementation of HFFACO milestone M-062-40, this System Plan, Rev. 7 is unique in that a current baseline was not evaluated.

The five presented cases selected and defined by Ecology for evaluation in System Plan, Rev. 7 are all what-if cases with outcomes that are based on certain key assumptions approved by Ecology, do not reflect the current status of ORP's mission, and do not reflect a complete and adequate understanding of assumptions of facility interim and startup dates associated with resolution of technical issues with the Waste Treatment and Immobilization Plant and the need to establish new or revised baselines for key project components.

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OFFICE OF RIVER PROTECTION

RIVER PROTECTION PROJECT SYSTEM PLAN

For

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HISTORY SHEET

Revision	Date	Reason for Revision	Revised By
0	August 2002	Initial issuance.	K.R. Wells
1	April 2003	Reflect proposed changes and additions to the waste treatment processes and facilities to accelerate mission completion.	K.R. Wells
2	September 2003	Reflect a Target Case, which depicts the mission based on how the U.S. Department of Energy, Office of River Protection expects the Waste Treatment and Immobilization Plant (WTP) to perform and a Stretch Case, which depicts the mission if significant increases in both WTP and non-WTP low-activity waste (LAW) treatment performance are realized.	P.J. Certa
3	May 2008	Reflects a Reference Case, which depicts a mission scenario based on beginning full WTP operations in 2019, in conjunction with supplemental LAW treatment and supplemental transuranic packaging. Generally aligned with key features of the fiscal year 2007 baseline.	P.J. Certa
3A	July 2008	Incorporate comments from the Office of Management and Budget.	P.J. Certa
4	September 2009	Reflects a Baseline Case consistent with the Performance Management Baseline. An Initial Planning Case consistent with the interim and draft Performance Measurement Baseline under the new Tank Operations Contract and an Unconstrained Case are used to evaluate program impacts against assumed *success criteria*.	M.N. Wells
5	November 2010	Reflects a Baseline Case, which provides the technical basis for the Performance Measurement Baseline, and a Sensitivity Case in which all potential transuranic tank waste is processed through WTP.	M.N. Wells

Revision	Date	Reason for Revision	Revised By
6	October 2011	Reflects a Baseline Case, which provides the technical basis for the Performance Measurement Baseline, and nine additional scenarios jointly selected by the Office of River Protection and the Washington State Department of Ecology to meet the requirements of Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989) milestone M-062-40.	M.N. Wells
7	October 2014	Utilizes the Baseline Case originally presented in System Plan, Rev. 6, plus five additional scenarios selected and defined by the Washington State Department of Ecology only, in order to meet the requirements of Hanford Federal Facility Agreement and Consent Order milestone M-062-40D.	M.N. Wells

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE), Office of River Protection (ORP), manages the River Protection Project. The mission of the River Protection Project is to retrieve and treat Hanford's tank waste and close the tank farms to protect the Columbia River. As a result, the Office of River Protection is responsible for the retrieval, treatment, and disposal of approximately 56 million gallons[1] of radioactive waste contained in the Hanford Site waste tanks and closure of all tanks and the associated equipment.

System Plan, Rev. 7 is being submitted in accordance with *Hanford Federal Facility Agreement and Consent Order* (HFFACO, Ecology et al. 1989) milestone M-062-40 and describes the disposition of all tank waste managed by the U.S. Department of Energy (DOE), Office of River Protection (ORP), including the retrieval of tanks not addressed by the Consent Decree in State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (E.D. WA, October 25, 2010) and the completion of the treatment mission as depicted in the five scenarios selected by Washington State Department of Ecology (Ecology). These five scenarios were selected and defined solely by Ecology without modification by DOE. ORP elected to not select or define scenarios for evaluation in System Plan, Rev. 7. In comparison to System Plans previously submitted by DOE both prior to and after implementation of HFFACO milestone M-062-40, this System Plan, Rev. 7 is unique in that a current baseline was not evaluated.

The five presented cases selected and defined by Ecology for evaluation in System Plan, Rev. 7 are all what-if cases with outcomes that are based on certain key assumptions approved by Ecology, do not reflect the current status of ORP's mission, and do not reflect a complete and adequate understanding of assumptions of facility interim and startup dates associated with resolution of technical issues with the Waste Treatment and Immobilization Plant and the need to establish new or revised baselines for key project components.

Background

The ORP strategy[2] for completing the River Protection Project mission involves a number of interrelated activities and facilities. ORP will reduce risk to the environment posed by tank wastes by:

- Retrieving the waste from the single-shell tanks and delivering the waste to the WTP.
- Constructing and operating WTP, which includes a Pretreatment Facility; a Low-Activity Waste Facility; a High-Level Waste Facility; an Analytical Laboratory; and the balance of facilities, which provides supporting services, like utilities.
- Evaluating supplemental treatment capability, which analysis includes for purposes of this SP7 a second low-activity waste vitrification facility, as set forth in the State's defined scenarios, to treat the remainder of the low-activity waste fraction not immobilized by the Low-Activity Waste Facility.

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[1] Refer to HNF-EP-0182, *Waste Tank Summary Report for Month Ending April 30, 2014*, Rev. 316. The total volume of tank waste fluctuates over time because water and chemicals may be added to tanks to facilitate waste retrieval processes; water is also removed by evaporation.

[2] Some of the activities described herein may be subject to analysis required by the *National Environmental Policy Act of 1969* and are included in this document for planning purposes only, not for decisional purposes.

- Developing and deploying supplemental pretreatment capability.
- Developing and deploying treatment and packaging capability for potential transuranic tank waste, followed by interim storage at the Central Waste Complex pending determination of the final disposal pathway.
- Deploying interim storage capacity for the immobilized high-level waste pending determination of the final disposal pathway.[3]
- Disposing of packaged immobilized low-activity waste onsite at the Integrated Disposal Facility.
- Closing the single-shell and double-shell tank farms, ancillary facilities, and associated waste management and treatment facilities.
- Optimizing the overall mission with resolution of technical and programmatic uncertainties; upgrading the tank farms to provide a steady, well-balanced feed to WTP.

As opportunities arise to improve project and plant performance or reduce risk, changes are made to the Tank Operations Contract or the WTP Contract, as appropriate. Implementation of these changes is managed through the Baseline Change Request process.

The HFFACO[4], also known as the Tri-Party Agreement, was signed by DOE, Ecology, and the U.S. Environmental Protection Agency in 1989. This comprehensive agreement includes milestones for regulatory compliance and environmental remediation. Between 2007 and 2009, DOE and Ecology negotiated new and revised HFFACO milestones, along with new milestones in a Consent Decree[5] filed in federal district court. That Consent Decree resolved a lawsuit filed in 2008 by the State of Washington against DOE. Both the Consent Decree and HFFACO changes became effective on October 25, 2010, the date the Consent Decree was entered into federal court. One of the new HFFACO milestones, M-062-40, requires ORP to prepare a System Plan every 3 years.

Purpose

This revision of the River Protection Project System Plan (Rev. 7) is an update to the previous revision (Rev. 6) issued in October 2011. SP7 satisfies the requirements of HFFACO milestone M-062-40D. The Office of River Protection's Baseline Case is the same case as was previously used in System Plan, Rev. 6. For purposes of SP7, the term Baseline Case refers to a reference case that is modified with additional Ecology-defined assumptions to define additional scenarios. SP7 does not form the technical basis for either the near-term baseline or the out-year planning estimate range because of uncertainties in the baseline as a result of currently unresolved technical issues at WTP. Additionally, ORP elected not to select or define any cases for this SP7.

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[3] Office of River Protection planning, with regard to final disposal of immobilized high-level waste, is subject to recognition of uncertainties with regard to an assumed, planned offsite geologic repository.

[4] Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement,* as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

[5] Consent Decree, 2010, State of Washington v. DOE, Case No. 08-5085-FVS (October 25), Eastern District of Washington.

In accordance with the milestone, SP7 presents results for five scenarios (Cases 1 through 5) selected and defined by Ecology. These cases, as described by Ecology and are as follows:

- Case 1 – Consent Decree Compliant Case
- Case 2 – Direct Feed Low-Activity Waste and Direct Feed High-Level Waste Flowsheet
- Case 3 – Contingency Case for Waste Treatment and Immobilization Plant Startup Uncertainty
- Case 4 – Leaking Tanks
- Case 5 – Consequences of Limited Funding.

A hierarchy of assumptions underpins the scope of each case. Success criteria, or metrics, used to determine how well a case meets overall mission goals or requirements, were selected from HFFACO or Consent Decree milestones. ORP directed its contractor, Washington River Protection Solutions LLC, to model the five cases selected and defined by Ecology for SP7 in accordance with the key assumptions and success criteria also selected by Ecology (see Appendix B). Washington River Protection Solutions LLC modeled the cases using the Hanford Tank Waste Operations Simulator and wrote the System Plan document.

Case 1 utilizes the same River Protection Project flowsheet as was used in System Plan, Rev. 6, in which the tank farm waste is fed first to the Pretreatment Facility, which pretreats and separates the waste into a low-activity waste stream, to be treated at the Low-Activity Waste Facility, and a high-level waste stream, to be treated at the High-Level Waste Facility. In contrast, Cases 2 through 5 present variations of a direct-feed flowsheet, in which operation of the Pretreatment Facility is deferred until technical issues are resolved, while staggered radioactive operations begin first at the Low-Activity Waste Facility, and later at the High-Level Waste Facility. Note that a new Low-Activity Waste Pretreatment System and a new Tank Waste Characterization and Staging Facility would be needed to support this flowsheet. However, this arrangement allows the tank farm waste treatment to begin earlier than would be possible if DOE waited to begin treatment until the technical issues with the Pretreatment Facility's issues are resolved and waste could first be pretreated through the Pretreatment Facility.

In order to provide the reader with additional context for the cases evaluated, the System Plan also includes a detailed description of the current state of the River Protection Project's facilities and supporting functions; a brief overview of the ORP regulatory environment; and an overview of recent planning improvements and facility accomplishments. Refer to Sections 1.0 and 3.0, respectively. The case-specific modeling results appear in Section 4.0. In accordance with HFFACO milestone M-062-40, Section 5.0 of the System Plan identifies and considers possible contingency measures for each of the cases selected by Ecology. Cited references are listed in Section 6.0.

The appendices contain additional useful information. Appendix A includes a glossary. Appendix B provides the detailed assumptions used to model the cases. Appendix C includes a detailed description of the various computer models used to develop the System Plan, as well as other related planning documents.

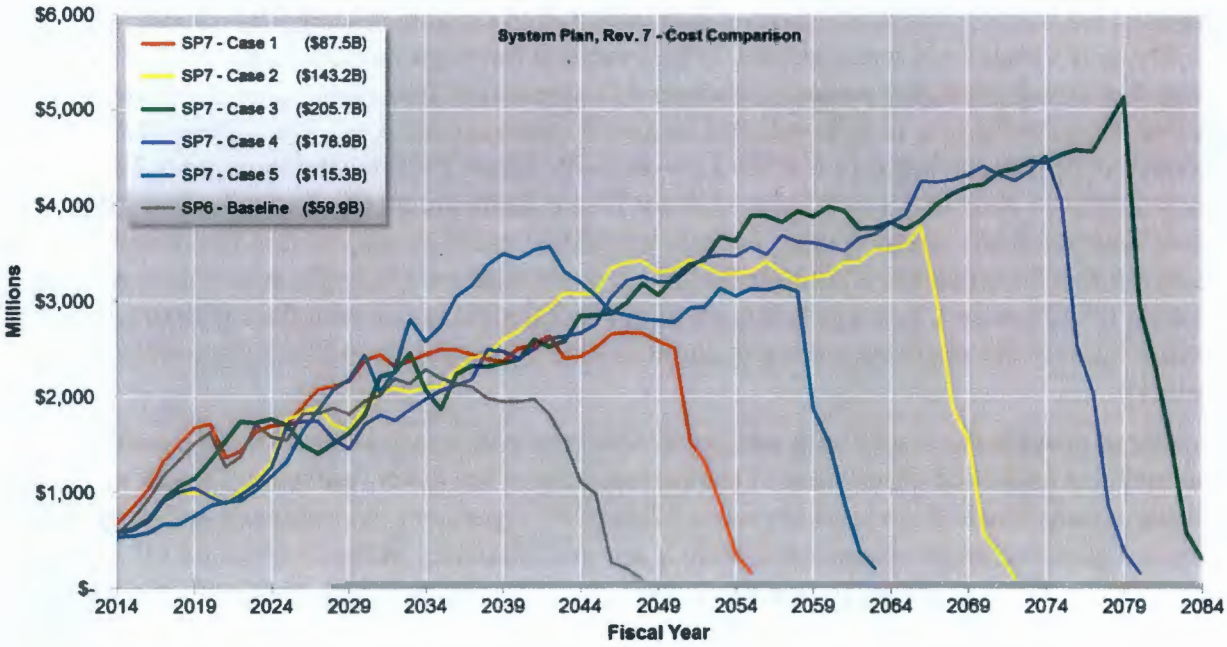
Additionally, in order to demonstrate compliance with the milestone, Appendix D contains a crosswalk from each specific system-planning requirement in the milestone to each section of the document that implements that requirement.

Results

The modeling results are compared to the success criteria defined in Appendix B for each case and are briefly summarized in Figure ES-1, Table ES-1, and Table ES-2. Detailed case-specific system descriptions; planning bases; projected results, including cost and schedule impacts; and key issues and vulnerabilities are provided in Section 4.0.

Lifecycle cost profile estimates were generated for SP7's Cases 1 through 5, and are shown individually in each case results summary section (Figure 4-11, Figure 4-26, Figure 4-37, Figure 4-48, and Figure 4-59, respectively). Refer to those figures and Sections 4.n.4 (n representing the case number) for a detailed cost analysis of each case. However, in order to gain an overall perspective on the relative cost and schedule impacts, Figure ES-1 presents the lifecycle cost profiles for all five SP7, cases, plus the System Plan, Rev. 6, Baseline Case. Additionally, Table ES-1 shows the key factors influencing the lifecycle cost. Overall modeling results are highlighted in Table ES-2.

Figure ES-1. Lifecycle Cost Comparison.



In all cases, where activity schedules show delayed starts or extended durations, costs increase with escalation. The later a facility starts and the longer it operates, the higher the lifecycle cost.

The planned start dates for the three primary WTP waste processing facilities are pivotal to long-term costs and schedules. Not only do the costs directly associated with the plant's facilities increase when start dates are delayed (caused by escalation), the costs associated with supporting facilities also increase for the same reason because their construction and operations schedules are tied to the dates the WTP facilities are needed.

Table ES-1. Key Factors Affecting Lifecycle Cost.

Key Cost Variance Factors	System Plan (Rev. 6) Baseline	System Plan (Rev. 7)				
		Case 1	Case 2	Case 3	Case 4	Case 5
SST/DST Items						
SST Retrieval Water Usage	SVF-1647 Rev. 3da (Basis)	SVF-1647 Rev. 5b (Increase)	SVF-1647 Rev. 5b (Increase)	SVF-1647 Rev. 5b (Increase)	SVF-1647 Rev. 5b (Increase)	SVF-1647 Rev. 5b (Increase)
SST Retrieval Timing	Basis	Projected to Start Later	Projected to Start Later	Projected to Start Later	Projected to Start Later	Projected to Start Later
Farm Closure Timing	Basis	Projected to End Later	Projected to End Much Later (Tied to TWCSF Size)	Projected to End Much Later (Tied to TWCSF Size)	Projected to End Much Later (Tied to TWCSF Size)	Projected to End Later
DST 241-AY-102 Retrieval Included	No	Yes	Yes	Yes	Yes	Yes
Loss of DSTs for Use (Other than 241-AY-102)	N/A	N/A	N/A	N/A	5	N/A
New DSTs	No	No	No	42	No	8
DST Equipment Installation Timing	Basis	Slight Delay	Slight Delay	Slight Delay	Slight Delay	Significant Delay
Waste Treatment Items						
WTP Startup	Together	Together	Staggered	Staggered	Staggered	Staggered
Timing of WTP Startup	Basis	Basis	Delay	Significant Delay	Delay	Delay
LAWPS/TWCSF Included	No	No	Yes	Yes	Yes	Yes
TWCSF Tank Size	N/A	N/A	250 kgal	250 kgal	250 kgal	500 kgal
Treatment Duration (WTP PT to Endc)	23 years	31 years	39 years	47 years	47 years	29 years
Model and Cost Basis Items						
Modeling Assumptions Basis	FY 2011	FY 2014	FY 2014	FY 2014	FY 2014	FY 2014
PMB Used	FY 2011	FY 2014	FY 2014	FY 2014	FY 2014	FY 2014
Mission Duration (Starting FY 2014)	34 years	42 years	57 years	70 years	66 years	49 years

a SVF-1647, 2011, "SVF 1647 Rev 3D Calculation of SST Retrieval Volumes and Durations.xlsx," Rev. 3D, Washington River Protection Solutions LLC, Richland, Washington.

b SVF-1647, 2014, "SVF 1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx," Rev. 5, Washington River Protection Solutions LLC, Richland, Washington.

c Cases 2 through 5 start partial treatment (WTP LAW) earlier than PT Facility operations. The duration between the start of LAW Facility operations and the start of PT Facility operations is as follows: Case 2 = 6 years, Case 3 = 5 years, Case 4 = 6 years, Case 5 = 7 years.

DST	double-shell tank	PMB	Performance Measurement Baseline
FY	fiscal year	PT	pretreatment
LAW	low-activity waste	SST	single-shell tank
LAWPS	Low-Activity Waste Pretreatment System	TWCSF	Tank Waste Characterization and Staging Facility
N/A	not applicable	WTP	Waste Treatment and Immobilization Plant

Table ES-2. System Plan, Rev. 7, Highlights.[6]

Metric (Milestone)	Success Criteria	System Plan (Rev. 6) Baseline Case	System Plan (Rev. 7) Scenarios				
			Case 1 – Consent Decree Compliant Case	Case 2 – DFLAW & DFHLW Flowsheet	Case 3 – Contingency for WTP Startup Uncertainty	Case 4 – Leaking Tanks	Case 5 – Consequences of Limited Funding
Lifecycle Cost, FY 1997 to End of Mission	$61.5B[a]	$59.9B	$87.5B	$143.2B	$205.7B	$178.9B	$115.3B
Meets Near-Term Funding Targets Through 2015	$1,320M/$970M	$1,280M	$1,526M	$1,190M	$1,206M	$1,170M	$940M
Meets Near-Term Funding Profile Through 2015	Notes b, c, d	Yes	No	Yes	Yes	Yes	Yes
Complete 241-C Tank Farm Retrievals (B-1)	09/30/2014	12/21/2013	September 2014	September 2014	September 2014	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	12/31/2017	07/23/2017	November 2017	December 2017	December 2017	December 2017	September 2017
Close WMA-C (M-045-83)	06/30/2019	11/09/2018	June 2019	November 2022	November 2022	November 2022	February 2036
Complete Nine Additional SST Retrievals (B-4)	09/30/2022	12/16/2020	July 2019	July 2025	July 2022	May 2034	August 2027
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)[e]	09/30/2022	–	February 2020	March 2038	August 2033	April 2034	July 2029
Complete all SST Retrievals (M-045-70)	12/31/2040	09/08/2039	May 2044	January 2054	January 2058	January 2066	May 2047
Close all SSTs (M-045-00)	01/31/2043	10/05/2043	December 2048	August 2058	May 2063	March 2070	August 2051
Treat all Tank Waste (M-06200)	12/31/2047	04/23/2043	August 2050	March 2067	October 2079	May 2075	August 2058
Close all DSTs (M-042-00A)	09/30/2052	03/18/2048	August 2055	January 2072	August 2084	March 2080	May 2063
Complete Potential TRU Tank Waste Packaging	–	07/13/2023	July 2025	July 2025	N/A	N/A	N/A
HLW Glass Mass (MTG)	–	31,968	30,845	30,749	32,306	32,586	33,205
HLW Glass Canisters	–	10,586	10,214	10,183	10,618	10,791	10,996
HLW Glass Waste Oxide Loading	–	36.9%	35%	36%	36%	37%	35%
LAW Glass Mass (MTG)	–	527,838	687,187	678,251	682,419	656,419	663,345
LAW Glass Containers	–	95,825	124,753	123,131	123,888	119,169	120,425
LAW Glass Sodium Oxide Loading	–	17.8%	16%	16%	16%	16%	16%
Sodium Reporting to LAW Glass (MT)	–	69,659	79,056	78,809	79,109	78,243	78,829
Potential TRU Tank Waste Drums	–	7,492	8,285	8,243	N/A	N/A	N/A

[6] System Plan, Rev. 7 (SP7) is being submitted in accordance with *Hanford Federal Facility Agreement and Consent Order* (HFFACO) milestone M-062-40 and describes the disposition of all tank waste managed by the U.S. Department of Energy (DOE), Office of River Protection (ORP), including the retrieval of tanks not addressed by the Consent Decree in State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (E.D. WA, October 25, 2010) and the completion of the treatment mission as depicted in the five scenarios selected by the Washington State Department of Ecology (Ecology). These five scenarios were selected and defined solely by Ecology without modification by DOE. ORP elected to not select or define scenarios for evaluation in SP7. In comparison to System Plans previously submitted by DOE both prior to and after implementation of HFFACO milestone M-062-40, this SP7 is unique in that a current baseline was not evaluated.

The five presented cases selected and defined by Ecology for evaluation in SP7 are all what-if cases with outcomes that are based on certain key assumptions approved by Ecology, do not reflect the current status of ORP's mission, and do not reflect a complete and adequate understanding of assumptions of facility interim and startup dates associated with resolution of technical issues with the Waste Treatment and Immobilization Plant and the need to establish new or revised baselines for key project components.

Notes:
BOLD RED text indicates a figure or date that does not meet the success criteria.
All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.
Lifecycle costs for Cases 1 through 5 were developed using the Tank Operations Contract cost model. Lifecycle cost figures in the System Plan are used for comparative purposes only, and do not reflect the current approved Performance Measurement Baseline.
The System Plan, Rev. 6 (SP6), Lifecycle Cost Model is based on Performance Measurement Baseline output from FY 2011. The System Plan, Rev. 7 (SP7), Lifecycle Cost Model is based on Performance Measurement Baseline output from FY 2014.

a Lifecycle cost success criteria apply to Case 1 through 4 and SP6, Baseline Case.
b Near-term funding targets for Cases 1 through 4 and SP6, Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million; Total FY 2014 through FY 2015 = $1,320 million.
c Near-term funding targets for Case 5 are: FY 2014 = $460 million; FY 2015 = $510 million; Total FY 2014 through FY 2015 = $970 million. Values for Case 5 do not include the U.S. Department of Energy, Office of River Protection costs or Effluent Treatment Facility costs. It was required to transfer $35 million from the Waste Treatment and Immobilization Plant Contract to the Tank Operations Contract to meet the FY 2014 target.
d SP6, Near-Term Success Criteria for FY 2011 through FY 2015 = $2,750 million. SP6, Baseline Case near-term cost for FY 2011 through FY 2015 = $2,440 million. Near-term values shown in this table reflect success criteria and values as a summation of FY 2014 and FY 2015.
e The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7, Assumption B4.1.1.2.

DFHLW	direct feed high-level waste	HLW	high-level waste	MTG	metric tons of glass	TRU	transuranic
DFLAW	direct feed low-activity waste	LAW	low-activity waste	N/A	not applicable	WMA-C	C Farm Waste Management Area
DST	double-shell tank	MT	metric ton	SST	single-shell tank	WTP	Waste Treatment and Immobilization Plant
FY	fiscal year						

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TERMS

Acronyms

ATL	Advanced Technologies and Laboratories International, Inc.
BDGRE	buoyant displacement gas release event
BNI	Bechtel National, Inc.
BOF	balance of facilities
CD	critical decision
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CH-TRU	contact-handled transuranic
CHPRC	CH2M HILL Plateau Remediation Company
CWC	Central Waste Complex
DFHLW	direct feed high-level waste
DFLAW	direct feed low-activity waste
DOE	U.S. Department of Energy
DSGRE	deep sludge gas release event
DST	double-shell tank
Ecology	Washington State Department of Ecology
EIS	environmental impact statement
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
GFM	glass formulation model
HFFACO	Hanford Federal Facility Agreement and Consent Order
HGR	hydrogen generation rate
HIHTL	hose-in-hose transfer line
HLW	high-level waste
HSF	Hanford Shipping Facility
HTRH	hard-to-remove heel
HTWOS	Hanford Tank Waste Operations Simulator
ICD	Interface Control Document
ICD-19	24590-WTP-ICD-MG-01-019, ICD 19 – Interface Control Document for Waste Feed
IDF	Integrated Disposal Facility
IHLW	immobilized high-level waste
IHS	Interim Hanford Storage
ILAW	immobilized low-activity waste
IMUST	inactive miscellaneous underground storage tank
IPT	integrated project team
ISM	Integrated Solubility Model
IWFDP	Integrated Waste Feed Delivery Plan
IX	ion exchange

JCO	Justification for Continued Operation
LAW	low-activity waste
LAWPS	Low-Activity Waste Pretreatment System
LCM	Lifecycle Cost Model
LERF	Liquid Effluent Retention Facility
LLW	low-level waste
M	Manual
MARS	Mobile Arm Retrieval System
MLLW	mixed low-level waste
MUST	miscellaneous underground storage tank
ORP	U.S. Department of Energy, Office of River Protection
ORP-14/14X	U.S. Department of Energy's Congressional Budget Office line item numbers ORP-0014 and HG-HLW-0014X
PMB	Performance Measurement Baseline
PNNL	Pacific Northwest National Laboratory
PT	Pretreatment (Facility)
R&OMP	Risk and Opportunity Management Plan
RAMI	reliability/availability/maintainability/inspectability
RCRA	*Resource Conservation and Recovery Act of 1976*
RDF	retrieval duration factor
RL	U.S. Department of Energy, Richland Operations Office
ROD	Record of Decision
RPP	River Protection Project
SALDS	State-Approved Land Disposal Site
SCIX	small-column ion exchange
SLWT	secondary liquid waste treatment
SP6	System Plan, Rev. 6
SP7	System Plan, Rev. 7
SST	single-shell tank
SSTIP	Single-Shell Tank Integrity Project
TC & WM	Tank Closure and Waste Management
TOC	Tank Operations Contract
TOE	total operating efficiency
TPA	Tri-Party Agreement
TRU	transuranic
TRUM	transuranic mixed
TWCSF	Tank Waste Characterization and Staging Facility
TWDIF	Tank Waste Disposition Integrated Flowsheet
TWRWP	Tank Waste Retrieval Work Plan
WAC	waste acceptance criteria
WESF	Waste Encapsulation and Storage Facility
WFD	waste feed delivery

WIPP	Waste Isolation Pilot Plant
WMA-C	C Farm Waste Management Area
WOL	waste oxide loading
WRF	Waste Receiving Facility
WRPS	Washington River Protection Solutions LLC
WTP	Waste Treatment and Immobilization Plant

Units

ft	feet
FY	fiscal year
gal	gallon
kgal	kilogallons
L	liter
MCi	millicurie
Mgal	million gallons
MT	metric ton
MTG	metric tons of glass
wt%	weight percent

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1.0 INTRODUCTION

One of the world's largest environmental cleanup projects is underway at the Hanford Site in Washington State. A fully integrated system of waste storage, treatment, and disposal facilities is in varying stages of design, construction, operation, or future planning. ORPs mission is to safeguard the nuclear waste stored in Hanford's 177 underground tanks, and to manage the waste safely and responsibly until it can be treated in the Waste Treatment and Immobilization Plant for final disposition. Many challenges must be met to achieve site cleanup and closure.[7]

1.1 FEDERAL OFFICES AND PRIME CONTRACTS

The U.S. Department of Energy (DOE) has three federal offices that conduct environmental management activities at Hanford. The DOE Office of River Protection (ORP) is responsible for cleanup of Hanford Site tank waste. The DOE Richland Operations Office (RL) is responsible for nuclear waste and facility cleanup and overall management of the Hanford Site. The Office of Science manages the Pacific Northwest National Laboratory (PNNL). Each DOE office oversees separate contracts held by various government contractors.

At this time, ORP manages three prime contracts within the River Protection Project (RPP):

- The Tank Operations Contract (TOC) (DE-AC27-08RV14800, *Washington River Protection Solutions LLC*), held by Washington River Protection Solutions LLC (WRPS), includes the construction, operation, and maintenance activities necessary to store, retrieve, and transfer tank wastes; provide supplemental pretreatment for tank waste; provide treatment, storage, and/or disposal of glass product and secondary waste streams; and provide Waste Treatment and Immobilization Plant (WTP) support to ORP.
- The WTP Contract (DE-AC27-01RV14136, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*), held by Bechtel National, Inc. (BNI), includes the design, construction, and commissioning of a pretreatment facility, two vitrification facilities (one for high-level waste [HLW] and one for low-activity waste [LAW]),[8] a dedicated laboratory, and supporting facilities to treat

[7] Selected terms are hyperlinked to definitions provided in the Glossary in Appendix A.

[8] The U.S. Department of Energy (DOE) has not yet made a waste determination under DOE O 435.1, *Radioactive Waste Management*, for tank waste; as a result, the tank waste is managed as if it is high-level waste (HLW). As used in this System Plan, Rev. 7, the term *high-level waste* has the meaning set forth in the *Nuclear Waste Policy Act of 1982* definition of HLW. This waste will contain insoluble radionuclides associated with tank waste sludge as well as cesium (principally cesium-137) removed from the liquid waste by ion exchange. The HLW stream will contain over 90 percent of the radioactivity associated with the tank waste. It will be vitrified, interim stored onsite, and will be ultimately disposed of in an appropriate repository. The low-activity waste (LAW) stream refers to the soluble fraction of the tank waste from which most of the radioactivity has been removed by filtration and ion exchange and which has been formally determined by DOE in consultation with the U.S. Nuclear Regulatory Commission (NRC) to not be HLW using the waste incidental to reprocessing (WIR) evaluation process set forth in DOE M 435.1-1, *Radioactive Waste Management Manual*. The Waste Treatment and Immobilization Plant (WTP) will immobilize a portion of the LAW into glass for disposal onsite in the Integrated Disposal Facility. DOE has not yet determined how it will immobilize the fraction of LAW that cannot be vitrified in the WTP. DOE is also considering whether some sludge waste in certain tanks is not HLW on the basis of its radioactive characteristics and its origin. This waste could potentially be determined to be contact-handled transuranic waste as defined in *The*

radioactive tank wastes by immobilizing them into glass for long-term storage or final disposal.

- The 222-S Laboratory Analytical Services and Testing contract (DE-AC27-10RV15051, *Laboratory Analytical Services and Testing Contract*) held by Advanced Technologies and Laboratories International, Inc. (ATL) includes operation of the site's primary laboratory for highly radioactive samples in support of cleanup and closure activities.

The facilities and activities described in this System Plan, Rev. 7 (SP7) are primarily the responsibility of ORP. Interfaces with RL facilities and activities are described where appropriate.

1.2 SYSTEM PLAN PURPOSE

The primary purpose of this document, hereinafter referred to as the SP7, is to evaluate scenarios selected and defined by the Washington State Department of Ecology (Ecology) using modeling assumptions also selected by Ecology for the disposition of all tank waste managed by ORP and the completion of the treatment mission as required by *Hanford Federal Facility Agreement and Consent Order* (HFFACO, Ecology et al. 1989) milestone M-062-40. The HFFACO (also known as the Tri-Party Agreement [TPA][9]) outlines requirements known as milestones. Milestone M-062-40 states (in part):

> ...Every three years...Ecology and DOE will each have the right to select a minimum of three scenarios that will be analyzed in the System Plan...

The scenarios evaluated in this SP7 were selected and defined exclusively by Ecology. No new scenarios were selected or defined by ORP. The purpose of Ecology's scenarios was to assess the impacts of various scenario-specific planning assumptions on the RPP mission.

1.3 SUCCESS CRITERIA

Success criteria are metrics used to determine how well a case meets overall mission goals or requirements. The success criteria used in this SP7 include both schedule-based and cost-based metrics. The schedule-based metrics are selected TPA or Consent Decree milestones. The cost-based metrics include near-term funding targets as well as a total lifecycle cost target. Refer to Appendix B for case-specific success criteria for each of the five cases.

Each case is defined by a set of case-specific detailed assumptions. Modeling predicts the impacts of each case's assumptions on the RPP system's mission duration, infrastructure needs, and cost. The modeling results are summarized in Table 1-1 and are consistent with the success criteria defined in Appendix B for each case. For additional details on Ecology's five cases, refer to Section 1.4, Table 1-2, and Section 4.0. Detailed case-specific system descriptions; planning bases; projected results, including cost and schedule impacts; and key issues and vulnerabilities are provided in Section 4.0.

Waste Isolation Pilot Plant Land Withdrawal Act. Waste residuals remaining in tanks at the completion of retrieval will be evaluated by DOE in consultation with the NRC using the WIR evaluation process.

[9] Note that HFFACO and TPA represent the same document and may be used interchangeably depending on the source from which the information was obtained.

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Table 1-1. System Plan, Rev. 7, Highlights.[10]

Metric (Milestone)	Success Criteria	System Plan (Rev. 6) Baseline Case	System Plan (Rev. 7) Scenarios				
			Case 1 - Consent Decree Compliant Case	Case 2 - DFLAW & DFHLW Flowsheet	Case 3 - Contingency for WTP Startup Uncertainty	Case 4 - Leaking Tanks	Case 5 - Consequences of Limited Funding
Lifecycle Cost, FY 1997 to End of Mission	$61.5B[a]	$59.9B	$87.5B	$143.2B	$205.7B	$178.9B	$115.3B
Meets Near-Term Funding Targets Through 2015	$1,320M/$970M	$1,280M	$1,526M	$1,190M	$1,206M	$1,170M	$940M
Meets Near-Term Funding Profile Through 2015	Notes b, c, d	Yes	No	Yes	Yes	Yes	Yes
Complete 241-C Tank Farm Retrievals (B-1)	09/30/2014	12/21/2013	September 2014	September 2014	September 2014	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	12/31/2017	07/23/2017	November 2017	December 2017	December 2017	December 2017	September 2017
Close WMA-C (M-045-83)	06/30/2019	11/09/2018	June 2019	November 2022	November 2022	November 2022	February 2036
Complete Nine Additional SST Retrievals (B-4)	09/30/2022	12/16/2020	July 2019	July 2025	July 2022	May 2034	August 2027
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)[e]	09/30/2022	–	February 2020	March 2038	August 2033	April 2034	July 2029
Complete all SST Retrievals (M-045-70)	12/31/2040	09/08/2039	May 2044	January 2054	January 2058	January 2066	May 2047
Close all SSTs (M-045-00)	01/31/2043	10/05/2043	December 2048	August 2058	May 2063	March 2070	August 2051
Treat all Tank Waste (M-06200)	12/31/2047	04/23/2043	August 2050	March 2067	October 2079	May 2075	August 2058
Close all DSTs (M-042-00A)	09/30/2052	03/18/2048	August 2055	January 2072	August 2084	March 2080	May 2063
Complete Potential TRU Tank Waste Packaging	–	07/13/2023	July 2025	July 2025	N/A	N/A	N/A
HLW Glass Mass (MTG)	–	31,968	30,845	30,749	32,306	32,586	33,205
HLW Glass Canisters	–	10,586	10,214	10,183	10,618	10,791	10,996
HLW Glass Waste Oxide Loading	–	36.9%	35%	36%	36%	37%	35%
LAW Glass Mass (MTG)	–	527,838	687,187	678,251	682,419	656,419	663,345
LAW Glass Containers	–	95,825	124,753	123,131	123,888	119,169	120,425
LAW Glass Sodium Oxide Loading	–	17.8%	16%	16%	16%	16%	16%
Sodium Reporting to LAW Glass (MT)	–	69,659	79,056	78,809	79,109	78,243	78,829
Potential TRU Tank Waste Drums	–	7,492	8,285	8,243	N/A	N/A	N/A

[10] System Plan, Rev. 7 (SP7) is being submitted in accordance with *Hanford Federal Facility Agreement and Consent Order* (HFFACO) milestone M-062-40 and describes the disposition of all tank waste managed by the U.S. Department of Energy (DOE), Office of River Protection (ORP), including the retrieval of tanks not addressed by the Consent Decree in State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (E.D. WA, October 25, 2010) and the completion of the treatment mission as depicted in the five scenarios selected by the Washington State Department of Ecology (Ecology). These five scenarios were selected and defined solely by Ecology without modification by DOE. ORP elected to not select or define scenarios for evaluation in this SP7. In comparison to System Plans previously submitted by DOE both prior to and after implementation of HFFACO milestone M-062-40, this System Plan 7 is unique in that a current baseline was not evaluated.

The five presented cases selected and defined by Ecology for evaluation in this SP7 are all what-if cases with outcomes that are based on certain key assumptions approved by Ecology, do not reflect the current status of ORP's mission, and do not reflect a complete and adequate understanding of assumptions of facility interim and start-up dates associated with resolution of technical issues with the Waste Treatment and Immobilization Plant and the need to establish new or revised baselines for key project components.

Notes:

BOLD RED text indicates a figure or date that does not meet the success criteria.

All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.

Lifecycle costs for Cases 1 through 5 were developed using the Tank Operations Contract cost model. Lifecycle cost figures in the System Plan are used for comparative purposes only, and do not reflect the current approved Performance Measurement Baseline (PMB).

The SP6, Lifecycle Cost Model (LCM) is based on PMB output from FY 2011. The SP7 LCM is based on PMB output from FY 2014.

a Lifecycle cost success criteria apply to Case 1 through 4 and SP6 Baseline Case.

b Near-term funding targets for Cases 1 through 4 and SP6, Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million; Total FY 2014 through FY 2015 = $1,320 million.

c Near-term funding targets for Case 5 are: FY 2014 = $460 million; FY 2015 = $510 million; Total FY 2014 through FY 2015 = $970 million. Values for Case 5 do not include ORP costs or ETF costs. It was required to transfer $35 million from the WTP Contract to the Tank Operations Contract to meet the FY 2014 target.

d The SP6 near-term success criteria for FY 2011 through FY 2015 = $2,750 million. The SP6 Baseline Case near-term cost for FY 2011 through FY 2015 = $2,440 million. Near-term values shown in this table reflect success criteria and values as a summation of FY 2014 and FY 2015.

e The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7, Assumption B4.1.1.2.

DFHLW	direct feed high-level waste	HLW	high-level waste	ORP	U.S. Department of Energy, Office of River Protection	TOC	Tank Operations Contract
DFLAW	direct feed low-activity waste	LAW	low-activity waste	PMB	Performance Measurement Baseline	TRU	transuranic
DST	double-shell tank	MT	metric ton	SP6	System Plan, Rev. 6	WMA-C	C Farm Waste Management Area
ETF	Effluent Treatment Facility	MTG	metric tons of glass	SP7	System Plan, Rev. 7	WTP	Waste Treatment and Immobilization Plant
FY	fiscal year	FY	fiscal year	SST	single-shell tank		

1.4 SCENARIOS

During the period of June 10 to November 20, 2013, key personnel from ORP and Ecology, supported by WRPS, met numerous times to discuss the scenarios to be modeled. ORP and Ecology led the discussions; WRPS provided limited guidance as necessary to ensure the scenarios were developed in a manner consistent with existing model protocols and conventions. The scenarios were later renamed "cases," in order to be consistent with established modeling terminology.

ORP's Baseline Case is the same case as was previously used in System Plan, Rev. 6 (SP6). Details on the scope and model results of the Baseline Case, as well as details related to key issues and uncertainties and technology development, are available in SP6. Key results for the Baseline Case are reproduced in this SP7 for the convenience of the reader (Table 1-1). A simplified flowsheet for the Baseline Case appears in Figure 1-1.

ORP elected not to select or define any cases for analysis in this SP7; WRPS modeled Ecology's cases and wrote the System Plan document.

Ecology selected and defined five cases for this SP7:

- Case 1 – Consent Decree Compliant Case
- Case 2 – Direct Feed Low-Activity Waste and Direct Feed High-Level Waste Flowsheet
- Case 3 – Contingency Case for Waste Treatment and Immobilization Plant Startup Uncertainty
- Case 4 – Leaking Tanks
- Case 5 – Consequences of Limited Funding.

The five Ecology cases are related in that they all share some features, but each case also has some features that are unique. Some of these unique distinguishing factors include variations in facility start dates, processing rates, storage options, flowsheets, or budget limitations. These distinguishing features are contained in the detailed assumptions in Appendix B. ORP directed WRPS to model the five cases selected and defined by Ecology for SP7 in accordance with the Appendix B also selected by Ecology (Section 1.7.1).

The scenario selection process and each scenario's distinguishing features are detailed in RPP-56408, *Selected Scenarios for the River Protection Project System Plan*, Revision 7. RPP-56408 was transmitted by ORP and Ecology to the U.S. Environmental Protection Agency to confirm completion of TPA milestone M-062-40C (13-TPD-0070, "Completion of Hanford Federal Facility Agreement and Consent Order Milestone M-062-40C, to Select a Minimum of Three Scenarios and Partial Completion of Milestone M-062-40"). A summary of the five cases is shown in Table 1-2. Model results for each case are discussed in Section 4.0.

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Figure 1-1. System Plan, Rev. 6, Baseline Case Simplified Process Flow Diagram.

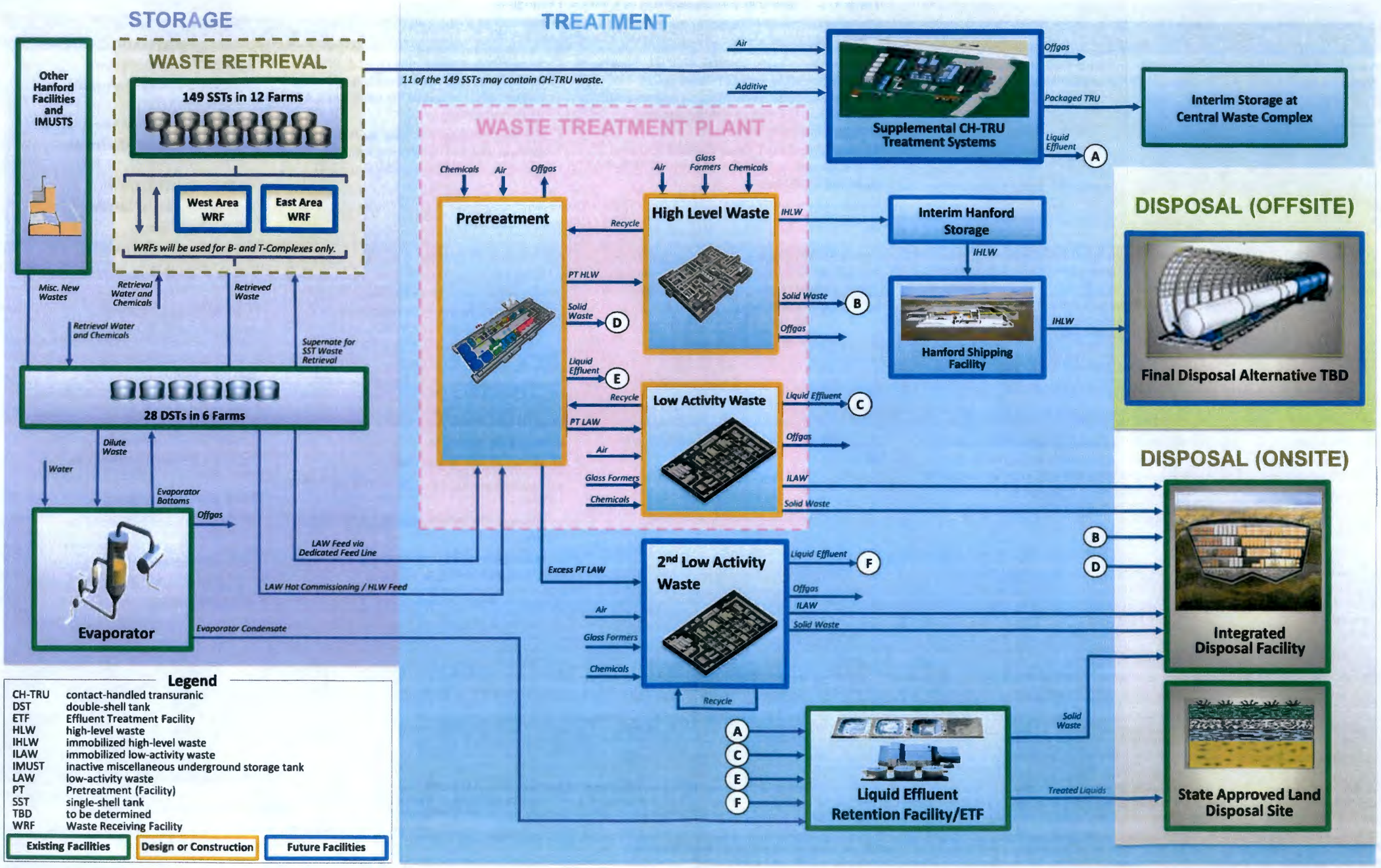

Table 1-2. Description Summaries of Cases 1 Through 5.[11]

Case	Title	Purpose	General Description	Flowsheet Highlights	Schedule Highlights	
1	Consent Decree Compliant Case	Maintain compliance perspective consistent with current HFFACO and Consent Decree requirements.	Case 1 is similar to the SP6 Baseline Case, but Case 1 is updated to reflect recent HTWOS model improvements, plus recent planning updates related to DST 241-AY-102, sludge tank management strategies, and other factors. The sensitivity Case 1A uses the same flowsheet as Case 1, but applies the 2013 advanced GFM for both HLW and LAW glass.	• Assumes simultaneous startup of all WTP facilities; the tank farms provide feed to the PT Facility, which separates the waste into LAW and HLW feed streams. • Processes potential CH-TRU waste through a supplemental TRU waste treatment and packaging system (refer to Section 3.2.1).	LAWPS Start Hot Operations WTP LAW Start Hot Operations TWCSF Start Hot Operations WTP HLW Start Hot Operations WTP PT Start Hot Operations Supplemental LAW Start Hot Operations WTP at Full Capacity	N/A 12/31/2019 N/A 12/31/2019 12/31/2019 10/01/2022 02/06/2025
2	Direct Feed Low-Activity Waste and Direct Feed High-Level Waste Flowsheet	Evaluates impacts on throughput when bypassing the PT Facility and accommodates the need to address the current status of the PT Facility, the impact of DF on DSTs, the efficiency and effectiveness of the LAWPS, and the impact of the advanced GFMs during DF operations.	Case 2 builds on Case 1. The sensitivity Case 2A uses the same flowsheet as Case 2, but applies the 2013 Advanced GFMs for both HLW and LAW glass.	• Uses a DF flowsheet. • Includes LAWPS and TWCSF. • Processes potential CH-TRU waste through a supplemental TRU waste treatment and packaging system (refer to Section 3.2.1).	LAWPS Start Hot Operations WTP LAW Start Hot Operations TWCSF Start Hot Operations WTP HLW Start Hot Operations WTP PT Start Hot Operations Supplemental LAW Start Hot Operations WTP at Full Capacity	10/01/2021 01/01/2022 01/01/2023 01/01/2025 01/01/2028 01/01/2030 02/06/2030
3	Contingency Case for Waste Treatment and Immobilization Plant Startup Uncertainty	Determine the number of new DSTs needed in the 200 West Area, and provide possible project schedule for construction in order to continue to support SST retrievals consistent with Consent Decree milestones, if WTP is not fully operational until 2033.	Case 3 builds on Case 2 with the addition of new DSTs.	• Uses a DF flowsheet. • Includes LAWPS and TWCSF. • Assumes new DSTs can be built in the 200 West Area. • Assumes a WRF will be built in the 200 East Area. • Processes potential CH-TRU waste through the WTP (refer to Section 3.2.2).	LAWPS Start Hot Operations WTP LAW Start Hot Operations TWCSF Start Hot Operations WTP HLW Start Hot Operations WTP PT Start Hot Operations Supplemental LAW Start Hot Operations WTP at Full Capacity	07/01/2027 10/01/2027 10/01/2028 10/01/2030 01/10/2033 10/01/2035 11/06/2035

[11] System Plan, Rev. 7 (SP7) is being submitted in accordance with *Hanford Federal Facility Agreement and Consent Order* (HFFACO) milestone M-062-40 and describes the disposition of all tank waste managed by the U.S. Department of Energy (DOE), Office of River Protection (ORP), including the retrieval of tanks not addressed by the Consent Decree in State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (E.D. WA, October 25, 2010) and the completion of the treatment mission as depicted in the five scenarios selected by the Washington State Department of Ecology (Ecology). These five scenarios were selected and defined solely by Ecology without modification by DOE. ORP elected to not select or define scenarios for evaluation in SP7. In comparison to System Plans previously submitted by DOE both prior to and after implementation of HFFACO milestone M-062-40, this SP7 is unique in that a current baseline was not evaluated.

The five presented cases selected and defined by Ecology for evaluation in SP7 are all what-if cases with outcomes that are based on certain key assumptions approved by Ecology, do not reflect the current status of ORP's mission, and do not reflect a complete and adequate understanding of assumptions of facility interim and startup dates associated with resolution of technical issues with the Waste Treatment and Immobilization Plant and the need to establish new or revised baselines for key project components.

Table 1-2. Description Summaries of Cases 1 Through 5.[11]

Case	Title	Purpose	General Description	Flowsheet Highlights	Schedule Highlights	
4	Leaking Tanks	Determine the impact of emergent leaking tanks at a specified frequency which will require immediate, unplanned retrieval.	Case 4 builds on Case 2. Case 4 assumes specific SSTs and DSTs become unfit for use at specified intervals, requiring the use of emergency tank space.	• Uses a DF flowsheet. • Includes LAWPS and TWCSF. • Assumes two WRFs will be built (one each in 200 West and 200 East Areas). • Processes potential CH-TRU waste through the WTP (refer to Section 3.2.2).	LAWPS Start Hot Operations WTP LAW Start Hot Operations TWCSF Start Hot Operations WTP HLW Start Hot Operations WTP PT Start Hot Operations Supplemental LAW Start Hot Operations WTP at Full Capacity	10/01/2021 01/01/2022 01/01/2023 01/01/2025 01/01/2028 01/01/2030 02/06/2030
5	Consequences of Limited Funding	Understand the impact of limited funding on mission metrics.	Case 5 builds on Case 2. Case 5 assumes a specific funding profile that is more conservative than SP6 Baseline Case projections. It allows flexibility for DST construction. The WTP start dates are based on activities chosen per fiscal year by Ecology.	• Uses a DF flowsheet. • Includes LAWPS and TWCSF. • Assumes four new DSTs will be built in 200 East Area, and four new DSTs will be built in 200 West Area. • Assumes two WRFs will be built (one each in 200 West and 200 East Areas). • Process potential CH-TRU waste through the WTP (refer to Section 3.2.2).	LAWPS Start Hot Operations WTP LAW Start Hot Operations TWCSF Start Hot Operations WTP HLW Start Hot Operations WTP PT Start Hot Operations Supplemental LAW Start Hot Operations WTP at Full Capacity	10/01/2022 10/01/2022 10/01/2024 07/01/2026 10/01/2029 10/01/2032 08/06/2031

Note: "WTP at Full Capacity" indicates the date at which the LAW and HLW Facilities are capable of achieving their maximum rated capacity.

CH-TRU	contact-handled transuranic
DF	direct feed
DST	double-shell tank
Ecology	Washington State Department of Ecology
GFM	glass formulation model
HFFACO	*Hanford Federal Facility Agreement and Consent Order*
HLW	high-level waste
HTWOS	Hanford Tank Waste Operations Simulator
LAW	low-activity waste
LAWPS	Low-Activity Waste Pretreatment System
N/A	not applicable
PT	pretreatment
SP6	System Plan, Rev. 6
SST	single-shell tank
TRU	transuranic
TWCSF	Tank Waste Characterization and Staging Facility
WRF	Waste Receiving Facility
WTP	Waste Treatment and Immobilization Plant

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1.5 SYSTEM PLANNING PROCESS

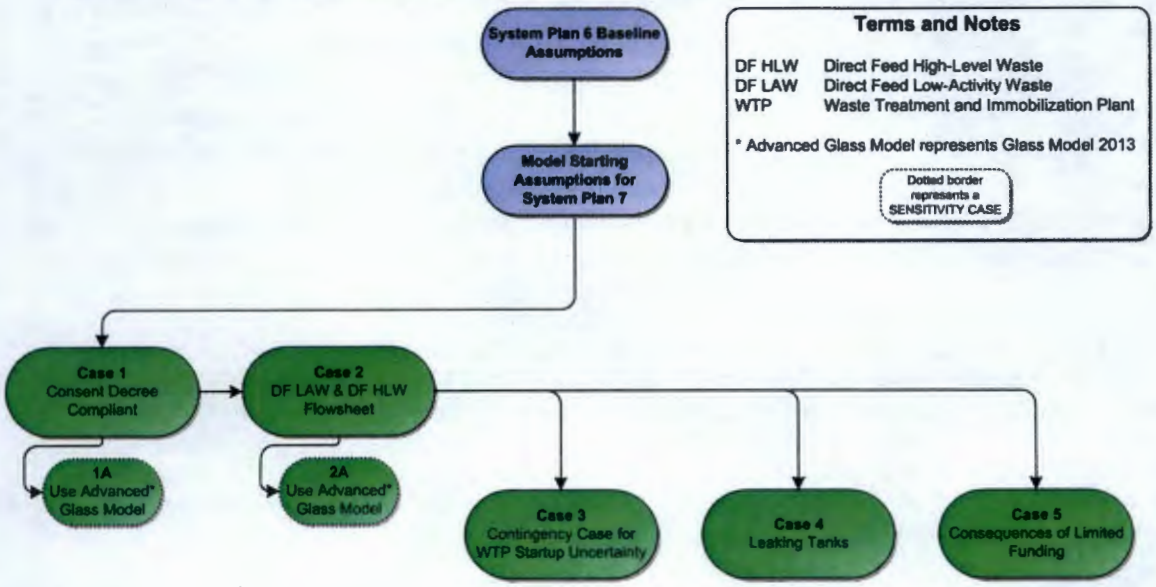
Because strategic planning is ongoing, the System Plan will be revised periodically to reflect recent progress, current plans, responses to emergent issues, assumptions selected for analysis, changes in the regulatory environment, and budget constraints. In addition, system planning activities occur in compliance with the Tank Operations Contractor, and in conjunction with other upper-tier planning documents. For additional details on these relationships, refer to TFC-PLN-143, "River Protection Project System Integration Management Plan."

For each System Plan, the Hanford Tank Waste Operations Simulator (HTWOS) is used to prepare and evaluate the scenarios. In order to model each case, distinguishing features must be translated into detailed assumptions. As the initial step for the development of SP7, WRPS took the detailed assumptions used for the SP6 Baseline Case and updated them to reflect:

- Recent improvements to HTWOS (refer to Appendix C for details)
- Recent planning changes, such as current expectations for Double-Shell Tank (DST) 241-AY-102 and evolving sludge tank management strategies.

In general, these Model Starting Assumptions apply to all five of the cases in this SP7. However, some assumptions were modified in order to reflect the distinguishing features of each case. Those modifications were selected and defined by Ecology, with technical information from WRPS, as necessary, to keep the detailed assumptions consistent with existing HTWOS protocols and conventions. The ORP observed the development of the detailed assumptions, but did not provide input. ORP directed WRPS to model the five cases selected and defined by Ecology for SP7 in accordance with the key assumptions and success criteria also selected by Ecology (Section 1.7.1). The final assumptions for SP7 are included in Appendix B. Relationships among the cases are illustrated in Figure 1-2. DOE made no modifications to the scenarios or assumptions unless specifically directed by Ecology, for example, when Ecology directed DOE to change the tank volume of the Tank Waste Characterization and Staging Facility (TWCSF) from 250,000-gallon tanks to 500,000-gallon tanks for Case 5.

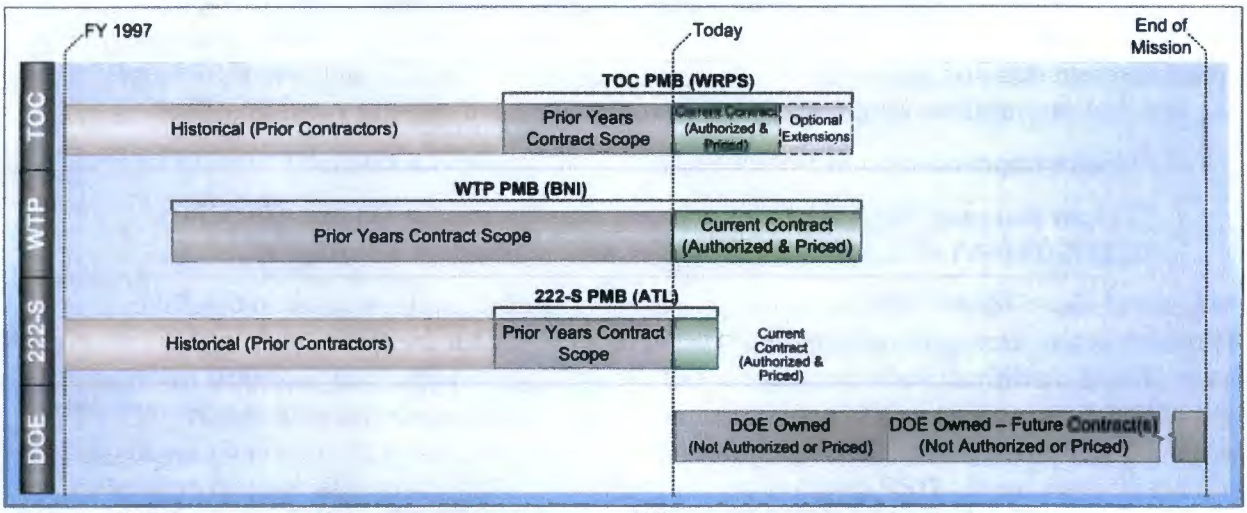
Figure 1-2. The Relationships of System Plan, Rev. 7, Ecology-Defined Cases.



1.6 PERFORMANCE MEASUREMENT BASELINE AND LIFECYCLE COST ANALYSIS

Each of Hanford's primary contractors maintains their own Performance Measurement Baseline (PMB), which is valid for the life of each contract's scope and duration. Each contractor's PMB is a subset of the overall RPP lifecycle PMB (Figure 1-3). Changes in planning guidance, funding, schedule, or other matters are addressed via Baseline Change Requests.

Figure 1-3. Components of the River Protection Project Lifecycle Baseline.



222-S	222-S Laboratory Analytical Services and Testing Contract	PMB	Performance Measurement Baseline
ATL	Advanced Technologies and International Laboratories, Inc.	TOC	Tank Operations Contract
BNI	Bechtel National, Inc.	WRPS	Washington River Protection Solutions, LLC
DOE	U. S. Department of Energy	WTP	Waste Treatment and Immobilization Plant (Contract)
FY	Fiscal Year		

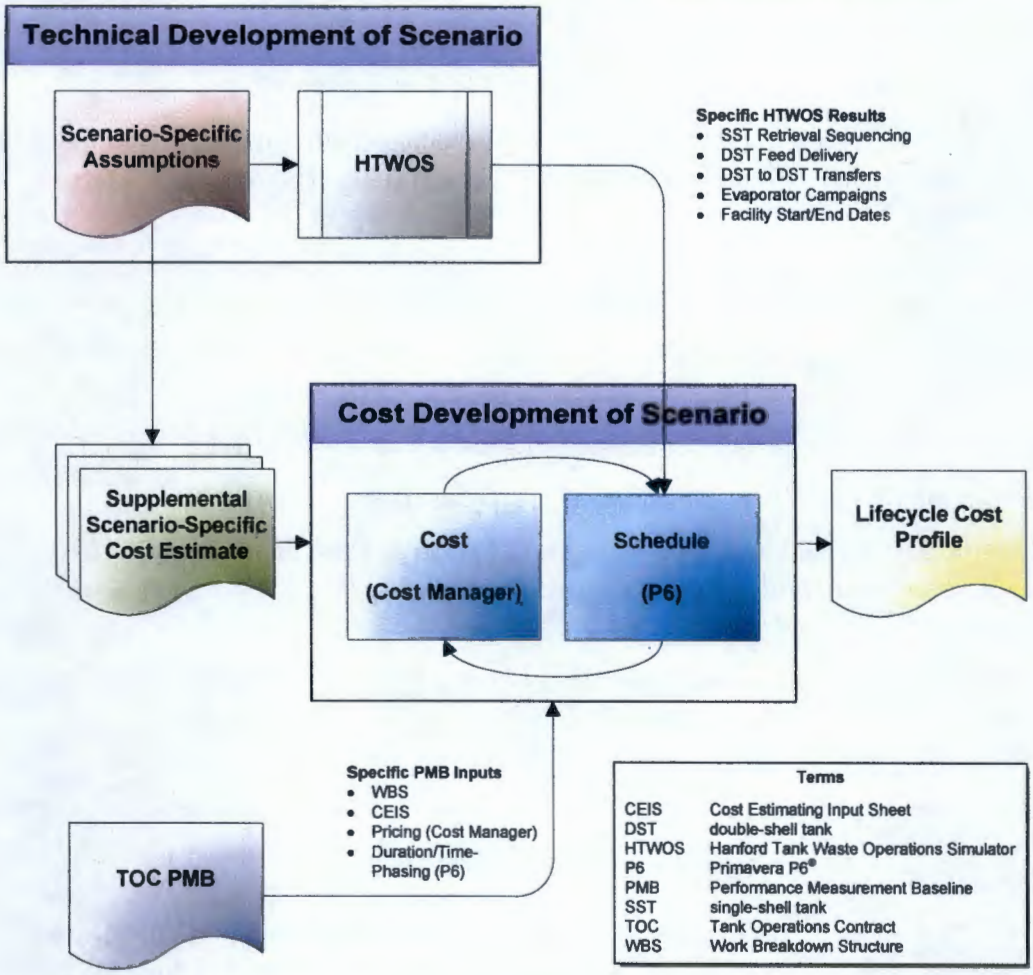
The Lifecycle Cost Model (LCM) tool automates the process of generating a lifecycle cost profile based on the results of an HTWOS run. For SP7, the LCM uses the PMB from the DOE's Congressional Budget Office line item numbers ORP-0014 and HG-HLW-0014X (ORP-14/14X[12]) extracted in February 2014 and modified by Baseline Change Requests through April 2014. The ORP-14/14X PMB includes the costs for the TOC and 222-S Laboratory; costs for WTP through commissioning are not included. A data flow chart outline for the lifecycle cost development for all scenarios is shown on Figure 1-4. The ORP-14/14X PMB is comprised of the scope, schedule, and cost for all authorized baseline activities. Because some SP7 cases involve new facilities or system configurations that would require additional work scope, some supplemental scenario-specific cost estimates were necessary. These estimates, time-phased with a schedule, were developed by estimators, project managers, or knowledgeable staff, and were incorporated into an LCM schedule for the appropriate scenario using placeholder work

[12] The U.S. Department of Energy's Congressional Budget Office line item numbers ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition," and HG-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository," under the Office of Protection has been renamed in this document to ORP-14/14X. This budgetary line item includes tank farm activities under contracts to Washington River Protection Solutions LLC and Advanced Technologies and Laboratories International, Inc. within their contract durations and as estimated thereafter to complete the mission regardless of the contractor(s) selected.

breakdown structure elements. The new scope estimates are all considered rough order of magnitude and relied on information obtained from existing reports and studies, sketches and reference drawings, historical cost data (costs escalated to current year, as applicable), scaling of baseline data, and estimator judgment. These estimates do not form the technical basis for either the near-term baseline or the out-year planning estimate range because of uncertainties in the baseline as a result of currently unresolved technical issues at WTP.

With the exception of the supplemental scenario-specific estimates that were added for major scope additions, no attempt was made to change or improve the estimating accuracy of activities in the ORP-14/14X PMB or to deviate from the existing set of estimating assumptions. Additionally, the funded management reserve and unfunded DOE contingency totals were assumed to be held constant for fiscal year (FY) 2014 through FY 2016.

Figure 1-4. General Flow of Data for Cost and Schedule Analysis.



The LCM schedule for each scenario represents the unique dates and durations of activities projected by the HTWOS results. Predecessor project activities are moved in the schedule to coincide with the start of operations from HTWOS results, and successor activities begin immediately after operation completion. The methodology used by the LCM does not include resource- or cost-leveling or allocation of schedule float. By aligning the start and end dates of

activities directly to HTWOS results, and not constraints, the LCM produces zero-float schedules. This approach is useful in demonstrating the schedule fluctuations resulting from different technical assumptions, but risk analysis and confirmation of availability of resources and funds would be required before using LCM schedules for anything other than comparative analysis.

All costs have been escalated to the projected year of occurrence, so lifecycle costs reported for each scenario have escalation included. Lifecycle cost profiles for each of the five SP7 cases are reported in Section 4.0.

1.7 CONVENTIONS

This section explains the more important conventions used in this System Plan and considerations in interpreting results.

1.7.1 Reference Dates

Several dates are essential to understanding the basis of this System Plan:

- ORP directed WRPS to model the five cases selected and defined by Ecology for this SP7 in accordance with the key assumptions and success criteria also selected by Ecology on February 2014
- Demarcation between historical and projected activities is January 2014 (email from T.K. Dhaliwal to M.N. Wells, "Demarcation Date" [Dhaliwal, T.K., 2014-02-12]).
- Starting point for cost and schedule estimates and PMB scope is February 2014, as modified by Baseline Change Requests through April 2014
- Effective date of the Project Lifecycle schedule is February 2014
- Description of the RPP system status is current as of June 2014
- Effective date for tank waste inventory in HTWOS is April 2014 (RPP-33715, *Double-Shell and Single-Shell Tank Inventory Input to the Hanford Tank Waste Operation Simulator Model – 2014 Update*)
- Decay date for reporting radionuclides is January 2008, unless stated otherwise.

1.7.2 Reporting

In Appendix B, the general convention is to use the same units and precision as the source documents. This is done to improve traceability and to avoid unnecessary propagation of rounding errors.

In the rest of this document, results are reported to full precision, generally to the nearest $100,000 for costs, and to the nearest whole unit for other quantities (metric ton [MT] or metric tons of glass [MTG] for product mass, canisters, containers, or drums for product containers). This approach is used to provide consistency in presentation and to promote traceability between HTWOS and LCM results, spreadsheets, figures, tables, and text. Calendar events will be rounded to the nearest month.

The reported precision does not reflect the underlying accuracy or uncertainties in technical and programmatic assumptions and modeling methodology.

1.8 RECENT PLANNING IMPROVEMENTS

Long-range planning for the Tank Waste Treatment Complex is a multifaceted, iterative process. Each revision of the System Plan builds on the best strategies identified in previous plans, thereby increasing planning confidence. Several important planning improvements identified during or after the development of SP6 have been incorporated in the planning basis for this SP7:

- The One System Integrated Project Team (IPT) is an integrated team of WRPS and BNI personnel whose focus is to integrate planning, scheduling, and interface activities between the contractors of the TOC and the WTP Contract. Within One System, the Technical organization performs all system planning and modeling, including evaluation of baseline and alternative flowsheets to support DST space management, retrieval strategies, and other needs; formulates the waste acceptance criteria (WAC) and manages the Interface Control Documents (ICD); conducts testing and demonstrations to improve understanding of waste feed delivery (WFD) mixing, blending, and sampling; and manages the WFD program. For additional information, refer to RPP-51471, *One System IPT Charter*.
- Significant improvements have been made to HTWOS. A brief description of each follows here (refer to Appendix C, or RPP-17152, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.7 Model Design Document* for additional details):
  - The integrated solubility model (ISM) uses a graded approach to predict the solubility of each waste constituent in HTWOS, based on its relative solubility and impact to the RPP mission. This method replaces the use of most of the water wash factors and leach factors.
  - Two advanced glass formulation models (GFM), one for HLW glass and one for LAW glass, were added to HTWOS. The new models incorporate data from a wider variety of simulated waste glasses than were previously available. This allows the models to evaluate projected WTP waste glasses over a wider range of compositions and properties than was previously possible. Alternate operating scenarios for the RPP system can be evaluated using the GFM of the modeler's choice.
  - Individual facility availability factors have been implemented in HTWOS for the Pretreatment (PT) Facility (approximately 81 percent), the LAW Facility (approximately 70 percent), and the HLW Facility (approximately 83 percent), based on results generated by the Operations Research (OR) Assessment. The LAW and HLW Facilities' availability factors are implemented by reducing the LAW and HLW production capacities to 70 percent of the maximum capacities. Downtime is added to the ultrafiltration cycle time, in order to meet the overall PT Facility target availability factor. The resulting integrated WTP availability factor is at least 70 percent. To calibrate the facility availability factor, HTWOS' WTP module is fed

using a fixed feed vector so that variability in tank farms does not affect the calculation.[13]

- Correction to SP6 calculation: Between the SP6 and SP7 modeling, an error was found in the HTWOS LAW 2004 GFM calculation. The error over-predicted the amount of sulfur in each LAW container. The corrected LAW 2004 GFM increases the number of predicted immobilized LAW (ILAW) containers.

- All three volumes of the Integrated Waste Feed Delivery Plan (IWFDP) were integrated with the SP6 Baseline Case (RPP-40149-VOL1, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Strategy*; RPP-40149-VOL2, *Integrated Waste Feed Delivery Plan, Volume 2 – Campaign Plan*; and RPP-40149-VOL3, *Integrated Waste Feed Delivery Plan, Volume 3 – Project Plan*).
- ICD 24590-WTP-ICD-MG-01-019, *ICD 19 – Interface Control Document for Waste Feed* (ICD-19) was updated. The ICD addresses tank waste being fed from the tank farms to the PT Facility. The new revision (Rev. 6) and Interface Change Form (24590-WTP-ICF-ENG-13-0001) incorporate better-defined WAC (including a maximum feed particle size of 310 microns) and updated information on waste feed qualification and requirements. It also identifies an open item regarding the ability of WTP systems to accommodate slurry with a yield strength greater than 1 Pascal. The ICD Team will investigate and close the item.
- TFC-PLN-39, "Risk and Opportunity Management Plan" (R&OMP), describes the systematic process used by WRPS to assess and manage program and project risks within the RPP program. The R&OMP supports prudent and effective project management through minimization of risk and maximization of opportunities inherent in the TOC lifecycle scope, schedule, and cost baseline. Risks and opportunities associated with the current RPP Baseline Case are addressed in SP6. For each risk or opportunity identified, attendant assumptions, issues and uncertainties, and potential mitigating actions are also articulated. WRPS-57232, *Enterprise Risk and Opportunity Management (EROM) Framework*, released in June 2014, establishes new guidance for future updates to WRPS's R&OMP.
- RPP-RPT-56516, *One System River Protection Project Mission Analysis Report*, was updated in 2013 to be consistent with the SP6 Baseline Case. The Mission Analysis Report defines the current mission architecture (i.e., the structures, systems, and components) needed to complete the RPP mission based on the functions and direct requirements delineated in RPP-51303, *River Protection Project Functions and Requirements*, and RPP-53359, *One System River Protection Project Mission Functional Analysis*.
- RPP-PLAN-40145, *Single-Shell Tank Waste Retrieval Plan*, and RPP-40545, *Quantitative Assumptions for Single-Shell Tank Waste Retrieval Planning*, were updated to reflect (1) current Best-Basis Inventory data, and (2) updated retrieval plans for several SSTs in 241-C and 241-A Tank Farms, based on the development and testing of the

[13] The facility availability factors were implemented into HTWOS v7.7; however, the functionality of this improvement was not used for the case scenarios processed for this SP7.

Extended Reach Sluicing System. Concurrently, supporting spreadsheets SVF-1647, "SVF-1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx," and SVF-2404, "SVF-2404 Rev 1 Calculation of Selected SST Retrieval Parameters.xlsx," were also updated.

- In August 2012, visual inspections of the annulus between the primary and secondary tank walls of DST 241-AY-102 identified suspect waste material from the primary containment tank. A formal leak assessment team confirmed that the material discovered on the annulus floor was the result of a leak from a breach in the bottom of the primary tank. The probable cause was identified as accelerated corrosion from high temperatures, and reduced containment margins resulting from fabrication challenges during tank construction. SP7 modeling assumes DST 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220, *241-AY-102 Pumping Plan*, Rev. A. After DST 241-AY-102 is retrieved, it is no longer used.

1.9 PATH FORWARD

ORP will continue to evaluate possible mission scenarios to accelerate the completion of SST retrievals, mitigate known risks, and optimize the overall mission using systems engineering, project management, and risk management processes.

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2.0 REGULATORY ENVIRONMENT

DOE conducts its planning and activities at the Hanford Site in accordance with applicable state and federal laws, regulations, DOE orders, presidential executive orders, and agreements with other government entities, including but not limited to:

- *Atomic Energy Act of 1954*
- Nuclear Waste Policy Act of 1982
- Waste Isolation Pilot Project Land Withdrawal Act
- *Resource Conservation and Recovery Act of 1976* (RCRA)
- *Comprehensive Environmental Response, Compensation, And Liability Act of 1980* (CERCLA)
- *National Environmental Policy Act of 1969*
- HFFACO
- Consent Decree, State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (October 25, 2010)
- Tank Closure and Waste Management Environmental Impact Statement
- DOE O 435.1, *Radioactive Waste Management*[14].

The HFFACO (Ecology et al. 1989), also known as the Tri-Party Agreement, was signed by DOE, Ecology, and U.S. Environmental Protection Agency in 1989. This comprehensive agreement includes milestones for regulatory compliance and environmental remediation. Between 2007 and 2009, DOE and Ecology negotiated new and revised HFFACO milestones, along with new milestones in a Consent Decree (Case No. 08-5085-FVS) filed in federal district court. That Consent Decree resolved a lawsuit filed in 2008 by the State of Washington against DOE. Both the Consent Decree and HFFACO changes became effective on October 25, 2010, the date the Consent Decree was entered into federal court. One of the new HFFACO milestones, M-062-40, requires ORP to prepare a System Plan every 3 years.

Milestone M-062-40 and the River Protection Project System Plan

Milestone M-062-40 provides, in pertinent part, as follows:

> *Every three years... Ecology and DOE will each have the right to select a minimum of three scenarios that will be analyzed in the System Plan...*

and:

> One year prior to the issuance of the System Plan, DOE and Ecology will each select the scenarios (including underlying common and scenario-specific assumptions) that will be analyzed in the System Plan... (Ecology et al. 1989)

The overall minimum requirements for each scenario include all of the following:

- System description
- Planning bases
- Key issues, assumptions, and vulnerabilities

[14] See footnote 8.

- Sensitivity analyses
- Schedule impacts
- New equipment, technology, or actions needed
- Issues, techniques, or technologies that require further evaluation
- Impacts on closure activities.

Modeling results for Cases 1 through 5 are provided in Section 4.0 for Ecology's selected scenarios. Appendix D includes details on how each aspect of the milestone requirements are met in this System Plan.

3.0 STATE OF THE RIVER PROTECTION PROJECT SYSTEM

A fully integrated system of RPP waste storage, treatment, and disposal facilities is in varying stages of design, construction, operation, or future planning. In addition to the facilities highlighted in Figure 1-1, this section addresses waste retrieval from SSTs, waste transfers into and out of DSTs, miscellaneous underground storage tanks (MUST), inactive miscellaneous underground storage tanks (IMUST),[15] waste transfer systems, the TWCSF, the 242-A Evaporator, the Vadose Zone Integration Program, supplemental treatment facilities, WTP, and other interfacing facilities. Current events and recent accomplishments are also described in this section.

3.1 STORAGE

Many facilities are involved in the safe storage of waste at Hanford. These facilities include 149 SSTs, 28 DSTs, numerous MUSTs, miles of waste transfer lines and supporting facilities, and the 242-A Evaporator. The Waste Encapsulation and Storage Facility (WESF), while not considered a component of the RPP system, may impact future RPP system operations, so it is included here for completeness. Likewise, while the Vadose Zone Integration Program is an integral part of ORP's strategy to reduce the threat from contaminants already present in the ground around the tank farms, that program does not bear on RPP processes directly; however, this program was included because the lessons learned during this program may influence future remediation and closure options within the tank farms.

All waste storage activities within the RPP system are located in either the 200 West or 200 East operating areas. The tank farms waste volumes are shown in Table 3-1 and graphically represented in Figure 3-1 and Figure 3-2.

Note: Total waste volumes fluctuate slightly from the addition of water and chemicals during waste retrieval operations, the receipt of laboratory wastes, and operation of the 242-A Evaporator.

Table 3-1. Tank Farms Waste Volumes.

Tank Type	200 East Area	200 West Area	Total
Single-Shell Tanks			
Sludge	3.2 Mgal	5.4 Mgal	8.6 Mgal
Saltcake	6.2 Mgal	13.9 Mgal	20.1 Mgal
Supernate	56 kgal	41 kgal	97 kgal
Subtotal	9.4 Mgal	19.3 Mgal	28.8 Mgal
Double-Shell Tanks			
Sludge	1.9 Mgal	0.2 Mgal	2.1 Mgal
Saltcake	3.2 Mgal	0.6 Mgal	3.8 Mgal
Supernate	19.4 Mgal	1.6 Mgal	21.0 Mgal
Subtotal	24.5 Mgal	2.4 Mgal	26.9 Mgal
Total	33.9 Mgal	21.7 Mgal	55.7 Mgal

Note: Data from HNF-EP-0182, 2014, Waste Tank Summary Report for Month Ending April 30, 2014, Rev. 316, Washington River Protection Solutions LLC, Richland, Washington. Summary volumes include the volume of retained gas but do not include the miscellaneous underground storage tank inventory.

kgal kilogallon
Mgal million gallon

[15] Note that, generally in this plan, MUSTs and IMUSTs are collectively referred to as MUSTs (described further in Section 3.1.3).

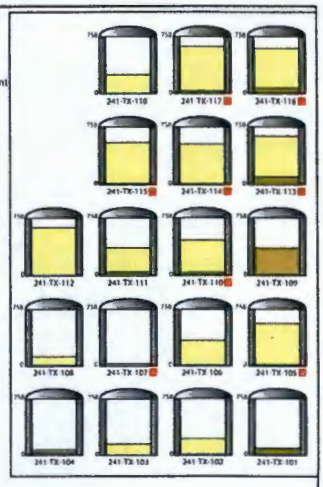
Figure 3-1. 200 West Area Tank Waste Contents per HNF-EP-0182.

S-Tank Farm- Constructed 1950-1951
12 @ 758 Kgal Tank Capacity, Single-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-S-101	235	117	0
241-S-102	22	69	2
241-S-103	9	227	1
241-S-104 ■	132	156	0
241-S-105	2	404	0
241-S-106	0	455	0
241-S-107	320	38	0
241-S-108	5	545	0
241-S-109	13	520	0
241-S-110	96	293	0
241-S-111	76	325	0
241-S-112	2	0	0

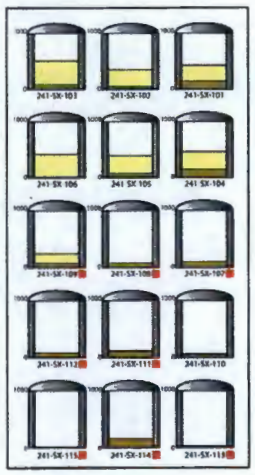
TX-Tank Farm- Constructed 1947-1948
18 @ 758 Kgal Tank Capacity, Single-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-TX-101	74	13	0
241-TX-102	2	215	0
241-TX-103	0	145	0
241-TX-104	34	33	2
241-TX-105 ■	11	560	0
241-TX-106	5	343	0
241-TX-107 ■	0	30	0
241-TX-108	6	121	0
241-TX-109	359	0	0
241-TX-110 ■	37	430	0
241-TX-111	43	321	0
241-TX-112	0	634	0
241-TX-113 ■	93	545	0
241-TX-114 ■	4	528	0
241-TX-115 ■	8	545	0
241-TX-116 ■	66	533	0
241-TX-117 ■	29	597	0
241-TX-118	0	247	0



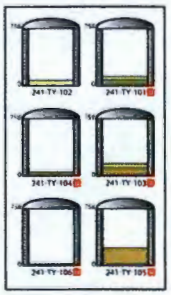
SX-Tank Farm- Constructed 1953-1955
15 @ 1,000 Kgal Tank Capacity, Single-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-SX-101	144	276	0
241-SX-102	55	287	0
241-SX-103	78	431	0
241-SX-104	136	310	0
241-SX-105	63	312	0
241-SX-106	0	396	0
241-SX-107 ■	94	0	0
241-SX-108 ■	74	0	0
241-SX-109 ■	66	175	0
241-SX-110	49	7	0
241-SX-111 ■	97	18	0
241-SX-112 ■	75	0	0
241-SX-113 ■	19	0	0
241-SX-114 ■	126	29	0
241-SX-115 ■	4	0	0



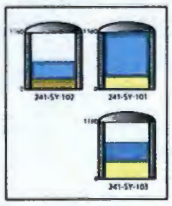
TY-Tank Farm- Constructed 1951-1952
6 @ 758 Kgal Tank Capacity, Single-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-TY-101 ■	72	46	0
241-TY-102	0	69	0
241-TY-103 ■	103	51	0
241-TY-104 ■	43	0	1
241-TY-105 ■	231	0	0
241-TY-106 ■	16	0	0



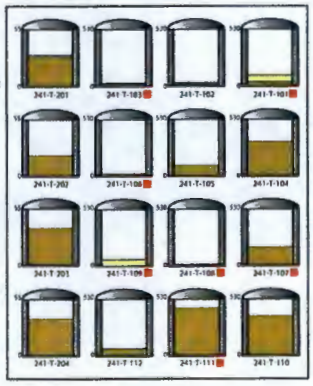
SY-Tank Farm- Constructed 1974-1976
3 @ 1,160 Kgal Tank Capacity, Double-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-SY-101	0	255	864
241-SY-102	199	11	360
241-SY-103	0	356	377



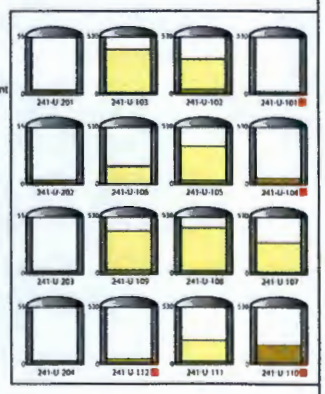
T-Tank Farm- Constructed 1943-1944
12 @ 530 Kgal Tank Capacity, Single-Shell
4 @ 55 Kgal Tank Capacity, Single-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-T-101 ■	37	62	0
241-T-102	19	0	13
241-T-103 ■	23	0	4
241-T-104	317	0	0
241-T-105	98	0	0
241-T-106 ■	22	0	0
241-T-107 ■	173	0	0
241-T-108 ■	5	11	0
241-T-109 ■	0	62	0
241-T-110	369	0	1
241-T-111 ■	447	0	0
241-T-112	60	0	7
241-T-201	28	0	2
241-T-202	20	0	0
241-T-203	38	0	0
241-T-204	36	0	0



U-Tank Farm- Constructed 1943-1944
12 @ 530 Kgal Tank Capacity, Single-Shell
4 @ 55 Kgal Tank Capacity, Single-Shell

Tank	Sludge	Saltcake	Supernatant
	Kgal		
241-U-101 ■	23	0	0
241-U-102	43	283	1
241-U-103	11	405	1
241-U-104 ■	54	0	0
241-U-105	32	321	0
241-U-106	0	168	2
241-U-107	15	279	0
241-U-108	29	405	0
241-U-109	35	366	0
241-U-110 ■	176	0	0
241-U-111	26	196	0
241-U-112 ■	45	0	0
241-U-201	3	0	1
241-U-202	3	0	1
241-U-203	2	0	1
241-U-204	2	0	1



LEGEND: Sludge; Saltcake; Supernatant; Available Space; Assumed/Confirmed Leaker ■

Data Derived From Waste Tank Summary Report Dated 4/30/2014

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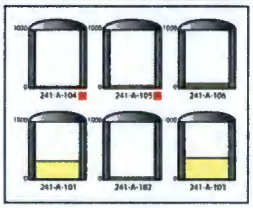
Figure 3-2. 200 East Area Tank Waste Contents per HNF-EP-0182.

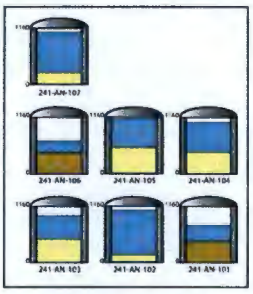
A-Tank Farm- Constructed 1953 1955
6 @ 1,000 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-A-101	3	317	0
241-A-102	0	37	3
241-A-103	2	372	4
241-A-104 ■	28	0	0
241-A-105 ■	37	0	0
241-A-106	50	29	0



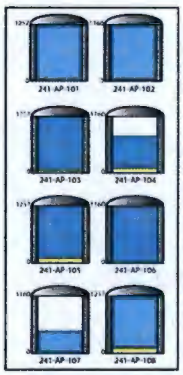
AN-Tank Farm- Constructed 1977 1980
7 @ 1,160 Kgal Tank Capacity, Double-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-AN-101	403	31	340
241-AN-102	0	154	913
241-AN-103	0	486	476
241-AN-104	0	443	608
241-AN-105	0	536	590
241-AN-106	407	25	233
241-AN-107	0	241	835



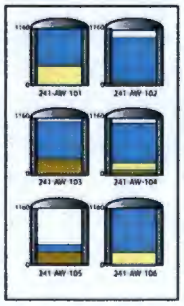
AP-Tank Farm- Constructed 1982 1986
4 @ 1,160 Kgal Tank Capacity, Double-Shell
4 @ 1,257 Kgal Tank Capacity, Double-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-AP-101	0	33	1200
241-AP-102	28	0	1110
241-AP-103	0	52	1182
241-AP-104	0	100	647
241-AP-105	0	105	1140
241-AP-106	0	0	1129
241-AP-107	0	0	439
241-AP-108	0	112	1128



AW-Tank Farm- Constructed 1976-1980
6 @ 1,160 Kgal Tank Capacity, Double-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-AW-101	0	396	736
241-AW-102	52	0	912
241-AW-103	280	40	760
241-AW-104	97	157	800
241-AW-105	248	0	153
241-AW-106	0	264	872



AX-Tank Farm- Constructed 1963 1965
4 @ 1,000 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-AX-101	3	355	0
241-AX-102 ■	6	24	0
241-AX-103	8	99	0
241-AX-104 ■	7	0	0

AY-Tank Farm- Constructed 1968-1970
2 @ 1,018 Kgal Tank Capacity, Double-Shell

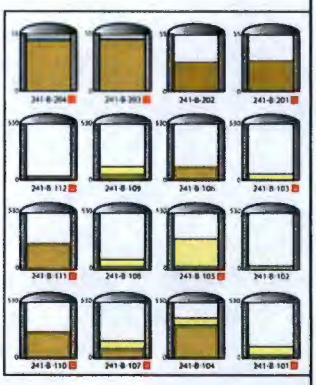
Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-AY-101	105	0	893
241-AY-102 ■	151	0	643

AZ-Tank Farm- Constructed 1970 1974
2 @ 1,018 Kgal Tank Capacity, Double-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-AZ-101	52	0	773
241-AZ-102	105	0	886

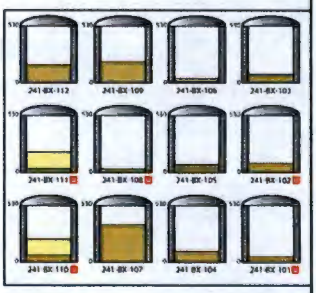
B-Tank Farm- Constructed 1943-1944
12 @ 530 Kgal Tank Capacity, Single-Shell
4 @ 55 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-B-101 ■	28	81	0
241-B-102	0	28	4
241-B-103 ■	1	55	0
241-B-104	309	65	0
241-B-105 ■	28	262	0
241-B-106	122	0	1
241-B-107 ■	86	75	0
241-B-108	27	65	0
241-B-109	50	76	0
241-B-110 ■	244	0	1
241-B-111 ■	241	0	1
241-B-112 ■	15	17	3
241-B-201 ■	29	0	0
241-B-202	28	0	0
241-B-203 ■	49	0	1
241-B-204 ■	48	0	2



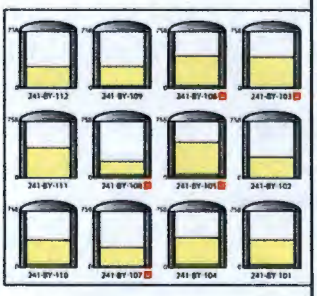
BX- Tank Farm- Constructed 1946 1947
12 @ 530 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-BX-101 ■	48	0	0
241-BX-102 ■	79	0	0
241-BX-103	62	0	15
241-BX-104	97	0	3
241-BX-105	42	25	5
241-BX-106	10	28	0
241-BX-107	347	0	0
241-BX-108 ■	31	0	0
241-BX-109	193	0	0
241-BX-110 ■	65	148	1
241-BX-111 ■	32	156	0
241-BX-112	163	0	1



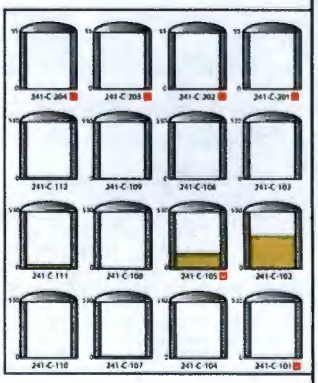
BY-Tank Farm- Constructed 1948 1949
12 @ 758 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-BY-101	37	333	0
241-BY-102	0	278	0
241-BY-103 ■	9	405	0
241-BY-104	46	359	0
241-BY-105 ■	48	433	0
241-BY-106 ■	32	398	0
241-BY-107 ■	15	256	0
241-BY-108 ■	40	182	0
241-BY-109	24	263	0
241-BY-110	43	323	0
241-BY-111	0	402	0
241-BY-112	2	284	0



C-Tank Farm- Constructed 1943 1944
12 @ 530 Kgal Tank Capacity, Single-Shell
4 @ 55 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-C-101 ■	4	0	1
241-C-102	304	0	0
241-C-103	2	0	0
241-C-104	1	0	1
241-C-105 ■	132	0	8
241-C-106	3	0	0
241-C-107	16	0	0
241-C-108	3	0	0
241-C-109	2	0	0
241-C-110	2	0	0
241-C-111	32	0	1
241-C-112	13	0	0
241-C-201 ■	0	0	0
241-C-202 ■	0	0	0
241-C-203 ■	0	0	0
241-C-204 ■	0	0	0



LEGEND: Sludge; Saltcake; Supernatant; Available Space; Assumed/Confirmed Leaker ■

Data Derived From Waste Tank Summary Report Dated 4/30/2014

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3.1.1 Single-Shell Tanks

Status: Interim Stabilized, Retrieved, or Retrievals in Progress

Responsibility: ORP TOC (WRPS)

There are 149 SSTs on the Hanford Site that were constructed between 1943 and 1964. Sixty-six SSTs are located in the 200 East Area and 83 SSTs are located in the 200 West Area. SSTs are used only for storage and have had nearly all free liquid removed as part of the Interim Stabilization Program. SST waste inventories today are primarily solidified sludges and crystallized salts with some liquid.

SSTs are monitored to provide assurance that any future SST loss of integrity can be detected. Monitoring activities include dome deflection surveys; SST integrity assessments (RPP-10435, *Single-Shell Tank System Integrity Assessment Report*); photo and video archives of dome interiors; leak history archives; and a variety of surveillance methods, including liquid observation wells, drywell monitoring, material balances during retrieval, transfer route monitoring, waste surface level measurements, and leak detection during waste retrieval. In addition, tank farms personnel use high-resolution resistivity leak detection and monitoring systems for SSTs during retrieval operations. This system was first demonstrated on SST 241-S-102 and has since been deployed on 11 tanks[16] in 241-C Tank Farm. Surface geophysical exploration technologies have been demonstrated in many of the SST farms; this method allows personnel to identify areas of higher conductivity in the soil. Transfer routes are monitored for radioactivity, toxic vapor releases, and visual indications of possible leaks. A formal tank leak assessment process is also in place, using approved tank operating procedures.

Because the oldest SSTs were more than 60 years old, and knowing that completion of SST waste retrieval was still decades away, a new SST Integrity Project (SSTIP) was developed in 2009 to identify and implement those activities needed to extend the life of the tanks. An expert panel convened and met twice in 2009 to address SST integrity concerns. From these two meetings, the panel provided 33 recommendations, documented in RPP-RPT-43116, *Expert Panel Report for Hanford Site Single-Shell Tank Integrity Project*, for implementation of an enhanced SSTIP. The panel focused on four key elements for the tank integrity project: (1) confirmation of tank structural integrity, (2) assessment of the likelihood of future tank liner degradation, (3) leak identification and prevention, and (4) mitigation of contaminant migration. Some of the panel's recommendations were converted into HFFACO milestones. Several significant efforts are in progress:

- Sidewall coring was completed in SST 241-A-106. Concrete degradation is linked with elevated temperature, and the high-heat history of SST 241-A-106 is expected to provide a bounding case for evaluation. A series of 1-foot (ft) to 5-ft cores were drilled and extracted to a depth of 38 ft from the tank sidewall through the haunch, down the full height of the SST sidewall, and into, but not through, the wall footing. A similar effort was completed in 1981 on SST 241-SX-115. Obtaining this new core will provide additional information on the present condition of SST concrete. The cores have been shipped to a laboratory for testing and analysis.

[16] Includes Tanks 241-C-101, 241-C-102, 241-C-103, 241-C-104, 241-C-105, 241-C-107, 241-C-108, 241-C-109, 241-C-110, 241-C-111, and 241-C-112.

- Investigative work employing the process described in RPP-32681, *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning*, has concluded that many of the 67 SSTs previously designated as assumed leakers may have been miscategorized because of spills and overflows that occurred as the result of the normal, intended cascade process when the tanks were operating and were not the result of liner breaches. This conclusion is subject to tank-by-tank formal confirmation via TFC-ENG-CHEM-D-42, "Tank Leak Assessment Process." Sixty-three SSTs are currently listed in HNF-EP-0182 as assumed leakers. To date, the RPP-32681 process has concluded that 25 of these tanks have had a liner breach. The remaining 38 tanks have either been redesignated as sound tanks, or need to be further evaluated. Whether or not a tank is an assumed leaker or sound is a critical determining factor in the selection of retrieval technologies as the more efficient retrieval technologies require the addition of considerable amounts of liquid (supernatant or water), which has the potential to significantly exacerbate any existing leaks.
- Recent reviews of historical monitoring data for the 149 SSTs indicate unanticipated level changes in some tanks (see additional details below). Any change in tank level data, whether positive or negative, represents the net impact of possible:
  - Liquid intrusion
  - Generation or release of retained gases in the waste
  - Water evaporation
  - Physical changes in the waste
  - Leakage from the tank
  - The interstitial liquid level of the tank not being at equilibrium following liquid observation well installation or saltwell pumping.

  Visual (video) inspections can help identify structural defects, stains, or dried accumulations of waste that may indicate past intrusions; wet surfaces on tank walls or internal structures that should be dry; or active intrusions. All of these factors are considered when evaluating the status of a tank.

  Some tanks may be experiencing liquid intrusion. Intrusion of liquid into an SST is a concern because liquid addition could increase the consequences of a tank leak or mask a leak from a tank. Sixty-six SSTs showed increasing surface or interstitial liquid levels at a rate greater than 0.001 inch/year. Twenty-one tanks showing the largest increases were selected for in-tank video inspection.

  - In FY 2013, 12 of these 21 tanks received in-tank video inspections:

241-A-103	241-BX-101	241-BX-103	241-BX-110	241-BY-101	241-BY-102
241-BY-111	241-S-109	241-S-111	241-SX-106	241-TX-112	241-U-111

    Of those, six tanks (241-A-103, 241-BX-101, 241-BX-103, 241-BX-110, 241-BY-102, and 241-SX-106) were confirmed to have liquid intrusion. Problem

Evaluation Requests[17] were written for each of the six listed tanks. For additional details, refer to RPP-RPT-50799, *Suspect Water Intrusion in Hanford Single-Shell Tanks*.

- In FY 2014 (as of March 2014), tanks specifically inspected for intrusion evaluation include 241-A-102, 241-A-103 (repeat from FY 2013), 241-B-109, 241-B-202, 241-BY-103, 241-S-106, 241-T-101, 241-TY-102, and 241-U-111 (repeat from FY 2013). Intrusions were identified in 241-A-102, 241-B-202, 241-BY-103, and 241-U-111. The intrusion in 241-A-103 appears to have stopped. Several more tanks are scheduled for video inspections during the remainder of FY 2014.
- In addition to the above, 241-SX-102 received an in-tank video inspection in FY 2014 for evaluation of a surface-level change and was noted to have an intrusion. Tank 241-T-111 received an in-tank video inspection in FY 2013 for evaluation of a level decrease and no intrusion was noted; however, a repeat of the inspection in FY 2014 confirmed an intrusion was present, and a reanalysis of the FY 2013 video showed the intrusion was previously present but had been missed.

If an intrusion is noted during an in-tank inspection, the tank farms contractor will recommend actions to minimize or stop the intrusion. Actions taken will be dependent upon the intrusion rate, volume of liquid in the tank, the tank status (sound or assumed leaker), and resources.

Refer to HNF-SD-RE-TI-178, *Single-Shell Tank Interim Stabilization Record*, contained the details regarding how each of the 149 SSTs were interim stabilized. In all cases, the Interim Stabilization Consent Decree defined criteria (less than 50,000-gal drainable interstitial liquid and less than 5,000 gal. supernate) were applied.

- Recent reviews of historical monitoring data for the 149 SSTs indicated that 83 SSTs showed decreasing surface or interstitial liquid levels at a rate less than 0.001 inch/year. Of these 83 SSTs, 20 were selected for further evaluation:

241-A-102	241-A-106	241-AX-101	241-AX-103	241-B-203
241-B-204	241-BY-108	241-S-104	241-SX-102	241-SX-105
241-SX-114	241-T-111	241-T-203	241-T-204	241-TX-108
241-TY-101	241-TY-103	241-TY-105	241-U-104	241-U-108

Note: DST 241-A-102 is on both the level increase list and the level decrease list, because tank level data has risen and fallen by similar amounts at different times.

Six of these tanks (241-B-203, 241-B-204, 241-T-111, 241-T-203, 241-T-204, and 241-TY-105) received in-tank video inspections in FY 2013 and were evaluated in RPP-RPT-55263, *Evaluation of Tank 241-TY-105 Level Data and In-Tank Video Inspection*; RPP-RPT-55264, *Evaluation of Tank 241-T-203 and 241-T-204 Level Data and In-Tank Video Inspection*; RPP-RPT-55265, *Evaluation of Tank 241-B-203 and 241-B-204 Level Data and In-Tank Video Inspection*; and RPP-RPT-54964, *Evaluation*

[17] The WRPS Problem Evaluation Request system provides a means for the timely identification, evaluation, and correction of conditions that are adverse to the environment, safety, and health, including quality assurance and integrated safety management, safeguards and security, operability, cyber security, and emergency management (TFC-ESHQ-Q_C-C-01, "Problem Evaluation Request").

of Tank 241-T-111 Level Data and In-Tank Video Inspection. The remaining 14 tanks were evaluated in RPP-RPT-54981, *Evaluation of Fourteen Tanks with Decreasing Level Baselines Selected for Review in RPP-PLAN-55113, March 2013 Single-Shell Tank Waste Level Decrease Evaluation, Revision 1*. For 19 of the tanks, DOE concluded that evaporation or improved data analysis was the basis for the waste-surface-level decrease. One tank, 241-T-111, was concluded to be leaking.

3.1.1.1 Single-Shell Tank Waste Retrieval Process Fundamentals

Because the SSTs contain materials with different waste characteristics, design attributes, and operating histories, waste retrieval from SSTs requires a variety of techniques. DOE may need to deploy different technologies within a single tank to meet waste retrieval requirements; for example, up to three technologies may be required for tanks being retrieved under the Consent Decree.

Each SST waste retrieval process results in the transfer of waste from the SST to a receiver tank, which is typically a DST or a tank within a Waste Receiving Facility (WRF). Tank waste retrieved from the T Complex and B Complex tanks will first be collected in the T Complex and B Complex WRFs, respectively, before eventually being transferred to DSTs in the 200 East Area. Potential transuranic (TRU) waste currently stored in seven tanks in 241-T Tank Farm and four tanks in 241-B Tank Farm could be retrieved and sent directly to supplemental TRU treatment facilities located at those farms.

The retrieved waste is transferred as slurry consisting primarily of dissolved salt or suspended solids. The concentration of SST waste in this slurry is a key parameter for measuring retrieval effectiveness. Each retrieval, regardless of retrieval method, tank design, or waste composition, is assumed to consist of three possible operational phases are as follows:

- Bulk retrieval occurs where the waste slurry concentration is approximated as a constant value. Bulk retrieval begins at the start of retrieval and ends when the cumulative waste slurry concentration begins to show a definite decline as retrieval progresses.
- The transition starts when bulk retrieval ends. In the transition phase, the waste slurry concentration steadily declines as the remaining waste volume in the tank is reduced. The transition ends when the waste slurry concentration is reduced to the point at which retrieval with the current equipment is no longer effective, or when additional equipment or technology is deployed to increase the retrieval rate.
- Hard-to-remove heel (HTRH) operations begin when the transition operations are no longer effective. If HTRH retrieval is required, HTRH equipment is installed and removal begins. The waste slurry concentration during HTRH retrieval begins at a specified concentration and reduces steadily as remaining waste in the tank is reduced until the HTRH retrieval process is no longer effective.

For some retrieval processes, transition operations are assumed to result in waste levels below the HFFACO residual waste volume requirement. For these processes, retrieval is complete at the end of the transition phase, and no HTRH removal is required. Typically, for the remaining retrieval processes to be required, the transition operations end with waste levels above the HFFACO residual waste volume limit so HRTH retrieval would be required. For tanks with Consent Decree milestones, DOE may request Ecology's agreement that implementing a third technology is not practicable under the criteria specified in the Consent Decree. Once the

residual goal of 360 cubic feet is reached, or Ecology agrees a third technology is not practicable, retrieval for a tank is considered complete. The HFFACO does not contain similar provisions and requires retrieval to 360 cubic feet or the limits of technology, whichever is less subject to the Appendix H process, in the HFFACO, that could require deployment of additional technologies or a waiver of the 360 cubic feet requirement.

A variety of waste retrieval technologies have been deployed in Hanford SSTs for bulk waste retrieval that are briefly described below:

- Modified Sluicing – A stream of supernate pumped from another DST is directed onto the sludge in order to mobilize the waste and direct it to the pump inlet. Supernate is used instead of water in order to minimize the addition of water to the DST system, which would take up valuable space or require evaporation. Modified sluicing is so named to distinguish it from the sluicing techniques used from the 1950s through the 1970s, which used significantly more liquid than is necessary with modified sluicing today. A variation of this method, the Extended Reach Sluicing System-high-pressure water, uses a sluicing arm with an elbow and an extendable boom to locate the sluicing nozzle closer to the waste than is possible using a standard sluicing nozzle. The Extended Reach Sluicing System-high-pressure water is minimally used and only when needed in order to minimize the addition of water.

Figure 3-3. Mobile Arm Retrieval System.

- Mobile Arm Retrieval System (MARS) – The MARS unit is a robotic arm installed in a central riser with an internal diameter of 47 inches (Figure 3-3 and Figure 3-4). The arm has an elbow and three telescoping segments, which allows the unit to reach all areas of the tank, unless access is blocked by some obstruction. There are two forms of the MARS used – the MARS-Sluicing for sluicing and the MARS-Vacuum with a vacuum attachment. The MARS-Sluicing system is typically used in tanks that do not contain leaks or liner breaches. It has nozzles on the end of the arm to accommodate both low-pressure supernate sluicing and high-pressure water washing. The MARS-Vacuum, on the other hand, can be used in tanks with liner breaches because the end of the arm contains a suction nozzle in addition to

Figure 3-4. Mobile Arm Retrieval System Test at the Cold Test Facility.

the spray nozzles. The waste is mobilized with supernate and/or water and then sucked up through the nozzle instead of directing the waste to a central pump.

- Vacuum Retrieval in 200-Series tanks (VR-200) – A mast arm inserted through a riser near the perimeter of a tank is equipped with a vacuum head with low- and high-pressure sprays.
- Mobile Retrieval System for 100-Series tanks (vacuum retrieval with in-tank vehicle) – The Mobile Retrieval System is a vacuum retrieval system with an in-tank tracked vehicle. The vehicle is used to push or spray waste towards the vacuum retrieval head.

HTRH retrieval technologies deployed to date include:

- In-Tank Vehicles – A generic, tracked, in-tank vehicle equipped with a high-pressure water sprayer that moves around the tank, breaks up the waste, helps dissolve it or mobilize the particles, and moves the resulting solution or particles toward a pump or jet for removal from the tank.
- Chemical Dissolution – Oxalic acid may be added to a tank to help mobilize heels consisting largely of metal oxides. Caustic (sodium hydroxide) may be added to a tank heel largely composed of insoluble aluminum hydroxide (which may be present in a hydrated form as gibbsite), in order to convert the heel into soluble sodium aluminate solids, which can then be removed with water.

For additional details describing these and other waste retrieval technologies, refer to RPP-PLAN-40145.

3.1.1.2 Single-Shell Tank Waste Retrieval Progress to Date

Waste retrieval from SSTs is ongoing, in accordance with the Consent Decree, which applies to 10 C Farm Waste Management Area (WMA-C) tanks and 9 additional SSTs as described in milestone B-2. Waste retrieval work on these tanks is documented by ORP in accordance with the Consent Decree, Section IV.B, and Appendix C.

Table 3-2 provides an overview of the current status of SST waste retrievals, based on the most recently completed documentation for each tank as cited therein.

3.1.1.3 Single-Shell Tank Closure

Detailed descriptions of closure plans for Hanford facilities are still under development and are beyond the purview of this document. In the Tank Closure and Waste Management (TC & WM) Environmental Impact Statement (EIS) Record of Decision (ROD) (78 FR 75913, "Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington: Record of Decision"), the DOE identified landfill closure as the preferred alternative for closure of SSTs. Final closure of each SST and its associated waste management area is assumed to be completed within about 5 years after the last SST from that farm is retrieved. Closure will be conducted in accordance with applicable regulatory requirements.

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Table 3-2. Single-Shell Tank Waste Retrieval Current Status and Reference Documents. (4 Pages)

Tank	Retrieval Start Date	Retrieval Completion Date	Consent Decree Waste Residual Goal (ft^3)	Approx. Waste Volume Remaining (ft^3)	First Technology Deployed	Second Technology Deployed	Third Technology Deployed	Current Status and Reference Documents
241-C-101	12/10/2012	09/11/2013	360 or less	667	Modified Sluicing using two ERSSs	HPW	TBD	Status: ORP submitted to Ecology the request to forego implementing a third retrieval technology in 241-C-101. Documents are currently under review by Ecology. Ref: Letter 14-TF-0012, ORP to Ecology, "Request for Washington State Department of Ecology Agreement that the U.S. Department of Energy, Office of River Protection May Forego Implementing a Third Retrieval Technology in Tank 241-C-101." [a] RPP-55849, *Practicability Evaluation Request to Forego a Third Retrieval Technology for Tank 241-C-101.*[b]
241-C-103	11/06/2005	08/26/2006	360 or less	351	Modified Sluicing 2005-2006	N/A	N/A	Status: Ecology confirms SST 241-C-103 has been retrieved to the limits of technology. Ref: Letter 0075083, Ecology to ORP, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204."[c] Letter 07-TPD-027, ORP to U.S. Environmental Protection Agency, "Submittal of Retrieval Data Report (RDR) for Single Shell Tank 241-C-103, RPP-RPT-33060, Revision 0."[d] RPP-RPT-33060, *Retrieval Data Report for Single-Shell Tank 241-C-103.*[e]
241-C-104	01/08/2010	08/17/2012	360 or less	236	Modified Sluicing	Caustic Dissolution	TBD	Status: ORP submitted the retrieval completion certificate and the retrieval data report to Ecology. Documents are currently under review by Ecology. Ref: Letter 13-TF-0018, ORP to Ecology, "The US Department of Energy, Office of River Protection Submits the Retrieval Completion Certification and Report for Tank 241-C-104." [f] RPP-53823, *Retrieval Completion Certification Report for Tank 241-C-104.*[g] Letter 14-TF-0013, ORP to Ecology, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Data Report for Tank 241-C-104."[h] RPP-RPT-54072, *Retrieval Data Report for Single-Shell Tank 241-C-104.*[i]
241-C-106	11/1998	12/2003	360 or less	370	Sluicing 1998-1999	Modified Sluicing with Oxalic Acid Dissolution 2003	N/A	Status: ORP transmitted the retrieval data reports for SST 241-C-106 to Ecology. Ref: Letter 04-TPD-059, ORP to Ecology, "Request for Exception to the Hanford Federal Facility Agreement and Consent Order (HFFACO) Waste Retrieval Criteria, Retrieval Data Reports for Single-Shell Tank 241-C-106; HFFACO Milestones M-45-00 and M-45-05H, and Target Dates M-45-05L-T01 and M-45-05M-T01."[j] RPP-20110, *Stage 1 Retrieval Data Report for Single-Shell Tank 241-C-106.*[k] RPP-20577, *Stage II Retrieval Data Report for Single-Shell Tank 241-C-106.*[l]
241-C-107	09/26/2011	In progress	360 or less	TBD	MARS-S with Supernate Sluicing 2011-2014	MARS-S with HPW 2012-2014 HPW with Backstop 2013-2014	Chemical Dissolution with Hot Water, Followed by MARS-S Planned in Late 2014	Status: ORP has submitted the TWRWP for SST 241-C-107 to Ecology, as well as subsequent updates. Planning is underway to deploy chemical dissolution with MARS-S as a third technology. Ref: RPP-22393, *241-C-102, 241-C-104, 241-C-107, 241-C-108, and 241-C-112 Tanks Waste Retrieval Work Plan.*[m] Note: Retrieval start date per HNF-EP-0182, Rev. 316.[n]
241-C-108	12/20/2006	03/22/2012	360 or less	460	Modified Sluicing	Caustic Dissolution with One Sluicer	N/A	Status: ORP submitted a request to forego deployment of a third technology. Ecology approved the request. The ORP then submitted the retrieval completion certificate report and the retrieval data report to Ecology. Ref: Letter 12-TF-0037, ORP to Ecology, "Request for Ecology Agreement that the U.S. Department of Energy (DOE), Office of River Protection (ORP) May Forego

Table 3-2. Single-Shell Tank Waste Retrieval Current Status and Reference Documents. (4 Pages)

Tank	Retrieval Start Date	Retrieval Completion Date	Consent Decree Waste Residual Goal (ft^3)	Approx. Waste Volume Remaining (ft^3)	First Technology Deployed	Second Technology Deployed	Third Technology Deployed	Current Status and Reference Documents
								Implementing a Third Technology in Tank 241-C-108".[o] Letter 12-NWP-178, Ecology to ORP, "Department of Ecology Response to the United States Department of Energy's Letter 12-TF-0037, dated September 4, 2012, and Practicability Evaluation Request to Forego a Third Retrieval Technology for Tank 241-C-108, RPP-52290, Rev. 1."[p] Letter 13-TF-0025, ORP to Ecology, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Completion Certification Report for Tank 241-C-108."[q] RPP-53869, *Retrieval Completion Certification and Report for Tank 241-C-108.*[r] Letter 13-TF-0120, ORP to Ecology, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Data Report for Tank 241-C-108."[s] RPP-RPT-55896, *Retrieval Data Report for Single-Shell Tank 241-C-108.*[t]
241-C-109	06/19/2007	09/12/2012	360 or less	230	Modified Sluicing 2007	Caustic Dissolution 2012	N/A	Status: ORP has submitted the retrieval completion certification report and the retrieval data report for SST 241-C-109. Ref: Letter 13-TF-0037, ORP to Ecology, "The US Department of Energy (DOE), Office of River Protection (ORP) Submits the Retrieval Completion and (sic) Report for Tank 241-C-109."[u] RPP-53824, *Retrieval Completion Certification Report for Tank 241-C-109.*[v] Note: The FoldTrack® Mobile Retrieval Tool was deployed as a demonstration in 241-C-109 prior to the Consent Decree. No credit was taken for the FoldTrack® Mobile Retrieval Tool as a separate technology in removing waste from SST 241-C-109. Letter 14-TF-0020, ORP to Ecology, "The US Department of Energy (DOE), Office of River Protection (ORP) Submits the Retrieval Data Report for Tank 241-C-109."[w] RPP-RPT-55284, *Retrieval Data Report for Single-Shell Tank 241-C-109.*[x]
241-C-110	09/22/2008	10/16/2013	360 or less	280	Modified Sluicing 2008-2009	FoldTrack® Mobile Retrieval Tool with Hot Water Sluicing 2013	N/A	Status: ORP has submitted the retrieval completion certification report for SST 241-C-110.[y] Ref: Letter 14-TF-0007, ORP to Ecology, "The US Department of Energy (DOE), Office of River Protection Submits the Retrieval Completion Certification and Report for Tank 241-C-110."[y] RPP-56214, *Retrieval Completion Certification Report for Tank 241-C-110.*[z]
241-C-112	12/28/2011*	~01/30/2014	360 or less	4,490	Modified Sluicing using two ERSSs	N/A	N/A	Status: Retrieval operations were halted, and WRPS is evaluating the residual heel. Ref: RPP-RPT-52480, *Retrieval Completion Report for Modified Sluicing of Tank 241-C-112.*[aa]
241-C-201	10/25/2005	03/23/2006	30 or less	20	Vacuum Retrieval	N/A	N/A	Status: Ecology confirms that SST 241-C-201 has been retrieved to the limits of technology. Ref: Letter 0075083, Ecology to ORP, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204."[c] RPP-RPT-30181, *Retrieval Data Report for Single-Shell Tank 241-C-201.*[bb]
241-C-202	06/30/2005	08/11/2005	30 or less	20	Vacuum Retrieval 2005	N/A	N/A	Status: Ecology confirms that SST 241- C-202 has been retrieved to the limits of technology. Ref: Letter 0075083, Ecology to ORP, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204."[c]

Table 3-2. Single-Shell Tank Waste Retrieval Current Status and Reference Documents. (4 Pages)

Tank	Retrieval Start Date	Retrieval Completion Date	Consent Decree Waste Residual Goal (ft^3)	Approx. Waste Volume Remaining (ft^3)	First Technology Deployed	Second Technology Deployed	Third Technology Deployed	Current Status and Reference Documents
								RPP-RPT-29095, *Retrieval Data Report for Single-Shell Tank 241-C-202.*[cc]
241-C-203	06/30/2004	03/25/2005	30 or less	19	Vacuum Retrieval 2004-2005	N/A	N/A	Status: Ecology confirms that SST 241- C-203 has been retrieved to the limits of technology. Ref: Letter 0075083, Ecology to ORP, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204."[c] RPP-RPT-26475, *Retrieval Data Report for Single-Shell Tank 241-C-203.*[dd]
241-C-204	07/23/2006	12/11/2006	30 or less	19	Vacuum Retrieval 2006	N/A	N/A	Status: Ecology confirms that SST 241-C-204 has been retrieved to the limits of technology. Ref: Letter 0075083, Ecology to ORP, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204."[c] RPP-RPT-34062, *Retrieval Data Report for Single-Shell Tank 241-C-204.*[ee]
241-S-102	12/16/2004	07/26/2007	NA	Interim Stabilized	Saltwell Pumping 1999-2002	Pumping 2004-2007	N/A	Status: SST 241-S-102 is in storage mode. Initial retrieval operations were stopped prematurely in July 2007 because of an above-grade waste spill. Subsequent operations led to SST 241-S-102 meeting interim stabilization criteria. Ref: Letter 10-TPD-163, ORP to Ecology, "Completion of Interim Stabilization (IS) of Single-Shell Tank (SST) 241-S-102 Under Interim Stabilization Consent Decree Case No. CT-99-5076-EFS."[ff] Note: Tank status per HNF-EP-0182, Rev. 316.[n]
241-S-112	09/26/2003	02/28/2007	360 or less	326	Saltcake Dissolution and Modified Sluicing 2003-2005	Remote Water Lance,a Caustic Dissolution, and Sluicing 2005-2007	TBD	Status: ORP submitted an retrieval data report to Ecology. Ref: Letter 07-TPD-066, ORP to Ecology, "Submittal of Retrieval Data Report (RDR) for Single-Shell Tank 241-S-112, RPP-RPT-35112, Revision 0."[gg] RPP-RPT-35112, *Retrieval Data Report for Single-Shell Tank 241-S-112.*[hh]

a 14-TF-0012, 2014, "Request for Washington State Department of Ecology Agreement that the U.S. Department of Energy, Office of River Protection May Forego Implementing a Third Retrieval Technology in Tank 241-C-101" (letter from K.W. Smith to J.A. Hedges, February 18), U.S. Department of Energy, Office of River Protection, Richland, Washington.
b RPP-55849, 2014, *Practicability Evaluation Request to Forego a Third Retrieval Technology for Tank 241-C-101*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
c 0075083, 2008, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204" (letter from J. J. Lyon to S. J. Olinger, January 7), Washington State Department of Ecology, Olympia, Washington.
d 07-TPD-027, 2007, "Submittal of Retrieval Data Report (RDR) for Single Shell Tank 241-C-103, RPP-RPT-33060, Revision 0" (letter from S. J. Olinger to M. A. Bussell, May 22), U.S. Department of Energy, Office of River Protection, Richland, Washington.
e RPP-RPT-33060, 2007, *Retrieval Data Report for Single-Shell Tank 241-C-103*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
f 13-TF-0018, 2013, "The US Department of Energy, Office of River Protection Submits the Retrieval Completion Certification and Report for Tank 241-C-104" (letter from T. W. Fletcher to J. A. Hedges, March 21), U.S. Department of Energy, Office of River Protection, Richland, Washington.
g RPP-53823, 2013, *Retrieval Completion Certification for Tank 241-C-104*, Rev. 2A, Washington River Protection Solutions LLC, Richland, Washington.
h 14-TF-0013, 2014, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Data Report for Tank 241-C-104" (letter from K.W. Smith to J.A. Hedges, February 18), U.S. Department of Energy, Office of River Protection, Richland, Washington.
i RPP-RPT-54072, 2014, *Retrieval Data Report for Single-Shell Tank 241-C-104*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
j 04-TPD-059, 2004, "Request for Exception to the Hanford Federal Facility Agreement and Consent Order (HFFACO) Waste Retrieval Criteria, Retrieval Data Reports for Single-Shell Tank 241-C-106; HFFACO Milestones M-45-00 and M-45-05H, and Target Dates M-45-05L-T01 and M-45-05M-T01"(letter from R. J. Schepens to M. A. Wilson, June 3), U.S. Department of Energy, Office of River Protection, Richland, Washington.
k RPP-20110, 2004, *Stage I Retrieval Data Report for Single-Shell Tank 241-C-106*, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.
l RPP-20577, 2007, *Stage II Retrieval Data Report for Single-Shell Tank 241-C-106*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.
m RPP-22393, 2013, *241-C-102, 241-C-104, 241-C-107, 241-C-108, and 241-C-112 Tanks Waste Retrieval Work Plan*, Rev. 7, Washington River Protection Solutions LLC, Richland, Washington. (Also refer to Change Notice 2014-02, received by Ecology 6/05/2014.)
n HNF-EP-0182, 2014, *Waste Tank Summary Report for Month Ending April 30, 2014*, Rev. 316, Washington River Protection Solutions LLC, Richland, Washington.
o 12-TF-0037, 2012, "Request for Ecology Agreement that the U.S. Department of Energy (DOE), Office of River Protection (ORP) May Forego Implementing a Third Technology in Tank 241-C-108" (letter from T. W. Fletcher to J. A. Hedges, September 4), U.S. Department of Energy, Office of River Protection, Richland, Washington.
p 12-NWP-178, 2012, "Department of Ecology Response to the United States Department of Energy's Letter 12-TF-0037, dated September 4, 2012, and Practicability Evaluation Request to Forego a Third Retrieval Technology for Tank 241-C-108, RPP-52290, Rev. 1" (letter from J.A. Hedges to T.W. Fletcher, November 16), Washington State Department of Ecology, Olympia, Washington.
q 13-TF-0025, 2013, "The US Department of Energy, Office of River Protection Submits the Retrieval Completion Certification Report for Tank 241-C-108," (letter from T.W. Fletcher to J. A. Hedges, May 1), U.S. Department of Energy, Office of River Protection, Richland, Washington.
r RPP-53869, 2013, *Retrieval Completion Certification and Report for Tank 241-C-108*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington.
s 13-TF-0120, 2013, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Data Report for Tank 241-C-108"(letter from K.W. Smith to J.A. Hedges, November 27), U.S. Department of Energy, Office of River Protection, Richland, Washington.
t RPP-RPT-55896, 2013, *Retrieval Data Report for Single-Shell Tank 241-C-108*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

Table 3-2. Single-Shell Tank Waste Retrieval Current Status and Reference Documents. (4 Pages)

Tank	Retrieval Start Date	Retrieval Completion Date	Consent Decree Waste Residual Goal (ft^3)	Approx. Waste Volume Remaining (ft^3)	First Technology Deployed	Second Technology Deployed	Third Technology Deployed	Current Status and Reference Documents

u 13-TF-0037, 2013, "The US Department of Energy (DOE), Office of River Protection (ORP) Submits the Retrieval Completion and (sic) Report for Tank 241-C-109," (letter from K.W. Smith to J.A. Hedges, June 4), U.S. Department of Energy, Office of River Protection, Richland, Washington.
v RPP-53824, 2013, *Retrieval Completion Certification Report for Tank 241-C-109*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.
w 14-TF-0020, 2014, "The US Department of Energy (DOE), Office of River Protection (ORP) Submits the Retrieval Data Report for Tank 241-C-109," (letter from K.W. Smith to J.A. Hedges, March 13), U.S. Department of Energy, Office of River Protection, Richland, Washington.
x RPP-RPT-55284, 2014, *Retrieval Data Report for Single-Shell Tank 241-C-109*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
y 14-TF-0007, 2014, "The US Department of Energy (DOE), Office of River Protection Submits the Retrieval Completion Certification and (sic) Report for Tank 241-C-110," (letter from K.W. Smith to J.A. Hedges, January 29), U.S. Department of Energy, Office of River Protection, Richland, Washington.
z RPP-56214, 2014, *Retrieval Completion Certification Report for Tank 241-C-110*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
aa RPP-RPT-52480, 2012, *Retrieval Completion Report for Modified Sluicing of Tank 241-C-112*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
bb RPP-RPT-30181, 2006, *Retrieval Data Report for Single-Shell Tank 241-C-201*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
cc RPP-RPT-29095, 2006, *Retrieval Data Report for Single-Shell Tank 241-C-202*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
dd RPP-RPT-26475, 2007, *Retrieval Data Report for Single-Shell Tank 241-C-203*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
ee RPP-RPT-34062, 2007, *Retrieval Data Report for Single-Shell Tank 241-C-204*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
ff 10-TPD-163, 2010, "Completion of Interim Stabilization (IS) of Single-Shell Tank (SST) 241-S-102 Under Interim Stabilization Consent Decree Case No. CT-99-5076-EFS," (letter from D. A. Brockman to J. A. Hedges, December 9), U.S. Department of Energy, Office of River Protection, Richland, Washington.
gg 07-TPD-066, 2007, "Submittal of Retrieval Data Report (RDR) for Single-Shell Tank 241-S-112, RPP-RPT-35112, Revision 0," (letter from S. J. Olinger to J. Hedges, December 21), U.S. Department of Energy, Office of River Protection, Richland, Washington.
hh RPP-RPT-35112, 2007, *Retrieval Data Report for Single-Shell Tank 241-S-112*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

DOE	U.S. Department of Energy	MARS-S	Mobile Arm Retrieval Sluicing System	TBD	to be determined
Ecology	Washington State Department of Ecology	N/A	not applicable	TWRWP	Tank Waste Retrieval Work Plan
ERSS	Extended Reach Sluicing System	ORP	Office of River Protection	WRPS	Washington River Protection Solutions LLC
HPW	high-pressure water	SST	single-shell tank		

3.1.2 Double-Shell Tanks

Status: 27 DSTs Operational, 1 DST Confirmed Leaker from Primary Tank into annulus

Responsibility: ORP TOC (WRPS)

There are 28 DSTs on the Hanford Site: 3 in the 200 West Area and 25 in the 200 East Area. All were constructed between 1968 and 1986. Generally, the DSTs contain liquids and settled solids, either salts or sludge. The DSTs currently play an integral role within the RPP system, including:

- Supporting SST waste retrieval by receiving the retrieved SST waste
- Supporting 242-A Evaporator operations
- Staging feed for delivery to the WTP.

The DST Integrity Project implements controls and inspections to ensure that the DSTs and their ancillary equipment will be available for use through the end of the RPP mission. Activities for the DST Integrity Project include the following:

- Conducting DST integrity assessments (e.g., ultrasonic and video examinations) and documenting the results for use in subsequent inspections
- Conducting waste chemistry sampling and adjustments for corrosion mitigation
- Performing waste chemistry corrosion optimization studies to quantify the best waste chemistry parameters to minimize DST corrosion, while adding a minimal amount of chemicals to the waste
- Developing and installing in-tank corrosion probes for DSTs with new or revised corrosion control limits
- Performing DST structural analysis and studies for thermal, operating, and seismic loads
- Performing in-service leak testing needed to raise the operating levels of tanks in the 241-AP Tank Farm from 1.144 Mgal to 1.2465 Mgal
- Conducting periodic testing, evaluation, and certification of DST support equipment (e.g., waste transfer lines, valve pits, etc.).

In 2012, DOE determined that DST 241-AY-102 had a small amount of dry material at two locations in the tank annulus. Laboratory analysis of the material confirmed that it was dried waste. Inspections of the tank and ancillary equipment indicate that no DST 241-AY-102 waste has escaped into the surrounding soil. Additional dry material was discovered at a third location inside the annulus in 2014. The waste inventory currently stored in DST 241-AY-102 was intended to be used as startup feed for the WTP. Alternative plans for dispositioning the current inventory, providing initial feed to WTP, and determining the future role of the tank are being explored.

Effective and efficient management of the storage space available in the remaining 27 DSTs must be coordinated with other elements of the RPP mission. The theoretical total capacity of the 27 DSTs is 31,156,000 gal. Although the majority of the space in the DSTs is used for waste storage, not all of the space is available for that purpose. Some headspace (i.e., the space above the waste surface in the tank) must be set aside to accommodate certain operating constraints:

- Safety basis headspace is unfilled space in a DST containing waste that has an associated safety issue. For example, in Group A tanks (241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, and 241-SY-103), the current waste conditions pose the potential for a spontaneous buoyant displacement gas release event (BDGRE) involving flammable gas (RPP-13033, *Tank Farms Documented Safety Analysis*). Therefore, no additional waste shall be transferred into those tanks until the safety issue has been mitigated.
- Emergency space, in accordance with DOE M 435.1-1, *Radioactive Waste Management Manual*, is 1.265 Mgal of available space that could be used to receive waste from a leaking DST. DOE selected the value for the emergency space allocation based on the maximum volume of waste that could be stored in a 241-AP Tank Farm DST (OSD-T-151-00007, "Operating Specifications for the Double-Shell Storage Tanks"). The DOE has also requested that the tank farms contractor provide the capability to receive up to the volume equivalent of one DST from the WTP on an emergency basis, to accommodate a potential emergency return of either LAW or HLW (99-AMPD-006/CCN 9952261 A, "Contract No. DE-AC06-96RL13200 – Planning Guidance Revisions for Development of Contract Deliverables Required by Performance Agreement TWR1.3.5"). The space to receive the WTP returns is counted as part of the emergency space allocation. Emergency space is not associated with a specific tank but is distributed throughout the DST system. Evaporator operational space and WTP feed headspace can be used to provide DST emergency space, if needed. When practical, one or two DSTs are designated to provide the bulk of DST emergency space.
- WTP feed headspace is the unfilled space in a DST that contains already-sampled waste specifically identified for delivery to WTP as waste feed. Once the contents of these feed tanks have been sampled for WTP feed, they must be isolated from any transfers into the tank. The addition of more waste could corrupt the feed batch and provoke a schedule delay of at least 210 days (30 days to resample and 180 days required by the ICD). Over the course of the RPP mission, several DSTs will rotate in and out of the role of staging, sampling, and feeding waste to WTP.

There are other DST management issues associated with the waste itself. Solids and liquids must be carefully managed so as to avoid a BDGRE, a deep sludge gas release event (DSGRE), or a tank bump (RPP-RPT-24887, *The Long-Term Management of Tank Waste at Hanford*).

- A BDGRE is the rapid release of gas that may be retained in low shear-strength salt slurries, resulting in the temporary creation of a flammable mixture in the headspace of the tank (RPP-7771, *Flammable Gas Safety Issue Resolution*).
- A DSGRE is similar to a BDGRE, but it is postulated to occur in tanks containing settled sludge solids if the waste-generated gases are unable to escape at a slow, continuous rate through channels in the sludge. Laboratory-scale tests were conducted by PNNL to determine whether this postulated mechanism is viable in Hanford sludges, and additional tests were conducted in a tall column installed at the Cold Test Facility.

- A tank bump is the rapid release of gas, mostly water vapor, causing the tank headspace to pressurize as a result of local superheated liquid vaporization (RPP-6213, *Hanford Waste Tank Bump Accident and Consequence Analysis*).

The controls to prevent each of these events, directly or indirectly, limit the depth of the solids in the tank, the depth of the supernate, and/or the heat load from radioactive decay requiring careful coordination with SST retrieval plans. Effective use of the DSTs before waste treatment processes are online is crucial.

Another consideration in operating the DSTs is managing waste containing high concentrations of phosphates. Wastes containing phosphates pose a high risk of solids precipitation and/or gelling during transfers, after evaporation and cooling, or during mixing with the waste in the receiver tank. This could (and has in the past) lead to formation of plugs in waste transfer lines or could cause significant difficulties during evaporator operations. Additionally, it is asserted that a tank containing phosphate gel might retain flammable gases leading to a gas release event of a different mechanism than a BDGRE (RPP-23584, *Safety Evaluation of Waste Gel in the Tank Farms*). Because of these issues, controls for the transfer of phosphate wastes are provided by HNF-SD-WM-OCD-015, *Tank Farms Waste Transfer Compatibility Program.*

Additionally, the majority of strontium-90 and TRU is bound in the solids and will be transferred as HLW. However, two DSTs, 241-AN-102 and 241-AN-107, currently store waste that includes high concentrations of complexed strontium-90 and TRU in supernate (which is typically transferred and treated as LAW). These two components must be precipitated out of solution prior to vitrification to avoid having to transfer those components to the LAW Facility. Although the PT Facility has the capability to do the precipitation, the current plan is to precipitate the strontium-90/TRU in situ in the DST system. The precipitated strontium-90 and TRU will be incidentally blended with other HLW solids and will be vitrified at the HLW Facility.

Closure of each DST and associated waste management area will be completed within approximately five years after all the Hanford tank waste has been treated. Closure will be conducted in accordance with applicable regulatory requirements. Additional information regarding the DST assumptions used for modeling the cases analyzed in this System Plan is provided in Appendix B.

3.1.3 Miscellaneous Underground Storage Tanks

Status: Operational/Inactive

Responsibility: ORP TOC (WRPS)

ORP is currently responsible for dozens of ancillary underground storage tanks known as MUSTs and IMUSTs. These smaller, auxiliary tanks supported SST operations. In the past, there was a regulatory distinction between the two: IMUSTs were removed from service before RCRA permitting and therefore were not included in the RCRA operating permit for the tank farm facilities, while the MUSTs were permitted under either RCRA SST Part A or RCRA DST Part A permits. However, at Ecology's request, during a May 2010 revision to the RCRA SST Part A permit application, all IMUSTs were added to the SST Part A permit.

The number of MUSTs under ORP management changes over time as the status of waste sites and operable units is better understood and as agreements between ORP and RL are adjusted.

ORP is currently responsible for approximately 60 MUSTs (including 43 inactive and 17 active tanks). The list of these tanks and their waste volumes is provided in HNF-EP-0182.

Efforts are underway to better integrate the MUSTs into RPP waste retrieval planning, as documented in the following reports:

- RPP-RPT-31148, *Composite Liquid Mitigation Report*, documents plans to mitigate the free liquids from 19 selected catch tanks and double-contained receiver tanks in 241-A, 241-AX, 241-AZ, 241-B, 241-BX, 241-S, 241-TX, and 241-U Tank Farms.
- RPP-PLAN-41977, *Single-Shell Tank System Component Identification and Proposed Closure Strategy*, identifies a closure strategy for other structures associated with the SST system (but not including the SSTs themselves) such as catch tanks, vaults, double-contained receiver tanks, sumps, cells, and ancillary equipment. This report was updated in 2010 in order to better align plans with new HFFACO milestone M-045-101.
- RPP-RPT-42231, *Summary of Twenty-Five Miscellaneous Tanks Associated with the Single-Shell Tank System*, was prepared as a supporting document to RPP-PLAN-41977, and summarizes MUST information available from historical data, stabilization reports, and other sources for 25 specific MUSTs that were not assessed for interim closure in RPP-RPT-41977. This report was updated in 2011.

Waste in some of the MUSTs may be difficult to retrieve because of the lack of ready-access ports for retrieval equipment, unknown tank integrity conditions, and incomplete waste characterization data. Hence, although the waste inventory in MUSTs is small, the effort, resources, and time required for MUSTs retrieval may be disproportionately large. Consequently, the retrieval and closure of MUSTs have the potential to impact the RPP mission resources' allocation and duration.

However, decisions regarding the retrieval of any remaining liquid or sludge from other MUSTs have not yet been made. Therefore, this System Plan assumed that waste from the MUSTs would be retrieved into the DST system and treated with the rest of the waste. The combined inventory of the MUSTs is not well known and was estimated from RPP-33715. Additional details regarding retrieval of MUSTs will be addressed in future System Plans as those retrieval plans mature.

3.1.4 Waste Transfer Systems

Status: Operational

Responsibility: ORP TOC (WRPS)

Most DSTs, and those SSTs undergoing retrieval, are equipped with transfer pumps. Eventually all tanks will be equipped with waste transfer pumps, or an equivalent system, to remove the waste to other tanks, to WTP, or to a supplemental TRU treatment facility. Tank farms contain underground piping so the waste can be pumped between tanks, between tank farms, to and from different facilities, and between the 200 East and 200 West Areas. These farms also contain other equipment such as valve pits that are used to route the waste. For safety and environmental protection, the pipelines have an encased pipe-in-pipe design with sensors to monitor for leaks. For retrieval of SSTs, aboveground hose-in-hose transfer lines are used directly or in combination with existing transfer routes to permit more rapid deployment, reduce costs, and provide additional flexibility (Figure 3-5).

Figure 3-5. Hose-in-Hose Transfer Lines.

Upgrades to the current waste transfer system will be required before tanks can be retrieved and waste can be delivered to the WTP. These upgrades include installation or replacement of transfer pumps, installation of mixer pumps, replacement of some valves in the pits, activation of the cross-site slurry transfer system, and extension of some pipe encasements through the pit wall. RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3 define the upgrades and refine the approach for delivering feed to the WTP. See Figure 3-6 for an overview of the tank status and WFD systems.

In September 2011, eight underground waste transfer lines in the 241-SY Tank Farm were removed. They were cut, cleared of highly radioactive waste, and cemented for radiation protection and disposal. New lines, connectors, and control systems were installed. In the future, these transfer lines will play an essential role in transferring tank waste from the 200 West Area to the WTP.

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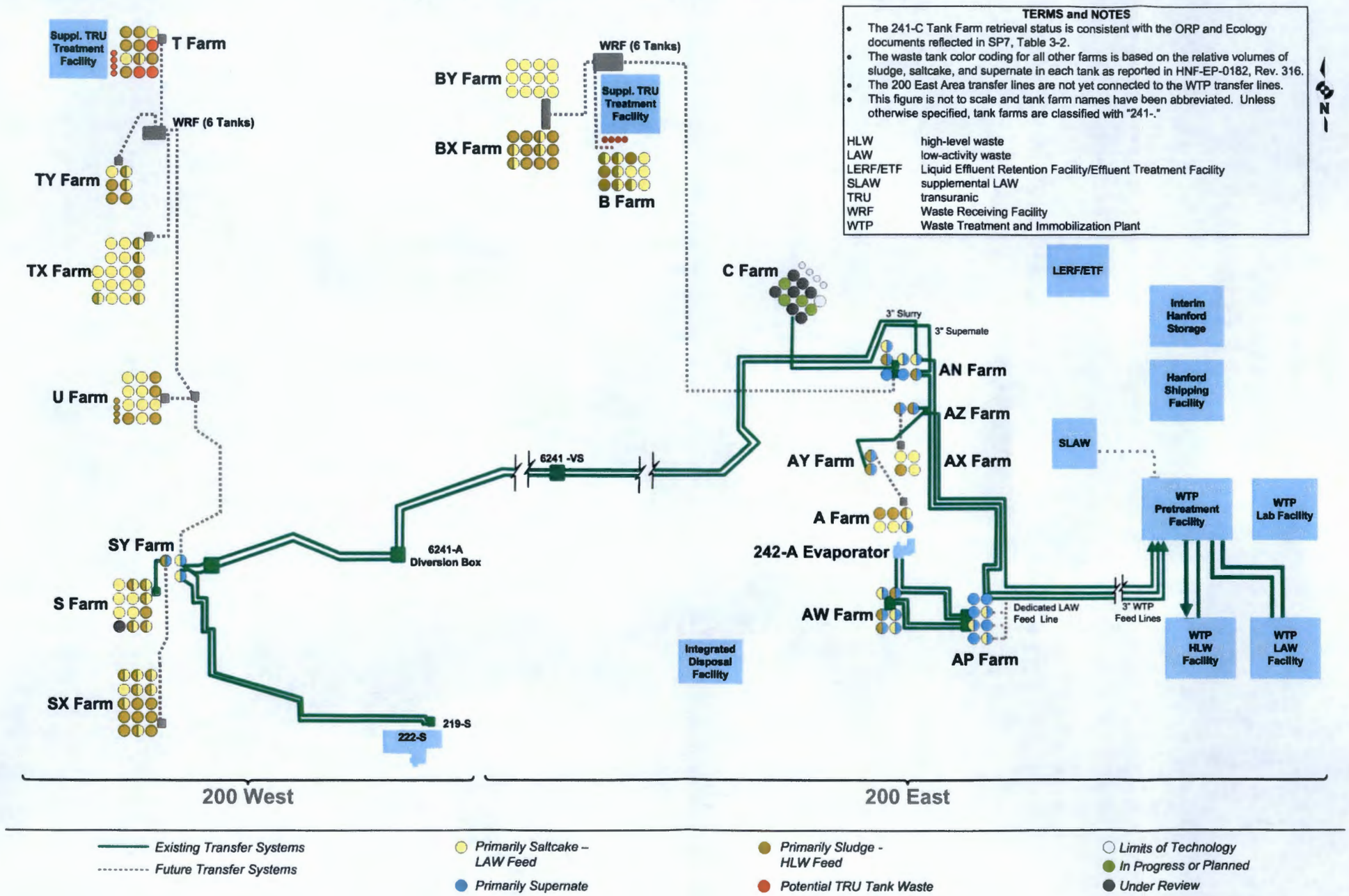
Figure 3-6. Hanford Tank Cleanup Status and Waste Transfer System.



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3.1.5 Waste Receiving Facilities

Status: Proposed

Responsibility: ORP TOC (WRPS)

The TOC baseline currently includes the design, construction, and operation of two WRFs: One in the 200 East Area near B Complex and one in the 200 West Area near T Complex. These two waste complexes are geographically distant from the nearest DST farms by several miles. As such, they require additional facilities to support timely and efficient SST waste retrievals. Each WRF would provide:

- Six 150,000-gal waste receipt tanks with pumps, transfer lines to the SSTs, and other ancillary equipment to allow recycling of supernate during waste retrieval, thereby minimizing the volume of waste generated by retrieval operations. The tanks would also provide space for the temporary storage of the retrieved waste, decoupling SST retrievals from the near-term limits of DST storage space.
- Waste transfer lines from the WRF to the DSTs and the pumping capacity needed to transfer the retrieved waste slurries at high-solids loadings over the considerable distance to the nearest storage DSTs, without exceeding the allowable pressure ratings for transfer-system components.

The WRFs are included in HTWOS. Planning assumptions used in this System Plan related to the WRFs are provided in Appendix B, Assumptions B3.3.3.5 through B3.3.3.9.

3.1.6 242-A Evaporator

Status: Operational

Responsibility: ORP TOC (WRPS)

The primary mission of the 242-A Evaporator (Figure 3-7) is to support tank farm waste storage by reducing dilute waste volume. The 242-A Evaporator operates on a campaign basis, using the time between campaigns to implement facility upgrades as necessary. The 242-A Evaporator has a final status RCRA Part B permit.

Operation of the 242-A Evaporator must be coordinated with other elements of the RPP mission because this evaporator boils off liquids in the waste feed and creates space within the DSTs, which facilitates continued SST waste retrievals in the near-term and waste treatment returns from initial operations in the future, including if waste is ever directly fed to WTP facilities. Additionally, the 242-A Evaporator is used to adjust the sodium levels of the waste feed in order to meet WTP feed requirements.

Figure 3-7. 242-A Evaporator Facility.

Numerous facility upgrades and preventive maintenance activities have been completed during an extended outage over the past three years. These improvements were necessary to

prepare the evaporator systems to support the increase in SST waste retrievals and tank-to-tank transfers that will be associated with the start of the WTP. In light of both the long outage and a significant change to the Documented Safety Analysis, an extensive cold run is being conducted to prepare for the evaporator's return to radioactive operations. During the cold run, facility systems will be started, operated, and shut down; operators will perform work according to procedures; and an internal WRPS team will perform a readiness assessment and evaluate facility documentation, equipment, and operations. The readiness assessment will be followed by implementing corrective actions and conducting necessary maintenance. This cycle will be followed by another WRPS Readiness Assessment with attendant corrective actions, and finally by an ORP readiness assessment, to confirm that the facility is ready to resume radioactive operations. Evaporator campaigns began in late 2014.

The 242-A Evaporator began operating in 1977, and since that time has removed more than 67 Mgal of water from Hanford waste, maximizing DST space availability.

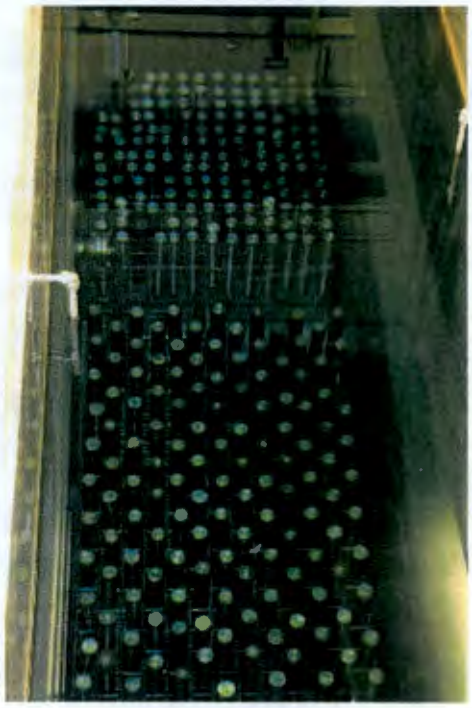
3.1.7 Waste Encapsulation and Storage Facility

Status: Operational

Responsibility: RL (CH2M HILL Plateau Remediation Company [CHPRC])

The WESF, adjacent to the west end of B Plant, was constructed in 1974 to encapsulate and store cesium and strontium that were separated from the Hanford Site's tank waste. Approximately one-third of the cesium and strontium contained in the original tank waste was previously removed and incorporated into capsules. The cesium waste is stored as a chloride salt and is double-contained in 316L stainless-steel capsules with maximum outer dimensions of 21 inches long by 3 inches in diameter. Because of integrity concerns, 23 cesium capsules have been sealed within an additional 316L stainless-steel containment boundary, called a Type W overpack, with maximum outer dimensions of 21.225 inches long by 3.25 inches in diameter. The strontium waste is stored as a fluoride salt and is double-contained. The inner strontium capsule is made of Hastelloy C-276 and the outer capsule is made of 316L stainless steel, with maximum outer dimensions of 20.1 inches long by 2.625 inches in diameter. The WESF provides safe storage and monitoring of the capsules underwater in pool cells (Figure 3-8).

Figure 3-8. Underwater Storage of Capsules at the Waste Encapsulation and Storage Facility.



The WESF is an interim status RCRA facility. The current inventory at WESF consists of 1,312 cesium capsules and 601 strontium capsules. The capsules contain approximately 97 MCi of radioactivity,[18] including daughter products.

[18] Note that the decay date for this activity is January 2014.

The management of the WESF and the disposition of the cesium and strontium capsules is the responsibility of RL. A decision as to the viability of direct disposal of the capsules at a future national HLW repository will be made under HFFACO milestone M-092-05 in 2017. If that disposal path is not viable, and if processing of the capsules is determined to be required for final disposition, the capsules may be treated at WTP. The scope of the WTP Contract already includes a requirement that BNI provide the capability to receive and vitrify the capsule contents as HLW, after appropriate conditioning.

DOE addressed alternatives for cesium and strontium capsule storage and disposal in the TC & WM EIS (DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*). The No-Action Alternative includes maintaining the capsules in storage in underwater pools at the WESF pending implementation of final disposition. Under all other alternatives analyzed in the EIS, a Cesium and Strontium Capsule Processing Facility would be built to de-encapsulate the waste and prepare a cesium-strontium slurry for feed to the HLW Facility. There, the cesium-strontium waste would be processed in a separate, 1-year long campaign following completion of tank waste processing. Approximately 340 additional immobilized high-level waste (IHLW) canisters would be produced during this campaign. Final disposition of the cesium and strontium capsules will be determined under a separate National Environmental Policy Act of 1969 process.

Since future treatment of the cesium and strontium capsules may take place at the HLW Facility, the WESF is discussed in this SP7 for the sake of completeness. However, WESF is not currently included in the RPP system scope, and this System Plan assumes that the capsules will not require processing at WTP (Appendix B, Assumption B3.6.8.1). Therefore, the treatment of the cesium and strontium capsules is not modeled in HTWOS.

3.1.8 Vadose Zone Integration Program

Status: Operational

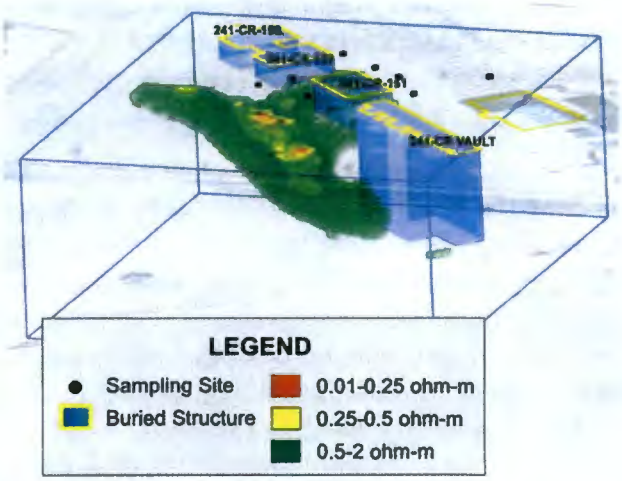
Responsibility: ORP TOC (WRPS)

Contamination is already present in the soil within the vadose zone (the hydrogeological region between the land surface and the water table) on the Hanford Site as a result of unintentional releases and historical waste discharge practices. DOE estimates that approximately 450-billion gallons of waste was directly discharged into the soil at Hanford during production operations from 1944 to the 1990s through a series of trenches, French drains, ponds, ditches, injection wells, and cribs. The Closure and Corrective Measures group is responsible for implementing the tank farm interim measures and RCRA corrective action program through field characterization, laboratory analyses, technical analyses, risk assessments for past tank leaks, and implementation of corrective measures that will mitigate the risk to human health and the environment.

The first step in vadose zone remediation is acquiring site characterization data. Successful adaptation of existing technologies has led to recent advancements in soil characterization tools. Various types of data are gathered through techniques like direct push characterization (to obtain soil samples and install subsurface sensors) and soil electrical resistivity studies (or surface geophysical exploration), as illustrated in Figure 3-9.

Vadose zone remediation is an important step to protect the Columbia River. Reduction of surface water infiltration is expected to reduce continued migration potential for existing contamination. Accordingly, interim surface barriers were installed in 241-T and 241-TY Tank Farms. Initial vadose zone desiccation testing has shown that it may be possible to remove both water and some mobile contaminants from the vadose zone. Also, characterization in the 200 West Area has shown that the downward migration of plumes of contamination to groundwater can be impacted by the low permeability of the Cold Creek stratigraphic unit, thereby delaying its migration to the groundwater. The contamination is sometimes held in soil containing high concentrations of water. This indicates a possible need to remove moisture already present in the vadose zone, not just prevent additional infiltration. Potential mobile contaminant removal technologies offer opportunities to remediate the contamination, rather than just slow its migration to groundwater.

Figure 3-9. Subsurface Contamination Plume.



Ongoing work is focused on vadose zone characterization in 241-TX Tank Farm using direct-push logging. Data will be evaluated to determine whether there is a need to install an interim surface barrier. Additional vadose zone characterization has been conducted in 241-U Tank Farm, using surface geophysical exploration to evaluate the possible deployment of an interim surface barrier or some other interim measure before final closure. In 241-SX Tank Farm, DOE has performed initial field testing of soil pore water extraction (contaminant removal) technology to assess its potential to remediate identified contamination. Results are scheduled to be submitted by ORP to Ecology in 2014, in accordance with HFFACO milestone M-045-22. Vadose zone characterization work is starting in 241-A and 241-AX Tank Farms in 2014 to support planned retrieval leak detection, and support future interim measures and RCRA corrective actions.

3.2 TREATMENT

3.2.1 Supplemental Transuranic Treatment Facility

Status: Early Design

Responsibility: ORP TOC (WRPS)

Eleven SSTs have been evaluated by the TOC contractor as containing waste that could potentially be designated as TRU waste based on analytical reports identifying the origins of the waste in those tanks (refer to Assumption B3.5.2.2 for a list of the 11 tanks). ORP has conducted an extensive review of the Hanford Site's history and determined that the sludge waste in these tanks are candidates for disposition as TRU because either they were not produced as a result of reprocessing spent nuclear fuel and, therefore, do not fall within the definition of HLW within the Nuclear Waste Policy Act of 1982, and because the wastes contain alpha-emitting TRU

radionuclides in concentrations defined as TRU waste in the Waste Isolation Pilot Plant Land Withdrawal Act. DOE has not taken steps to formally designate the waste as TRU.

DOE has, however, identified its preference to consider options for retrieving, treating, and disposing of the candidate TRU waste evaluated in the TC & WM EIS (DOE/EIS-0391) and further clarified this preference in a Federal Register notice issued March 11, 2013 (78 FR 15358, "DOE's Preferred Alternative for Certain Tanks Evaluated in the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington"). As stated in that notice, DOE prefers to retrieve, treat, package, characterize, and certify the wastes that are properly and legally classified as TRU mixed (TRUM) waste for disposal at the Waste Isolation Pilot Plant (WIPP). Initiating retrieval of tank waste for disposition as TRUM waste would be contingent on, among other things, DOE obtaining the applicable and necessary permits, ensuring that the WIPP WAC and all other applicable regulatory requirements are met, and making a determination that the waste is properly classified as TRUM waste. DOE did not decide to implement its preferred or any other alternative associated with this matter in the TC & WM EIS ROD (78 FR 75913).

The SP7 Model Starting Assumptions for potential TRU waste (see the assumptions in Section B3.5.2) indicate that 11 SSTs would be handled as containing potential contact-handled transuranic (CH-TRU) tank waste, which would be treated at a supplemental TRU treatment facility (described below), and then stored onsite at the Central Waste Complex (CWC) until final disposition has been determined.[19]

The potential TRU tank waste treatment and packaging process, as designed, uses a modular approach. First the facility would be located at 241-B Tank Farm, the tank farm supplying the initial TRU tank waste feed, and then relocated to 241-T Tank Farm, which supplies the remaining TRU tank waste feed. A single modular system, designed for relocation, has the advantage of cost-effectively maintaining a pristine TRU product, thus maintaining its TRU designation and meeting the the WIPP WAC. A single fixed system would require transfer of the SST TRU waste material through existing DSTs and cross-site piping, risking contamination with residual non-TRU waste material.

The potential TRU tank waste treatment system design uses a high-vacuum, low-temperature, rotary dryer to remove water from the retrieved sludge. The dried product, consisting of approximately 10 weight percent (wt%) water, 10 wt% sand, and 80 wt% waste solids is packaged in 55-gal drums. The low-dosage TRU waste product allows manual operation of the drum-filling equipment and movement of product drums without requiring remote manipulators. Condensate from the dryer is filtered and then discharged to the Liquid Effluent Retention Facility (LERF)/Effluent Treatment Facility (ETF) via a tank truck or reused to retrieve and transport additional TRU sludge. Offgas is filtered through high-efficiency particulate air filters and then discharged to the atmosphere.

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[19] The treated potential CH-TRU tank waste could be disposed at WIPP near Carlsbad, New Mexico. To do so, DOE would need to submit a WIPP RCRA Part B Permit Class III permit modification request (PMR) to the New Mexico Environment Department for approval. Waste that is approved via the PMR process for disposal at WIPP would be retrieved, dried, packaged, and certified to meet the WIPP RCRA permit and Waste Acceptance Criteria prior to shipment to WIPP for disposal. However, if DOE elects not to seek PMR approval to dispose of this waste at WIPP, or if the PMR is denied, that waste could be blended with other Hanford sludge waste and processed in the WTP as HLW. This option was explored in SP6 Case 2 in 2011.

Significant design of the potential TRU tank waste packaging system was completed, and several pieces of long-lead fabrication equipment were procured and fabricated. The project was placed in standby by DOE in 2005 to await final approval of the TC & WM EIS (DOE/EIS-0391). Reactivation of the project will initially involve generation of critical decision (CD) design packages in accordance with DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets. In FY 2014, limited funding was provided to support the resumption of project planning. Additional funds are anticipated in FY 2015, allowing for a more thorough evaluation of project technologies, which, in turn, may lead to significant rescoping of the project. In the meantime, using the existing flowsheet allows a basis for comparison between model results from SP6 and SP7. The startup of the packaging system at 241-B Tank Farm is expected to occur a little over 5 years after project reactivation. For additional information related to disposal of potential TRU tank waste, refer to Section 3.5.1.

3.2.2 Waste Treatment and Immobilization Plant

Status: Design and Construction

Responsibility: ORP WTP Contract (BNI)

The WTP (Figure 3-10) is currently being designed and constructed by BNI. Tank waste from the tank farms will be pumped to WTP, separated into HLW and LAW streams, and vitrified. The HLW molten glass will be poured into stainless steel canisters, and stored onsite until they canisters can be shipped to an offsite HLW repository. The LAW molten glass will be poured into stainless steel containers and transported to the onsite Integrated Disposal Facility (IDF) for final disposal. There are five main systems within the WTP project: PT Facility, HLW Facility, LAW Facility, dedicated Analytical Laboratory, and balance of facilities, which includes supporting infrastructure systems such as air, water, electrical, power, fire protection, and others.

Figure 3-10. Hanford Waste Treatment and Immobilization Plant.

WTP will generate secondary solid and liquid waste streams. The secondary solid waste (e.g., spent LAW melters, spent ion-exchange resin, high-efficiency particulate air filters, carbon absorbers, silver mordenite columns, etc.) is planned to be disposed of in the IDF (see Section 3.4.1). A disposal path for spent HLW melters has not yet been identified. The secondary liquid waste is assumed to be treated at the LERF/ETF (see Section 3.2.4). More detailed planning assumptions used in this System Plan are provided in Appendix B.

The individual WTP facilities are briefly described in the subsections that follow.

3.2.2.1 Pretreatment Facility

Status: Construction Suspended Pending Resolution of Technical Issues

Responsibility: ORP WTP Contract (BNI)

The WTP feed is transferred from a designated DST to the PT Facility. LAW is transferred to WTP as solutions that may contain some undissolved solids. Typically, about 1 Mgal of LAW feed is transferred at a time to the four feed-receipt process vessels inside the PT Facility. HLW is transferred as a slurry, containing both dissolved and undissolved solids, into a separate process vessel in the PT Facility. A typical HLW slurry transfer is about 140,500 gal.

The PT Facility waste feed evaporator processes recycle streams from the PT, LAW, and HLW Facilities, as well as waste feed that is low in both sodium concentration and solids content.

When the sodium concentration is acceptable for further processing (either as-received or after evaporation), the LAW feed is blended with the HLW feed in an ultrafilter preparation vessel. The ratio of LAW to HLW undissolved solids is established to support both LAW and HLW

glass production rates. The solids from the blended HLW and LAW feed streams are treated if necessary (caustic and oxidative leaching) and filtered to separate them into two streams:

- LAW permeate, which is processed through ion exchange (IX) to remove cesium, concentrated by evaporation, and then transferred to the LAW Facility
- Concentrated HLW solids slurry, which is washed and blended with cesium-137 from IX before being transferred to the HLW Facility.

The PT Facility also has the capability to precipitate complexed strontium-90 and TRU elements to avoid having those constituents partition to LAW. These complexed wastes would have to be segregated from other streams during pretreatment, and the precipitate intentionally blended with pretreated HLW sludge that is high in strontium-89 content to force the strontium-90 to precipitate. However, implementing this process in the ultrafiltration feed vessels was expected to cause a delay of approximately 6 to 24 months in HLW processing, since those same vessels are also used for sludge processing (RPP-RPT-48340, *Evaluation of Alternative Strontium and Transuranic Separation Processes*). Therefore, current plans are to precipitate the strontium and TRU elements in the DST system prior to transferring the waste to the WTP. Additional details are provided in Section 3.1.2 and in Appendix B, Assumption B3.3.2.9.

The PT Facility also contains a pretreatment vessel vent process system, an offgas treatment system, and a stack. Liquid effluents are either recycled back into the facility or sent to the LERF/ETF (Section 3.2.4).

The initial feed to WTP for hot commissioning is currently staged in DST 241-AY-102. However, in light of leaks from DST 241-AY-102's primary vessel into the tank annulus, alternatives for removing DST 241-AY-102 as the staging tank and preparing feed for WTP are under evaluation.

Prior to delivery of feed from the selected DST, the waste will be mixed and sampled. The solids will be allowed to settle, and a portion of the supernate will be decanted and delivered to the WTP as the initial feed for hot commissioning.

One of the technical issues being addressed prior to resumption of the PT Facility construction is related to vessel mixing. The Full-Scale Test Facility, owned by Washington State University and located on George Washington Way in Richland, Washington, will conduct testing for difficult-to-mix vessels in the PT Facility and prove instrumentation and control of pulse jet mixers in these vessels. Specific vessel configurations and testing requirements are being developed. Construction is scheduled to complete in FY 2014, with controls and instrumentation testing for the Full-Scale Test Facility scheduled to complete in FY 2015.

3.2.2.2 High-Level Waste Vitrification Facility

Status: Construction in Progress

Responsibility: ORP WTP Contract (BNI)

The HLW Facility is comprised of two joule-heated ceramic-lined melters, each with its own dedicated feed train and offgas system. The two melters share a canister handling system and secondary effluent collection system.

The PT Facility transfers pretreated HLW feed to the melter feed preparation vessels, where it is blended with glass-forming chemicals before being transferred to the melter feed vessel. The melter feed slurry is introduced at the top of the melter and forms a cold cap on the surface of the melt pool. Water and volatile components evaporate or decompose and are drawn off through the dedicated primary and secondary offgas systems. Nonvolatile components react to form oxides that become part of the molten glass.

Figure 3-11. High-Level Waste Canister (left) and Low-Activity Waste Container (right).

A common canister receipt system supplies canisters to each melter pouring system. An airlift system inside the melter transfers molten HLW glass into stainless steel canisters (Figure 3-11). Each HLW canister will have ⅜-inch thick walls, and will hold 3.02 MTG on average. After filling, each canister is inspected, the glass is sampled as necessary, and the canister is sealed. The canisters are decontaminated and transferred to the interim storage area within the HLW Facility. From there, the canisters are transported to Hanford Site's Interim Hanford Storage (IHS) (refer to Section 3.3.1 for additional details), where they will await disposition at an appropriate disposal facility. The HLW Facility will produce approximately two canisters of IHLW each day.

In 2013, structural steel was placed to the 37-ft elevation of the HLW Facility, thereby meeting Consent Decree milestone A-21 (Figure 3-12).

Figure 3-12. Hanford High-Level Waste Facility.

3.2.2.3 Low-Activity Waste Facility

Status: Construction in Progress

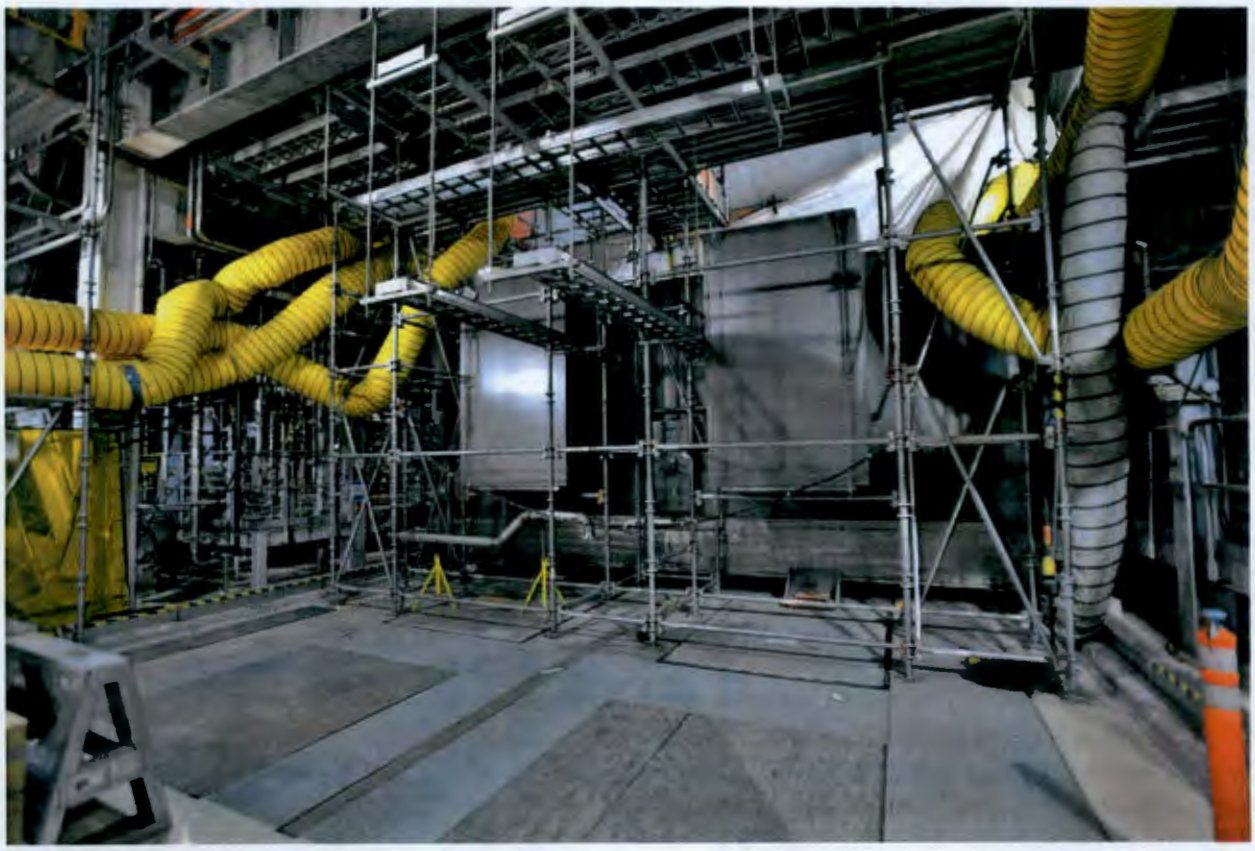
Responsibility: ORP WTP Contract (BNI)

Treated LAW from the PT Facility is transferred to the LAW Facility for vitrification. The LAW vitrification process consists of two melter systems operated in parallel. Each melter system has a dedicated set of feed preparation vessels, a joule-heated ceramic-lined melter, and an offgas treatment system. The facility also has a secondary offgas system shared by the two melter systems. The following description applies to each of the two LAW melter systems.

Pretreated LAW waste feeds are received into one of two common LAW concentrate receipt vessels within the LAW Facility. Batches of concentrated LAW feed are transferred from these vessels to the melter feed preparation vessels, where glass formers and sucrose are added and blended to form a uniform batch of feed to the LAW melters. The slurry feed is transferred to the melter feed vessels, where it is fed continuously to the LAW melters.

Each LAW melter (Figure 3-13) is designed to operate at a facility design capacity of 15 MTG per day of ILAW. The feed enters the melter from the top and forms a cold cap layer on top of the melt pool. Volatile components in the feed are evaporated or decomposed, then drawn off through the melter offgas system. Nonvolatile components react to form oxides or other compounds dissolved in the glass matrix. Bubblers agitate the mixture to increase the glass production rate. An airlift system pours the glass from the melter into stainless steel containers.

Figure 3-13. Hanford Low-Activity Waste Facility Melters.



After being filled, each ILAW container cools for several days, then a lid is sealed to the top of the container and external contamination is removed. The LAW Facility will produce five containers of ILAW each day. Each ILAW container will hold 5.51 MTG on average. The filled ILAW containers will be transferred to the onsite IDF for disposal, consistent with the DOE's preferred alternatives published in the TC & WM EIS ROD (78 FR 75913).

3.2.2.4 Analytical Laboratory

Status: Construction Substantially Complete

Responsibility: ORP WTP Contract (BNI)

The WTP Analytical Laboratory will provide operational support to the PT, HLW, and LAW Facilities. Substantial construction on the Analytical Laboratory was completed in FY 2013, meeting Consent Decree milestone D-00-A-05.

3.2.2.5 Balance of Facilities

Status: Construction and Turnover to Startup Teams

Responsibility: ORP WTP Contract (BNI)

WTP includes 20 support facilities collectively referred to as the balance of facilities, which provide various utilities (e.g., chilled water, compressed air, diesel generators, fire suppression, etc.) and other functions to support the PT Facility, HLW Facility, LAW Facility, and Analytical Laboratory (see Appendix B, Assumption B3.4.1.2). The balance of facilities steam plant construction (Figure 3-14) was completed in FY 2013, meeting Consent Decree milestone A-12. The chiller compressor plant was also completed, and the switchgear building (Figure 3-15) was turned over to a startup team.

Figure 3-14. The Balance of Facilities Steam Plant.

3.2.3 Supplemental Treatment for Low-Activity Waste

Status: Future Facility

Responsibility: ORP TOC (WRPS)

SP7 assumes that supplemental LAW treatment will be provided by a second LAW facility. However, the Supplemental Treatment and Immobilization Program will consider alternative technologies.

For years, the RPP baseline has relied on the HLW Facility processing capacity to pace the RPP mission; that is, the HLW Facility capacity determines the overall length of the RPP mission, and all supporting activities are required to finish within the same time frame. Annual costs to operate the RPP system are expected to be approximately $1 billion per year, so a strong financial incentive exists to complete the overall mission as soon as possible. However, the LAW Facility capacity alone was never intended to treat the entire inventory of

Figure 3-15. The Balance of Facilities Switchgear Building.

Hanford LAW in the same timeframe as the HLW can be treated. The LAW Facility will treat approximately 37 percent of the LAW; additional capacity was always envisioned to treat the remaining 63 percent. These percentages are based on flowsheet predictions made using the current glass models (2009 HLW and 2004 LAW GFMs) and associated waste loading.

Although work related to supplemental treatment needs had begun previously, the Supplemental Treatment and Immobilization Program was formalized via direction from the DOE's Office of Environmental Management in January 2011 (Triay 2011). This program is divided into two subprojects, one each for treatment and immobilization.

The supplemental treatment project will evaluate the need to provide additional pretreatment capacity to facilitate mission acceleration and reduce mission lifecycle costs. Treatment of LAW must provide the means to remove solids and remove cesium. Technologies initially considered for solids removal include cross-flow filtration and rotary microfiltration. Technologies initially considered for cesium removal include caustic side solvent extraction, IX, and fractional crystallization.

The supplemental immobilization project will evaluate potential immobilization technologies to convert the treated LAW into an immobilized form suitable for disposal at the IDF. Technologies initially considered for immobilization included joule-heated ceramic-lined melter vitrification (which is already planned for use in the LAW Facility, and is assumed to be the technology deployed if a second LAW facility is constructed), cast stone, fluidized bed steam reforming, and bulk vitrification.

A variety of possible supplemental LAW treatment technologies were considered by DOE in the TC & WM EIS (DOE/EIS-0391). However, the ROD stated that, "DOE does not have a preferred alternative regarding supplemental treatment for LAW; DOE believes it is beneficial to study further the potential cost, safety, and environmental performance of supplemental treatment technologies. When DOE is ready to identify its preferred alternative regarding supplemental treatment for LAW, it will provide a notice of its preferred alternative in the Federal Register."

This SP7 assumes that the flowsheet for a second LAW facility would be similar to the flowsheet for the LAW Facility currently being constructed by the WTP Project. Additional details used for the analysis of the cases in this System Plan are available in Appendix B.

3.2.4 Liquid Effluent Retention Facility/Effluent Treatment Facility

Status: Operational

Responsibility: RL Plateau Remediation Contract (CHPRC)

The LERF, shown in Figure 3-16, is designed to store 242-A Evaporator process condensate and other dilute liquid waste streams for treatment at the 200 East Area ETF. The ETF provides for the collection, treatment, and storage of low-level mixed wastes and the disposal of treated wastes meeting applicable state

Figure 3-16. Liquid Effluent Retention Facility/Effluent Treatment Facility.

and federal permit requirements. The Liquid Effluent Retention Facility/200 Area Effluent Treatment Facility Treatment, Storage, and/or Disposal unit is included in the final status RCRA Part B permit issued for the Hanford Site.

In addition to the waste streams already being collected, treated, and disposed at LERF/ETF, liquid effluent secondary wastes generated during waste treatment operations (WTP, supplemental LAW treatment, and supplemental treatment of potential TRU tank waste) will be sent to the ETF for treatment and disposal, either as liquids at the State-Approved Land Disposal Site (SALDS) or as a solidified waste form at the IDF. A new solidification treatment facility (also known as the Waste Solidification Unit) was proposed for the ETF in the Secondary Liquid Waste Treatment [SLWT] Project conceptual design, which would solidify the liquid waste in a form that would be acceptable for disposal at the IDF.

In 2008, ORP requested that the DOE Office of Waste Processing (EM-21) sponsor a workshop for developing a roadmap to outline the steps necessary to design the secondary waste form. Workshop participants included representatives from DOE, U.S. Environmental Protection Agency, Ecology, U.S. Nuclear Regulatory Commission, Oregon Department of Energy private consultants, and technical experts from DOE national laboratories and academia. The participants focused on three areas: Regulatory drivers, waste composition, and waste forms. Their efforts culminated in a roadmap of proposed actions (PNNL-18196, Hanford Site Secondary Waste Roadmap) necessary to address regulatory and performance requirements, waste composition, preliminary waste form screening, waste form development, process design and support, and validation. Successful implementation of the roadmap led to the down selection of cast stone as the preferred waste form for secondary liquid waste (RPP-RPT-51127, *Value Engineering Report for Secondary Liquid Waste Treatment Project*). Candidate formulations are currently being tested to determine their capabilities for waste loading, retention of contaminants, and compliance with IDF WAC. Additional cast stone testing is planned to support the IDF performance assessment.

This System Plan assumes that the LERF and ETF will support the needs of the waste treatment mission. The technical and programmatic assumptions for the LERF and ETF used in this System Plan are included in Appendix B, Section B3.6.1.

The LERF and ETF are managed by RL. However, ORP has directed WRPS to initiate transition planning activities to support the future turnover of the LERF/ETF from the RL Plateau Remediation Contract (CHPRC) to the ORP TOC. Under the TOC (DE-AC27-08RV14800), WRPS will assume responsibility for the LERF and ETF in FY 2015.

3.3 ONSITE STORAGE AND HANDLING

3.3.1 Interim Hanford Storage

Status: Planned Future Facility

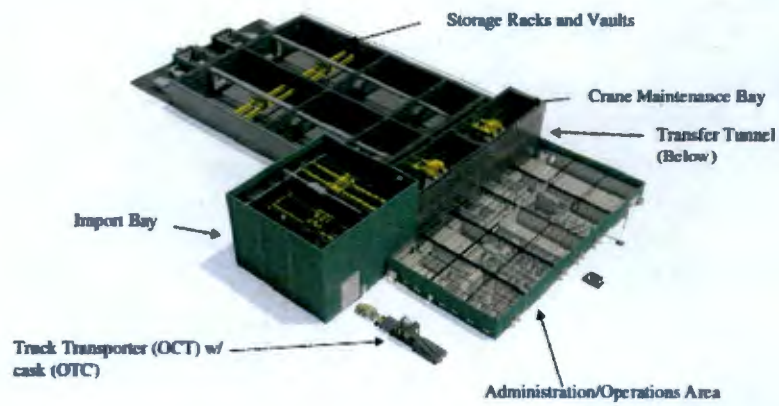
Responsibility: ORP TOC (WRPS)

The current process flowsheet, as depicted on Figure 1-1, requires temporary storage of IHLW canisters prior to being transferred to the Hanford Shipping Facility (HSF) (Section 3.3.2) and further on to a final offsite disposal location. Interim IHLW canister storage is necessary for overall mission success. The HLW Facility's Export Cave Room only has 46 storage rack slots:

One for canister inspection, 21 for nonconforming canisters, and 24 for interim storage pending certification for shipment to interim onsite storage. Without adequate temporary storage for IHLW canisters, the HLW processing could be delayed or shutdown.

The IHS (a conceptual image is depicted on Figure 3-17) will provide safe, economic, and environmentally sound receipt, handling, and storage of the IHLW canisters initially for approximately 10 years (or 4,000 canisters) after the startup of the HLW Facility operations. In the TC & WM EIS ROD issued in December 2013, however, DOE indicated that enough IHLW Interim Storage Modules are planned to be constructed to store all the IHLW generated by WTP treatment (78 FR 75913). At this time, the project incorporates expansion capabilities to accommodate the entire IHLW production as well as a future offsite shipping module (RPP-PLAN-48151, *Interim Hanford Storage Project Execution Plan*).

Figure 3-17. Conceptual Interim Hanford Storage Facility Isometric.



According to RPP-PLAN-48151, Project T3W14, IHS, is currently in CD-0 and has completed conceptual design in this project definition phase, as well as demonstrated a mission need. The result of this current phase will be CD-1 with an approved alternative selection and cost range for the project. Alternative selections have been evaluated with a recommendation on an open rack configuration (RPP-RPT-50488, *Project T3W14 Interim Hanford Storage (IHS) Alternative Decision Document*). The open rack storage option utilizes standard handling technologies based on established and proven mechanical handling machinery. In addition, the IHS Facility is designed with a compact footprint, a simple configuration with redundancies, and ventilation to accommodate a wide range of possible heat loads. Additional details are available in RPP-RPT-52176, *Interim Hanford Storage (T3W14) Conceptual Design Report*.

HLW Facility design requirements include an average throughput of 1.74 canisters per day, with a maximum throughput of 2.5 canisters per day. An OR model for the IHS Facility depicts the ability to receive and store 3.4 canisters per day at 95.5 percent total operating efficiency (TOE). The IHS, however, is not specifically modeled in HTWOS; it is assumed to be available in time for HLW Facility operations. The technical and programmatic assumptions for the IHS Facility used in this System Plan are included in Appendix B.

3.3.2 Hanford Shipping Facility

Status: Potential Future Facility

Responsibility: ORP TOC (WRPS)

The current flowsheet identifies the HSF as the means of receiving, packaging, and loading the IHLW canisters from the IHS Facility for transportation to an offsite repository. However, in

2009 the near-term focus for the HSF shifted from shipping to onsite storage because of the uncertainty of an available repository (WRPS-0900637, "Contract number DE-AC27-08RV14800 – Washington River Protection Solutions LLC Reaffirmation of Mission Need for Hanford Shipping Facility").

As it is currently envisioned, the HSF would receive, package, and stage the IHLW canisters from the HLW Facility (managed by ORP) and the spent nuclear fuel multi-canister overpacks and standard canisters managed by RL. Since the disposal of IHLW will be performed by DOE's Office of Civilian Radioactive Waste Management, the canisters and overpacks would be packaged into casks in accordance with its procedures. The casks would be loaded onto transport vehicles for offsite shipment at a minimum rate of 600 per year (DE-AC27-08RV14800, Section C.2.3.3).

The HSF would be located in the 200 East Area and, as a result of the shift in focus to storage, would likely be built as part of the IHS (RPP-34544, *Cost Benefit Analysis for Immobilized High-Level Waste Storage*). The HSF is assumed to be available when needed but it is not specifically modeled in HTWOS. The applicable technical and programmatic assumptions for the HSF used to analyze the cases in this System Plan are included in Appendix B, Section B3.6.4.

3.3.3 Central Waste Complex

Status: Operational

Responsibility: RL Plateau Remediation Contract (CHPRC)

The CWC, located in the 200 West Area, began waste management operations in August 1988 and is presently operated under RCRA interim status standards in accordance with the Hanford Facility Dangerous Waste Permit (RCRA Part B Permit). The CWC provides interim compliant storage for solid radioactive and nonradioactive waste from onsite and offsite sources, including low-level waste (LLW), MLLW, solid TRU waste, and CERCLA cleanup activities. The CWC consists of multiple buildings and outdoor storage areas categorized into operating or management groups. With approximately 300,000 ft^2 of space, the CWC (Figure 3-18) provides interim storage until appropriate treatment and/or final disposal can be performed.

Figure 3-18. Aerial View of the Central Waste Complex.

The CWC generates, stores, overpacks, and transfers/ships dangerous and/or mixed waste in a safe and environmentally compliant manner. Waste entering the CWC is packaged in containers according to U.S. Department of Transportation regulations or onsite requirements depending on the disposal pathway. Currently all waste received at the CWC must meet the requirements of HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*. However, the TC & WM EIS ROD (78 FR 75913) acknowledged that upgrades would be needed to expand the treatment capabilities at CWC, Waste Receiving and Processing Facility, and T Plant in order to support ongoing and planned waste management activities for LLW and MLLW generated at Hanford and from other DOE sites. For example, a secondary-solid-waste handling facility, also known as the Consolidated Waste Management Facility could be added to CWC. An evaluation may be needed to determine the size and location of this facility based on the amount and type of waste generated by each source.

HNF-EP-0063 requirements allow the CWC to accept TRU and TRUM wastes in certifiable form with no identifiable disposition path only with case-by-case approval from RL. It is assumed to provide, to the extent practical, permitted waste storage and characterization for the potential TRU tank waste that may be packaged by the supplemental TRU treatment system.

3.4 ONSITE DISPOSAL

3.4.1 Integrated Disposal Facility

Status: Construction Complete and in Preactive Life Mode

Responsibility: RL Plateau Remediation Contract (CHPRC)

In the TC & WM EIS ROD (78 FR 75913), DOE announced its decision to operate one IDF located in the 200 East Area (Figure 3-19) and, in addition, construct and operate the RPP Disposal Facility in the 200 Area for disposal of tank closure waste, as needed. The IDF, discussed in this section, will provide an onsite disposal location for LLW and MLLW from:

- Tank waste treatment operations
- Waste generated from WTP and ETF operations
- Onsite non-CERCLA sources
- Fast Flux Test Facility decommissioning waste
- Onsite waste management waste.

Figure 3-19. Onsite Disposal Facilities in the Central Plateau.

Currently, the dangerous waste permit for IDF only allows for the following MLLW:

1. IDF operational waste
2. ILAW in glass form from the LAW Facility
3. ILAW from the Bulk Vitrification Research Demonstration and Development Facility.

Disposing of any other MLLW will require a permit modification to be approved by Ecology.

The actual date the IDF is planned to be operational depends on the schedule for WTP, which is currently being revised (DOE/RL-2012-57, *Annual Summary of the Integrated Disposal Facility Performance Assessment 2012*). Once operational, the IDF will be operated as an LLW/MLLW disposal facility and used for permanent disposal of ILAW. The existing facility consists of a single landfill with two separate disposal areas called cells. The landfill is designed to be expanded to a total capacity of six cells as additional capacity is needed. The first phase of the IDF construction was completed in April 2006 (Figure 3-20). One cell (Cell 1) is permitted as a RCRA Subtitle C landfill system and designed in accordance with Washington Dangerous Waste Regulations. The cell may receive dangerous and/or hazardous waste, specifically MLLW, including the ILAW from the LAW Facility. Assuming issuance of a permit modification, Cell 1

will also receive the ETF secondary waste and, as designated by the TC & WM EIS ROD (78 FR 75913), the spent or failed LAW melters.[20] The other cell (Cell 2), which is specifically excluded from the dangerous waste permit, would not receive dangerous and/or hazardous waste, but only LLW. Both cells include a double-liner system, leachate collection and removal systems, and a leak-detection system. The engineered surface barrier has not yet been designed. Currently the pre-conceptual design is a modified RCRA Subtitle C compliant barrier. Once closure plans are developed, the design will be finalized. The technical and programmatic assumptions for the IDF used in this System Plan are included in Appendix B.

Figure 3-20. Integrated Disposal Facility.

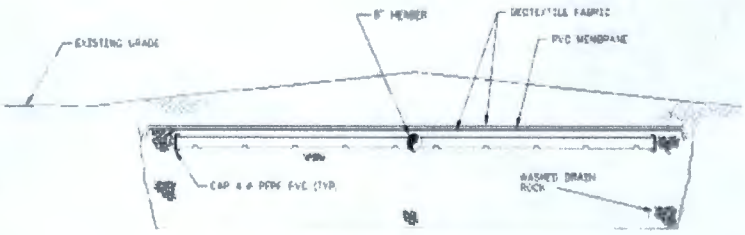
3.4.2 State-Approved Land Disposal Site

Status: Operational

Responsibility: RL Plateau Remediation Contract (CHPRC)

The SALDS is located north of the 200 West Area. Secondary liquid effluents requiring permanent disposal are sampled, monitored, and discharged to the ground (Figure 3-21). Liquid effluents not requiring treatment (non-radioactive, non-dangerous liquid effluents) are discharged to the Treated Effluent Disposal Facility. Contaminated liquid effluents, on the other hand, are first treated at ETF and transferred via pipeline to the SALDS in the 600 Area where it is discharged as non-dangerous, delisted waste, permitted under State Waste Discharge Permit ST-4500. (RPP-RPT-56516)

Figure 3-21. Simplified Representation of the State-Approved Land Disposal Site.



The SALDS is not explicitly modeled in HTWOS, although the volumetric demand on the SALDS from the ETF can be estimated. The programmatic assumptions for the SALDS used in this System Plan are included in Appendix B.

[20] Currently there is no final disposal location for the spent and failed HLW melters. The alternatives discussed in the TC & WM EIS (DOE/EIS-0391) assume that these spent HLW melters will be packaged in an overpack and stored at the IHS facility until they can be removed for disposition and final disposal. For planning purposes, the final disposition of the HLW melters is assumed to be at the IDF to maintain consistency with the current PMB. Plans will be updated, as needed, after a ROD that addresses HLW melter disposal is published. See Appendix E of the TC & WM EIS for more information.

3.4.3 Environmental Restoration Disposal Facility

Status: Operational

Responsibility: RL River Corridor Closure Contract (Washington Closure Hanford)

Built from 1995 to 1996, the Environmental Restoration Disposal Facility (ERDF) is a large CERCLA landfill in the center of Hanford. After operations began in 1996, the disposal trench was expanded several times by adding disposal cells. The latest expansion was completed in January 2011 with the addition of two "super cells," cells 9 and 10 (seen on the left of Figure 3-22). The capacity of the ERDF is now 18 million tons and currently contains more than 15 million tons of LLW, MLLW, and hazardous waste materials.

Figure 3-22. The Environmental Restoration Disposal Facility.

Photograph provided by Washington Closure Hanford.

In accordance with the requirements of DOE O 435.1, the ERDF treats and disposes of various wastes from activities at Hanford such as radiologically and chemically contaminated soil, demolition debris, and other miscellaneous contaminated material from remediation activities. The facility can only accept solid Hanford waste that is (1) LLW or MLLW; (2) complies with RCRA land disposal restriction; (3) generated waste in support of RCRA, *Toxic Substances Control Act of 1976*, *Atomic Energy Act of 1954*, and CERCLA cleanup actions;[21] and (4) capable of meeting ERDF WAC. Some RCRA land disposal restriction waste can be treated at ERDF in order to meet ERDF WAC. The site cannot accept liquid waste, waste classified greater than U.S. Nuclear Regulatory Commission Class C, high-level radioactive waste, TRU, or spent fuel. Operating under the authority of a CERCLA ROD, the ERDF is designed to meet the minimum technology requirements and specifications of RCRA and *Toxic Substances Control Act of 1976* (DOE/RL-2007-06, *Work Plan for Disposal of Hanford Waste at the Environmental Restoration Disposal Facility*).

Protecting the groundwater from contamination is a double-liner system built into each cell consisting of multiple layers of plastic, clay admix, and other materials. Liquid drainage from rain, snow, or dirt-control activities collects in a leachate removal system that is integrated with the liners and transported to the ETF for treatment to remove harmful contaminants. Residues from leachate treatment are returned to ERDF for disposal. As contaminated materials are unloaded at ERDF, they are compacted or filled with grout to provide a competent foundation for the RCRA Subtitle C compliant cover that will be emplaced at the end of disposal operations. Interim covers are placed over the cells as they are filled.

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[21] Several criteria must be met for waste to be accepted at ERDF. Additional details are provided in DOE/RL-2007-06, *Work Plan for Disposal of Hanford Waste at the Environmental Restoration Disposal Facility*.

3.5 OFFSITE DISPOSAL

3.5.1 Potential Transuranic Tank Waste Disposal

Status: Pending Decisions

In March 2013 following the release of the final TC & WM EIS (DOE/EIS-0391), DOE announced its preferred alternative in 78 FR 15358. That notice referred to TRU wastes at Hanford as follows:

> With regard to those wastes that, in the future, may be properly and legally classified as mixed transuranic waste (mixed TRU waste) DOE's preferred alternative is to retrieve, treat, package, and characterize and certify the wastes for disposal at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, a geologic repository for the disposal of mixed TRU waste generated by atomic energy defense activities.

Retrieval of potential TRU tank waste is contingent on obtaining the necessary permits, ensuring that the WIPP WAC can be met, meeting additional applicable regulatory requirements, and documenting a determination that the waste is properly classified as TRUM waste. Retrieval of this waste cannot begin until a decision is made and a formal ROD has been issued. The TC & WM EIS ROD (78 FR 75913) declared no decision to implement its preferred or any other alternative associated with the disposition of TRU waste.

The final classification and disposal decisions are pending. Until that occurs, the potential TRU tank waste is assumed to be stored at the CWC pending a determination of final disposition. At that time, the packaged waste can be either shipped offsite or treated (with additional conditioning) at the WTP and disposed of as HLW. In regards to the five Ecology-defined cases analyzed in this revision of the System Plan, Cases 1 and 2 include assumptions for a supplemental TRU treatment facility, while Cases 3 through 5 treat all potential TRU waste as HLW. Refer to Appendix B for the technical and programmatic assumptions used in this System Plan.

3.5.2 Final High-Level Waste Disposal Alternative

Status: Pending Decisions

As discussed in Section 3.3, the current flowsheet routes IHLW canisters from the HLW Facility to the IHS for temporary storage until they are shipped from the HSF to an offsite repository. Until the final disposal site has been determined, the IHLW canisters will be stored at the IHS. In 78 FR 75913, DOE indicated the decision that enough IHLW Interim Storage Modules are to be constructed to store all the IHLW generated by WTP treatment. At this time, the IHS project incorporates expansion capabilities to accommodate the entire IHLW production as well as a future offsite shipping module (RPP-PLAN-48151).

This System Plan assumes that the need date for the IHS Facility will be the date on which the first radioactive HLW canister leaves WTP, enough Interim Storage Modules will be available to store the IHLW, and that the canisters will meet the WAC of the final disposal alternative. The programmatic assumptions for IHLW storage and disposition used in this System Plan are included in Appendix B.

3.6 222-S LABORATORY

Status: Operational

Responsibility: ORP Laboratory Analytical Services and Testing Contract (ATL for Testing/Analysis)

ORL TOC (WRPS for Infrastructure Support/Maintenance)

The 222-S Laboratory is a full-service analytical facility located in the 200 West Area that handles highly radioactive samples (Figure 3-23). Organic, inorganic, and radiochemistry analyses are performed on a wide variety of air, liquid, soil, tank waste, and biota samples. The laboratory provides support for a variety of essential tank farm activities, including tank-to-tank transfers, corrosion rate studies, and chemical testing to support tank corrosion inhibition, and input to the engineering specifications for each 242-A Evaporator campaign. The 222-S Laboratory also studies the physical and chemical characteristics of waste that is necessary to enable waste retrievals, provides data to support tank closure requirements, and supports the vadose zone program. In addition, the 222-S Laboratory maintains the ability to analyze low-level and nonradioactive samples in support of developmental and industrial hygiene activities.

Figure 3-23. 222-S Laboratory Hot Cells.

Additionally, the 222-S Laboratory supports technology development for the RPP mission, including testing of proposed supplemental pretreatment and treatment processes using both simulants and actual tank waste, and verification of waste solid-liquid equilibria.

The 222-S Laboratory was constructed from 1950 to 1951. The laboratory, supporting structures, and office space have been progressively enlarged and upgraded as the mission warranted, including rebuilding and upgrading the laboratory infrastructure (i.e., installing new analytical equipment; replacing obsolete support facilities; modernizing the heating, ventilation, and air conditioning system; and other projects to extend the life of the facility in support of current mission needs). In the future, the 222-S Laboratory may provide support to WTP operations.

3.7 WASTE FEED INTERFACE

Timely, efficient, and compliant delivery of waste feed from the tank farms to the WTP is the key interface component affecting the success of the RPP mission. Details are available in RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3, as well as ICD-19. Several

activities, as follows, are in progress to strengthen this interface and further ensure smooth operations:

- Details of the required feed delivery interactions are described in ICD-19. Physical and administrative feed delivery interface details are described and updated as needed, including a description of unresolved items (open issues) that are currently in the reconciliation process.
- One System, comprised of WRPS and BNI personnel, has been supporting DOE's request for an integrated approach to resolve some uncertainties revolving around the abilities of WTP's and tank farms' waste feed interfaces. This strategy includes alignment of contracts, incentives, resources, projects, and funding profiles to meet these objectives. The integration of the operations of the TOC and the WTP contractors is facilitated by the One System IPT (RPP-51471) that aligns and coordinates both mission and contractual objectives.
- A Tank Waste Disposition Integrated Flowsheet (TWDIF) Team has been developed to define process flowsheets to support operations of tank farms and WTP in the overall RPP mission. TWDIF activity provides a means by which the mission flowsheet can be optimized through the identification and closure of gaps, mitigation of risks, and realization of opportunities. TWDIF activity's organizational structure consists of:
  - An Oversight Council, which is led by the ORP Manager and consists of senior management from the TOC and WTP contractors, PNNL, and Savannah River National Laboratory.
  - The Core Team, which is led by ORP's WTP Startup and Commissioning Integration organization and represented by engineering and nuclear safety functional managers from the TOC and WTP contractors and technical functional managers of the One System IPT, WRPS Strategic Planning and Technology Development, PNNL, and Savannah River National Laboratory.
  - A Working Team, which is led by the One System IPT and consists of staff from the One System IPT, WTP and TOC contractors' Process Engineering organizations, the TOC contractor's Risk Management organization, PNNL, and Savannah River National Laboratory.

  More information about the TWDIF can be found in RPP-PLAN-56634, *One System Plan for Developing and Managing the Tank Waste Disposition Integrated Flowsheet.*
- In order to start immobilizing waste as soon as possible, DOE has been evaluating the possibility of directly feeding the WTP vitrification facilities. If undertaken, this would commence vitrification operations as soon as practicable of the most mobile waste allowing for resolution of technical issues associated with the PT Facility and the HLW Facility to be resolved. Direct feed LAW (DFLAW) options are being considered along with a LAW Pretreatment System (LAWPS) and the capability to segregate, sample, and stage tank HLW to support early vitrification operations and resolution of technical issues.
  - The LAW flowsheet would include the LAWPS, previously referred to as an interim pretreatment system, between the tank farms and the LAW Facility. The LAWPS

would encompass many of the same LAW processing capabilities as the PT Facility, including filtration to remove entrained solids and ion exchange to remove cesium,[22] and would be sized to support feeding two LAW melters operating at 30 MTG/day at 70 percent TOE. Refer to Appendix B for additional details regarding the assumptions used for the cases analyzed in this System Plan.

As requested by Ecology, the LAWPS and TWCSF are distinctly modeled in Case 2. Section 4.0 discusses these potential WFD strategies in more details with the cases' system descriptions.

- In 2010, 24590-WTP-RPT-PET-10-005, *Feed Receipt Vessel Mixing Design Best Value Study – Tank Farms Transfers*, recommended the construction of a dedicated LAW transfer system physically isolated from the HLW transfer system in order to reduce the potential for transferring solids to the LAW feed receipt vessels in the WTP. In 2011, WRPS submitted a "plan that integrates a dedicated Low Activity Waste (LAW) Transfer System into the baseline," in response to an ORP request (WRPS-1003366 R1, "Contract Number DE-AC27-08RV14800 – Washington River Protection Solutions LLC Dedicated Law Transfer System Evaluation Plan, RPP-PLAN-48536, Revision 0"). The HTWOS Model Starting Assumptions in Section B3.0 assume the addition of a dedicated LAW feed line. The potential DFLAW system, should construction occur, would essentially provide the pathway for a dedicated LAW transfer system.

[22] RPP-SPEC-56967, 2014, *Project T5L01 Low Activity Waste Pretreatment System Specification,* Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

4.0 MODELING RESULTS

This SP7 is being submitted in accordance with HFFACO milestone M-062-40 and describes the disposition of all tank waste managed by ORP, including the retrieval of tanks not addressed by the Consent Decree in State of Washington v. Dept. of Energy, Case No. 08-5085-FVS (E.D. WA, October 25, 2010) and the completion of the treatment mission as depicted in the five scenarios selected by Ecology. These five scenarios were selected and defined solely by Ecology without modification by DOE. ORP elected to not select or define scenarios for evaluation in this SP7. In comparison to System Plans previously submitted by DOE both prior to and after implementation of HFFACO milestone M-062-40, this SP7 is unique in that a current baseline was not evaluated.

The five presented cases selected and defined by Ecology for evaluation in this SP7 are all what-if cases with outcomes that are based on certain key assumptions approved by Ecology, do not reflect the current status of ORP's mission, and do not reflect a complete and adequate understanding of assumptions of facility interim and startup dates associated with resolution of technical issues with WTP and the need to establish new or revised baselines for key project components.

4.1 CASE 1 – CONSENT DECREE COMPLIANT CASE

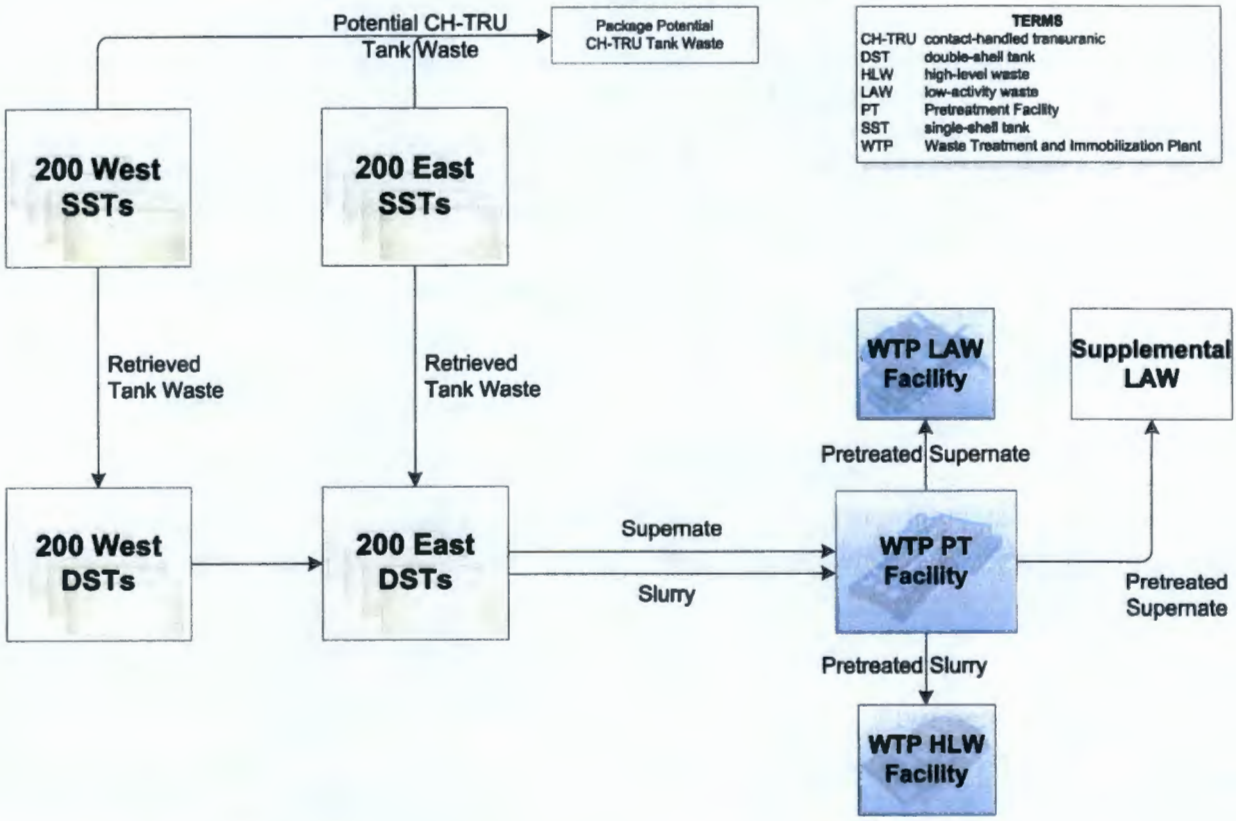
Selected and Defined by: Ecology

Purpose: The purpose of Case 1 is to present a scenario that maintains a compliance perspective per the current HFFACO and Consent Decree requirements.

4.1.1 System Description

Case 1 explores the impact of HTWOS improvements and programmatic updates made since the SP6 Baseline Case (see Section 1.8 and Appendix C for a description of these changes). The simplified flowsheet for Case 1, provided in Figure 4-1, is the same as the SP6 Baseline Case. Potential CH-TRU tank waste from the 200-West and 200-East SSTs is retrieved and treated onsite at the proposed Supplemental TRU Treatment Facility (Section 3.2.1) and then transported offsite for disposal. All other waste in the SSTs is retrieved into the DST system, and waste in the 200-West DSTs is transferred to the 200-East DSTs. From there all waste is sent to the PT Facility where it is pretreated. The pretreated slurry is sent to the HLW Facility and the pretreated supernatant is sent to either the LAW Facility or a supplemental LAW treatment facility.

Figure 4-1. Case 1 Simplified Flowsheet.



4.1.2 Planning Bases

ORP directed WRPS to model the five cases selected and defined by Ecology for SP7 in accordance with the key assumptions and success criteria also selected by Ecology. The planning bases for Case 1 are captured in the Model Starting Assumptions and Case 1 Case-Specific Key Assumptions in Appendix B, Sections B3.0 and B4.1, respectively. The following assumptions were modified prior to the start of modeling but after ORP directed WRPS to use the assumptions set forth in Appendix B:

- SST retrieval durations required shortening from the baseline SVF-1647, Rev. 5, (Assumptions B3.1.1.4 and B3.3.3.4) to be consistent with SP6 assumptions. The retrieval durations in SVF-1647, are calculated using a retrieval duration factor (RDF)[23] multiplier of 1.0. To be consistent with the assumptions used in SP6, the RDF was changed to 2.0 for Case 1 for tanks except those in 241-C, 241-A, and 241-AX Tank Farms. This adjustment was necessary to align the assumptions with the RDF used in

[23] RPP-40545 uses a number of known values and basic assumptions on the retrieval of the waste from SSTs to estimate a nominal, minimum retrieval duration for the waste in each tank. These minimum retrieval durations are used in HTWOS in determining the outcome of the RPP mission. The minimum retrieval durations can be adjusted by an RDF to modulate the minimum retrieval durations. Decreasing the RDF increases the retrieval duration. Increasing the RDF decreases the retrieval duration.

SP6.[24] No retrieval duration factors were used for the remaining tanks in 241-C Tank Farm. Instead the 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 (Assumption B4.1.1.2). Tanks 241-C-102 and 241-C-105 retrieval durations and the 241-C-102 raw water estimate were adjusted to meet 241-C Tank Farm retrieval Consent Decree milestones. RDFs for 241-A and 241-AX Tank Farms were maintained at 1.0 (SVF-1647, Rev. 5) as this approximated the same total retrieval durations as SP6 for these farms (within 4 percent).

- The DST equipment installation dates were changed from those identified in RPP-40149-VOL1 and RPP-40149-VOL2 (Assumption B3.1.1.2 and B3.3.3.13). Equipment installation dates were updated to reflect more recent project planning and to meet Consent Decree dates, as necessary.

4.1.3 Results

The primary key mission metrics, including the lifecycle cost, for this SP7 versus the success criteria, are outlined in Table 4-1. Key results for Case 1 are as follows:

- Based upon the assumptions selected by Ecology, Case 1 meets a number of the mission success criteria, as detailed below:
  - Complete all SST Retrievals (M-045-70) – the milestone for the completion of all SST retrievals is December 31, 2040. Case 1 completes SST retrievals in May 2044.
  - Close all SSTs (M-045-00) – the milestone for SST closure is January 31, 2043. Case 1 completes SST closure in December 2048.
  - Treat all Tank Waste (M-062-00) – the milestone for treating all tank waste is December 31, 2047. Case 1 completes tank waste treatment on August 2050.
  - Close all DSTs (M-042-00A) – the milestone for the closure of all DSTs is September 30, 2052, Case 1 completes DST closure in August 2055.
  - Lifecycle cost is approximately $27 billion more than SP6 Baseline Case ($87 billion versus $60 billion, or about 45 percent). A discussion in Section 4.1.4 describes many of the reasons for this increase.
  - The near-term funding targets through FY 2015 are exceeded by 16 percent (see Section 4.1.4 for a discussion of Case 1 Costs).

[24] SP6 used SVF-1647, Rev. 3D, which used an RDF of 2.0 for all SSTs (other than 241-C Tank Farm). Rev. 5 of SVF-1647 initially sets the RDF to 1.0 for all SSTs. For Case 1, per discussions with Ecology, it was determined to keep the RDF at 1.0 for 241-AX Tank Farm.

Table 4-1. Case 1 Key Mission Metrics.

Metric (Milestone)	Success Criteria	Case 1 – Consent Decree Compliant Case
Lifecycle Cost, FY 1997 to End of Mission[a]	$61.5B	**$87.5B**
Meets Near-Term Funding Targets through 2015	$1,320M	**$1,526M**
Meets Near-Term Funding Profile through 2015	Note b	**No**
Complete 241-C Tank Farm Retrievals (B-1)[c]	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	December 2017	November 2017
Close WMA-C (M-045-83)	June 2019	June 2019
Complete Nine Additional SST Retrievals (B-4)	September 2022	July 2019
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)	September 2022	February 2020
Complete all SST Retrievals (M-045-70)	December 2040	**May 2044**
Close all SSTs (M-045-00)	January 2043	**December 2048**
Treat all Tank Waste (M-062-00)	December 2047	**August 2050**
Close all DSTs (M-042-00A)	September 2052	**August 2055**
Complete Potential TRU Tank Waste Packaging	–	July 2025
HLW Glass Mass (MTG)	–	30,845
HLW Glass Canisters	–	10,214
HLW Glass Waste Oxide Loading (WOL)	–	35%
LAW Glass Mass (MTG)	–	687,187
LAW Glass Containers	–	124,753
LAW Glass Sodium Oxide Loading	–	16%
Sodium Reporting to LAW Glass (MT)	–	79,056
Potential TRU Tank Waste Drums	–	8,285

Notes: **BOLD RED** text indicates a figure or date that does not meet the success criteria.

All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.

Lifecycle costs for Cases 1 through 5 were developed using the TOC cost model. Lifecycle cost figures are used in the System Plan for comparative purposes only, and do not reflect the currently approved PMB.

SP7, Lifecycle Cost Model is based on PMB output from FY 2014.

[a] Lifecycle cost success criteria applies to Cases 1 through 4 and the SP6 Baseline Case.

[b] Near-term funding targets for Cases 1 through 4 and the SP6 Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million. Total FY 2014 through FY 2015 = $1,320 million.

[c] The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7 Assumption B4.1.1.2.

DST	double-shell tank	MTG	metric tons of glass	TRU	transuranic
FY	fiscal year	PMB	Performance Measurement Baseline	WMA-C	C Farm Waste Management Area
HLW	high-level waste	SP6	System Plan, Rev. 6	WOL	waste oxide loading
LAW	low-activity waste	SP7	System Plan, Rev. 7	WTP	Waste Treatment and Immobilization Plant
MT	metric ton	SST	single-shell tank		
		TOC	Tank Operations Contract		

4.1.3.1 Assessment of Case 1 Results Versus Planning Bases and Assumptions

During analysis of the results of Case 1 modeling, it was determined that some of the assumptions, as written in Appendix B, were not met. The following deviations were identified:

- Equipment installation dates for the DSTs were shifted from RPP-40149-VOL1 and RPP-40149-VOL2 (Assumptions B3.1.1.2 and B3.3.3.13), as necessary, to ensure there were no restrictions preventing the Consent Decree dates from being met. The types of equipment installed were followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2, which do not require sluicing equipment for Tanks 241-AN-101 and 241-AN-106. Tanks 241-AN-101 and 241-AN-106 will require sluicing equipment to remove the deep sludge down to a level where mixer pumps can mobilize the waste. This is also incorporated in the cost and schedule for Tanks 241-AN-106 and 241-AN-101.
- The maximum modeled operating level for Tanks 241-AP-101 and 241-AP-105 were not increased to 454 inches per Assumption B3.3.2.2, but operated at the current maximum of 416 inches The level in these two tanks was initially increased; however, a model anomaly caused them to reset to the lower value after September 2022 for Tank 241-AP-101 and October 2018 for 241-AP-105.
- Feed control list actions in HNF-SD-WM-OCD-015 (Assumption B3.3.2.7) are followed except for item 5:
  - Item 5 defines blending of Tank 241-AZ-101 waste with waste from Tanks 241-AW-103, 241-AN-106, and 241-AP-103 resulting in a hydrogen generation rate (HGR) below the limit. This specific blending was not performed, instead the near-term transfers modeled for Case 1 result in a reduced radiolytic heat load for Tank 241-AZ-101. The HLW feed batches were all within the HGR limits, thus the intent of this feed control item has been met.

4.1.3.2 Single-Shell Tank Retrieval Results

SSTs are projected to be retrieved by May 2044 with 241-C Tank Farm retrievals being completed in September 2014. The overall SST retrieval progress for Case 1 is shown in Figure 4-2. During the projected timeframe from 2015 until about 2026, less waste is retrieved from the SSTs because the available DST space is limited (Section 4.1.3.3). After the start of full operations at the WTP and supplemental LAW, the available DST space increases allowing a significant rise in the SST retrieval rate. There are several short timeframes between 2028 and 2044 when retrieval stops for the following reasons:

- The PT Facility is not processing LAW fast enough, tying up valuable DST space needed for receiving retrieved SST waste.
- Space in the DSTs remains very limited until 2038; some of the SST retrievals are further limited by a lack of DST space during this time period (Section 4.1.3.3).

Figure 4-2. Case 1 Overall Single-Shell Tank Retrieval Progress.

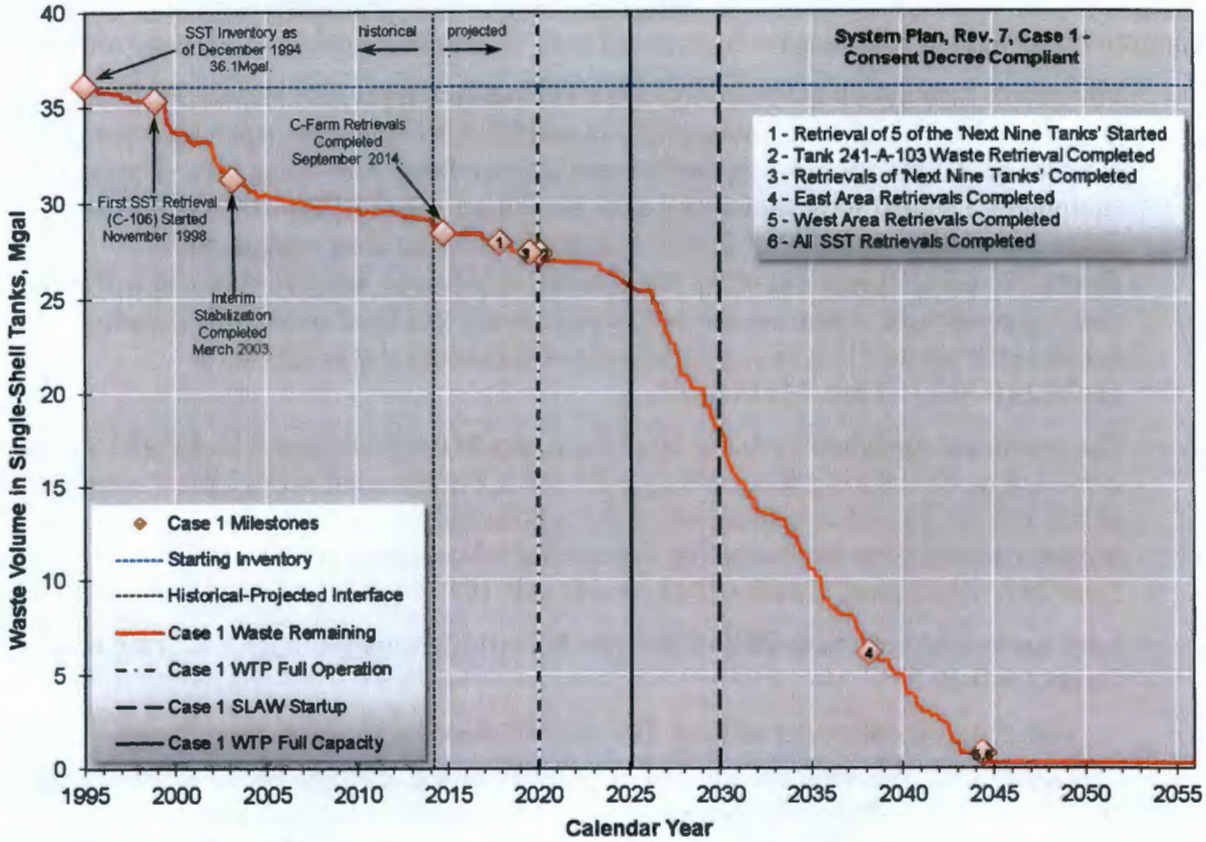
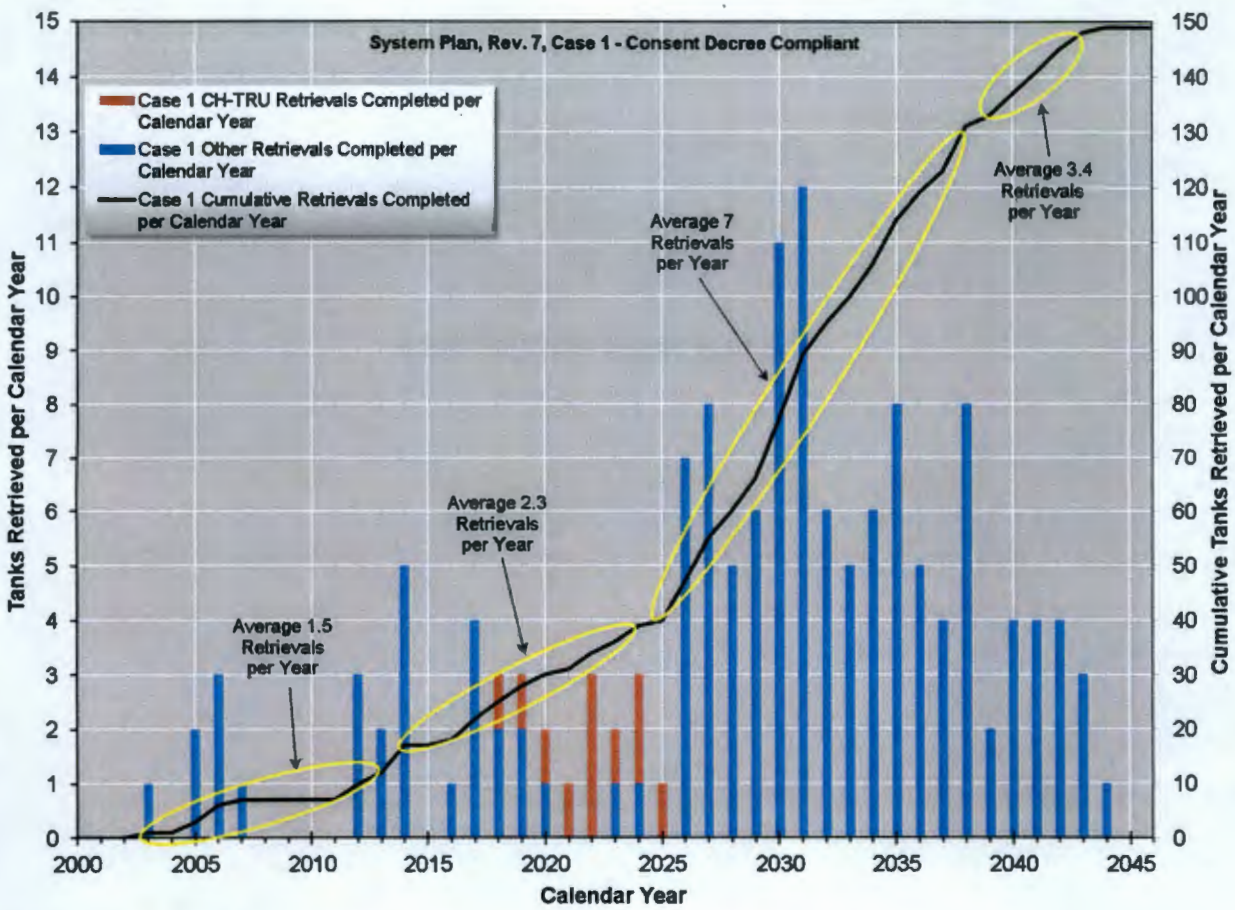


Figure 4-3 shows the number of retrievals that were completed or are projected to be completed during each calendar year. Between 2016 and 2025 the average number of retrievals completed per year is 2.3. This includes the 10 tanks in 241-A and 241-AX Tank Farms that will meet Consent Decree dates, as well as the assumed CH-TRU tanks and the beginning of the next farm to be recovered. In addition, the waste from DST 241-AY-102 is retrieved and transferred to a DST in 2016 (not shown in Figure 4-3). After all treatment facilities are running at their full capacity, the average number of retrievals completed increases significantly to seven retrievals per year between 2026 and 2038. For the remainder of the SST retrievals mission (2039 through 2044), the average retrievals per year is reduced to 3.4 as 200 East Area retrievals are complete and only the 200 West Area remains. The model restricts the number of retrievals at any time to two per area; hence, when retrievals in the 200 East Area are completed, the number of retrievals per year is reduced.

Figure 4-3. Case 1 Single-Shell Tank Retrievals Completed per Calendar Year.



Additionally, the sequence and timing of all SST retrievals is shown in Figure 4-4.

In 2015 the DST system is near capacity and retrieving sludge from DST 241-AY-102 is given priority. Evaporator campaigns free up space that allow SST retrievals to continue until the mid-2020s, when the DSTs allocated for solids accumulation (necessary for retrievals) have been filled slowing retrievals until WTP production is ramped up. Once the treatment facilities reach full processing capacity, SST retrievals increase. Bottlenecks in processing LAW through the PT Facility account for the majority of the remaining time periods when retrievals are limited.

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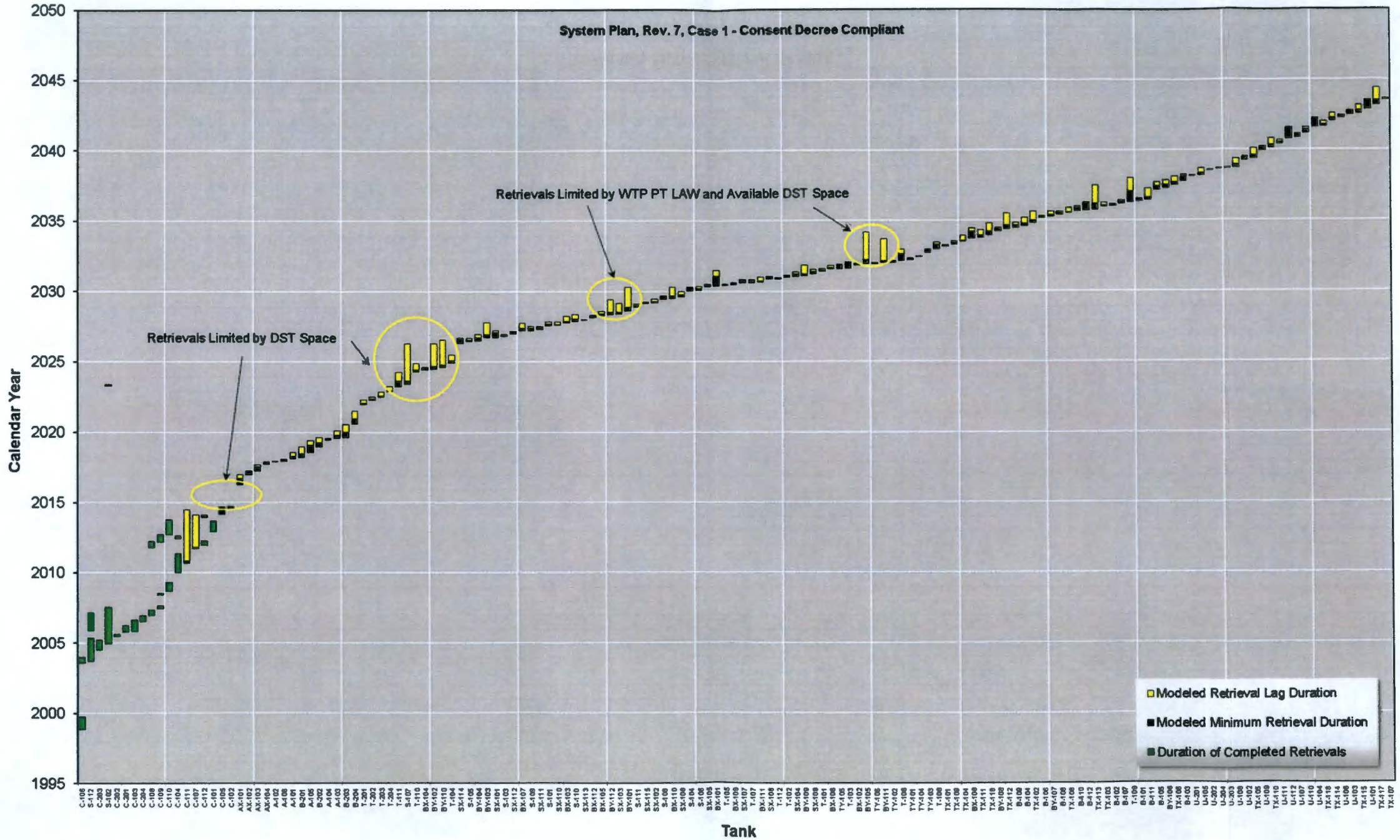
Figure 4-4. Case 1 Single-Shell Tank Retrieval Timing and Sequence.



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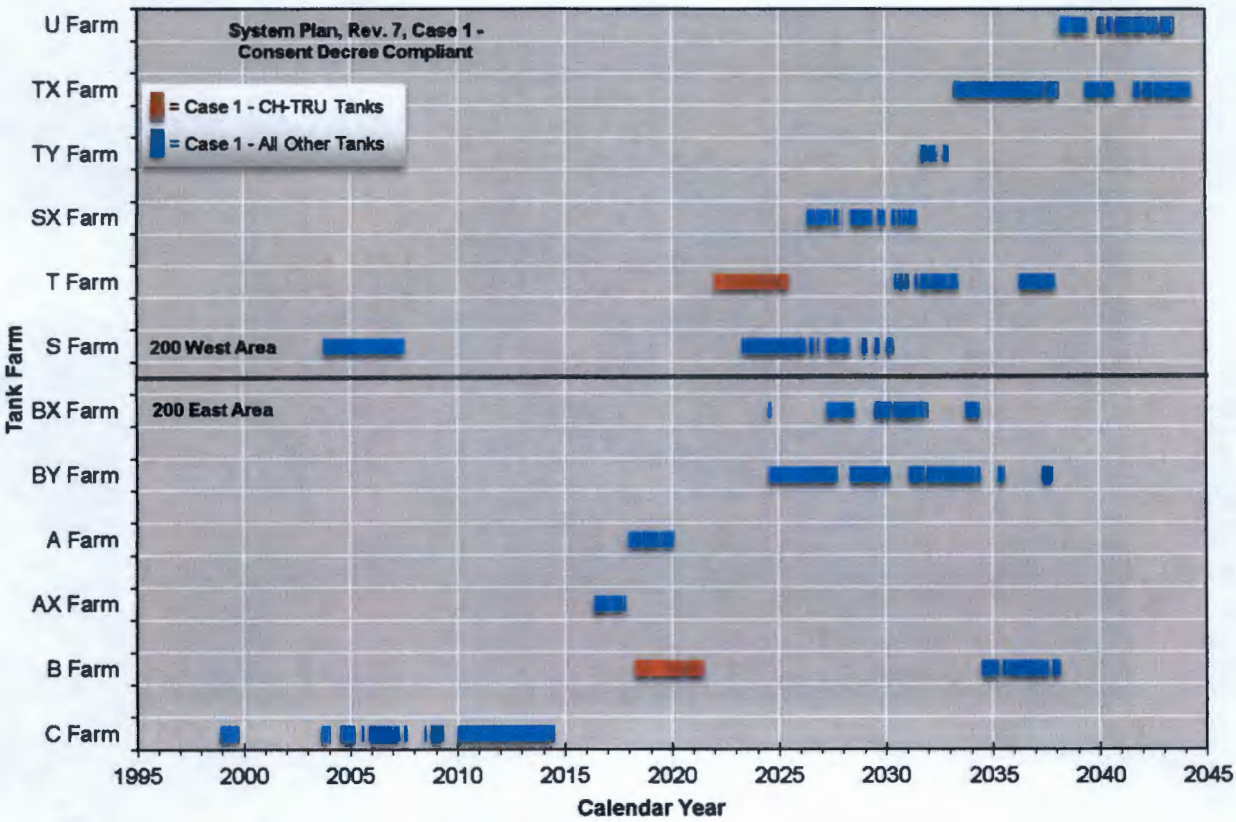
In Case 1 the tanks containing the potential CH-TRU waste in 241-B and 241-T Tank Farms are retrieved, treated at the proposed Supplemental TRU Treatment Facility, packaged, and sent to the CWC for interim storage pending arrangements for offsite disposal. Figure 4-5 shows the general timing of retrievals.

Figure 4-5. Case 1 General Timing of Single-Shell Tank Retrievals by Tank Farm.



4.1.3.3 Double-Shell Tank Space and 242-A Evaporator Operation Results

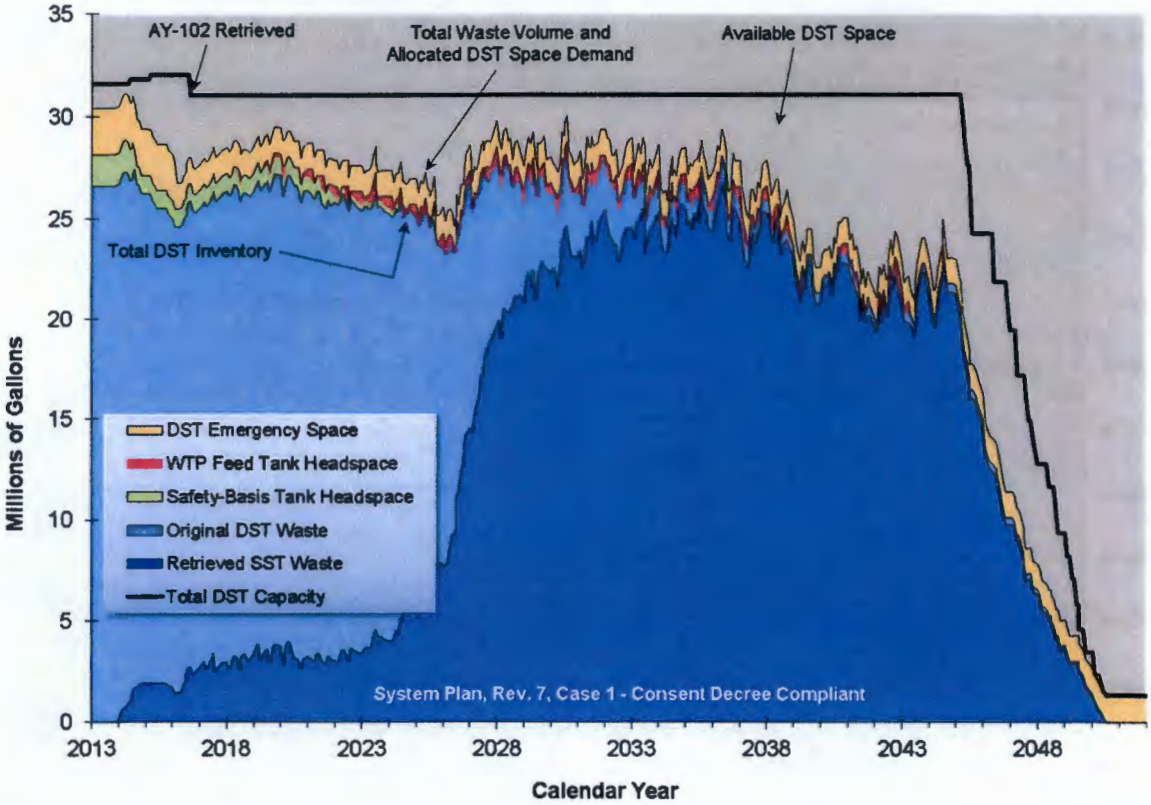
The allocation of DST space during the waste treatment mission is shown in Figure 4-6.[25] In 2014 the available DST space drops to less than 0.8 Mgal and then increases slightly as evaporator campaigns are able to free space. Over the next twenty years the available space varies between 1.0 and 6.5 Mgal, with the largest drop in available space occurring during 241-C-104 waste mitigation[26] in 2026. During this timeframe, the bulk of the available DST space is either distributed among multiple tanks and not readily available, or tied up in various waste mitigation procedures. Very little space exists in which SST retrievals could be collected without a complicated series of waste transfers. Level rises in Tanks 241-AP-101 and

[25] Note that the DST emergency space from September 2013 to February 2016 when 241-AY-102 starts being retrieved is increased by 1,001,000 gallons.

[26] Waste from SST 241-C-104 was retrieved to DST 241-AN-101 in 2012; however, the waste is still referred to by its source tank. The ratio of fissile uranium to total uranium in the 241-C-104 waste exceeds the WAC for WTP. To mitigate this condition, the 241-C-104 waste will be blended with sludge containing nonfissile uranium in two other DSTs and 241-AN-101.

241-AP-105 occurred early in the mission (September 2022 and October 2018, respectively), but because of a modeling error, were reset to the lower value resulting in 205 kilogallons (kgal) of DST volume that was not used for the majority of the mission. This modeling error has a very small impact to the overall mission as it accounts for less than 1 percent of the total DST space.

Figure 4-6. Case 1 Use of the Double-Shell Tanks.



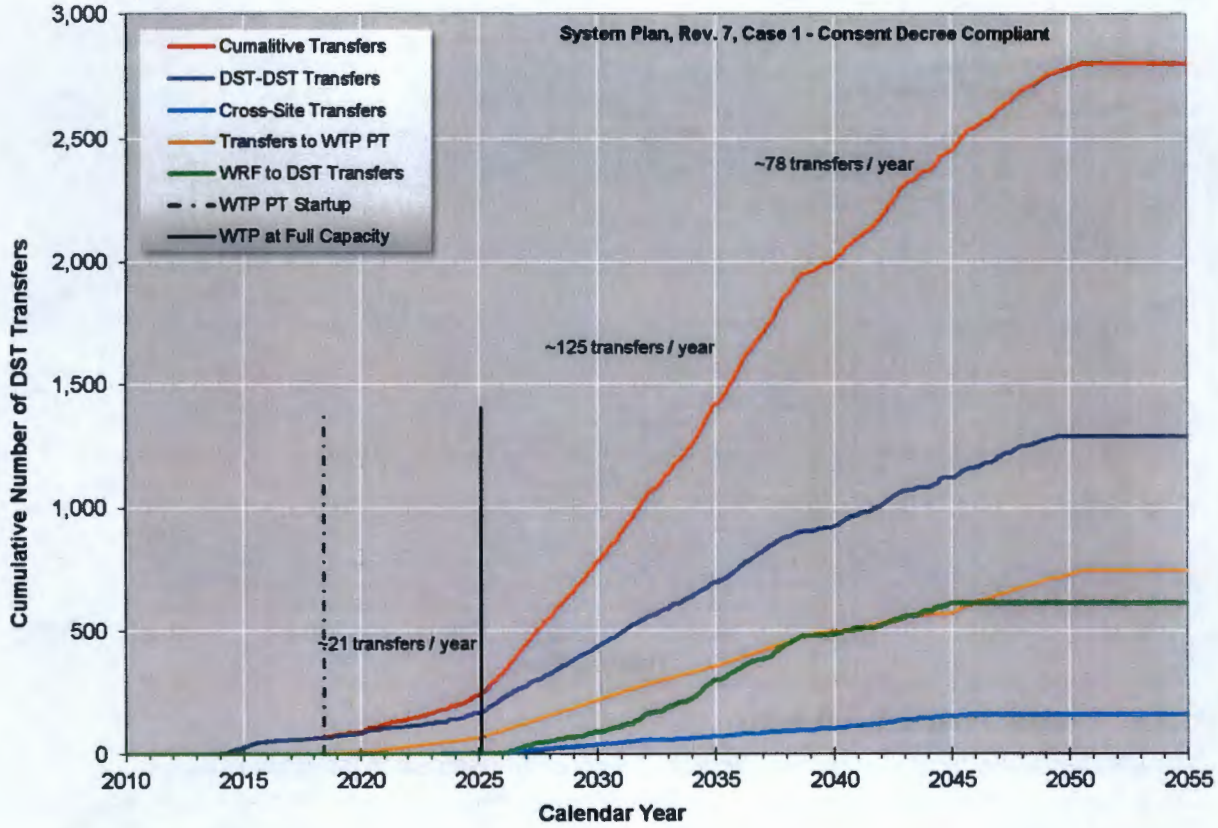
Numerous transfers occur between DSTs to support evaporator operations, support staging of feed to the WTP, and receive transfers from the SSTs. Figure 4-7 shows that Case 1 predicts approximately 2,800 cumulative DST transfers[27] will occur over the course of the RPP mission. This SP7 cumulative value includes 613 transfers from the WRF to DSTs, which was not included as part of the SP6 analysis. Subtracting the WRF transfers out and comparing it to the SP6 Baseline Case[28] shows a 41 percent increase in the number of transfers in SP7 Case 1 versus the SP6 Baseline Case. The majority of this increase in the number of transfers is associated with the additional demand on the evaporator caused by the changes in the SST assumptions which increased the SST retrieval volumes and the implementation of the ISM with solids

[27] Cumulative DST transfers are defined as transfers from DSTs to DSTs (including cross-site), DSTs to WTP, from WRFs to DSTs, from DSTs to LAWPS, from DSTs to TWCSF, and from TWCSF to WTP (via direct feed HLW or to PT), as applicable. Transfers to or from the 242-A Evaporator are not included, but are included in each 242-A Evaporator campaign.

[28] The SP6 Baseline Case predicted 1,766 cumulative DST transfers, which included DST to DST, cross-site, DST to WTP, and 242-A Evaporator transfers. To compare this value to the SP7 cumulative transfers, the 242-A Evaporator transfers (218 transfers) were subtracted out resulting in an adjusted cumulative value of 1,548 transfers. Note the SP7 cumulative value does not include 242-A Evaporator transfers.

mitigation[29], which also increases the amount of water added to the tank farms (see Section 4.1.7 for a discussion of these items).

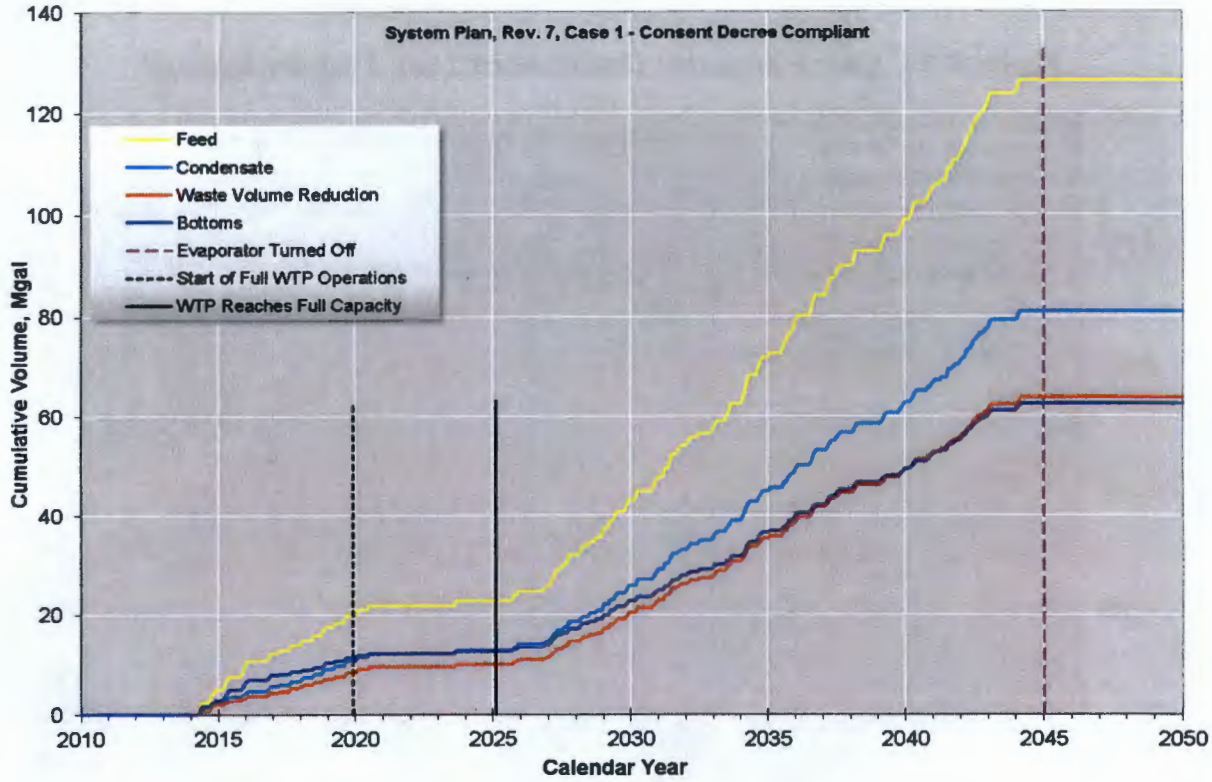
Figure 4-7. Case 1 Projected Double-Shell Tank Transfer Demand.



Use of the 242-A Evaporator to make more available space in the DST system is extremely important for Case 1. The projected demand on the evaporator is shown in Figure 4-8. From FY 2014 to the end of the mission, Case 1 is projected to have 119 evaporator campaigns. This correlates to more than 126 Mgal of waste, reducing the stored volume by almost 64 Mgal over the mission duration. The SP6 case estimated 83 Mgal of feed to the evaporator. The increase in evaporator demand is caused by (1) the updated SST retrieval assumptions in SVF-1647, Rev. 5, which increase the assumed retrieval volumes by nearly 16 Mgal, and (2) the implementation of the ISM with solids mitigation, which increases the amount of water added to the tank farms significantly (up to 50 Mgal).

[29] The ISM, as implemented, predicts large quantities of solids precipitating after evaporator campaigns. Solids mitigation was introduced to prevent the creation of Group A tanks. If the solids level is greater than 70 inches, the tank is taken out of service, and when DST equipment is installed, water is added (up to 600,000 gal), the tank is mixed, and the ISM is applied. Supernate is transferred out of the tank and the solids level is checked again. The process is repeated if the solids level is still greater than 70 inches.

Figure 4-8. Case 1 Projected Operation of the 242-A Evaporator for the Mission Duration.



4.1.3.4 Glass Production Results

Figure 4-9 shows the IHLW glass production compared to the assumed net capacity, and Figure 4-10 shows the same information for ILAW glass. Starting early in the mission ILAW is limiting the production of IHLW because LAW is generated during the pretreatment of HLW. Once the supplemental LAW facility is ramped to its full capacity in 2025, the production of IHLW begins to take over as the mission-limiting step. This lasts until about 2036 when the PT Facility is not processing LAW fast enough. This bottleneck in the PT Facility causes several time periods where the production of IHLW is halted, including two 1.5 years-long outages. Much of this bottleneck can be attributed to an increase of greater than 20 percent in the number of ILAW containers that must be produced compared to previous estimates in SP6 Baseline Case (95,825 containers in SP6 and 124,753 in Case 1). There are two reasons for this increase:

1. A correction to the DOE 2004 GFM calculation in HTWOS, which limits the amount of sulfur in each ILAW container accounts for approximately 70 percent of the ILAW increase.
2. The addition of the ISM in HTWOS predicts that more sodium hydroxide is required to be added to the PT Facility in order to minimize aluminum precipitation. This increase in sodium hydroxide use (from 69,659 MT to 79,056 MT) accounts for approximately 30 percent of the ILAW increase.

During the last 10 years of the mission the amount of solids left in the DST system has been reduced, but there still remains a substantial amount of LAW, resulting in several batches of

HLW delivered to the PT Facility, which are low in solids and the rate of HLW vitrification feed is reduced because of the unbalanced amount of LAW still remaining.

Figure 4-9. Case 1 Projected Immobilized High-Level Waste Production.

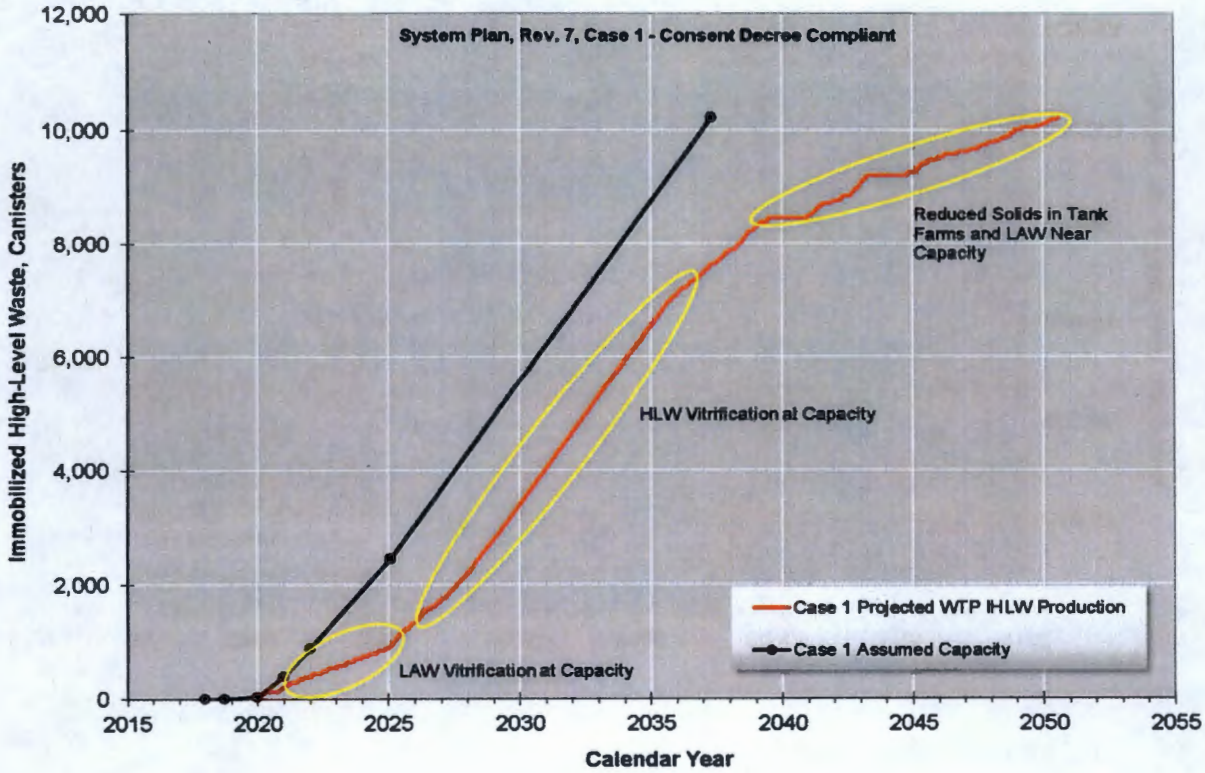
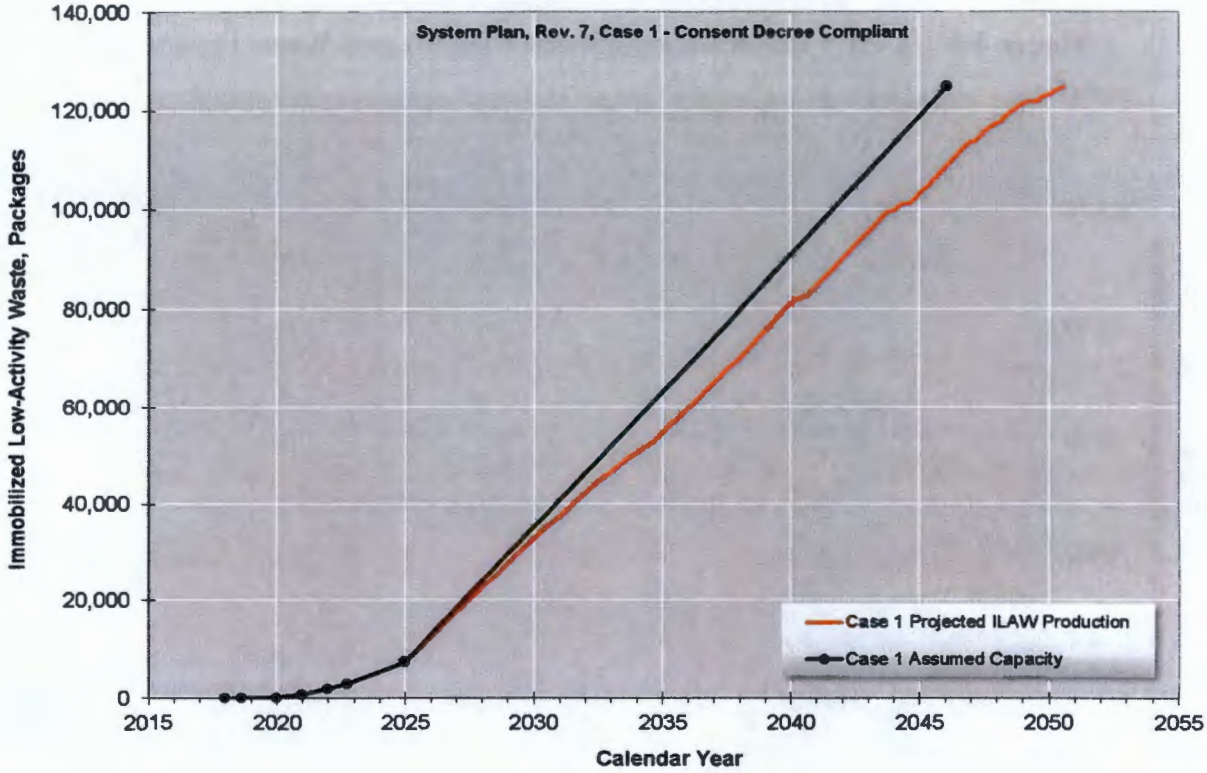


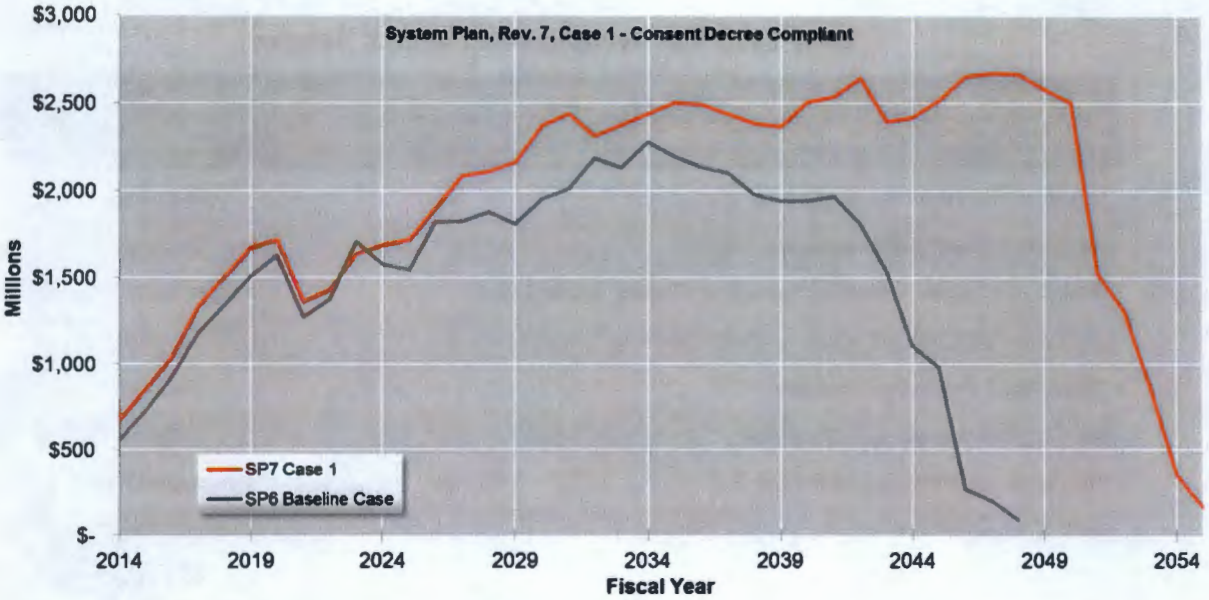
Figure 4-10. Case 1 Projected Immobilized Low-Activity Waste Production.



4.1.4 Cost and Schedule Impact

The projected schedule and lifecycle cost profile for Case 1 through FY 2024 is relatively close to the lifecycle profile for the SP6, Baseline Case. The net schedule effect results in a lifecycle mission duration of 7 years longer than the SP6, Baseline Case. The lifecycle cost for Case 1 is approximately $27 billion more than SP6 Baseline Case ($87 billion versus $60 billion, about 45 percent). Figure 4-11 shows the increase in funding for Case 1 over the SP6 Baseline Case starts in FY 2014 and continues for the majority of the mission. In addition, SP7 Case 1 exceeded the near-term funding targets noted in Appendix B for both FY 2014 and FY 2015 by 10 percent and 20 percent, respectively. SP7, Case 1 exceeded the $61.5 billion lifecycle cost noted in Appendix B by approximately 42 percent.

Figure 4-11. Case 1 Lifecycle Cost Profile.



Assessing the cost profile graph (above) prior to FY 2019 indicates that both the SP6 Baseline Case and Case 1 include a ramp up of capital projects that are required prior to the start of the WTP in May 2018. Slight changes in retrievals per year, MUST retrieval, a different set of DST-to-DST transfers (because of ISM implementation and SST retrieval assumptions), lack of evaporator operation in the last few years prior to FY 2014, and slight differences in facility completion dates results in the cost profiles varying after May 2018.

It should be noted that the SP6 Baseline Case uses the LCM outcome based on PMB information available in FY 2011. Case 1 for this SP7 uses the LCM outcome based on PMB information available in FY 2014. The effects of using a different PMB basis for Case 1 versus the SP6 Baseline Case are highlighted below.

Differences in Case 1 versus the SP6 Baseline Case are caused by the following high-level items:

- Early mission costs (prior to FY 2021) for Case 1 exceed those for SP6 Baseline Case because:
  - There are some activities that were projected in SP6 Baseline Case that were not executed as scheduled so the cost and duration of these activities was moved and occurs after the end of FY 2013. Table 4-2 shows a list of activities that were not completed but were projected to occur per SP6 Baseline Case and the status of those activities in FY 2014 of SP7, Case 1.

Table 4-2. System Plan, Rev. 6, Baseline Activities in Fiscal Year 2011 to Fiscal Year 2013 Not Accomplished and/or Delayed.

SP6, Baseline Activities in FY 2011 to FY 2013 Not Accomplished/Delayed	SP7, Case 1 FY 2014 Status
241-C-107 Retrieval Completion	Ongoing
241-C-110 Retrieval Completion	Ongoing
WMA-C Closure Activities Started (Including Some SSTs)	Projected to Start
241-AY-102 Mixing/Sampling Demonstration	Deleted
Start Mixer Pump Procurement	Delayed
241-AY/AZ Ventilation Upgrades	Delayed
IHLW Storage Project Activities	Projected to Start
SLWT Project Activities	Projected to Start
Start CH-TRU Activities[a]	Projected to Start
Start Supplemental LAW Project Activities	Projected to Start
Start WTP Pre-Operational/Commissioning Activities	Projected to Start

[a] Neither SP6 nor SP7 include disposal costs at WIPP.

CH-TRU	contact-handled transuranic	SP6	System Plan, Rev. 6
FY	fiscal year	SP7	System Plan, Rev. 7
IHLW	immobilized high-level waste	WIPP	Waste Isolation Pilot Plant
LAW	low-activity waste	WMA-C	C Farm Waste Management Area
SLWT	Secondary Liquid Waste Treatment	WTP	Waste Treatment and Immobilization Plant

- There were changes to the PMB that resulted in:
  - A supplemental LAW capital cost increase of approximately 20 percent from the SP6 Baseline Case.
  - Doubling the WTP Interface Management budget for Case 1 over the SP6 Baseline Case budget.
- Waste in DST 241-AY-102 is fully retrieved and the DST is no longer usable in Case 1 versus being used throughout the mission in SP6 Baseline Case.
- The durations of some of the activities were shortened in order to meet the WTP start date. The list of activities with shortened durations is summarized in Table 4-3.

Table 4-3. Tank Operations Contract Durations Shortened in Order to Meet Facility Start Dates for Case 1.

Activity Area (Each Area Contains Multiple Activities)	Number of Years Shortened
Secondary Liquid Waste Treatment Project	3.5
IHLW Storage Project	1.8
Secondary Waste Form Testing	3
WTP Operational Readiness	6.4
WTP Interface Management	6.4
WTP Pre-Operations and Commissioning	3.4
WTP Operations Transition	4
241-AY/AZ Infrastructure/Ventilation Upgrades	0.3
241-C Tank Farm Closure Project Management	0.4
WFD Mixing and Sampling	2.3
WFD – Dedicated LAW Feed Line	0.3
ILAW Transporters	0.3

Note: No change was made to the overall budget for each activity. As the duration was decreased, a higher cost per year was assessed to ensure the total budgeted value was held constant.

IHLW	immobilized high-level waste	WFD	waste feed delivery
ILAW	immobilized low-activity waste	WTP	Waste Treatment and Immobilization Plant
LAW	low-activity waste		

- SP6 Baseline Case costs from FY 2022 to FY 2023 exceed those for Case 1 mostly caused by a difference in the required operational date of the HSF. For the SP6 Baseline Case, the HSF start date is in FY 2026 (capital costs are incurred from FY 2017 to FY 2026), whereas for Case 1 the HSF start date is in FY 2030 (capital costs are incurred from FY 2020 to FY 2029).
- Overall mission costs for Case 1 exceed those for SP6 Baseline Case because of the following items:
  - Activities that occurred later than those in SP6, experience increased cost caused by escalation. This applies to the following subitems, as well as the items mentioned above:
    - Retrieval costs for Case 1 exceed those for the SP6 Baseline Case since SVF-1647 was updated reflecting increased retrieval volumes. Reduced DST availability resulted in some of the retrievals being executed later.
    - Retrieval costs are also higher because of an increase in labor required for the production schedule that is incorporated in this SP7, but was not accounted for in SP6 cases.
    - Case 1 shows 41 percent more DST-to-DST transfers and 50 percent more evaporator campaigns over the SP6 Baseline Case, attributed to the increase in

retrieval volumes reflected in the updated SST assumptions (SVF-1647, Rev. 5) and to the solids mitigation method implemented with the ISM.

- SST retrievals and accompanying farm closures in Case 1 are completed approximately 7 years later than in the SP6 Baseline Case. This resulted in higher costs since the cost ramp-down of the site infrastructure and personnel is related to the number of active tank farms and active facilities.
- Additional equipment is required for waste retrievals based on the creation of two deep sludge DSTs in the 241-AN Tank Farm. The cost of this equipment is included in Case 1, but was not included in the SP6 Baseline Case.
- There were changes to the PMB that resulted in an increase in supplemental LAW and ETF operating costs by approximately 30 percent from SP6 to this SP7, and tripling the Case 1 budget for the WTP Support Program Development over the SP6 Baseline Case budget.

4.1.5 Key Issues and Vulnerabilities

The key issues detailed in SP6, Section 7.0, and the corresponding issues identified in the three-volume IWFDP (RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3), along with the associated risks in the WRPS R&OMP (TFC-PLN-39), continue to be applicable in this SP7. In particular, the following issues have a large impact on the outcome of Case 1:

- Space management in the DSTs is important for Case 1 throughout the mission. The management of DST space, up until all treatment facilities have reached their full net capacities, is critical to maintaining the progress of SST retrievals.
- The 242-A Evaporator remains a potential failure point that would interrupt planned SST retrieval schedules and/or WFD schedules to the WTP.
- Bulk waste retrieval methods and the corresponding quantity of water used have a very significant impact on Case 1, as discussed in more detail in Section 4.1.7.
- WTP startup dates and funding play an important role in Case 1. If the WTP is not ready to start hot commissioning in 2018, it would significantly delay the completion of the RPP mission for Case 1.
- Necessary facilities are assumed to be available when needed to support operations. In addition, solid waste disposal issues are assumed to be resolved.

4.1.6 Sensitivity Case 1A – Results Using Advanced Glass Formulation Models

A sensitivity case was run for Case 1 in which the only difference is that the 2013 Advanced GFMs were used in place of the DOE 2004 and 2009 GFMs. There are several notable differences between the final model runs:

- The completion date for all SST retrievals was 6 months sooner in the sensitivity case, finishing in November 2043, which is still nearly 3 years past the Consent Decree date of December 31, 2040.

- The date by which all waste is treated is projected to be November 2048, which is 23 months sooner, but still 11 months past the Consent Decree date of December 31, 2047.
- The sodium immobilized in LAW glass was nearly the same for both models; however, the sodium oxide loading in the 2013 GFM LAW glass increased from 16 percent to 20 percent.
- The total number of ILAW glass containers predicted decreased by 27 percent to a total of 98,071 compared to the 2004 LAW GFM.
- The waste oxide loading in HLW glass increased from 35 percent with the 2009 GFM to 47 percent with the 2013 Advanced GFM.
- Glass canisters of IHLW totaled 7,650 in the sensitivity case – a 33 percent reduction when compared to the 2009 GFM.

Both the 2013 HLW and LAW GFMs were designed using an increased range of data, which allows each model to take a less conservative approach than previous GFMs. This results in higher waste oxide loadings, thereby reducing the total glass produced. See Appendix C for a description of the 2013 GFMs.

4.1.7 Consent Decree Milestones that would not be Met by Case 1

The purpose of Case 1 is to explore the impact of HTWOS improvements and programmatic updates made since the SP6 Baseline Case. These updates to HTWOS generally extended the mission and caused Case 1 to not meet the milestones for completion of all SST retrievals (M-045-70) and to treat all waste (M-062-00). The main causes for not meeting the final Consent Decree milestones have been attributed to the following changes in HTWOS:

- The new SST retrieval assumptions and calculation techniques in the updated SVF-1647 (which provides the basis for most of the SST retrieval volume and duration information in the model), had a significant impact on the overall delay of SST retrievals. Over the past two revisions of the spreadsheet, a large change occurred in the amount of information known about various retrieval regions and technologies. (Refer to Section 3.1.1.1 for a discussion of SST waste retrieval process fundamentals.) This advancement in knowledge of these processes led to an overall increase of 15.8 Mgal of SST retrieval volumes since the SP6 cases were modeled. An increase of this magnitude (22 percent increase in the amount of water and chemicals needed) causes a parallel increase in the amount of DST space needed to retrieve the waste. While the 242-A Evaporator can be used to reduce the overall impact on DST space, it cannot be utilized until after the SST waste has already been transferred into the DST system. All of this created a delay in SST retrievals and a delay in the processing of all tank waste. These increased SST retrieval volumes, and resulting demand on the 242-A Evaporator, are estimated to add approximately 1 year to the length of the overall SST retrieval operations and mission duration.
- The increase (over 20 percent) in ILAW production for SP7 added additional processing time to the WTP and reduced the pace of WFD to the WTP. The increase in ILAW containers is attributed to the correction of the DOE 2004 GFM calculation in HTWOS and to the additional sodium required for pretreatment using the ISM. The number of

ILAW containers predicted in Case 1 is 124,753 and was 95,825 in the SP6 Baseline Case; however, the production rate did not change. Based on the combined LAW and supplemental LAW capacity of 84 MTG/day, theoretically this required approximately five more years to produce the extra containers. This extra ILAW production demand required more PT Facility processing time and slowed the speed, which LAW and HLW could be moved out of the DSTs for treatment. This additional demand on vitrification treatment added time to the overall mission length, but also added time to the SST retrievals.

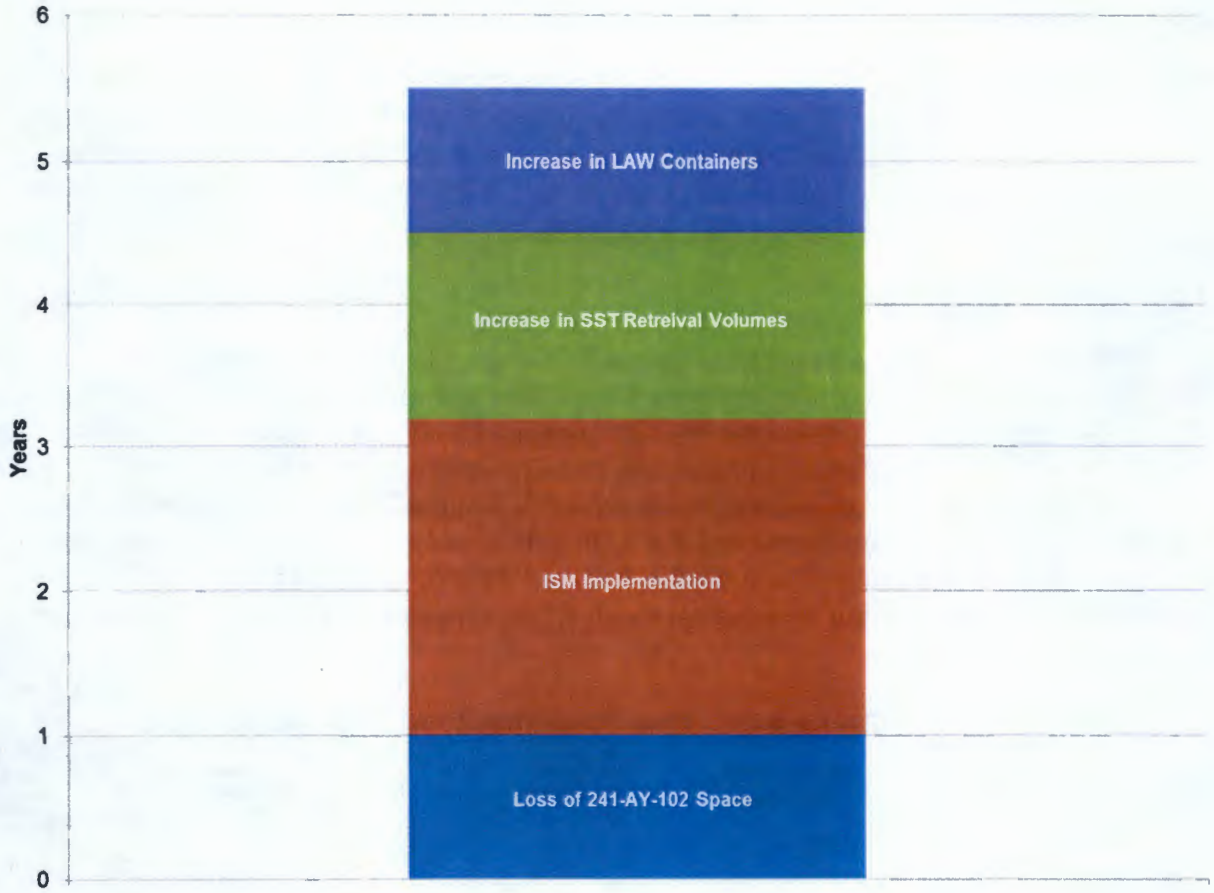
- The addition of the ISM model to predict solubility throughout the system changes the HTWOS forecasts and generally adds two or more years to the SST retrieval durations and to the overall mission compared to using the standard HTWOS solubility. Using the HTWOS standard solubility method, components in the tank farms are dissolved using wash factors but do not precipitate. The ISM predicts dissolution and precipitation based on waste conditions. The implementation of the ISM increased the amount of solids in the tank farms by approximately 16 volume percent, which can reduce the availability of solids-handling DSTs for retrievals.

  The ISM, as implemented, predicts large quantities of solids precipitating after evaporator campaigns. Solids mitigation was introduced to prevent the creation of Group A tanks. If the solids level is greater than 70 inches, the tank is taken out of service, and when DST equipment is installed, water is added (up to 600,000 gal), the tank is mixed, and the ISM is applied. The supernate is transferred out of the tank and the solids level is checked again. The process is repeated if the solids level is still greater than 70 inches. A large amount of water is added to the tank farms for solids mitigation (approximately 50 Mgal for Case 1), which increases the number of evaporator campaigns and transfer activities. The end result, caused by a reduction in DST availability, is an increased mission length and longer SST retrieval durations.

- The overall available DST space is very limited for most of the Case 1 mission, partly because of the reasons discussed above, but also caused by the retrieval of DST 241-AY-102 and its removal from service in 2016. The loss of the nearly 1 Mgal of space, coupled with the reasons above, cause the DST space to be limited and complicate the series of transfers necessary to support retrievals. The loss of the 241-AY-102 adds approximately 1 year to the overall duration of SST retrievals and to the mission length.

Figure 4-12 illustrates the four main factors that cause Case 1 to not meet Consent Decree dates. Each of the four changes listed above impact the model by approximately one or more years; however, as a result of the complex interactions within HTWOS, it is difficult to isolate the absolute impact from any single change in the model.

Figure 4-12. Case 1 Major Contributors to the Increase in Single-Shell Tank Retrieval and Mission Length.



4.1.8 U.S. Department of Energy Observations

Several key features and assumptions associated with Case 1 make this case challenging:

- Ongoing resolution of technical issues associated with the PT and HLW Facilities and construction delays of these facilities have pushed out the estimated startup dates well past the 2018 date assumed by Case 1.
- Case 1 assumes that existing tank farm facilities can meet all necessary feed conditioning and sampling capability to ensure reliable and predictable feed to WTP. This assumption is not consistent with the recent analysis demonstrating the need for the proposed TWCSF. This facility has been proposed to bridge the gap in the waste feed delivery system capabilities, and provide feed that will meet WTP WAC (13-ORP-0286, *Request for Approval of the Justification of Mission Need for a Tank Waste Characterization Staging Capability*).
- Several tank farms projects required shortening in order to meet the Case 1 schedule (Table 4-3). These projects were shortened up to 6 years in order to meet the schedule.
- Funding between FY 2015 and FY 2019 shows that a threefold increase (Figure 4-11) is required to meet the Case 1 schedule.

4.2 CASE 2 – DIRECT FEED LOW-ACTIVITY WASTE AND DIRECT FEED HIGH-LEVEL WASTE FLOWSHEET

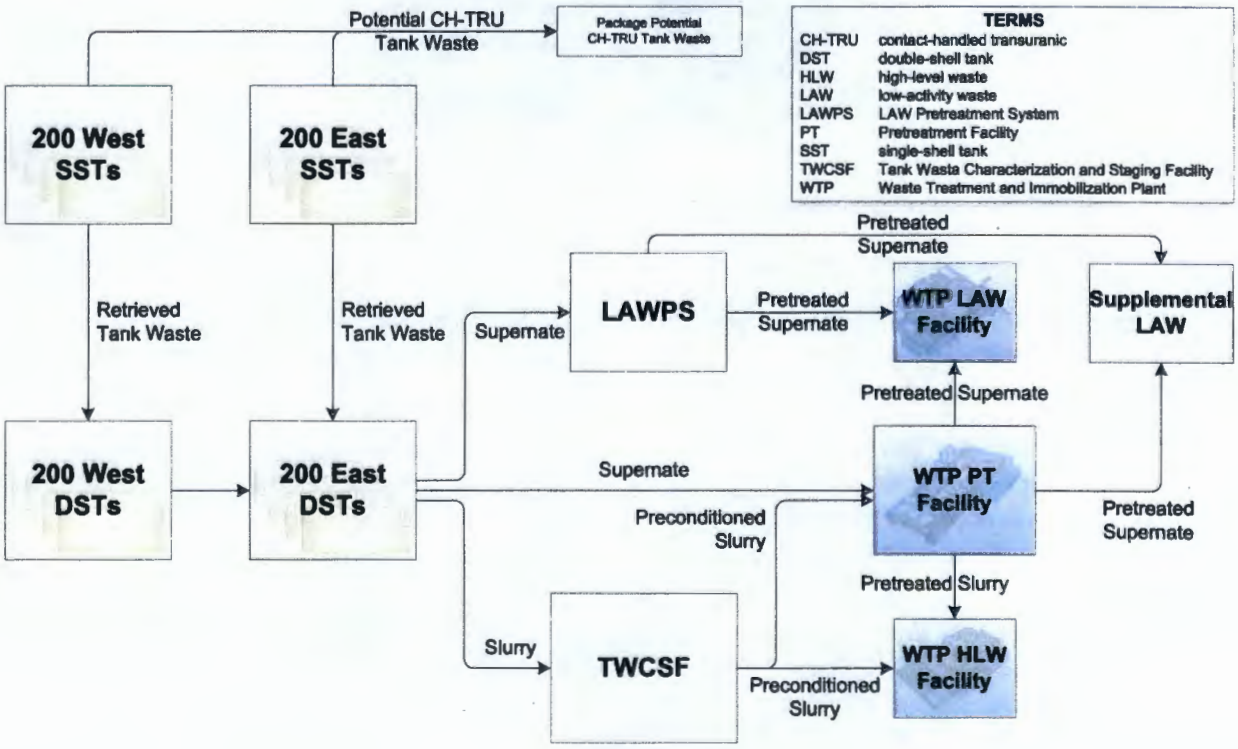
Selected and Defined by: Ecology

Purpose: Case 2 evaluates impacts on throughput when bypassing the PT Facility and accommodates the need to address the current status of the PT Facility, the impacts of direct feed on DSTs, the efficiency and effectiveness of the LAWPS, and the impact of the advanced GFMs during direct feed operations.

4.2.1 System Description

The flowsheet used for Case 2 builds on that used for Case 1 by adding direct feed HLW (DFHLW) and DFLAW capabilities (Figure 4-13). Two new systems support these capabilities: the LAWPS supports DFLAW and the TWCSF supports DFHLW. As requested by Ecology, the LAWPS and TWCSF are distinctly modeled in Case 2. They are described in Sections 4.2.1.1 and 4.2.1.2, respectively. Appendix B, Section B4.2.3.2, outlines the case-specific assumptions regarding the TWCSF. Modifications to the WTP will be necessary (not included in the cost for Case 2) to accept waste directly from the LAWPS and TWCSF rather than from the PT Facility. Potential CH-TRU tank waste is processed through the proposed Supplemental TRU Treatment Facility.

Figure 4-13. Case 2 Simplified Flowsheet.



4.2.1.1 Low-Activity Waste Pretreatment System

The concept of directly feeding waste to the WTP vitrification facilities would allow some tank waste treatment to begin prior to resolution of the technical issues that are currently delaying progress on the PT Facility design and construction. In order to accomplish this, some pretreatment of the waste would be necessary in the tank farms. The LAWPS is envisioned as a partial substitute for the PT Facility. It would encompass many of the same waste processing capabilities and would be sized to support feeding two LAW melters operating at 30 MTG/day at 70 percent TOE.

The LAWPS described in this section is consistent with the near-tank system described in RPP-RPT-50024, *Treatment Project T4S01 Conceptual Design Report*. RPP-RPT-50024 recommended a near-tank system for processing demands above 1,000 MT Sodium/year; two LAW melters operating simultaneously demand as much as 1,440 MT Sodium/year of pretreated LAW. The near-tank LAWPS is an underground vault-based system receiving feed directly from Tank 241-AP-107. This vault-based system would include the following major components:

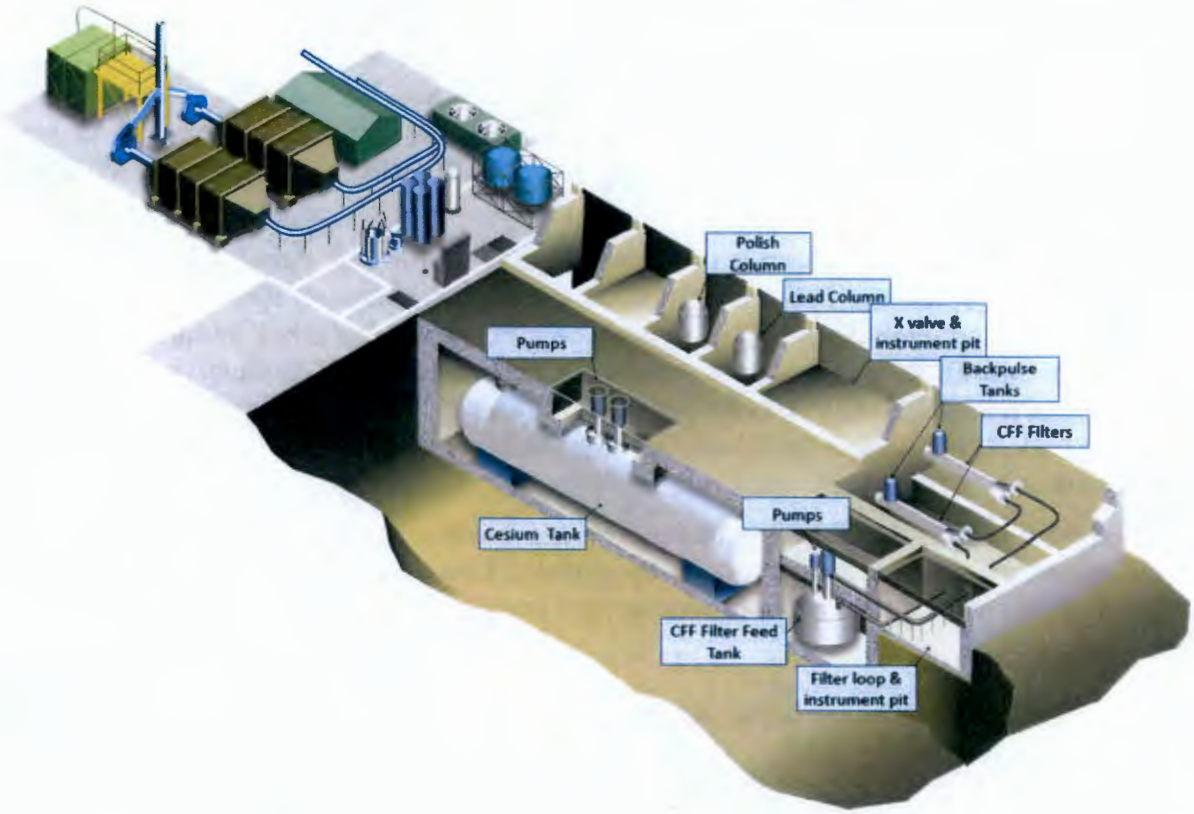
- A filter feed tank and pumping subsystem capable of transferring waste through cross-flow filters at high velocities while recirculating waste feed/slurry between Tank 241-AP-107 and the near-tank pretreatment system
- Two CFFs.
- Two IX columns in a lead-polish configuration using Spherical Resorcinol-Formaldehyde cesium IX media
- A cesium product storage and neutralization tank, wherein IX eluate is neutralized prior to sending it back to DSTs
- Above grade chemical storage for IX media elution, flushing, and conditioning
- Self-engaging dewatering system for disposing of spent IX media.

In addition, the following treated waste delivery systems, not included in RPP-RPT-50024, are required:

- Three 75,000-gal treated-waste lag storage tanks
- Treated waste pump/sample capabilities
- Two encased permanent transfer lines:
  - One from the treated-waste lag-storage tanks to the LAW Facility
  - One from the LAW Facility to the 241-AP Tank Farm for secondary liquid waste returns.

None of the above scope is currently in the TOC baseline. A diagram of the proposed LAWPS is shown on Figure 4-14.

Figure 4-14. Direct Feed Low-Activity Waste Near-Tank Treatment System.



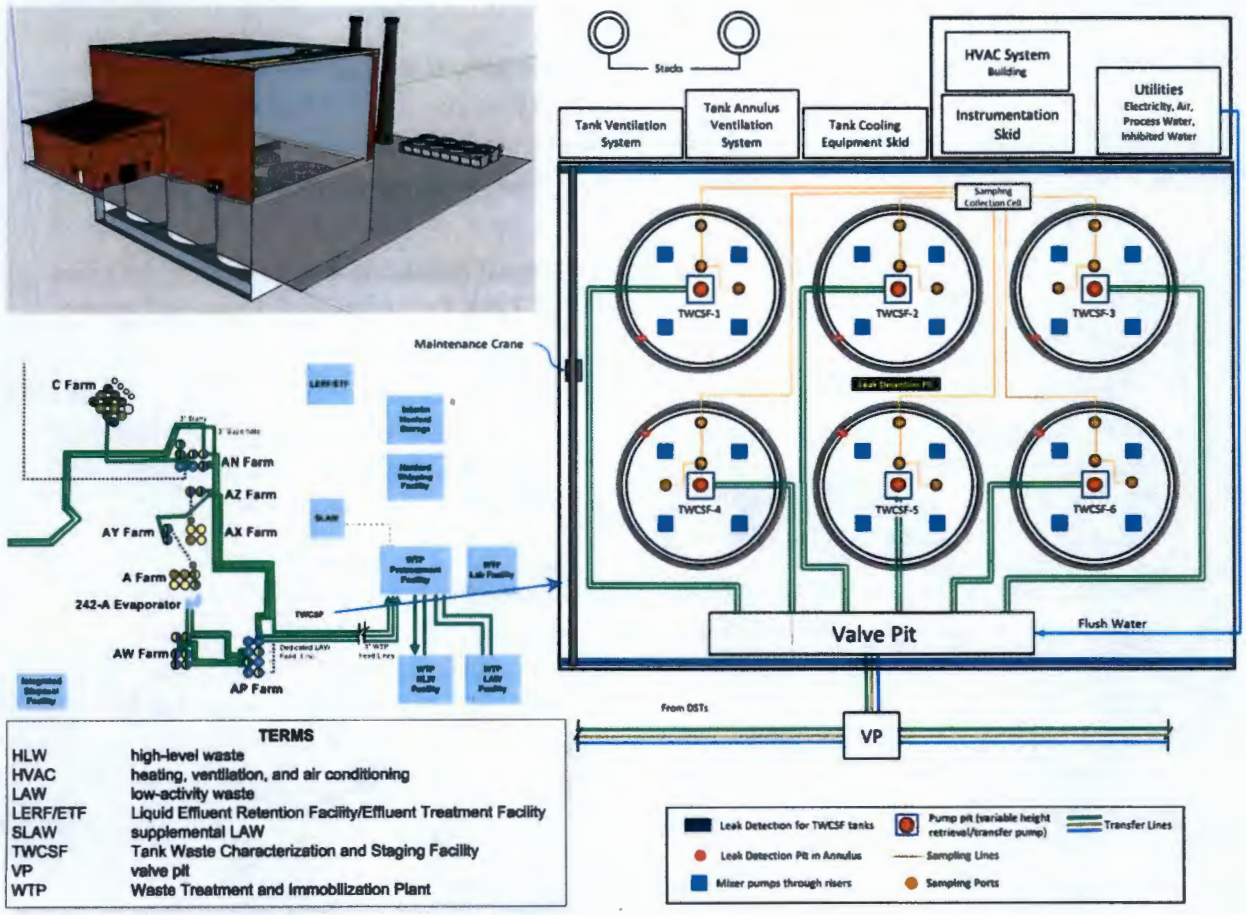
The LAWPS would likely be built in the 200 East Area near the 241-AP Tank Farm, and would operate until such time as the PT Facility becomes available. At that point, the LAWPS would be placed in an idle mode but maintained in an operable condition, so that operations could resume if, or when, the PT Facility required an outage. It could also be used *on demand* to provide additional LAW pretreatment capacity for feeding the supplemental LAW facility in situations where additional capacity is needed. In the Case 2 modeling, the LAWPS was used periodically throughout the mission during times when the supplemental LAW facility capacity was not being met by feed from the PT Facility and when excess LAW feed was available. The LAWPS project is currently at CD-0 and development is progressing. Refer to Appendix B, Assumption B4.2.3.1 for additional details on case-specific assumptions regarding the LAWPS.

4.2.1.2 Tank Waste Characterization and Staging Facility

The TWCSF predecisional concept, as modeled in this SP7 and shown on Figure 4-15, involves the provision of six[30] tanks in a vault configuration. The original concept used 500,000-gal tanks, but these were reduced to 250,000-gal tanks in Case 2, per Ecology's request. Also included are mixing, transferring, and sampling capabilities.

[30] Note that final selection on the number of tanks will be determined as requirements are further defined.

Figure 4-15. Potential Tank Waste Characterization and Staging Facility Layout.



The TWCSF would:

- Receive, stage, mix, and blend tank farm waste
- Sample and characterize HLW feed to the WTP
- Feed HLW to the WTP
- Store problematic wastes for later pretreatment
- Potentially mitigate problematic wastes prior to WTP feed
- Provide additional emergency DST space
- Safely store and monitor waste, including secondary containment and offgas
- Mix HLW solids in TWCSF tanks to a *uniform suspension*
- Provide consistent HLW feed to the WTP
- Segregate and/or reduce particle size to meet the WTP WAC.

Locating the TWCSF roughly halfway between the 241-AP Tank Farm and the WTP has the potential to reduce or resolve existing tank farm transfer line pressure issues.

4.2.2 Planning Bases

ORP directed WRPS to model the five cases selected and defined by Ecology for this SP7 in accordance with the key assumptions and success criteria also selected by Ecology. Planning bases for Case 2 are described in Appendix B, Section B4.2. Some planning bases were not met

in the Case 2 modeling and are discussed in Section 4.2.3.1. The following assumptions were modified prior to the start of modeling:

- It was determined that the supplemental LAW facility start date of October 1, 2024 (Assumption B4.2.6.1.1), was impractical since it occurred prior to the start of the PT Facility (January 1, 2028). The actual start date used in modeling was adjusted to January 1, 2030, with a rate of 9.0 MTG/day. The facility was ramped up per Assumption B3.5.1.6 on April 1, 2031.
- As with Case 1, 241-C-102 and 241-C-105 retrieval durations and the 241-C-102 raw water estimate were adjusted to meet the 241-C Tank Farm retrieval Consent Decree milestone.
- Assumptions B3.1.1.2 and B3.3.3.13 were followed except that sluicing equipment was installed in 241-AN-101 and 241-AN-106, which was not noted in the assumptions. The equipment is necessary to remove the deep sludge from these tanks, and is incorporated into the cost and schedule. Additionally, equipment installation dates for various DSTs differ from the dates given by the assumptions.
- Although not specifically noted in Appendix B, Section B4.0, case-specific assumptions regarding vitrification facility start dates and ramp rates (Assumptions B4.2.5.3.2 and B4.2.5.4.2) superseded base assumptions, therefore the hot commissioning activities outlined in Appendix B, Section B3.0 were not completed (Assumptions B3.4.1.4, B3.4.1.5, B3.4.1.6, B3.4.1.7, B3.4.3.2, and B3.4.4.3). As stated in the case-specific assumptions, hot commissioning was not modeled separately from the stated start dates and ramp rates.

4.2.3 Results

Table 4-4 shows the key mission metrics for SP7 Case 2 versus the results for Case 1. The major differences from Case 1 are as follows.

- The RPP mission took approximately 17 years longer in Case 2 than in Case 1
- SST retrievals finished 10 years later
- Completion of the *next nine* SST retrievals took 6 years longer
- Completion of 241-A-103 retrieval was delayed 18 years.

4.2.3.1 Assessment of Case 2 Results Versus Planning Bases and Assumptions

During analysis of the results of Case 2 modeling, it was determined that some of the assumptions, as written in Appendix B, were not met. The following deviations were identified:

- The two-month pause in the TWCSF functions prior to the startup of the PT Facility (Assumption B4.2.3.2.3) was not modeled. DFHLW continued to operate until the PT Facility was online. It was determined that the impact of not modeling the 2-month pause does not affect the overall modeling results, since HLW vitrification is limited by the availability of feed.

Table 4-4. Case 2 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 2 – DFLAW and DFHLW Flowsheet
Lifecycle Cost, FY 1997 to End of Mission[a]	$87.5B	**$143.2B**
Meets Near-Term Funding Targets Through 2015	$1,526M	$1,190M
Meets Near-Term Funding Profile Through 2015[b]	No	Yes
Complete 241-C Tank Farm Retrievals (B-1)[c]	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	November 2017	December 2017
Close WMA-C (M-045-83)	June 2019	November 2022
Complete Nine Additional SST Retrievals (B-4)	July 2019	July 2025
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)	February 2020	March 2038
Complete all SST Retrievals (M-045-70)	May 2044	January 2054
Close all SSTs (M-045-00)	December 2048	August 2058
Treat all Tank Waste (M-062-00)	August 2050	March 2067
Close all DSTs (M-042-00A)	August 2055	January 2072
Complete Potential TRU Tank Waste Packaging	July 2025	July 2025
HLW Glass Mass (MTG)	30,845	30,749
HLW Glass Canisters	10,214	10,183
HLW Glass WOL	35%	36%
LAW Glass Mass (MTG)	687,187	678,251
LAW Glass Containers	124,753	123,131
LAW Glass Sodium Oxide Loading	16%	16%
Sodium Reporting to LAW Glass (MT)	79,056	78,809
Potential TRU Tank Waste Drums	8,285	8,243

Notes:

BOLD RED text indicates a figure or date that does not meet the success criteria.

All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.

Lifecycle costs for Cases 1 through 5 were developed using the Tank Operations Contract cost model. Lifecycle cost figures are used in the System Plan for comparative purposes only, and do not reflect the currently approved Performance Measurement Baseline.

SP7, LCM is based on Performance Measurement Baseline output from FY 2014.

[a] Lifecycle cost success criteria applies to Cases 1 through 4 and the SP6 Baseline Case.

[b] Near-term funding targets for Cases 1 through 4 and the SP6 Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million. Total FY 2014 through FY 2015 = $1,320 million.

[c] The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7 Assumption B4.1.1.2.

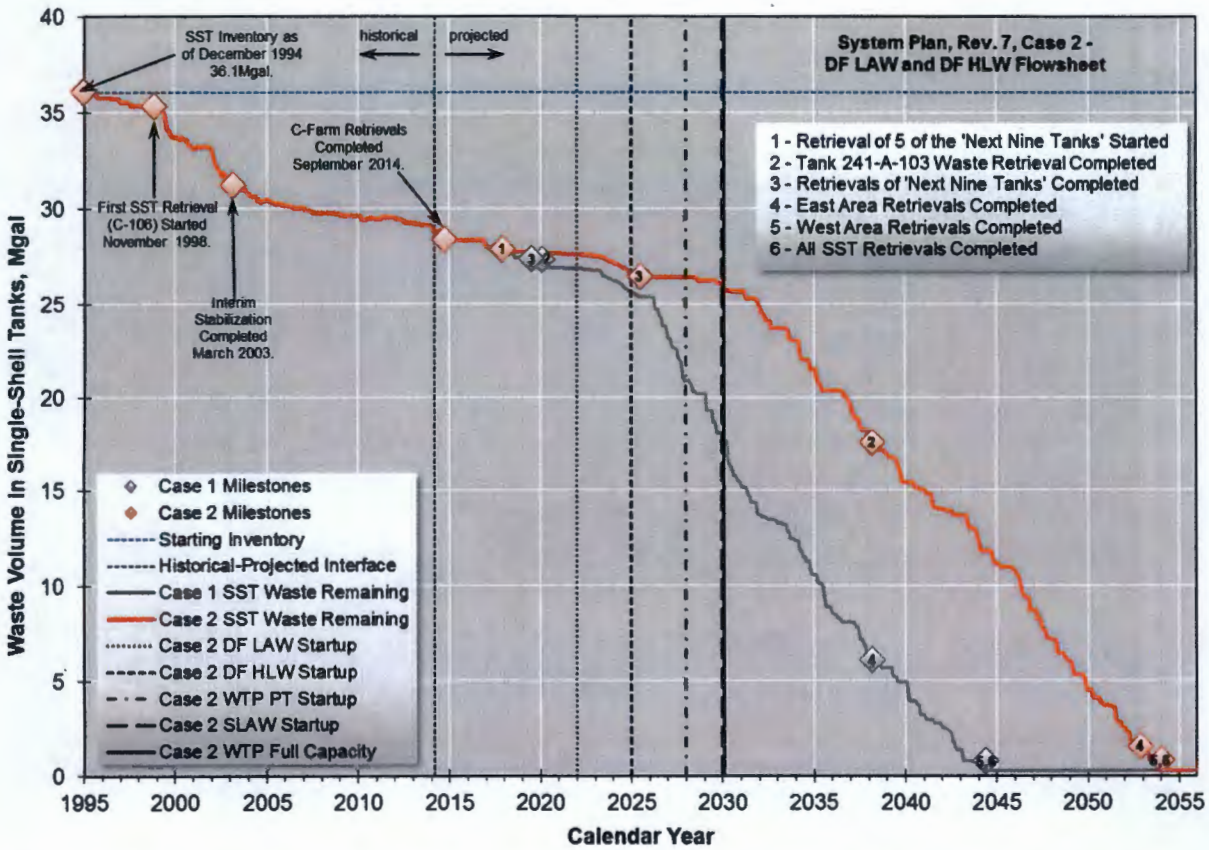
DST	double-shell tank	MTG	metric tons of glass	TRU	transuranic
FY	fiscal year	SP6	System Plan, Rev. 6	WMA-C	C Farm Waste Management Area
HLW	high-level waste	SP7	System Plan, Rev. 7	WOL	waste oxide loading
LAW	low-activity waste	SST	single-shell tank		
MT	metric ton				

- Four of 694 HLW batches fed to the PT Facility from the TWCSF exceeded 10 wt% solids (Assumption B4.2.3.2.3). This is not expected to affect the overall modeling results because the average of the 694 batches is approximately 8 wt%. Additionally, some batches did not meet other PT Facility acceptance criteria when they were screened in accordance with Assumption B3.4.1.1.
- DST 241-AY-101 exceeded nine fill-mix-empty cycles (Assumption B3.3.3.13). This is caused by washing the DFHLW batches in the tank and is discussed further in Section 4.2.5.
- Feed control list actions in HNF-SD-WM-OCD-015 (Assumption B3.3.2.7) are followed except for items 2 and 5:
  - Item 2 was replaced with the transfer of the 241-AY-102 HLW waste to Tanks 241-AY-101 and 241-AZ-102. Tank 241-AY-101 is used as the new HLW hot commissioning feed tank. Feed will have to be requalified to ensure it meets the WTP WAC.
  - Item 5 defines blending of 241-AZ-101 waste with waste from Tanks 241-AW-103, 241-AN-106, and 241-AP-103 resulting in an HGR below the limit. This specific blending was not performed; instead the near-term transfers modeled for Case 2 result in a reduced radiolytic heat load for Tank 241-AZ-101. The HLW feed batches were all within the HGR limits, thus the intent of this feed control item has been met.
- Assumption B3.3.3.3 states that 241-A and 241-AX Tank Farm SSTs will be retrieved as the *next nine* SSTs after 241-C Tank Farm. In the modeling, 241-AX Tank Farm and two SSTs from 241-A Tank Farm are completed after 241-C Tank Farm. The remaining four SSTs in 241-A Tank Farm are delayed to reserve space for DFLAW startup. The CH-TRU SSTs are retrieved during the DFLAW startup period, since they required no DST space. When non-CH-TRU SST retrievals resume, the model selected SSTs from 241-S, 241-SX and 241-BY Tank Farms as better candidates than the remaining 241-A Tank Farm tanks, based on the waste constituents present (solids or sodium). As a result, the remaining 241-A Tank Farm SSTs are retrieved after 2030.
- The lifecycle cost goal for Case 2 of $61.5 billion (Assumption B4.2.1.3) is exceeded by approximately $81.5 billion. Sources of additional cost incurred in Case 2 are discussed in Section 4.2.4.
- As modeled for Case 2, the time required to treat all tank waste exceeds the 40-year design life of the WTP (Assumption B3.4.1.1).

4.2.3.2 Single-Shell Tank Retrieval Results

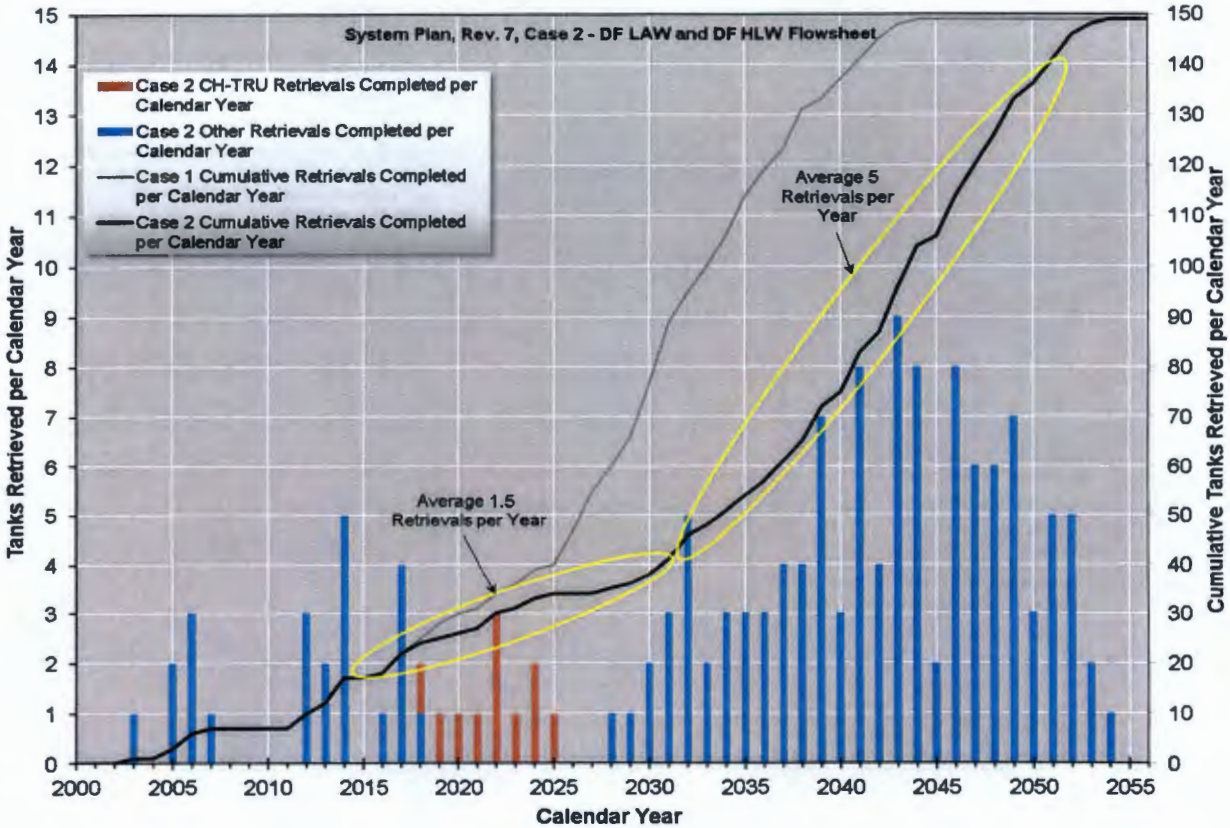
Completion of SST retrievals in Case 2 took significantly longer than Case 1. Figure 4-16 shows how the SST waste volume is reduced over the course of the mission. Case 2 completed 241-C Tank Farm retrievals and began the retrieval of 241-A and 241-AX Tank Farm SSTs in a similar timeframe as Case 1. First 241-AX Tank Farm is completed, as well as two SSTs from 241-A Tank Farm, at which point the remaining 241-A Tank Farm SSTs are delayed in order to reserve space in the 241-AP Tank Farm DSTs.

Figure 4-16. Case 2 Overall Single-Shell Tank Retrieval Progress.



Space is needed in the 241-AP Tank Farm to stage feed for DFLAW, as well as to receive effluent returns from the WTP. Additionally, 242-A Evaporator capacity is required in order to concentrate the WTP effluent returns, as well as to process the wash water used in preparing DFHLW feed batches. A total of 3.6 Mgal of wash water is used for DFHLW and requires evaporation. Although DST space and evaporator capacity preclude retrievals during this time, retrievals of the 11 CH-TRU SSTs are performed, since they do not impact DST space. A few 200-West-Area SSTs are retrieved in the late 2020s as space is created by DFLAW and DFHLW operations, but the bulk of SST retrievals resumed after 2030 when the PT Facility begins operating. Figure 4-17 shows the number of SST retrievals projected to be completed each year.

Figure 4-17. Case 2 Single-Shell Tank Retrievals Completed per Calendar Year.



When the bulk of the SST retrievals resume after 2030, HTWOS selects tanks to retrieve in an order that balances the amount of HLW and LAW in the DST system, based on whether the SST waste to be retrieved is primarily HLW or LAW. This caused SSTs in 241-S, 241-SX, and 241-BY Tank Farms to be selected prior to the remaining 241-A Tank Farm tanks. The order of SST retrievals is detailed on Figure 4-18 and the sequence of retrievals in the various farms is shown on Figure 4-19. After 2030, a few delays are experienced in the SST retrievals because of a lack of available capacity for solids in the DST system. Although there is overall space in the DST system, there is an excess of HLW caused by the slow rate of processing HLW through the WTP. Therefore, the DST system is unable to accommodate additional HLW solids from retrievals. As solids are processed through the HLW Facility, these delays are alleviated and the SST retrievals progress in an efficient manner.

Figure 4-18. Case 2 Single-Shell Tank Retrieval Timing and Sequence.

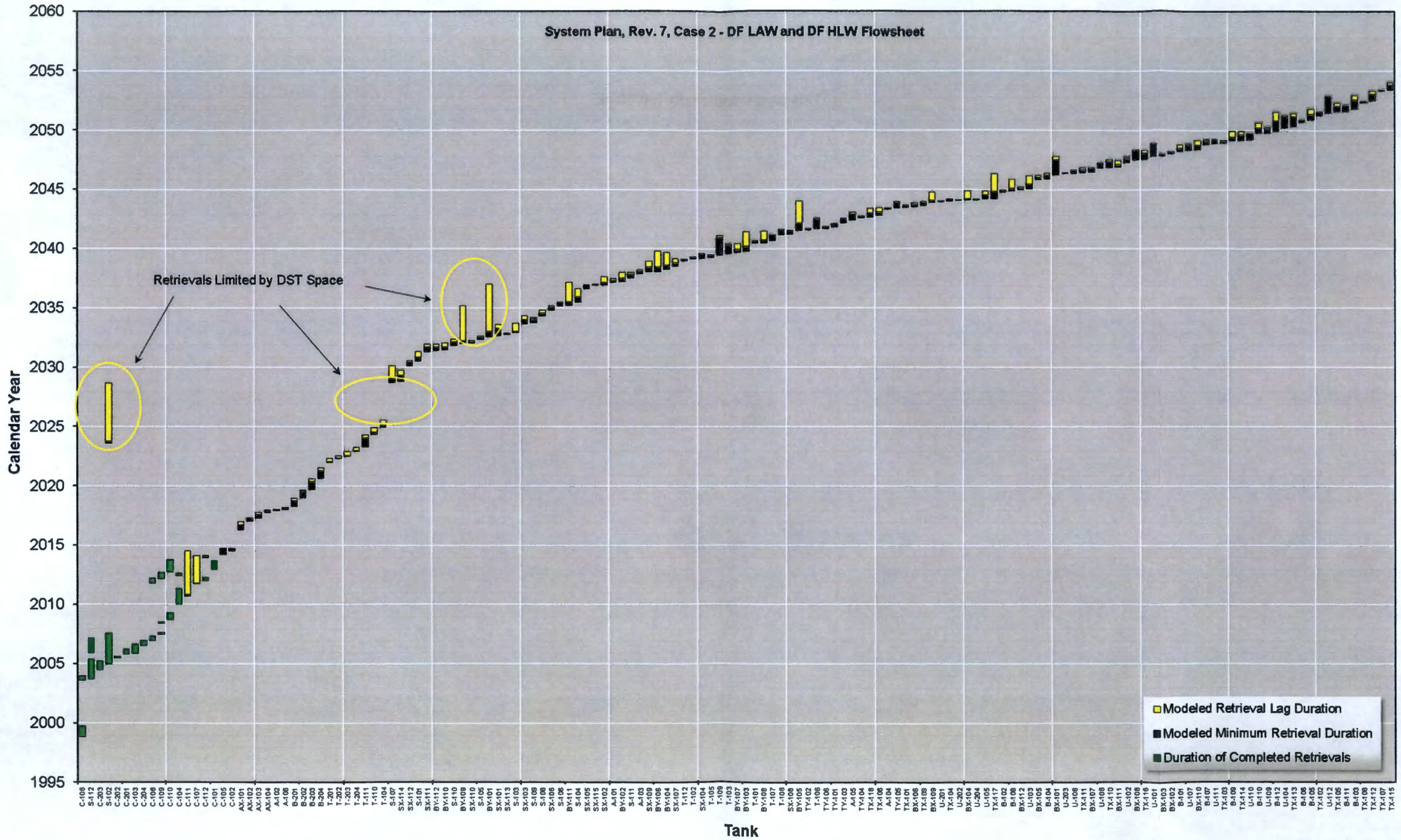


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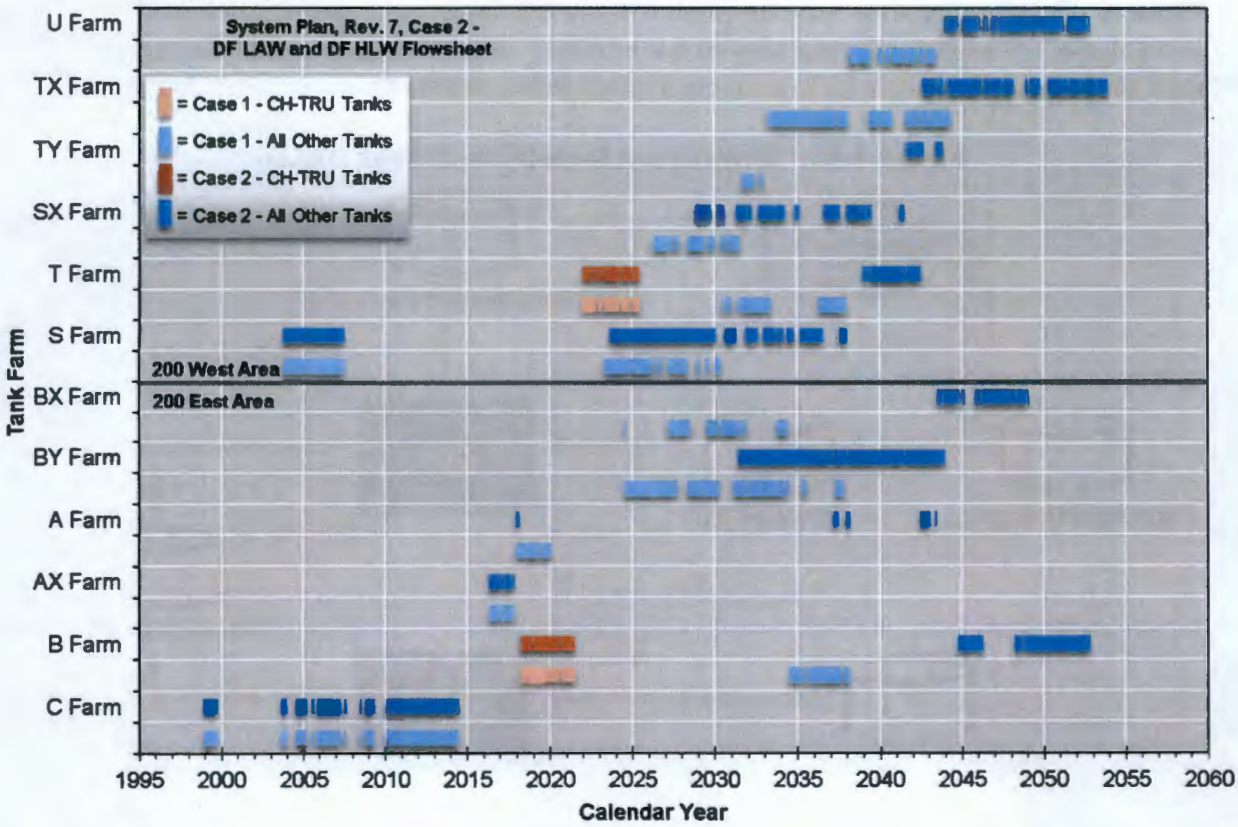
Figure 4-19. Case 2 General Timing of Single-Shell Tank Retrievals by Tank Farm.



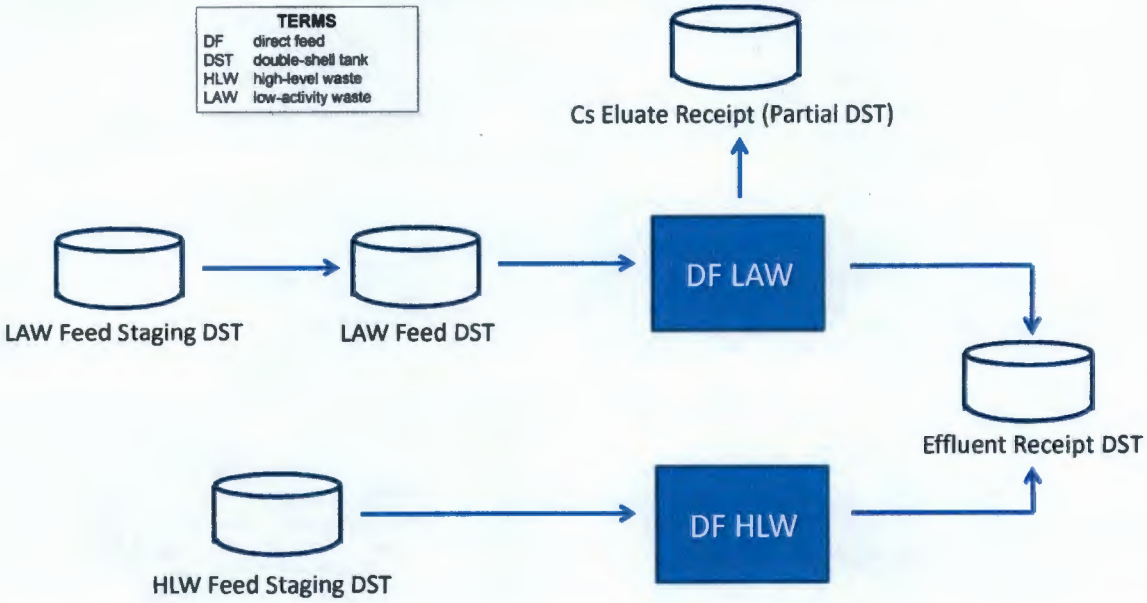
4.2.3.3 Double-Shell Tank Space and 242-A Evaporator Operation Results

DFLAW and DFHLW provide increased operational flexibility in completing the RPP mission, at the cost of increased, up-front demand on DST space and 242-A Evaporator capacity. From the start of direct feed operations until the start of the PT Facility, approximately 9 Mgal of waste is fed, and approximately 12 Mgal of effluent is returned to the DST system. Figure 4-20 depicts the DSTs required for direct feed operations. The DFLAW flowsheet requires at least two available DSTs for preparing and staging LAW feed for the LAWPS, as well as a partial third DST to receive high cesium eluate generated from the LAWPS IX process. Additionally, DFLAW and DFHLW would share another DST, which receives the effluent returns from the vitrification facilities. The effluent returns consist of dilute LAW and, therefore, require evaporation in the 242-A Evaporator, which uses 241-AW-102 for staging the evaporator feed, and another partial DST in 241-AP Tank Farm for receiving the evaporator bottoms. The DFHLW flowsheet also requires at least one DST for washing and staging HLW feed prior to delivery to the TWCSF. The washing consists of adding two 600,000-gal volumes of water to the feed and decanting it.

Three tanks worth of HLW feed are prepared in Case 2, resulting in 3.6 Mgal of wash water that requires handling and evaporation in the 242-A Evaporator. Washing is performed to remove water-soluble components such as aluminum from the waste, with the goal of reducing the amount of HLW glass produced. A small modeling error further impacted the available DST space for the majority of the mission, regarding expected level rises of approximately 100 kgal

each in Tanks 241-AP-101 and 241-AP-105. The level rises in Tanks 241-AP-101 and 241-AP-105 occur early in the mission (September 2022 and October 2018, respectively), but because of the modeling error they are reset to the lower value, resulting in 205 kgal of DST volume that is not used for the majority of the mission. This modeling error has a very small impact to the overall mission as it accounts for less than 1 percent of the total DST space.

Figure 4-20. Direct Feed Double-Shell Tank Needs.



As direct feed operations progress, they generate more DST space than they consume, since the WTP effluent returns are concentrated in the 242-A Evaporator, leaving less returned waste than was originally sent. Figure 4-21[31] shows that DST space increases between 2023 and 2030. This space increase occurs despite increasing effluent returns as the vitrification facilities ramp up, and is the result of an increase in the number of 242-A Evaporator campaigns.

Figure 4-22 shows that Case 2 has more cumulative DST transfers[32] than Case 1. Case 2 predicts approximately 4,200 transfers will occur with an average of 11 transfers per year prior to the startup of the HLW Facility increasing to 118 transfers per year during full WTP operations and 55 transfers per year in the latter part of the mission.

The dilute effluent and wash water generated by direct feed create additional demand on the 242-A Evaporator. Since liquid sent to the evaporator must undergo a 120-day sampling/analysis time, only two or three campaigns can be completed each year. More campaigns could be completed by staging evaporator feed in multiple DSTs, but this has not yet been investigated, and may adversely impact DST space. During the 6 years of direct feed

[31] Note that the DST emergency space from September 2013 to February 2016 when DST 241-AY-102 starts being retrieved is increased by 1,001,000 gallons.

[32] Cumulative DST transfers are defined as transfers from DSTs to DSTs (including cross-site), DSTs to WTP, from WRFs to DSTs, from DSTs to LAWPS, from DSTs to TWCSF, and from TWCSF to WTP (via direct feed HLW or pretreatment), as applicable. Transfers to or from the 242-A Evaporator are not included, but are included in each 242-A Evaporator campaign.

operations, 11 evaporator campaigns are completed, with five occurring in the last 2 years. The majority of these campaigns require a double-pass because of the level of dilution, which requires extra processing time.

Figure 4-21. Case 2 Use of the Double-Shell Tanks.

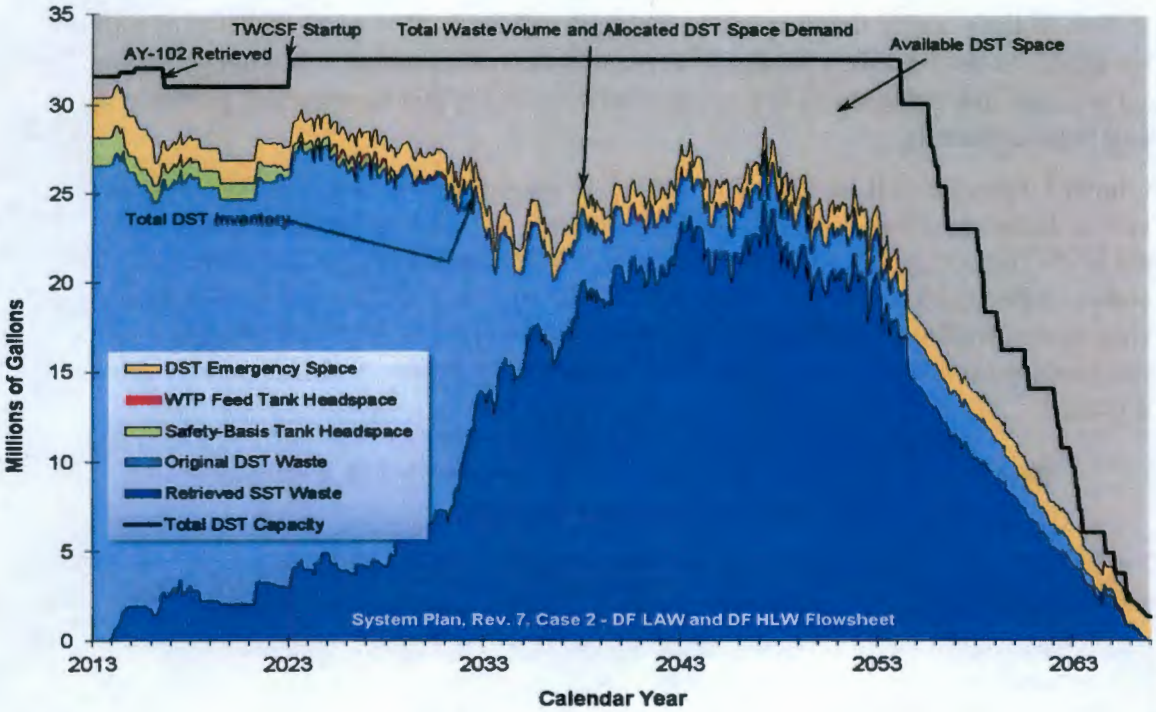


Figure 4-22. Case 2 Projected Double-Shell Tank Transfer Demand.

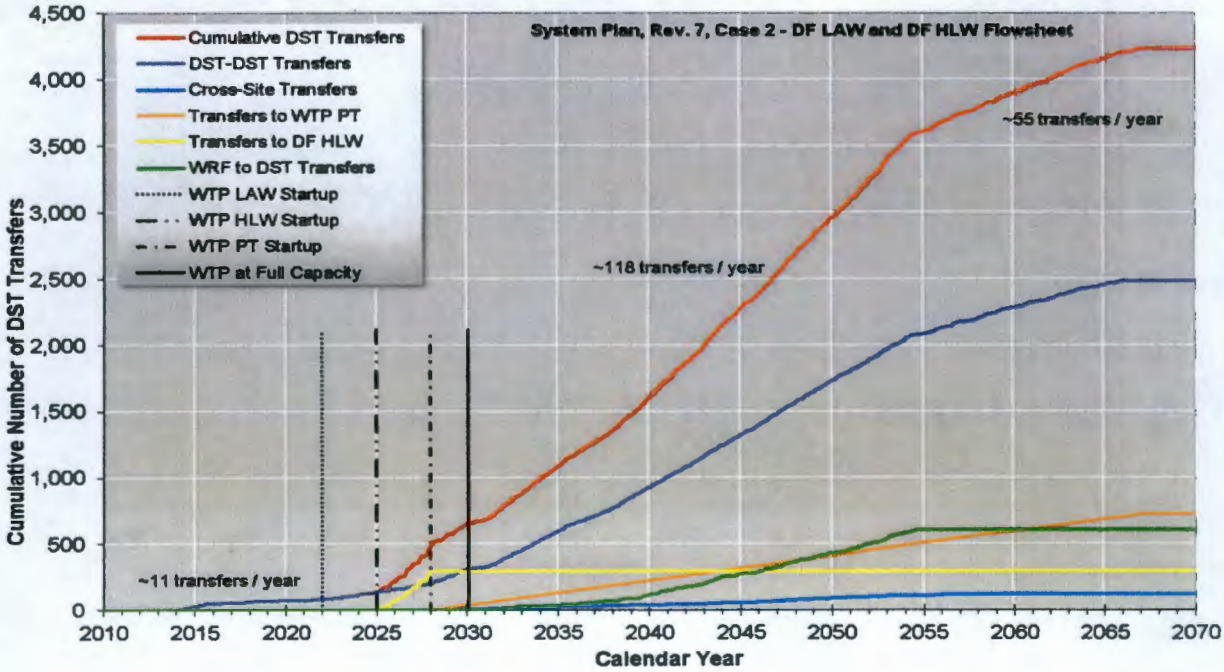
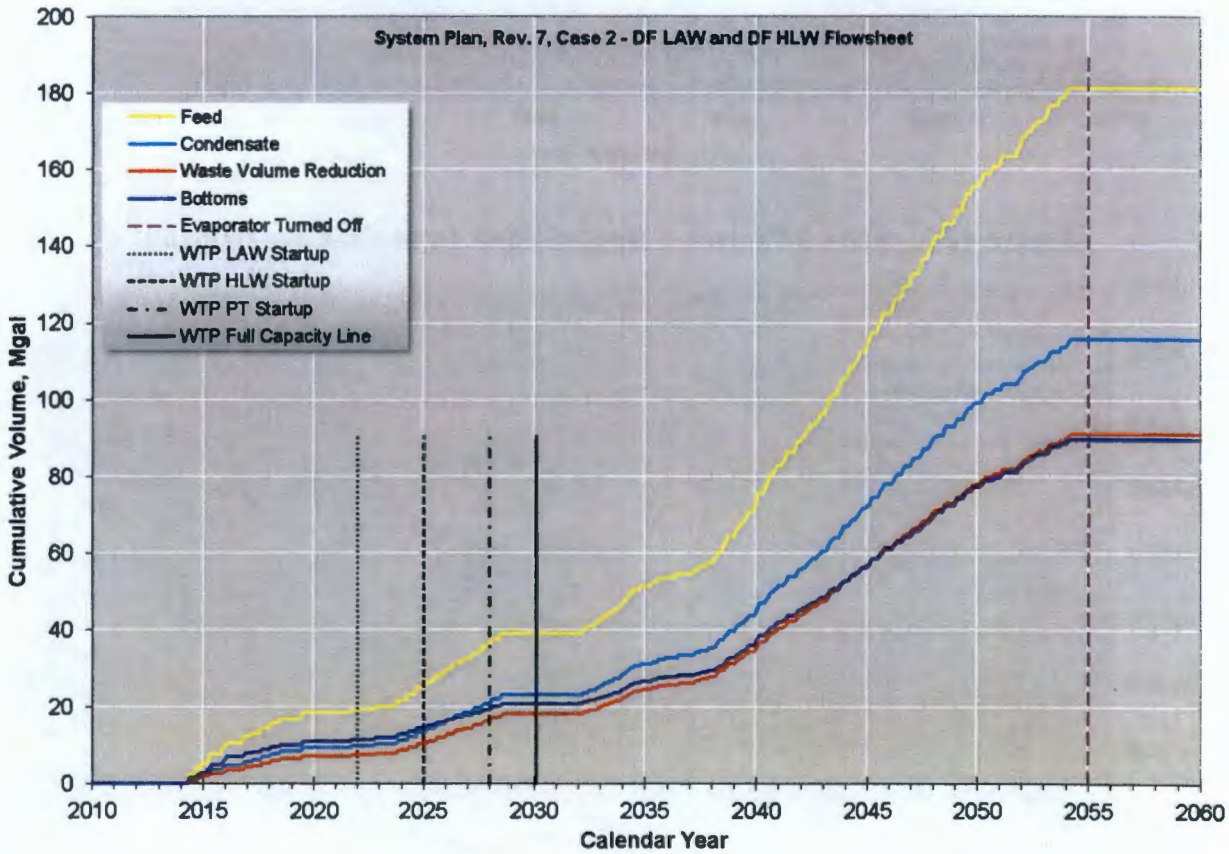


Figure 4-23 shows the waste volume reduction performed by the 242-A Evaporator over time. From FY 2014 to the end of the mission, Case 2 is projected to have 152 evaporator campaigns. This correlates to more than 181 Mgal of waste, reducing the stored volume by almost 91 Mgal over the mission duration. As can be seen by Figure 4-23, the slope of the evaporator feed line is not as steep during direct feed operations as it is later in the mission, indicating that there is not enough feed to fully utilize the evaporator during direct feed. However, the level of utilization requires a DST to be constantly available to receive the concentrated waste being returned. This, coupled with the low amount of DST space available during this time period, prevents many SST retrievals from occurring.

When the WTP reaches full capacity in 2030, DST space increases rapidly, allowing SST retrievals to occur more frequently. The increased rate of SST retrievals, in turn, causes an increase in the frequency of DST transfers, as well as an increase in the demand on the 242-A Evaporator. After 2030, the rate of waste consumption by the WTP exceeds the rate of SST retrievals, so the available space in the DST system increases. The available space could be better utilized by performing more simultaneous retrievals; however, this is outside the scope and cost of Case 2.

Figure 4-23. Case 2 Projected Operation of the 242-A Evaporator for the Mission Duration.



4.2.3.4 Glass Production Results

The addition of DFLAW and DFHLW to the RPP flowsheet offers several benefits:

- Glass production can begin in the HLW and LAW Facilities prior to resolution of the technical issues associated with the PT Facility.
- WTP facilities can be started in a phased approach, requiring fewer resources at any given time.
- Personnel would be able to gain operating experience in the (comparatively) less complex LAW Facility before progressively moving on to the more complex HLW Facility, and then to the PT Facility.
- Addition of the LAWPS and the TWCSF creates backup pathways for waste treatment that can be used to keep the HLW and LAW Facilities running in the event of outages in the PT Facility.

The success of DFLAW and DFHLW depends on LAWPS and TWCSF being able to adequately maintain feed to LAW and HLW Facilities to support the stated glass production rates. In Case 2, the TWCSF is defined as six 250,000-gal tanks, which is half the size of the TWCSF concept, used to support ORP's Framework document (DOE 2013).

During the direct feed period of the mission, the TWCSF, as sized in Case 2, is able to adequately feed the HLW Facility. The facility is in a ramp-up period, and also experiences several delays caused by a lack of space in the DST system for receiving the effluent produced by the vitrification facilities. The delays are depicted as flat areas on the production line of Figure 4-24. The LAW Facility experiences the same effluent-related delays as the HLW Facility. These delays occur when the DST that receives the effluent becomes full and is unable to empty to the evaporator because the evaporator is already in use.

When the PT Facility starts, it handles all of the effluent generated by the vitrification facilities, thus, effluent-related delays are alleviated. At the same time, the HLW and LAW Facilities reach their full production rates. The TWCSF is used to provide HLW feed for the entire mission, but because of its size in Case 2, it is unable to sustain the full IHLW production rate, creating a bottleneck, which significantly extends the completion of waste treatment. Figure 4-24 shows the IHLW canister production over the mission, compared to the theoretical rates. As can be seen, IHLW canisters are produced at approximately half of the theoretical rates. Production of ILAW containers depend on the rate of IHLW canister production to an extent, thus ILAW production is also hindered by the bottleneck. Figure 4-25 shows the projected ILAW container production compared to the theoretical production rates.

Although DFLAW and DFHLW can offer benefits to the RPP flowsheet, it is important that the facilities be sized correctly. The TWCSF, as sized in Case 2, was too small to meet the feed requirements of the WTP, thus the benefits of DFLAW and DFHLW are not realized.

Figure 4-24. Case 2 Projected Immobilized High-Level Waste Production.

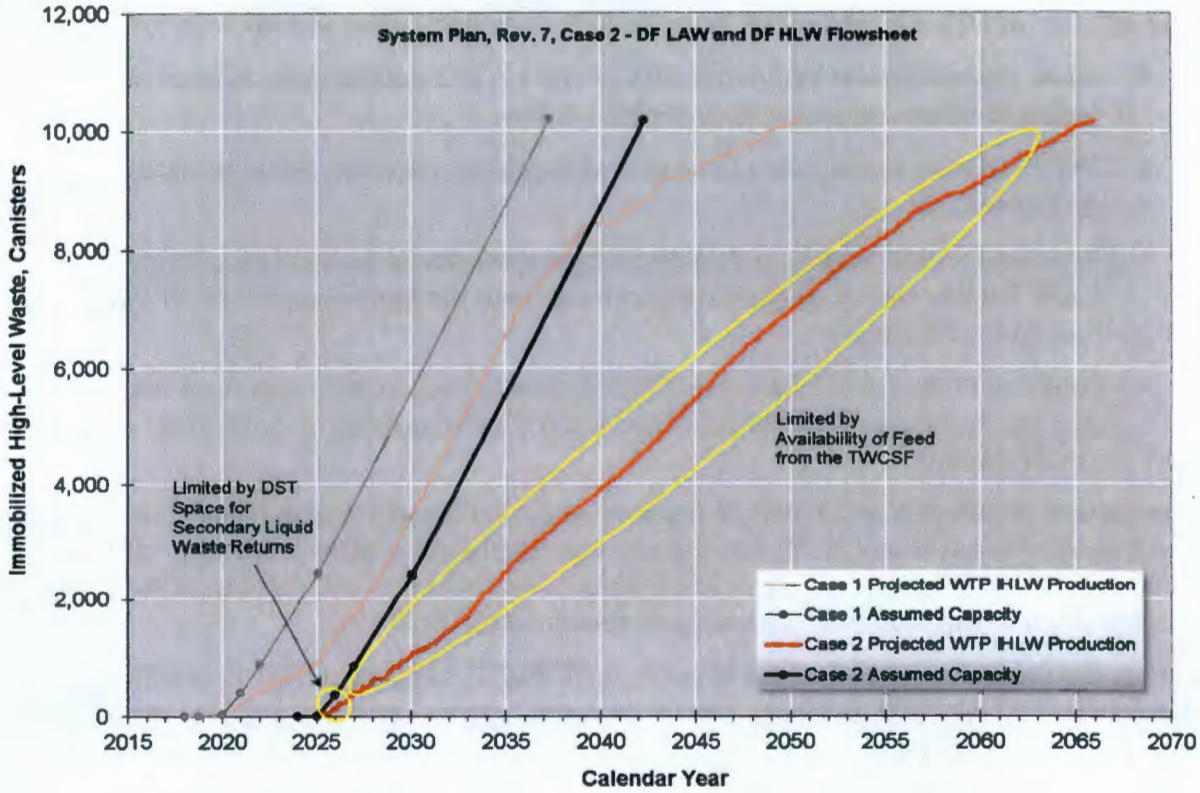
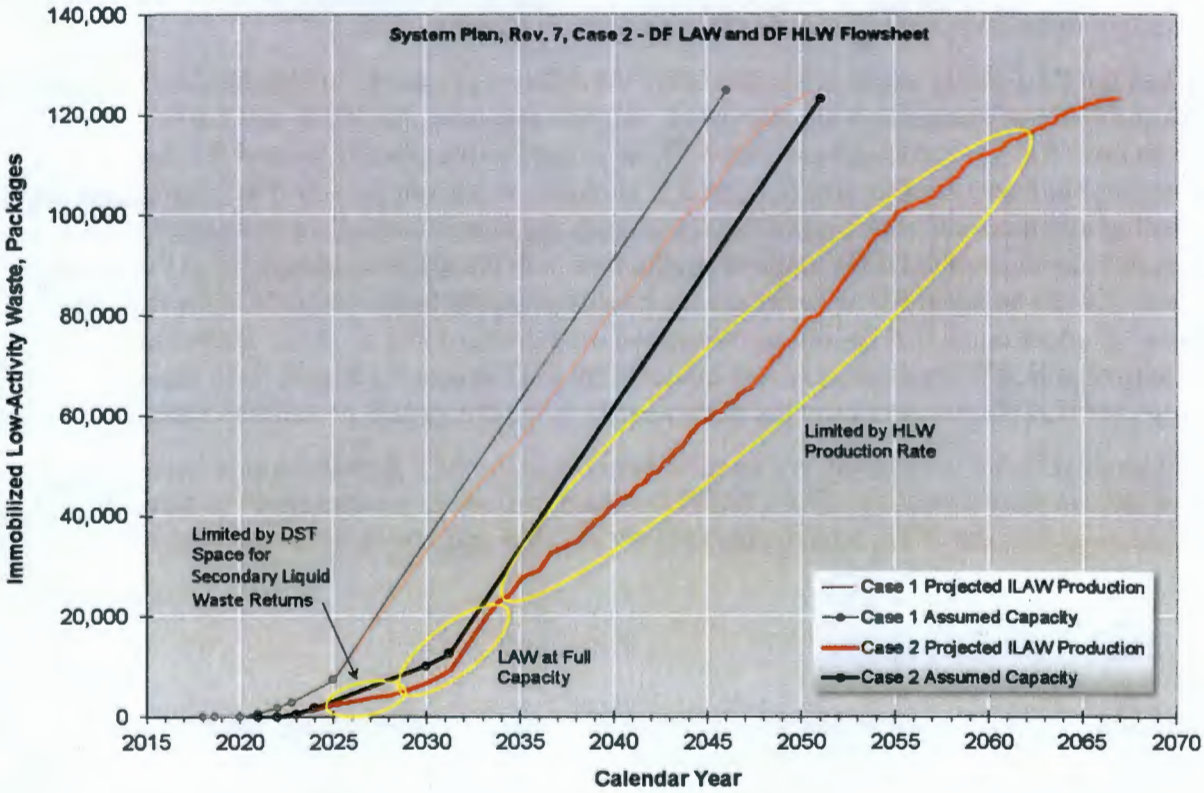


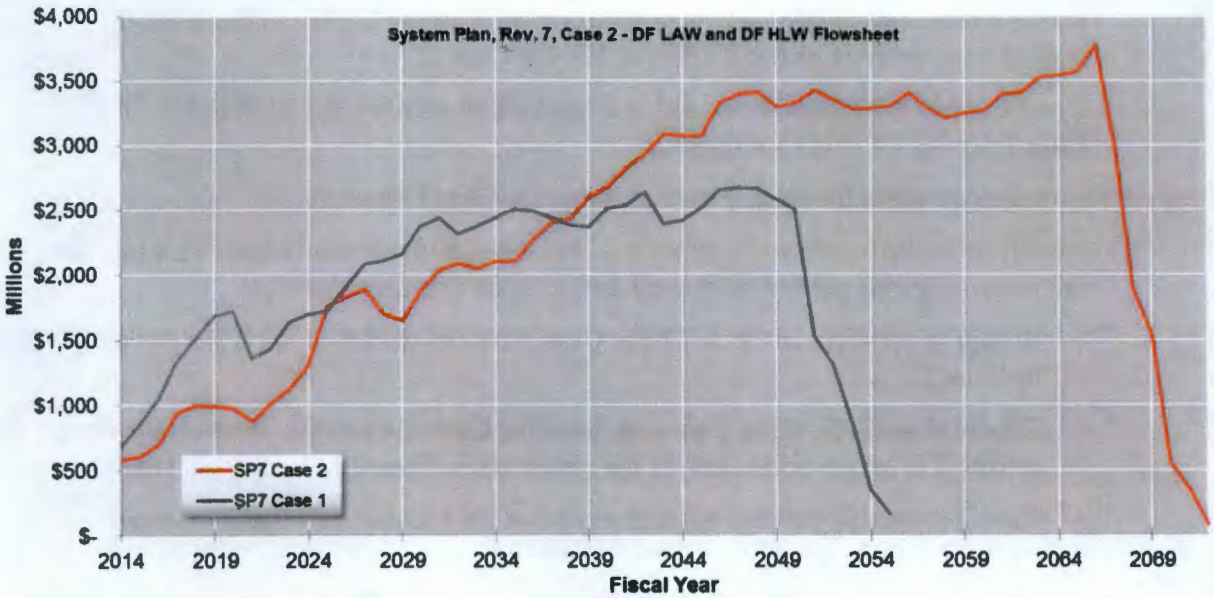
Figure 4-25. Case 2 Projected Immobilized Low-Activity Waste Production.



4.2.4 Cost and Schedule Impact

The projected schedule and lifecycle cost profile for Case 2 is significantly different from Case 1. The net schedule effect is a lifecycle mission duration of 16.5 years longer than Case 1. The lifecycle cost for Case 2 is nearly $56 billion more than Case 1 ($143 billion versus $87 billion, or about 64 percent). As depicted in Figure 4-26, the majority of the increase occurs between 2051 and 2072. Case 2 meets the near-term funding targets noted in Appendix B for both FY 2014 and FY 2015 by 5 percent and 14 percent, respectively. Case 2 exceeds the $61.5 billion lifecycle cost noted in Appendix B by approximately 133 percent.

Figure 4-26. Case 2 Lifecycle Cost Profile.



Assessing the cost profile graph (Figure 4-26) prior to FY 2019 indicates that Case 1 includes a ramp up of capital projects that are required prior to the start of the WTP in May 2018. Case 2, instead, has staggered facility start dates, which lead to a shift of capital project budgets in order to meet the facility need dates noted in Appendix B. For Case 2, the first capital cost expenditures of note are between FY 2015 and FY 2021 for 241-C Tank Farm closure, LAWPS, and TWCSF. The next large capital cost expenditure is for supplemental LAW from FY 2022 to FY 2028. During this time, the start of HLW Facility operations results in an increase in cost until the supplemental LAW facility is completed.

Differences in Case 2 versus Case 1 are caused by the following high-level items:

- Early mission costs for Case 1 exceed those for Case 2 because:
  - Case 1 DST retrieval equipment costs start in FY 2014 with all equipment being installed prior to the end of January 2030. Case 2 DST retrieval equipment costs start in FY 2015 with all equipment being installed prior to the end of January 2035.
  - WMA-C closure and 241-SX Tank Farm barrier costs are expended prior to 2019 in Case 1 versus extending them to 2022 for Case 2.

- Project costs for SLWT, upgrades to DST farms for HLW staging, and completion of a dedicated LAW transfer system for 241-AP Tank Farm are all expended prior to the end of May 2018 for Case 1. Case 2 activities, on the other hand, are extended in order to be completed prior to the facilities' need dates (LAW Facility, HLW Facility, or PT Facility, as applicable).
- Infrastructure for waste form and melter disposal is all completed prior to the end of May 2018 for Case 1, yet it is staggered to be finished based on applicable facility start dates for Case 2.
- Expenses for transition to the WTP are all completed prior to the start of operations of the PT Facility and the LAW and HLW Facilities at the end of May 2018 in Case 1, versus expenses spanning a 2-year duration prior to the startup of the LAW Facility and up to operations of the HLW Facility for Case 2.
- Costs for full WTP operations of LAW and HLW vitrification start in FY 2019 for Case 1 versus FY 2025 for Case 2.

- Overall mission costs for Case 2 exceed those for Case 1 because:
  - Activities occurring later experience increased cost from escalation. This applies to the following four subitems, as well as the items mentioned above:
    - Earlier processing in the WTP for Case 1 results in earlier costs for retrievals than in Case 2.
    - Retrieval costs for Case 2 exceed those for Case 1 since the duration for each retrieval is longer and many of the retrievals in Case 2 are executed later.
    - Case 2 shows 51 percent more cumulative DST transfers[33] and 27 percent more evaporator campaigns (152 versus 119) than Case 1.
    - Facility start dates for Case 2 are later than in Case 1. (See Appendix B for the assumptions governing the facility start dates.)
  - SST retrievals and accompanying tank farm closures are completed approximately 10 years later than in Case 1, resulting in a higher cost since the cost ramp-down of site infrastructure and personnel is related to the number of active tank farms and active facilities.
  - Capital and operating costs are included in Case 2 for LAWPS and TWCSF that are not included in Case 1 costs.
  - Processing time for HLW in Case 2 is extended resulting in a higher cost over time because the HLW Facility is unable to reach full production capacity as it is constrained by throughput restrictions in the TWCSF.

[33] It should be noted that for Cases 2 through 5, there is an inconsistency in how transfers are priced that originates at the TWCSF. Prior to operations of the PT Facility, the transfers are assumed to be part of the TWCSF operational costs. However, after the PT Facility starts operating, transfers from the TWCSF to the PT Facility are priced as DST transfers.

It should be noted that although packaging and shipping costs for CH-TRU are included, CH-TRU disposal costs at WIPP are not included in the LCM.

4.2.5 Key Issues and Vulnerabilities

The key issues detailed in SP6, Section 7.0, and the corresponding issues identified in the three-volume IWFDP (RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3), along with the associated risks in the WRPS R&OMP (TFC-PLN-39), continue to be applicable in this SP7. Case 2, as defined by the assumptions in Appendix B and presented in this section, includes a number of risks and challenges that will need to be addressed for it to become a practical scenario. The following bulleted items highlight the key issues and vulnerabilities:

- Necessary facilities are assumed to be available on time to support operations. In addition, solid waste disposal issues are assumed to be resolved.
- The TWCSF, as defined in the assumptions, creates a bottleneck in feeding the HLW Facility, extending the time required to retrieve and treat all tank waste.
- The lack of available DST space and limited 242-A Evaporator capacity during DFLAW creates a strain in being able to receive the WTP effluent returns, to keep the WTP operating at capacity, and to keep SST retrievals active. The loss of DST 241-AY-102 as a viable DST exacerbates this issue.
- The success of direct feed operations and of the mission depends on the efficient operation of the 242-A Evaporator, which creates a single point-of-failure.
- The spent IX resin proposed for use in the LAWPS facility may not meet the IDF disposal criteria and does not currently have a disposal pathway identified (Assumption B4.2.3.1.6).
- The effluent being returned from the WTP to the tank farms during the direct feed period is assumed to meet all tank farm acceptance criteria and corrosion specification limits (Assumption B4.2.5.1.3). Since the flowsheet for this case does not include intermediate tanks to collect the effluent and verify/correct effluent chemistry, a method for doing this in-line must be developed or collection points (e.g., WTP tanks) must be established. In the Framework (DOE 2013), intermediate collection points were established.
- The volume of effluent returned from the WTP to the tank farms during the direct feed period is based on design assumptions outlined in 24590-WTP-RPT-PT-02-005, *Flowsheet Bases, Assumptions, and Requirements*. Changes in the design resulting in increased effluent returns could significantly impact the mission, including the ability of the tank farms to provide continuous (direct) feed to the WTP.
- As modeled for Case 2, the time required to treat all tank waste exceeds the 40-year design life of the WTP (Assumption B3.4.1.1).
- Screening of feed delivered to the PT Facility was performed per Assumption B3.4.1.12 and indicated that some batches do not meet all of the acceptance criteria, as modeled for Case 2. Additional analyses must be performed and strategies developed to allow as much flexibility in the acceptance criteria as possible, and to ensure that waste prepared for delivery meets all applicable criteria. It should be noted that predicted DFLAW and

DFHLW batches for Case 2 were screened per Assumption B4.2.4.3.1 and found to be in compliance with the applicable criteria.

- As modeled, DST 241-AY-101 exceeds nine fill-mix-empty cycles (Assumption B3.3.3.13) caused by the washing of DFHLW feed batches in the tank. Approximately 15 cycles are performed, which may exceed the amount of fatigue allowed for 241-AY-101. Additionally, 241-AZ-101 and 241-AZ-102 are at the nine-cycle limit, so they could not be used to reduce the load on 241-AY-101. A newer HLW hot commissioning tank would need to be selected, or a fatigue analysis performed to show that the nine-cycle limit can be safely extended in 241-AY and 241-AZ Tank Farms.

4.2.6 Sensitivity Case 2A – Results Using Advanced Glass Formulation Models

A sensitivity run was performed for Case 2 using the 2013 Advanced GFMs. The differences in glass production are shown in Table 4-5.

Table 4-5. Case 2 Glass Formulation Models Production Comparison.

Product	Case 2 (Original GFMs)	Case 2A (2013 GFMs)	Difference
HLW Glass (MT)	30,749	24,026	-22%
IHLW Canisters	10,183	7,956	-22%
LAW Glass (MT)	678,251	522,241	-23%
ILAW Containers	123,131	94,809	-23%

GFM glass formulation model
HLW high-level waste
IHLW immobilized high-level waste
ILAW immobilized low-activity waste
LAW low-activity waste

The glass formulations used by the 2013 Advanced GFMs allow for an increase in waste loading in the glass thereby decreasing the overall glass production. Waste oxide loading in HLW glass increased from 36 percent to 46 percent, and sodium oxide loading in LAW glass increased from 16 percent to 20 percent.

Despite the increased efficiency in glass production, no significant changes in mission duration or retrieval completion are observed. Retrieval and treatment operations during DFLAW and DFHLW are still limited by the availability of DST space. The ability of the DST system to accept WTP and LAWPS effluent returns limits the capability to operate the WTP at the specified production rates. During full WTP operations, the WTP is starved for feed because of the bottleneck created by the TWCSF's tank sizes. Increased glass production efficiency results in faster consumption of waste feed accompanied by increased downtime in the HLW and LAW Facilities when compared to the primary Case 2. Therefore, the only benefit to the mission that is achieved by using the 2013 Advanced GFMs in this case is that there are fewer overall IHLW glass canisters to be stored and shipped to an offsite repository for disposal, and fewer ILAW glass containers to be disposed of onsite at IDF.

4.2.7 U.S. Department of Energy Observations

Several key features and assumptions associated with Case 2 make this case challenging:

- Although the funding targets for FY 2014 and FY 2015 were met, in subsequent years the cost increased sharply, exceeding $1 billion in FY 2022 and beyond. Additionally, Case 2 had a mission lifecycle cost of more than $140 billion, greatly exceeding the lifecycle cost target of $61.5 billion.
- There are uncertainties associated with the volume, composition and disposition of DFLAW and DFHLW effluent. The disposition of this effluent during DFLAW and DFHLW operation may impact DST space, the timing of SST retrievals and the ability to continue delivering feed to the WTP; or may require alternative pathways to recycle or purge these streams.
- Assumed size of the vessels in the TWCSF was too small, creating a bottleneck in the feed qualification and delivery process, which reduced the HLW glass production rate by approximately 50 percent, increasing the total mission duration and cost.

4.3 CASE 3 – CONTINGENCY CASE FOR WASTE TREATMENT AND IMMOBILIZATION PLANT STARTUP UNCERTAINTY

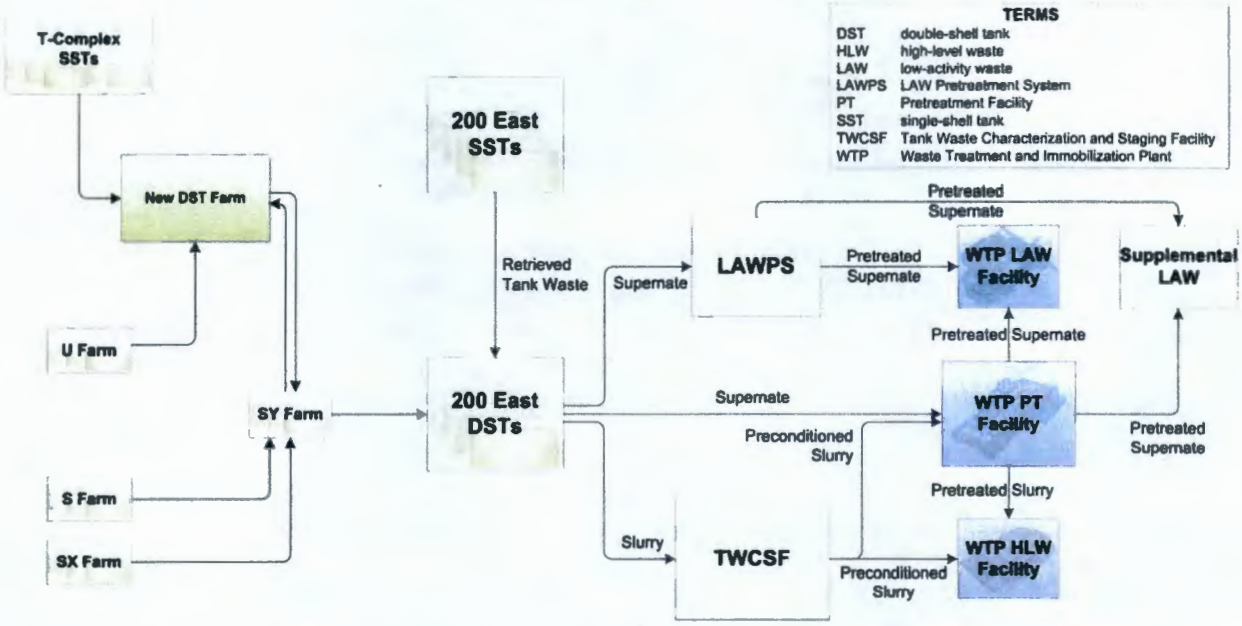
Selected and Defined by: Ecology

Purpose: Case 3 evaluates the number of new DSTs needed in the 200 West Area, and provides a project schedule for constructing the new DSTs required to support SST retrievals consistent with Consent Decree milestones, if the WTP is not fully operational until 2033.

4.3.1 System Description

The flowsheet used for Case 3 builds on that used for Case 2 by constructing new DSTs in the 200 West Area to support the retrieval of SSTs (Figure 4-27). Construction of the new DSTs replaces West Area WRFs. Case 3 also includes DFHLW and DFLAW capabilities. Two new systems support these capabilities: The LAWPS supports DFLAW and TWCSF supports DFHLW, and are described in Sections 4.3.1.1 and 4.3.1.2, respectively. Modifications to the WTP will be necessary (not included in the cost for Case 3) to accept waste directly from these facilities rather than from the PT Facility. Additionally, Case 3 explores processing potential CH-TRU waste as HLW, eliminating the supplemental TRU treatment system, and treating the CH-TRU waste at the WTP.

Figure 4-27. Case 3 Simplified Flowsheet.



4.3.1.1 Low-Activity Waste Pretreatment System

The concept of directly feeding waste to the WTP vitrification facilities would allow some tank waste treatment to begin prior to resolution of the technical issues that are currently delaying progress on the PT Facility design and construction. In order to accomplish this, some pretreatment of the waste would be necessary in the tank farms. LAWPS is envisioned as a partial substitute for the PT Facility. It would encompass many of the same waste processing capabilities and would be sized to support feeding two LAW melters operating at 30 MTG/day at 70 percent TOE.

LAWPS is described in detail in Section 4.2.1.1. A diagram of the proposed LAWPS is shown on Figure 4-14.

4.3.1.2 Tank Waste Characterization and Staging Facility

The TWCSF predecisional concept, as modeled in SP7 and shown on Figure 4-15, involves the provision of six[34] tanks in a vault configuration. The original concept used 500,000-gal tanks; at Ecology's request, these were reduced to 250,000-gal tanks in Case 3. Also included in the TWCSF are mixing capabilities, transfer capabilities, and sampling capabilities. The TWCSF is described in detail in Section 4.2.1.2.

4.3.2 Planning Bases

The planning bases for Case 3 were defined by Ecology. ORP directed WRPS to model the five cases selected and defined by Ecology for this SP7 in accordance with the key assumptions and success criteria also selected by Ecology. Planning bases for the Case 3 Model Starting

[34] Note that final selection on the number of tanks will be determined as requirements are further defined.

Assumptions are provided in Appendix B, Section B4.3. Some planning bases were further refined for the Case 3 modeling:

- The purpose of Case 3 is to examine the impact of the WTP startup uncertainty on SST retrieval completion and mission completion. The startup schedule for the WTP was delayed so the DFLAW radioactive operations started in October 2027, DFHLW radioactive operations start in October 2030, and the feed to the PT Facility for radioactive operations starts in October 2033. No hot commissioning was modeled for these facilities.
- The sequence of retrieval of the SST farms was changed to the following order: 241-C Tank Farm, 241-A/AX Tank Farms, T Complex, 241-U Tank Farm, B Complex, and 241-S/241-SX Tank Farms, where the retrieval sequence of the 200-East-Area SSTs was independent of the sequence of the 200-West-Area SSTs. Six simultaneous SST retrievals could occur at one time; however, these were limited to a maximum of four simultaneous retrievals per area (200 East Area or 200 West Area). These simultaneous retrievals could be from adjacent tanks.
- It was determined that the supplemental LAW facility start date of July 1, 2030 (Assumption B4.3.6.1.1), was impractical since it occurred prior to the star of the PT Facility (January 10, 2033). The actual start date used for modeling Case 3 was adjusted to October 1, 2035, with a rate of 9.0 MTG/day. The facility was ramped up per Assumption B3.5.1.6 on January 1, 2037.
- As with Case 1, 241-C-102 and 241-C-105 retrieval durations and the 241-C-102 raw water estimate were adjusted to meet the 241-C Tank Farm retrieval Consent Decree milestone.

4.3.3 Results

Table 1-1 (Section 1.3) and Table 4-6 show the key mission metrics, including lifecycle cost, for SP7 Case 3 compared to Case 1.

Table 4-6. Case 3 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 3 – Contingency WTP S/U Uncertainty
Lifecycle Cost, FY 1997 to End of Mission[a]	$87.5B	**$205.7B**
Meets Near-Term Funding Targets Through 2015	$1,526M	$1,206M
Meets Near-Term Funding Profile Through 2015[b]	No	Yes
Complete 241-C Tank Farm Retrievals (B-1)[c]	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	November 2017	December 2017
Close WMA-C (M-045-83)	June 2019	November 2022
Complete Nine Additional SST Retrievals (B-4)	July 2019	July 2022
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)	February 2020	August 2033
Complete all SST Retrievals (M-045-70)	May 2044	January 2058

Table 4-6. Case 3 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 3 – Contingency WTP S/U Uncertainty
Close all SSTs (M-045-00)	December 2048	May 2063
Treat all Tank Waste (M-062-00)	August 2050	October 2079
Close all DSTs (M-042-00A)	August 2055	August 2084
Complete Potential TRU Tank Waste Packaging	July 2025	N/A
HLW Glass Mass (MTG)	30,845	32,306
HLW Glass Canisters	10,214	10,618
HLW Glass WOL	35%	36%
LAW Glass Mass (MTG)	687,187	682,419
LAW Glass Containers	124,753	123,888
LAW Glass Sodium Oxide Loading	16%	16%
Sodium Reporting to LAW Glass (MT)	79,056	79,109
Potential TRU Tank Waste Drums	8,285	N/A

Notes:

BOLD RED text indicates a figure or date that does not meet the success criteria.

All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.

Lifecycle costs for Cases 1 through 5 were developed using the Tank Operations Contract cost model. Lifecycle cost figures are used in the System Plan for comparative purposes only, and do not reflect the currently approved PMB.

SP7, Lifecycle Cost Model is based on PMB output from FY 2014.

[a] Lifecycle cost success criteria applies to Cases 1 through 4 and the SP6 Baseline Case.

[b] Near-term funding targets for Cases 1 through 4 and the SP6 Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million. Total FY 2014 through FY 2015 = $1,320 million.

[c] The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7 Assumption B4.1.1.2.

DST	double-shell tank	MTG	metric tons of glass	SP7	System Plan, Rev. 7
FY	fiscal year	N/A	not applicable	SST	single-shell tank
HLW	high-level waste	PMB	Performance Measurement Baseline	TRU	transuranic
LAW	low-activity waste			WMA-C	C Farm Waste Management Area
MT	metric ton	SP6	System Plan, Rev. 6	WOL	waste oxide loading

For Case 3, 42 new DSTs were predicted to be needed to support SST retrievals in the T Complex and 241 U Tank Farm. The major trade-off of this option is the lifecycle cost impact, which is estimated to be $4.3 billion for the design, construction, and permitting of 42 new DSTs. Although not explicitly modeled, it can be inferred that if a new evaporator were built in conjunction with the new DSTs, fewer DSTs may be necessary.

4.3.3.1 Assessment of Case 3 Results Versus Planning Bases and Assumptions

During analysis of the results of Case 3 modeling, it was determined that some of the assumptions, as written in Appendix B, were not met. The following deviations were identified:

- Lifecycle cost of Case 3 is $206 billion, which exceeds the success criteria of $61.5 billion (Assumption B4.1.1.4).

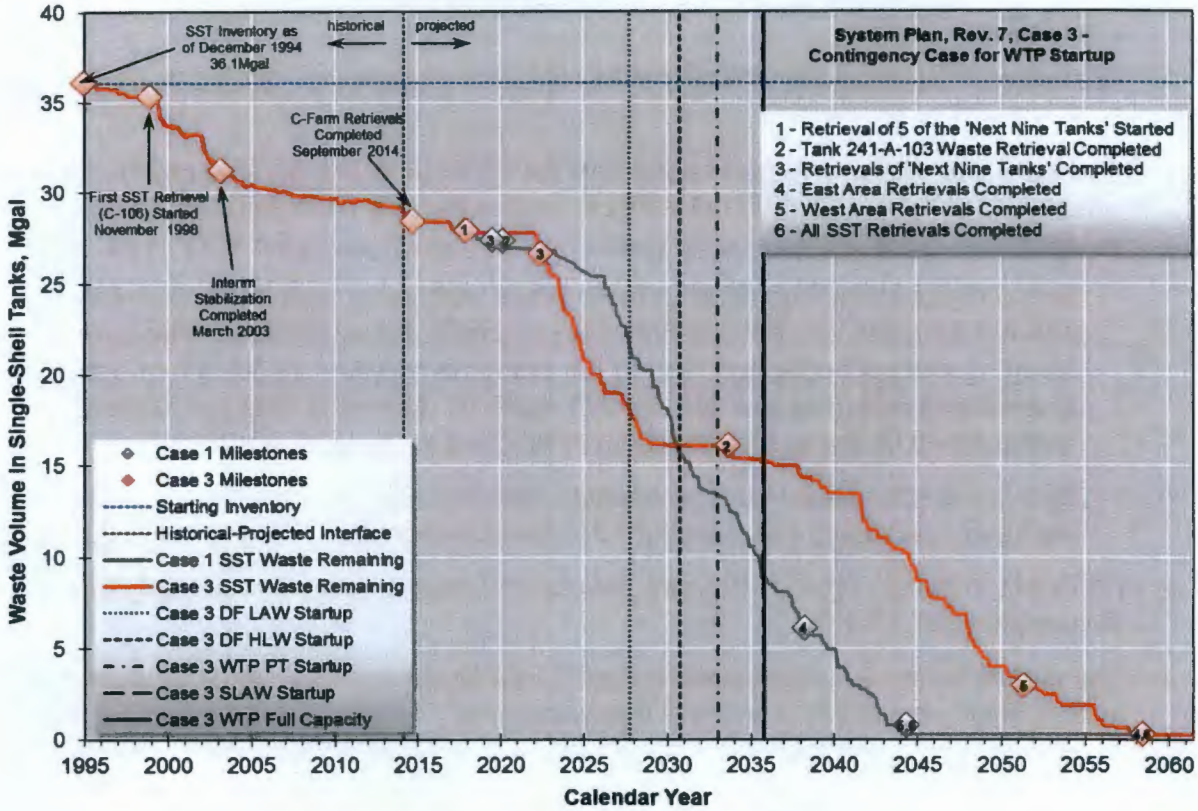
- All SST retrievals are completed by May 2058, which is after the Consent Decree milestone of December 31, 2040 (Assumption B4.3.4.1.1). The major contributors inhibiting this milestone from being met are (1) SST retrieval rate was limited to an RDF of 1.0, as determined by Ecology prior to modeling (superseded Assumption B4.3.4.1.1 that notes the pace of retrievals could be adjusted to meet the SST retrieval Consent Decree milestone date), and (2) reduced TWCSF size decreases the HLW production rate so that DST space is not available in the 200 East Area to support four simultaneous retrievals.
- The 2-month pause in the TWCSF functions prior to the startup of the PT Facility (Assumption B4.3.3.2.3) was not modeled. DFHLW continues to operate until the PT Facility is online. It was determined that the impact of not modeling the 2-month pause does not affect the overall modeling results, since HLW vitrification is limited by the availability of feed.
- Feed control list actions in HNF-SD-WM-OCD-015 (Assumption B3.3.2.7) are followed except for items 2, 5, and 7:
  - Item 2 was replaced with the transfer of the HLW from 241-AY-102 to 241-AY-101 and 241-AZ-102. Tank 241-AY-101 is used as the new HLW hot commissioning feed tank. Feed will have to be requalified to ensure it meets the WTP WAC.
  - Item 5 defines blending of 241-AZ-101 waste with waste from Tanks 241-AW-103, 241-AN-106, and 241-AP-103 resulting in an HGR below the limit. This specific blending was not performed; instead the near-term transfers modeled for Case 3 result in a reduced radiolytic heat load for 241-AZ-101. The HLW feed batches are all within the HGR limits, thus the intent of this feed control item has been met.
  - Item 7 was not completed. The assumptions for this case change the requirement of separately packaging and shipping TRU waste to processing TRU waste in the WTP.
- DSTs 241-AY-101, 241-AZ-101, and 241-AZ-102 exceed nine fill-mix-empty cycles (Assumption B3.3.3.13).
- The start of radioactive operations for the PT Facility are modeled starting January 2033 instead of October 2033, as stated in the assumptions. The early start of the PT Facility (9 months early) is not anticipated to impact the overall mission analysis.
- RPP-40149-VOL1 and RPP-40149-VOL2 (Assumptions B3.1.1.2 and B3.3.3.13) are followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2. The types of equipment installed were followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2, which do not require sluicing equipment for 241-AN-101 and 241-AN-106. Tanks 241-AN-101 and 241-AN-106 will require sluicing equipment to remove the deep sludge down to a level where mixer pumps can mobilize the waste. This is also incorporated in the cost and schedule for 241-AN-106 and 241-AN-101. In addition, the equipment installation dates for the DSTs are modified from those noted in Figure 3-2 of RPP-40149-VOL1.
- The time to treat all tank waste exceeds the 40-year design life of the WTP (Assumption B3.4.1.1).

- Some batches of feed delivered to the PT Facility do not meet all of the waste feed acceptance criteria (Assumption B3.4.1.12).
- The project cost estimation for the new DSTs is calculated on a per-farm basis instead of assuming DSTs are designed and built in two-pack increments (Assumption B4.3.4.2.9).

4.3.3.2 Single-Shell Tank Retrieval Results

The overall SST retrieval progress for this SP7 Case 3 is shown in Figure 4-28. The potential CH-TRU waste is retrieved into the DST system (as opposed to a supplemental TRU treatment facility) starting in 2022.

Figure 4-28. Case 3 Overall Single-Shell Tank Retrieval Progress.

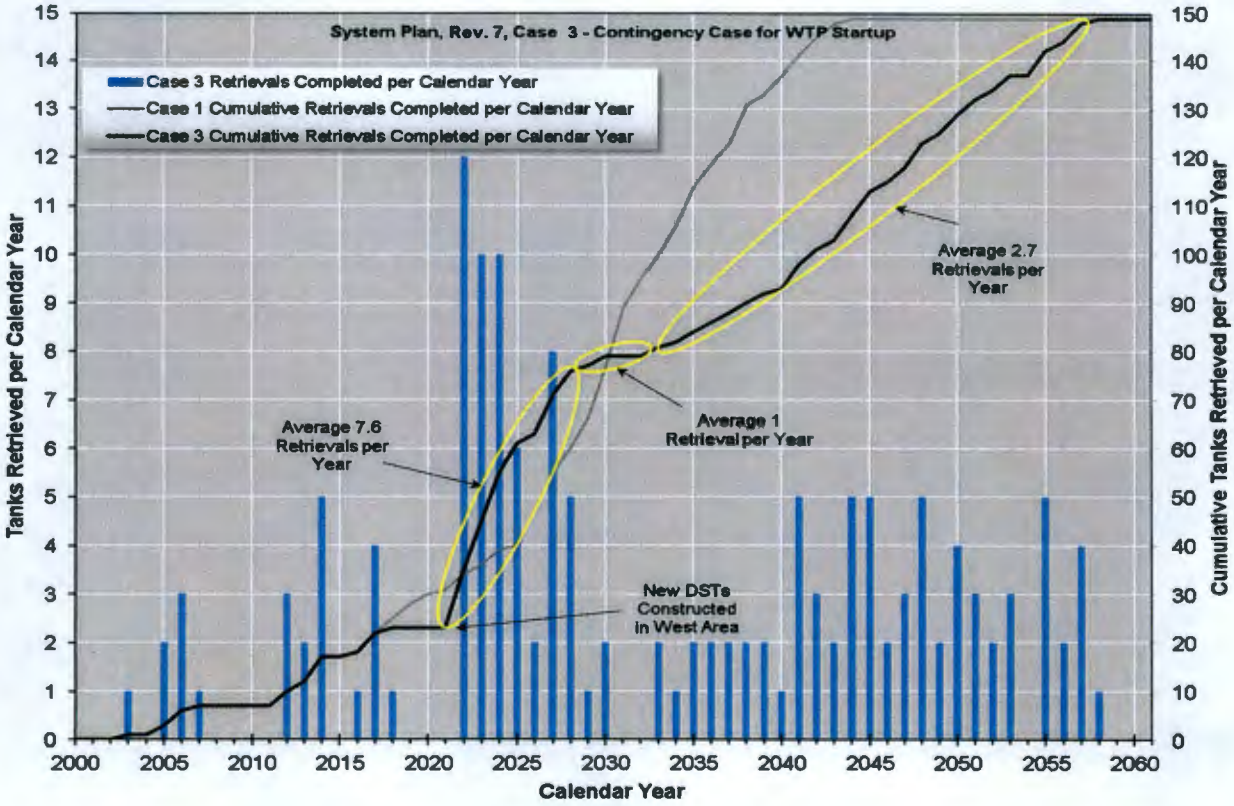


As with Case 2, the 241-AX Tank Farm tanks and two of the 241-A Tank Farm tanks are allowed to be retrieved prior to the start of DFHLW operations. In order to ensure DST space is available in the 200 East Area for washing HLW batches, preparing LAW batches, and maintaining DST space for secondary liquid returns from the WTP and the LAWPS, no other SSTs in the 200 East Area are allowed to be retrieved until after the PT Facility starts. Beginning in 2022 and continuing through 2028, there is a significant reduction in the SST waste volume, which is attributed to the construction of the new DSTs built to support the retrieval of T Complex tanks and 241-U Tank Farm tanks. There is a limited number of SSTs retrieved following the completion of T Complex and 241-U Tank Farm retrievals, from 2028 to 2033 caused by the limited amount of DST space that is needed in the 200 East Area to support DFLAW and DFHLW operations. No further retrievals can be completed in the 200 West Area

until space is available in the 200 East Area for cross-site transfers. More DST space becomes available in the 200 East Area as the PT Facility begins hot operations in 2033.

Figure 4-29 shows the number of retrievals that were completed, or projected to be completed, each calendar year for SP7 Case 3. Since Case 3 assumes that the potential CH-TRU waste is treated at the WTP, more SSTs are retrieved into the DST system in Case 3 (149 SSTs) than in Case 1 (138 SSTs). Ten or more retrievals are scheduled to be completed 2022 through 2024. These are all T Complex tank retrievals into the new DSTs. After 2033, the number of retrievals decreases as available DST space in the 200 East Area is restricted. Additionally, the size of the TWCSF tanks restricts the IHLW production rate. Thus, SST retrievals are restricted to the rate at which the HLW is transferred out of the DSTs to the TWCSF tanks.

Figure 4-29. Case 3 Single-Shell Tank Retrievals Completed Each Calendar Year.



The sequence and timing of each SST retrieval are shown on Figure 4-30. Figure 4-30 shows that the retrievals of the T Complex tanks and the 241-U Tank Farm tanks are completed in the minimum modeled duration because of the DST space availability in the new DSTs. Forty-two new DSTs are constructed in the 200 West Area. Although it was not explicitly modeled, it can be inferred that the construction and operation of a new evaporator in the 200 West Area would decrease the number of new DSTs needed to support the retrieval of the T Complex and the 241-U Tank Farm.

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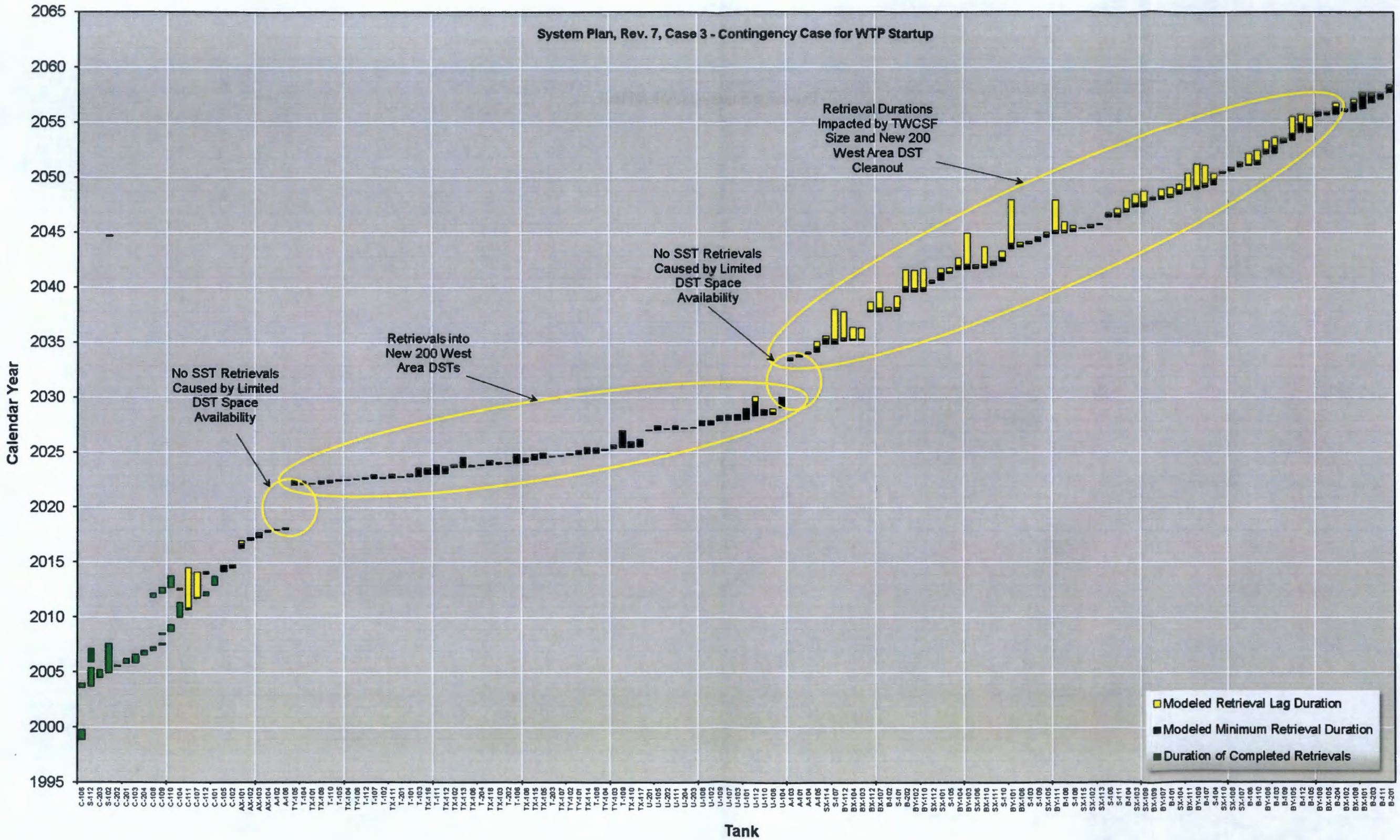
Figure 4-30. Case 3 Single-Shell Tank Retrieval Timing and Sequence.



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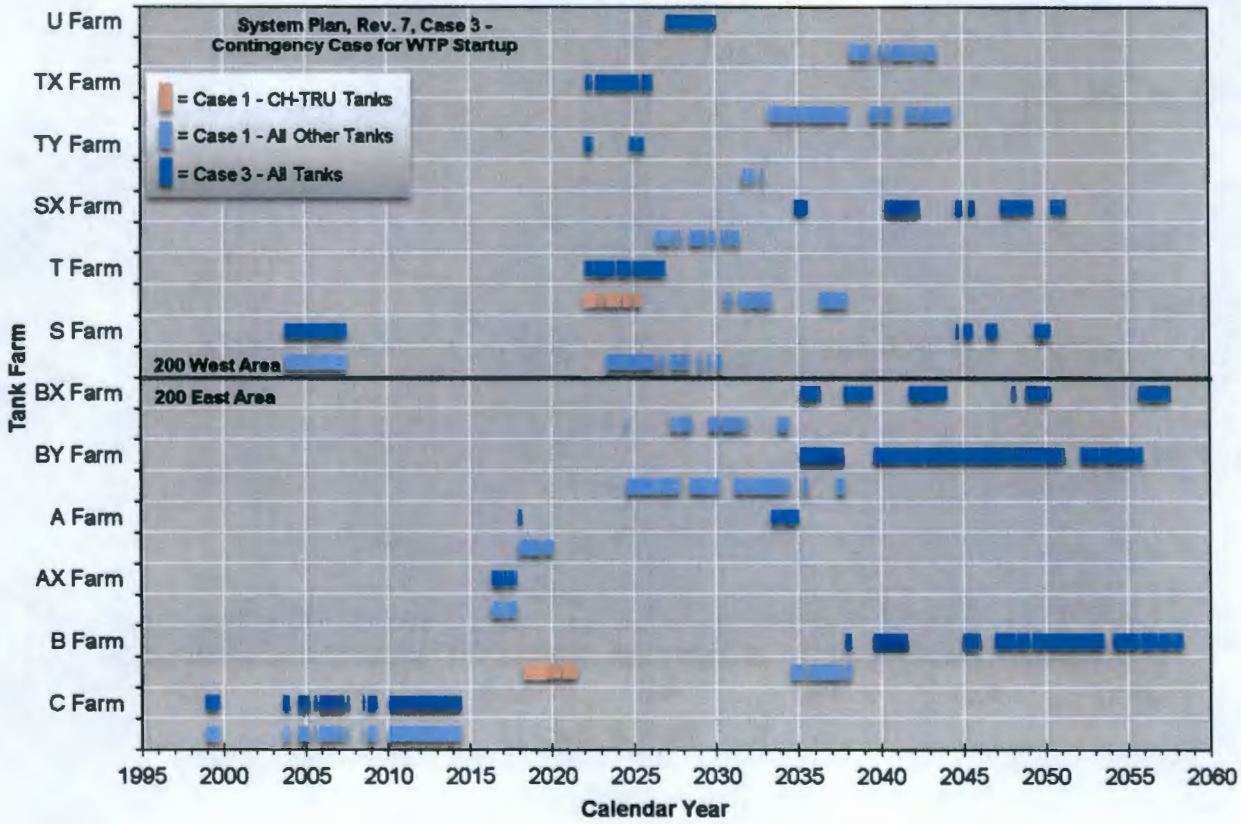
Once the PT Facility is operational in 2033, the model allows both DST mitigations and SST retrievals to occur in the 200 East Area. Figure 4-30 also indicates that between 2035 and 2055, the reduced-TWCSF tank size leads to a reduced IHLW production rate, and waste is not removed out of the DSTs at a rate that allows SST retrievals to progress at the minimum retrieval duration. During this time, delaying the start of the SST retrievals and/or delaying the cleanout of the new DSTs in the 200 West Area would avoid extended SST retrieval durations and avoid having the SST retrieval equipment sit idle.

In Case 3, the tanks containing potential CH-TRU waste in the T Complex and the B Complex are retrieved with the other T Complex and B Complex waste and are treated at the WTP (as opposed to Case 1). Figure 4-31 shows the general timing of the SST retrievals by tank farm.

Figure 4-31. Case 3 General Timing of Single-Shell Tank Retrievals by Tank Farm.



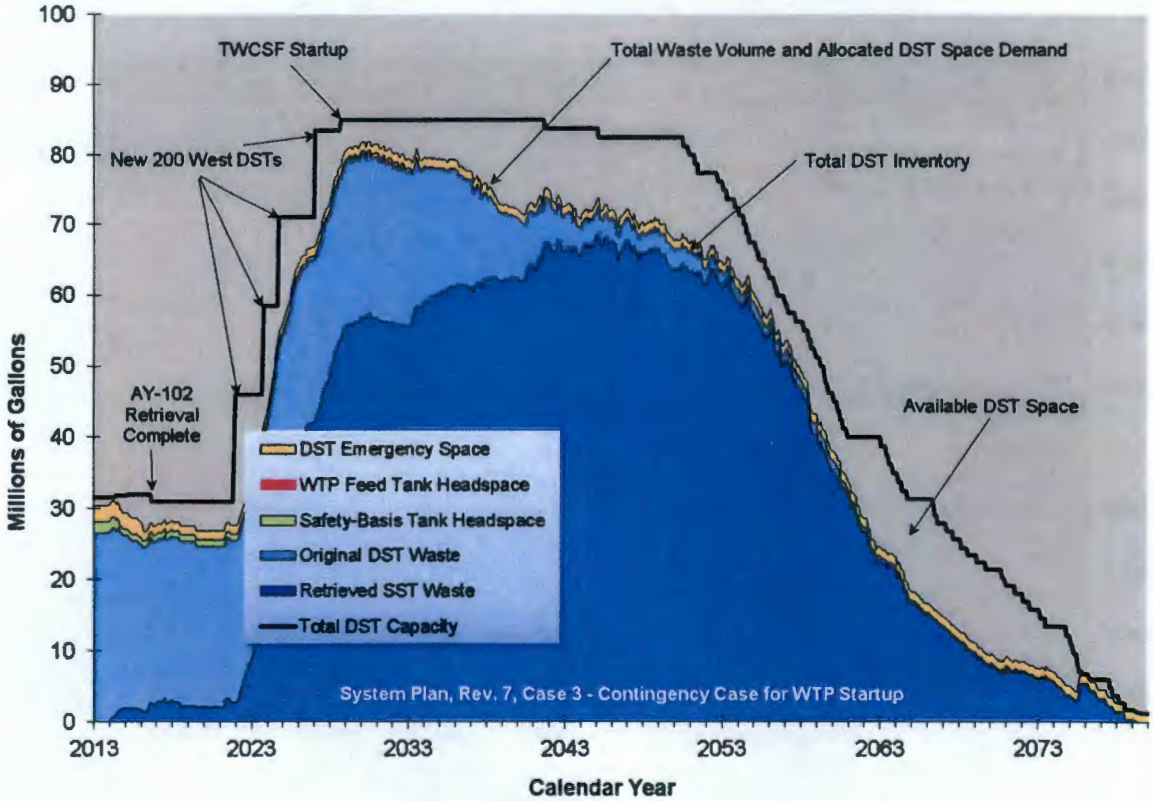
4.3.3.3 Double-Shell Tank Space and 242-A Evaporator Operation Results

Additional DSTs are constructed in the 200 West Area for Case 3 in order to accelerate the retrievals of SSTs in the T Complex and 241-U Tank Farm and to enable successful execution of the SST retrieval completion milestone.

Figure 4-32[35] shows the allocation of DST space, including the SST waste that is retrieved into the new DSTs starting in 2022. The new DSTs provides space to complete retrieval of T Complex and 241-U Tank Farm SSTs in 2030 because the retrievals occur independent of activities in the 200 East Area. Between 2040 and 2055, the model under-allocates the DST space for tanks 241-AP-102, 241-AP-104, and 241-AW-103. Better utilization of these tanks may have accelerated SST retrievals, but has no impact on WTP production.

Additional residual waste volume of 21,000 gal remains in the new DSTs upon the completion of the mission. This is much higher than the expected residual volume of 3,000 gal (WRF residual volume) and is the result of the additional DSTs in place of the 200 West Area WRF.

Figure 4-32. Case 3 Use of the Double-Shell Tanks.



The construction of the new DSTs also increases the number of DST-to-DST transfers that occur throughout the mission. Figure 4-33 shows the DST transfer demand and the cumulative DST transfers[36]. Case 3 predicts 4,235 transfers occur among the DSTs with an average of 7 transfers per year prior to the startup of the HLW Facility, which increases to 102 transfers per year after the startup of the PT Facility.

[35] Note that the DST emergency space from September 2013 to February 2016 when 241-AY-102 starts being retrieved is increased by 1,001,000 gallons.

[36] Cumulative DST transfers are defined as transfers from DSTs to DSTs (including cross-site), DSTs to WTP, from the WRFs to DSTs, from DSTs to LAWPS, from DSTs to TWCSF, and from TWCSF to WTP (via DFHLW or pretreatment), as applicable. Transfers to or from the 242-A Evaporator are not included, but are included in each 242-A Evaporator campaign.

Figure 4-33. Case 3 Projected Double-Shell Tank Transfer Demand.

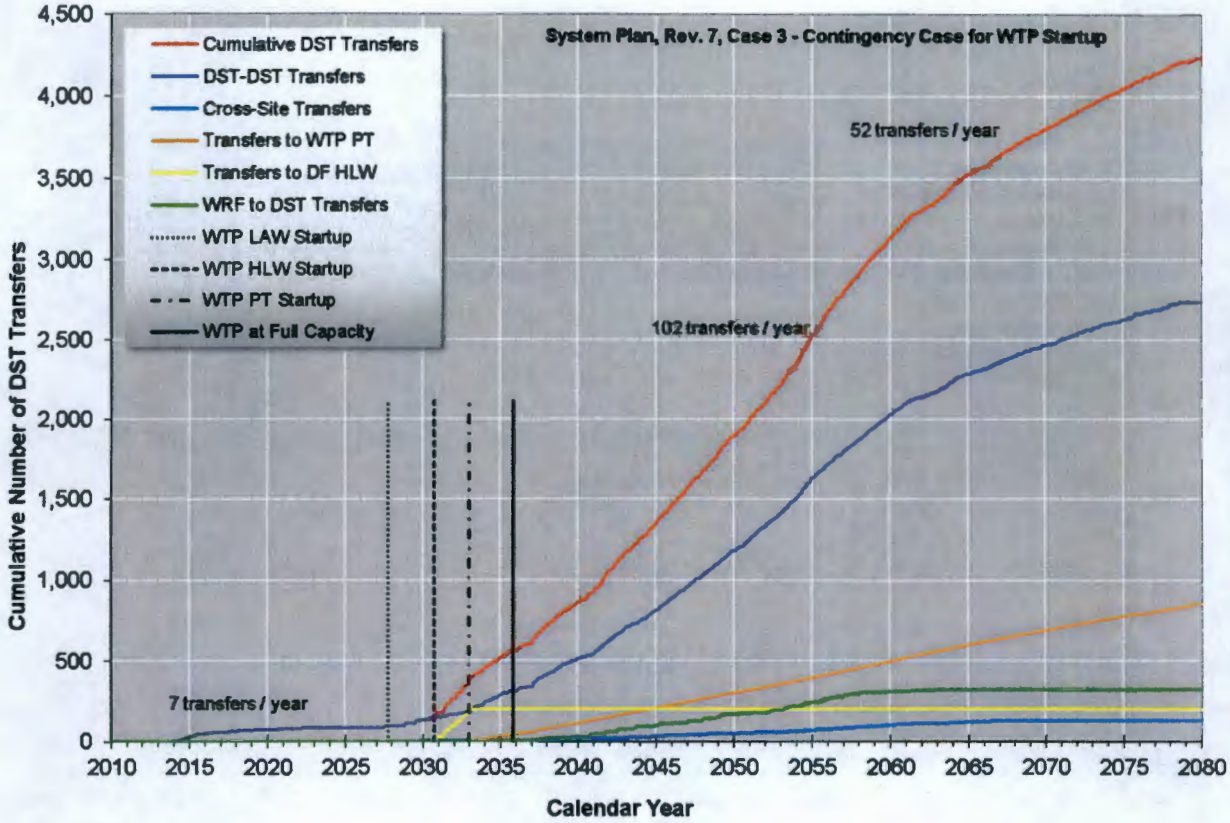
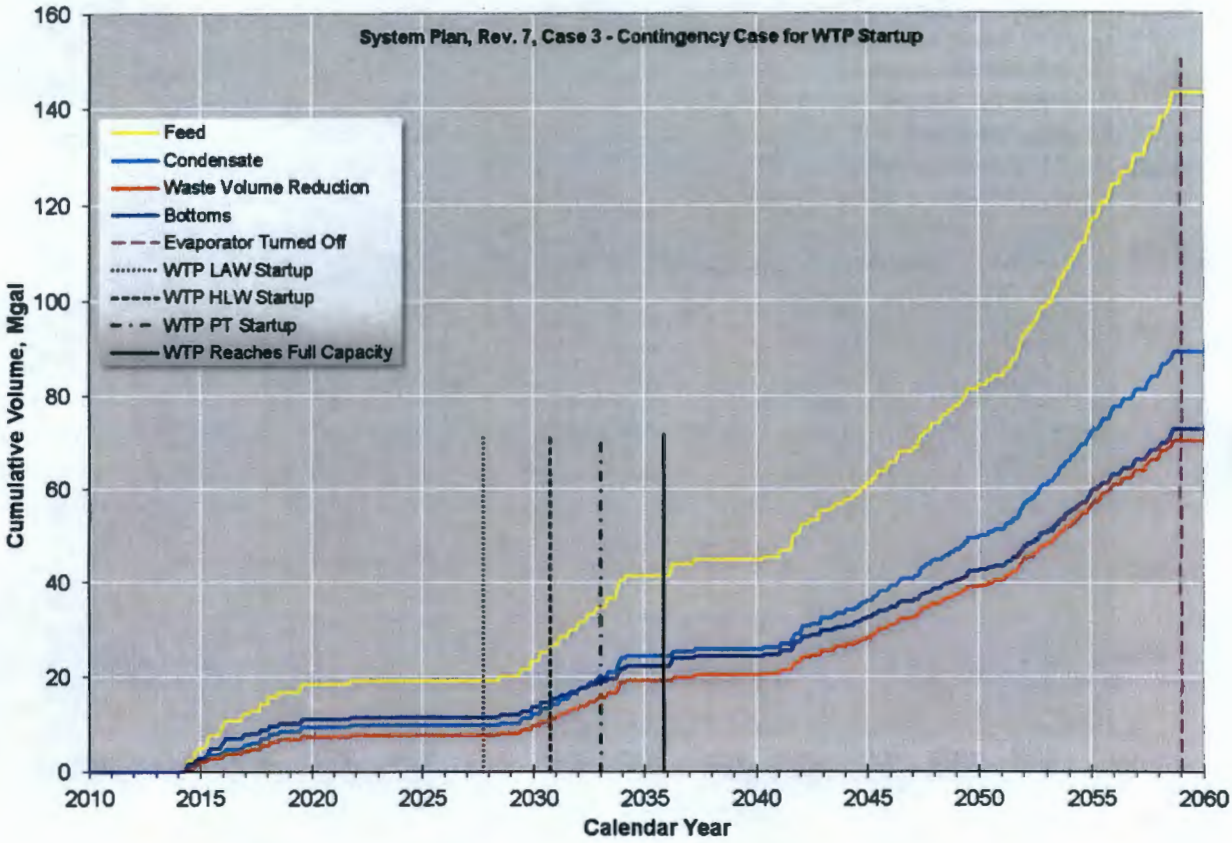


Figure 4-34 shows the waste volume reduction performed by the 242-A Evaporator over time, as well as the cumulative volume of evaporator feed, condensate, and bottoms. From 2019 to 2028, the 242-A Evaporator is almost inactive as a result of no cross-site transfers, SST retrievals, or DST mitigations occurring. Only one additional evaporator campaign occurs during this time in 2021.

Beginning in 2028, the 242-A Evaporator operates primarily to support returns from the WTP offgas system and LAWPS. The volume of waste transferred to the 242-A Evaporator is reduced following the start of the PT Facility in January 2033 as all the WTP offgas returns are sent through the PT Facility instead of being returned as dilute waste to the DST system, and activities within the DSTs do not produce significant dilute waste during this time. After the start of the PT Facility, the 242-A Evaporator concentrates waste from SST retrievals (from both the 200 East and 200 West Areas) and DST transfers. Throughout the mission, over 140 Mgal of waste is fed to the 242-A Evaporator and the waste volume stored in the DSTs is reduced to about 70 Mgal.

Figure 4-34. Case 3 Projected Operations of the 242-A Evaporator.



4.3.3.4 Glass Production Results

The addition of DFLAW and DFHLW to the RPP flowsheet offers several benefits:

- Glass production can begin in the HLW and LAW Facilities prior to resolution of the technical issues associated with the PT Facility.
- The WTP facilities can be started in a phased approach, requiring fewer resources at any given time.
- Personnel would be able to gain operating experience in the (comparatively) less complex LAW Facility before progressively moving on to the more complex HLW Facility, and then to the PT Facility.
- Addition of LAWPS and TWCSF creates backup pathways for waste treatment that can be used to keep the HLW and LAW Facilities running in the event of outages in the PT Facility.

The success of DFLAW and DFHLW operations depends on the LAWPS and TWCSF being able to adequately maintain feed to LAW and HLW Facilities to support the stated glass production rates. In Case 3, the TWCSF is defined as six 250,000-gal tanks, which is half the size of the TWCSF concept, used to support ORP's Framework document (DOE 2013).

During the direct feed period of the mission, the TWCSF, as sized in Case 3, is able to adequately feed the HLW Facility. The facility is in a ramp-up period, and also experiences

several delays caused by a lack of space in the DST system for receiving the effluent produced by the vitrification facilities. The delays are depicted as flat areas on the production line of Figure 4-35. The LAW Facility experiences the same effluent-related delays as the HLW Facility. These delays occur when the DST that receives the effluent becomes full and is unable to empty to the evaporator because the evaporator is already in use.

When the PT Facility starts, it handles all of the effluent generated by the vitrification facilities; thus, effluent related delays are alleviated. At the same time, the HLW and LAW Facilities reach their full production rates. Since the TWCSF is used to provide HLW feed for the entire mission, it is unable to sustain the full IHLW production rate, creating a bottleneck, which significantly extends the completion of waste treatment. Figure 4-35 shows the IHLW canister production over the mission, compared to the theoretical rates. As can be seen, IHLW canisters are produced at approximately half of the theoretical rates. Production of ILAW containers depends on the rate of IHLW production to an extent, thus ILAW production is also hindered by the bottleneck. Figure 4-36 shows the projected ILAW container production compared to the theoretical production rates.

Although DFLAW and DFHLW can offer benefits to the RPP flowsheet, it is important that the facilities be sized correctly. The TWCSF, as sized in Case 3, is too small to meet the feed requirements of WTP, thus the benefits of DFLAW and DFHLW are not realized.

Figure 4-35. Case 3 Projected Immobilized High-Level Waste Production.

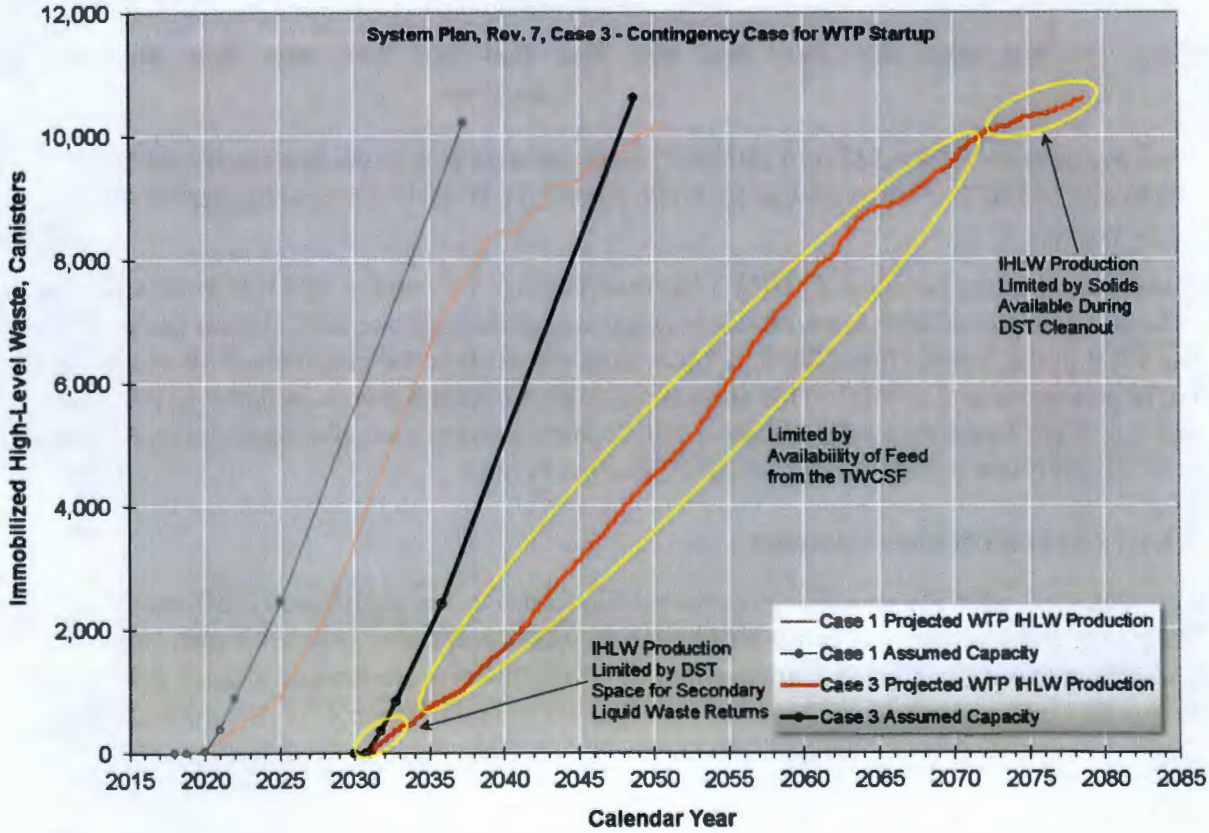
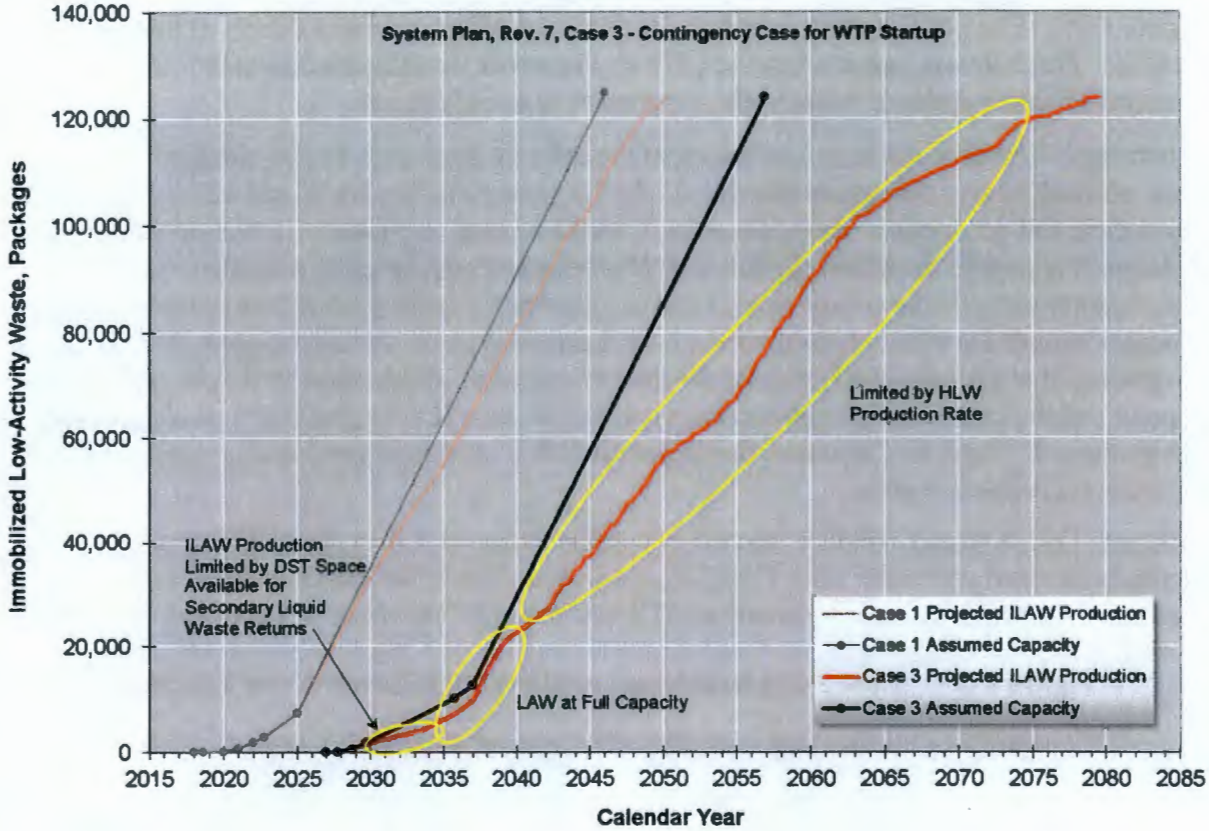


Figure 4-36. Case 3 Projected Immobilized Low-Activity Waste Production.



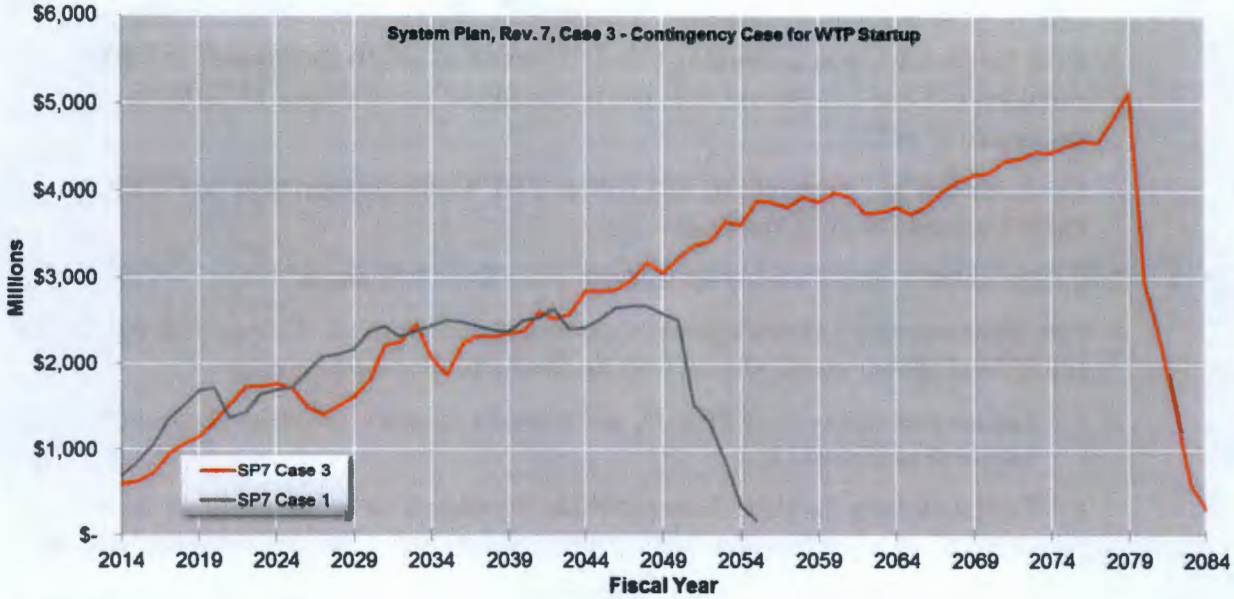
Case 3 produced 32,306 MTG of IHLW. The increase in IHLW production is caused by an additional 540 MT of waste oxides from the potential CH-TRU waste being sent through the HLW melters.

The retrieval of the potential CH-TRU waste with other T Complex and B Complex tanks results in large quantities of high bismuth waste being staged through the DST system and processed in the WTP in the 2060s. From 2059 to 2066, bismuth oxide is the glass driver for nearly all of the HLW processed in the WTP. This abundance of high bismuth waste, in both the DST system and the WTP, limits the opportunity for IHLW mass reduction via blending and leads to the production of low waste oxide loading HLW glass batches.

4.3.4 Cost and Schedule Impact

The projected schedule and lifecycle cost profile for Case 3 is significantly different from Case 1. The net schedule effect is a lifecycle mission duration of 29 years longer than Case 1. The lifecycle cost for Case 3 is approximately $118 billion more than the Case 3 ($206 billion versus $87 billion or about 137 percent). As can be seen on Figure 4-37, the majority of the increase occurs between 2052 and 2084. In addition, Case 3 meets the near-term funding targets noted in Appendix B for both FY 2014 and FY 2015. However, Case 3 exceeds the $61.5 billion lifecycle cost noted in Appendix B by approximately 234 percent.

Figure 4-37. Case 3 Lifecycle Cost Profile.



Assessing the cost profile graph (Figure 4-37) prior to FY 2019 indicates that Case 1 includes a ramp-up of capital projects that are required prior to the startup of WTP in May 2018. Case 3, instead, has staggered facility start dates which lead to a shift of capital project budgets in order to meet the facility need dates noted in Appendix B. For Case 3, the first capital cost expenditures of note are between FY 2022 and FY 2027 for LAWPS and TWCSF. The next large capital cost expenditure is for supplemental LAW from FY 2028 to FY 2034. During this time, the HLW Facility started operations which resulted in the increase in cost until the supplemental LAW Facility is completed, as seen on Figure 4-37.

Differences in Case 3 versus Case 1 are caused by the following high-level items:

- Early mission costs for Case 1 exceed those for Case 3 because:
  - Case 1 DST retrieval equipment costs start in FY 2014 with all equipment installed prior to the end of January 2030. Case 3 DST retrieval equipment costs start in FY 2015 with all equipment installed prior to August 2041.
  - WMA-C closure and 241-SX Tank Farm barrier costs are expended prior to 2019 in Case 1 versus extending to 2022 for Case 3.
  - Project costs for SLWT, upgrades to DST farms for HLW staging, and completion of a dedicated LAW transfer system for 241-AP Tank Farm are all expended prior to the end of May 2018 for Case 1. Case 3, on the other hand, extends the dates so they are completed prior to the facilities' need dates (LAW Facility, HLW Facility, or PT Facility, as applicable).
  - Infrastructure for immobilized waste and melter disposal is completed prior to the end of May 2018 for Case 1, yet is staggered to be finished based on applicable facility start dates for Case 3.
  - Expenses for transition to the WTP are all completed prior to the start of operations of the PT Facility and the LAW and HLW Facilities at the end of May 2018 in Case 1,

versus expenses spanning a 2-year duration prior to the startup of the LAW Facility and up to operations of the HLW Facility for Case 3.

  - Cost for packaging and shipping CH-TRU waste to WIPP (completed in FY 2024) is included in Case 1; however, it is not included in Case 3 since CH-TRU waste is processed at WTP.
  - Costs for full WTP operations of LAW and HLW vitrification start in FY 2019 for Case 1 versus FY 2031 for Case 3.

- Overall mission costs for Case 3 exceed those for Case 1 because:
  - Activities occurring later experience increased cost from escalation. This applies to the following four sub-items, as well as the items mentioned above:
    - Earlier processing in WTP for Case 1 results in costs for retrievals occurring earlier than in Case 3.
    - Retrieval costs for Case 3 exceed those for Case 1 since the retrieval duration for each retrieval was longer and many of the retrievals in Case 3 were executed later.
    - Case 3 shows 51 percent more cumulative DST transfers[37] and 8 percent more evaporator campaigns (128 vs. 119) than Case 1.
    - Facility start dates for Case 3 are later than in Case 1 (see Appendix B for the assumptions governing the facility start dates).
  - SST retrievals and accompanying tank farm closures are completed approximately 15 years later than in Case 1 resulting in a higher cost since the cost ramp-down of site infrastructure and personnel is related to the number of active tank farms and active facilities.
  - Capital and operating costs are included in Case 3 for LAWPS and TWCSF that are not included in Case 1 costs.
  - The processing time of HLW in Case 3 is extended resulting in a higher cost over time because the HLW Facility is unable to reach full production capacity as it is constrained by throughput restrictions in TWCSF.
  - The addition of four new tank farms (42 new tanks) in Case 3 results in a significant cost increase over Case 1 from FY 2014 to FY 2027. In addition, maintenance costs for each new tank continue until the DSTs are closed.

Although there is also a cost increase caused by processing the CH-TRU waste in the WTP in Case 3, it is difficult to quantify the net increase or decrease in cost over packaging CH-TRU as is included in Case 2 since the facility processing start dates vary between the cases. SP6 cases, with and without CH-TRU processing, have noted approximately 1 year of additional WTP

[37] It should be noted that for Cases 2 through 5, there is an inconsistency in how transfers are priced that originates at the TWCSF. Prior to operations of the PT Facility, transfers are assumed to be part of TWCSF operational costs. However, after the PT Facility starts operating, transfers from TWCSF to the PT Facility are priced as DST transfers.

processing time when directing CH-TRU to being processed through the WTP versus being packaged and shipped offsite.

4.3.5 Key Issues and Vulnerabilities

Key issues detailed in SP6, Section 7.0, and the corresponding issues identified in the three-volume IWFDP (RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3), along with the associated risks in the WRPS R&OMP (TFC-PLN-39), continue to be applicable in SP7. Case 3, as defined by the assumptions in Appendix B and presented in this section, include a number of risks and challenges that will need to be addressed for it to become a practical scenario. The following items highlight the key issues and vulnerabilities:

- Necessary facilities are assumed to be available on time to support operations. In addition, solid waste disposal issues are assumed to be resolved.
- There are two major causes for the increased mission duration in Case 3: Delayed start of waste treatment at the WTP and the reduced size of TWCSF as defined in the assumptions. These create a bottleneck in feeding the HLW Facility, extending the time required to retrieve and treat all tank waste.
- Another major issue affecting both direct feed operations as well as SST retrievals is the availability of DST space in the 200 East Area to support these operations. The loss of DST 241-AY-102 as a viable tank exacerbates this issue.
- The construction of new DSTs in the 200 West Area increases the cost in Case 3 and does not reduce the mission duration.
- Spent IX resin proposed for use in the LAWPS facility may not meet the IDF disposal criteria of LAW and does not currently have a disposal pathway identified (Assumption B4.3.3.1.6).
- Effluent being returned from the WTP to the tank farms during the direct feed period is assumed to meet all tank farm acceptance criteria and corrosion specification limits (Assumption B4.3.5.1.3). Since the flowsheet for this case does not include intermediate tanks to collect the effluent and verify/correct effluent chemistry, a method for doing this in-line must be developed or collection points must be established (e.g., WTP tanks).
- As modeled for Case 3, the time required to treat all tank waste exceeds the 40-year design life of the WTP (Assumption B3.4.1.1). Efficiencies such as those identified earlier can reduce the mission duration to within the 40-year design life. Alternatively, other initiatives could be pursued to increase the design life beyond 40 years.
- Screening of feed delivered to the PT Facility is performed per Assumption B3.4.1.12 and indicates that some batches do not meet all of the acceptance criteria, as modeled for Case 3. Additional analyses must be performed and strategies developed to allow as much flexibility in the acceptance criteria as possible, and to ensure that waste prepared for delivery meets all applicable criteria. It should be noted that DFLAW and DFHLW batches are screened per Assumption B4.3.4.3.1 and are found to be in compliance with the applicable criteria.
- As modeled, DSTs 241-AY-101, 241-AZ-101, and 241-AZ-102 exceed nine fill-mix-empty cycles (Assumption B3.3.3.13) caused by the washing of DFHLW feed

batches in the tank. DST 241-AY-101 performs approximately 17 fill-mix-empty cycles caused by the washing of DFHLW feed batches in the tank. Additionally, 241-AZ-101 performs approximately 10 fill-mix-empty cycles and 241-AZ-102 performs approximately 22 fill-mix-empty cycles, so they could not be used to reduce the load on 241-AY-101. However, the air-lift circulators in these tanks could be removed, alleviating the limit on fill-mix-empty cycles for the tanks in the 241-AY and 241-AZ Tank Farms. This would require an addition to the cost estimate for equipment removal.

4.3.6 U.S. Department of Energy Observations

Several key features and assumptions associated with Case 3 make this case challenging:

- Although the near-term cost profile targets are met, the mission extends well beyond the target date and results in a lifecycle cost that is about three times the target cost for the mission ($205.7 billion versus $61.5 billion).
- There are uncertainties associated with the volume, composition and disposition of DFLAW and DFHLW effluent. The disposition of this effluent during DFLAW and DFHLW operation may impact DST space, the timing of SST retrievals and the ability to continue delivering feed to the WTP; or may require alternative pathways to recycle or purge these streams.
- Estimated operating and capital costs associated with the WTP and supplemental LAW are expected to increase significantly from those assumed in Case 3.
- Assumed size of the vessels in the TWCSF was too small, creating a bottleneck in the feed qualification and delivery process which reduced the HLW glass production rate by approximately 50 percent, increasing the total mission duration and cost.

4.4 CASE 4 – LEAKING TANKS

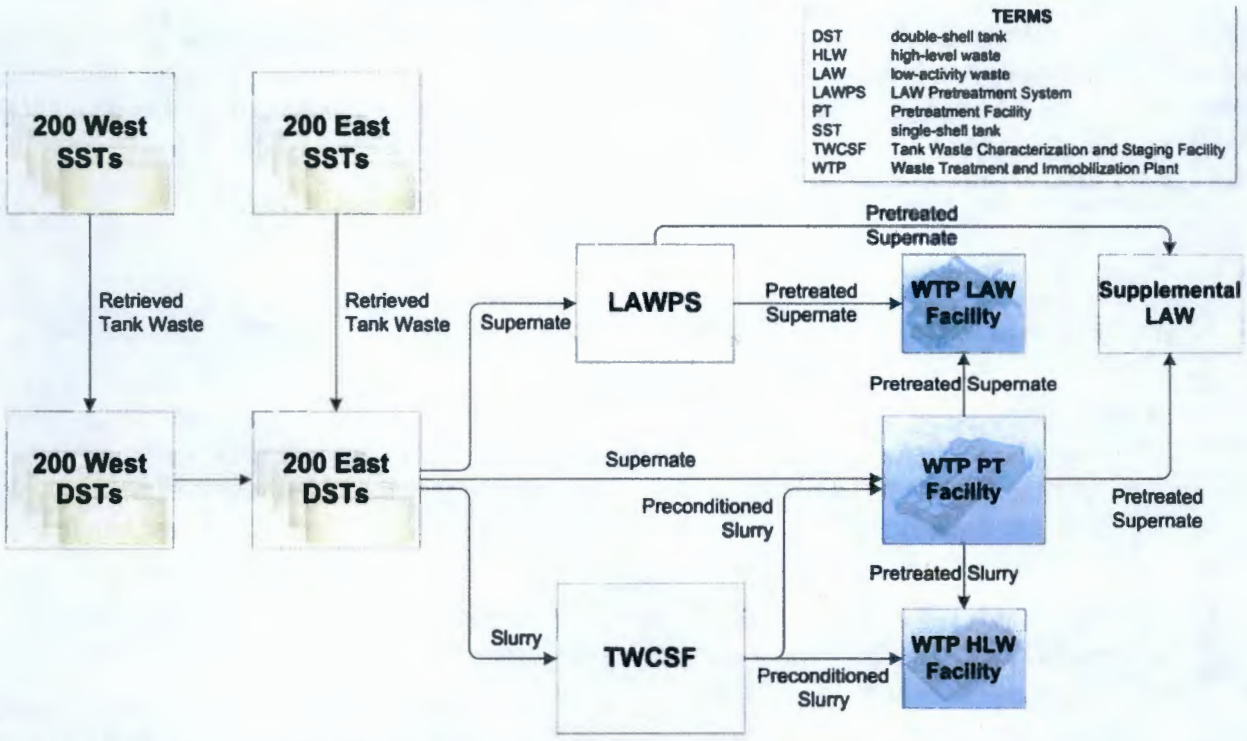
Selected and Defined by: Ecology

Purpose: Case 4 evaluates impacts on the RPP mission from emergent leaking SSTs and DSTs at a specified frequency, which requires immediate, unplanned activities.

4.4.1 System Description

The flowsheet used for Case 4 is basically the same as that used for Case 2 (Figure 4-38). Case 4 also includes DFHLW and DFLAW capabilities. Two new systems support these capabilities: LAWPS supports DFLAW and TWCSF supports DFHLW. They are described in Sections 4.4.1.1 and 4.4.1.2, respectively. Modifications to the WTP would be necessary (not included in the cost for Case 4) to accept waste directly from these facilities rather than through the PT Facility. Additionally, Case 4 processes all potential CH-TRU waste as HLW, eliminating the supplemental TRU treatment system, and treating the CH-TRU waste at WTP.

Figure 4-38. Case 4 Simplified Flowsheet.



4.4.1.1 Low-Activity Waste Pretreatment System

The concept of directly feeding waste to WTP vitrification facilities would allow some tank waste treatment to begin prior to resolution of the technical issues that are currently delaying progress on the PT Facility design and construction. In order to accomplish this, some pretreatment of the waste would be necessary in the tank farms. LAWPS is envisioned as a partial substitute for the PT Facility. It would encompass many of the same waste processing capabilities and would be sized to support feeding two LAW melters operating at 30 MTG/day at 70 percent TOE.

LAWPS is described in detail in Section 4.2.1.1. A diagram of the proposed LAWPS is shown on Figure 4-14.

4.4.1.2 Tank Waste Characterization and Staging Facility

The TWCSF predecisional concept, as modeled in this SP7 and shown on Figure 4-15, involves the provision of six[38] tanks in a vault configuration. The original concept uses 500,000-gal tanks, but these are reduced to 250,000-gal tanks in Case 4, per Ecology's request. Also included in the TWCSF are mixing capabilities, transfer capabilities, and sampling capabilities.

The TWCSF is described in detail in Section 4.2.1.2.

[38] Note that final selection on the number of tanks will be determined as requirements are further defined.

4.4.2 Planning Bases

ORP directed WRPS to model the five cases selected and defined by Ecology for this SP7 in accordance with key assumptions and success criteria also selected by Ecology. Planning bases for Case 4 are described in Appendix B, Section B4.4. Some planning bases were further refined for the Case 4 modeling:

- Prior to the start of modeling, Ecology decided not to adjust the RDFs (Assumption B4.4.4.1.2), resulting in all RDFs other than 241-C-102 and 241-C-105 being set at a value of 1.0.
- Retrieval of five of the next nine tanks was modeled as starting by December 2017 rather than December 2018 (Assumption B4.4.4.1.4).
- Prior to modeling, it was determined that the supplemental LAW facility start date of October 1, 2024 (Assumption B4.4.6.1), was impractical since it occurred prior to the start of the PT Facility (January 1, 2028). The actual start date used in modeling was adjusted to January 1, 2030, with a rate of 9.0 MTG/day. The facility was ramped up per Assumption B3.5.1.6 on April 1, 2031.
- As with Case 1, 241-C-102 and 241-C-105 retrieval durations and the 241-C-102 raw water estimate were adjusted to meet the 241-C Tank Farm retrieval Consent Decree milestone.
- Although not specifically noted in Appendix B, Section B4.0, case-specific assumptions regarding vitrification facility start dates and ramp rates (Assumptions B4.4.5.3.2 and B4.4.5.4.2) superseded base assumptions, therefore the hot commissioning activities outlined in Appendix B, Section B3.0 were not completed (Assumptions B3.4.1.4, B3.4.1.5, B3.4.1.6, B3.4.1.7, B3.4.3.2, and B3.4.4.3). As stated in the case-specific assumptions, hot commissioning was not modeled separately from the stated start dates and ramp rates.

4.4.3 Results

Table 4-7 shows the key mission metrics for SP7 Case 4 versus the results for Case 1.

Table 4-7. Case 4 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 4 – Leaking Tanks
Lifecycle Cost, FY 1997 to End of Mission[a]	$87.5B	**$178.9B**
Meets Near-Term Funding Targets through 2015	$1,526M	$1,170M
Meets Near-Term Funding Profile through 2015[b]	No	Yes
Complete 241-C Tank Farm Retrievals (B-1)[c]	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	November 2017	December 2017
Close WMA-C (M-045-83)	June 2019	November 2022
Complete Nine Additional SST Retrievals (B-4)	July 2019	May 2034

Table 4-7. Case 4 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 4 – Leaking Tanks
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)	February 2020	April 2034
Complete all SST Retrievals (M-045-70)	May 2044	January 2066
Close all SSTs (M-045-00)	December 2048	March 2070
Treat all Tank Waste (M-062-00)	August 2050	May 2075
Close all DSTs (M-042-00A)	August 2055	March 2080
Complete Potential TRU Tank Waste Packaging	July 2025	N/A
HLW Glass Mass (MTG)	30,845	32,586
HLW Glass Canisters	10,214	10,791
HLW Glass WOL	35%	37%
LAW Glass Mass (MTG)	687,187	656,419
LAW Glass Containers	124,753	119,169
LAW Glass Sodium Oxide Loading	16%	16%
Sodium Reporting to LAW Glass (MT)	79,056	78,243
Potential TRU Tank Waste Drums	8,285	N/A

Notes:

BOLD RED text indicates a figure or date that does not meet the success criteria.

All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.

Lifecycle costs for Cases 1 through 5 were developed using the Tank Operations Contract cost model. Lifecycle cost figures are used in the System Plan for comparative purposes only, and do not reflect the currently approved PMB.

SP7, Lifecycle Cost Model is based on PMB output from FY 2014.

[a] Lifecycle cost success criteria applies to Cases 1 through 4 and the SP6 Baseline Case.

[b] Near-term funding targets for Cases 1 through 4 and the SP6 Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million. Total FY 2014 through FY 2015 = $1,320 million.

[c] The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7 Assumption B4.1.1.2.

DST	double-shell tank	N/A	not applicable	TRU	transuranic
FY	fiscal year	PMB	Performance Measurement Baseline	WMA-C	C Farm Waste Management Area
HLW	high-level waste			WOL	waste oxide loading
LAW	low-activity waste	SP6	System Plan, Rev. 6		
MT	metric ton	SP7	System Plan, Rev. 7		
MTG	metric tons of glass	SST	single-shell tank		

4.4.3.1 Assessment of Case 4 Results Versus Planning Bases and Assumptions

During analysis of the results of Case 4 modeling, it was determined that some of the assumptions, as written in Appendix B, were not met. The following deviations were identified:

- Retrievals of SSTs 241-C-102 and 241-C-105 do not meet the minimum retrieval durations (Assumption B3.3.3.4). These retrieval durations were shortened and the raw water volume usage was reduced to meet the 241-C Tank Farm retrieval Consent Decree milestone, as was done in the modeling for Case 1.

- Feed control list actions in HNF-SD-WM-OCD-015 (Assumption B3.3.2.7) are followed except for items 2 and 5:
  - Item 2 was replaced with the transfer of the HLW from 241-AY-102 to 241-AW-105, 241-AY-101, and 241-AZ-102. Tank 241-AZ-101 was used as the new HLW hot commissioning feed tank. Feed will have to be requalified to ensure it meets the WTP WAC.
  - Item 5 defines blending of 241-AZ-101 waste with waste from Tanks 241-AW-103, 241-AN-106, and 241-AP-103 resulting in an HGR below the limit. This specific blending was not performed; instead the near-term transfers modeled for Case 4 resulted in a reduced radiolytic heat load for 241-AZ-101. HLW feed batches are all within the HGR limits, thus the intent of this feed control item has been met.
- The 2-month pause in TWCSF functions prior to the startup of the PT Facility (Assumption B4.4.3.2.3) was not modeled. DFHLW continued to operate until the PT Facility was online. It was determined that the impact of not modeling the 2-month pause does not affect the overall modeling results, since HLW vitrification is limited by availability of feed.
- Four of 797 HLW batches fed to the PT Facility from the TWCSF exceeded 10 wt% solids (Assumption B4.4.3.2.3). This is not expected to affect the overall modeling results because the average of the 797 batches is approximately 8 wt%.
- Tank 241-T-111 retrieval was not completed by December 31, 2022 (Assumption B4.4.4.1.5), because of the lack of available DST storage space.
- New *leaking DSTs* were to be completely emptied within 24 months of the leak confirmation. Tank 241-AN-103 took 25 months to completely empty.
- Assumption B3.3.3.3 states that the SSTs in the 241-A and 241-AX Tank Farms will be retrieved as the *next nine* SSTs after 241-C Tank Farm. In the modeling, 241-AX Tank Farm and one SST from 241-A Tank Farm were completed after 241-C Tank Farm. The remaining four SSTs in 241-A Tank Farm were delayed to reserve space for DFLAW startup, specific tanks identified in Assumptions B4.4.4.1.5 and B4.4.4.1.6, and potential leaking tanks. Thus, the remaining tanks in 241-A Tank Farm were retrieved after 2030.
- RPP-40149-VOL1 and RPP-40149-VOL2 (Assumptions B3.1.1.2 and B3.3.3.13) were followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2. The types of equipment installed were followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2, which do not require sluicing equipment for 241-AN-101 and 241-AN-106. Tanks 241-AN-101 and 241-AN-106 will require sluicing equipment to remove the deep sludge down to a level where mixer pumps can mobilize the waste. This is also incorporated in the cost and schedule for 241-AN-106 and 241-AN-101. In addition, the equipment installation dates for the DSTs were modified from those noted in Figure 3-2 of RPP-40149-VOL1.
- The total mission lifecycle cost goal of $61.5 billion was exceeded (Assumption B4.4.1.3).
- As modeled for Case 4, the time required to treat all tank waste exceeds the 40-year design life of the WTP (Assumption B3.4.1.1).

- Screening of feed delivered to the PT Facility was performed per Assumption B3.4.1.12 and indicated that some batches do not meet all of the acceptance criteria, as modeled for Case 4. Additional analyses must be performed and strategies developed to allow as much flexibility in the acceptance criteria as possible, and to ensure that waste prepared for delivery meets all applicable criteria. It should be noted that DFLAW and DFHLW batches were screened per Assumption B4.4.4.3.1 and found to be in compliance with the applicable criteria.
- As modeled, DSTs 241-AZ-101 and 241-AZ-102 exceed nine fill-mix-empty cycles (Assumption B3.3.3.13). Approximately 17 cycles were performed in each tank, which may exceed the amount of fatigue allowed. A newer HLW hot commissioning tank would need to be selected, or a fatigue analysis performed to show that the nine-cycle limit can be safely extended in the 241-AZ Tank Farm.

4.4.3.2 Single-Shell Tank Retrieval Results

The SSTs are projected to be retrieved by September 2065 with 241-C Tank Farm retrievals being completed in September 2014 and the next nine tanks (including Tank 241-A-103 for this case) being completed by April 2034. The overall SST retrieval progress (by volume of SST waste) for Case 4 is shown on Figure 4-39.

During the projected time period from 2018 through 2033, less than 1 Mgal of SST waste is retrieved from the SSTs because the available DST space is limited primarily by effluent returns from the WTP offgas system and the LAWPS, as well as DST mitigation once the PT Facility starts operations.

Figure 4-39. Case 4 Overall Single-Shell Tank Retrieval Progress.

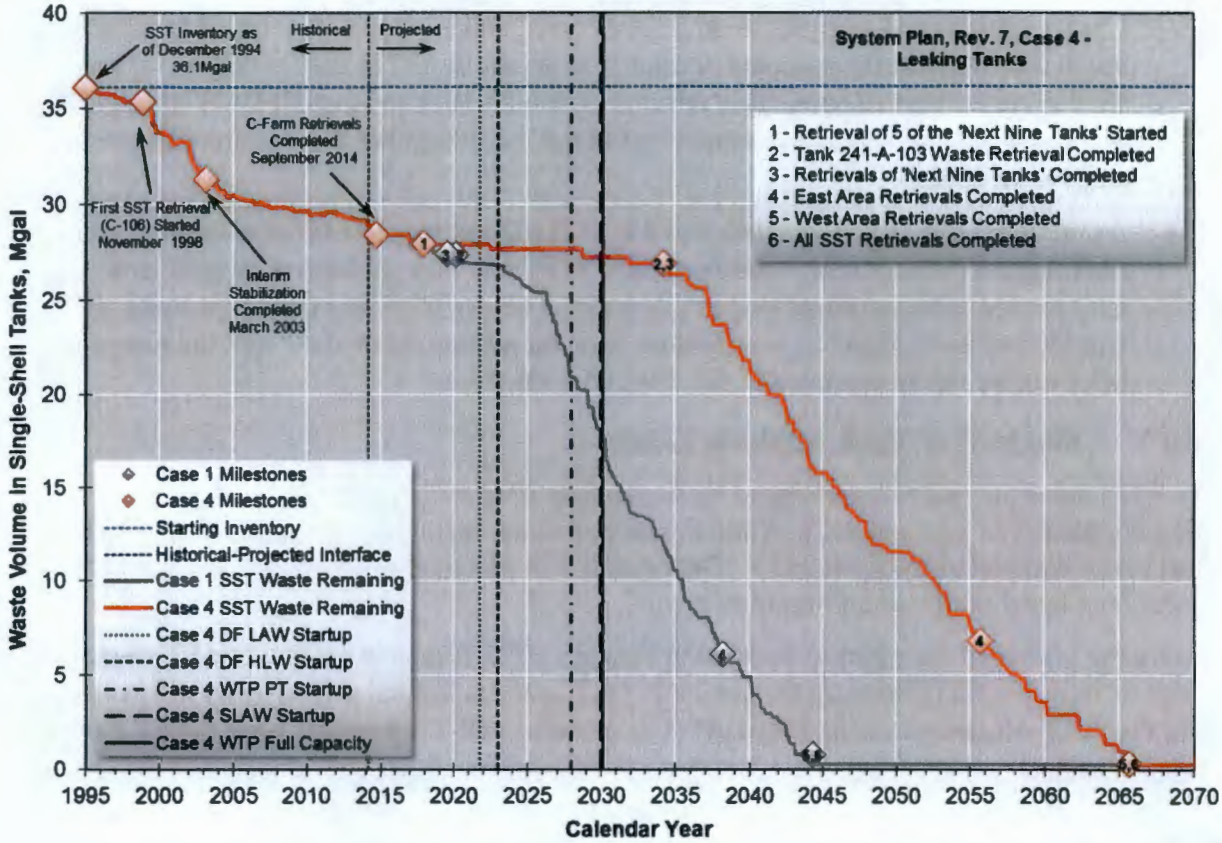
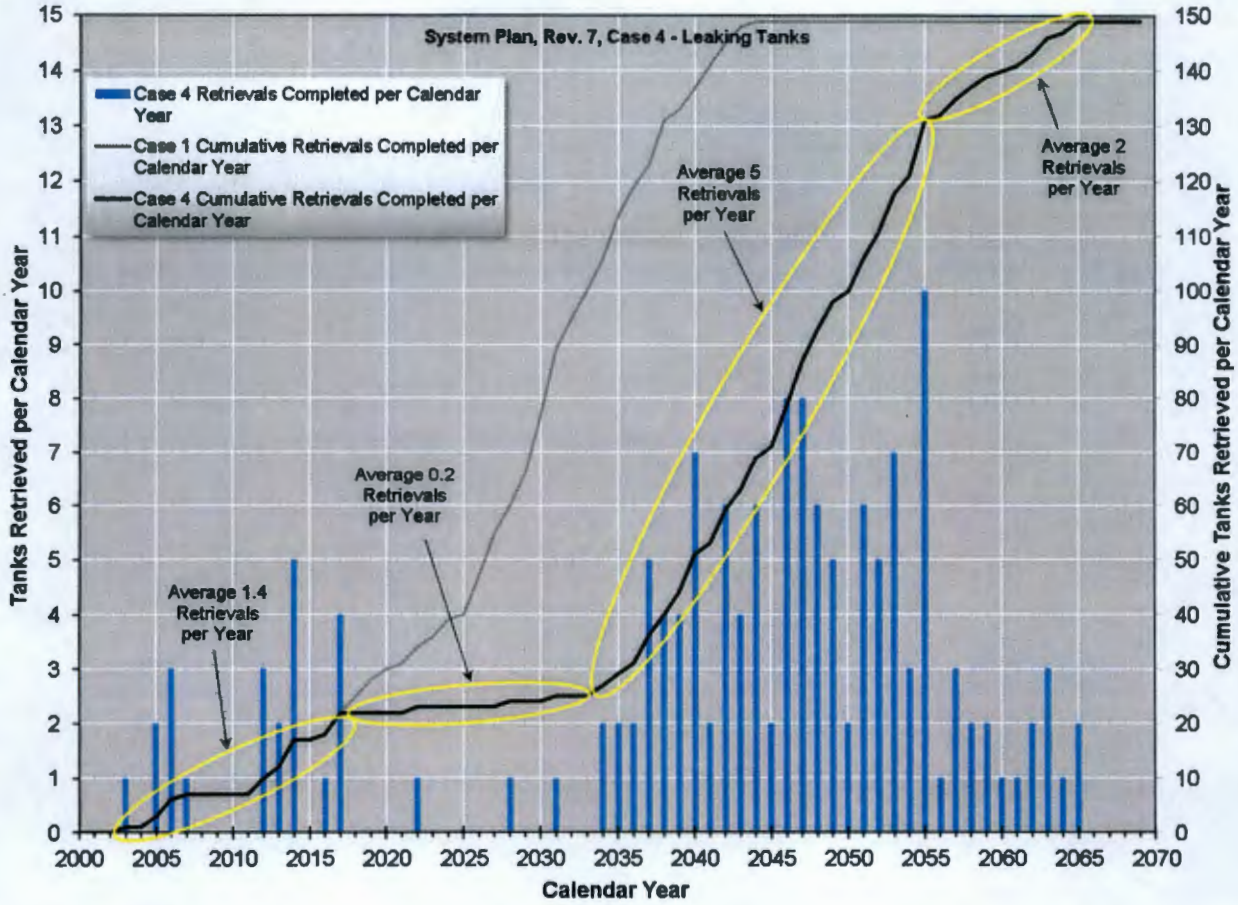


Figure 4-40 shows the number of retrievals that were completed or are projected to be completed during each calendar year. From 2018 through 2033, the average retrievals completed per year is 0.2. After all treatment facilities are running at their full capacity, the average number of retrievals completed increases significantly to five retrievals per year between 2034 and 2055. For the remainder of the SST retrievals mission (2056 to 2066), the average retrievals per year is reduced to two as 200-East-Area retrievals are complete and only 200-West-Area retrievals remain. The model restricts the number of retrievals per area at any time to four per the 200 East Area and two per the 200 West Area, so that when retrievals in the 200 East Area are complete, the number of retrievals per year is reduced significantly.

Figure 4-40. Case 4 Single-Shell Tank Retrievals Completed per Calendar Year.



The sequence and timing of all SST retrievals is shown on Figure 4-41. As can be seen on Figure 4-41, the number of active retrievals during the period from 2018 through 2034 is very low. This is caused by limited DST space. A slight decrease in the retrieval pace also occurs in 2055 through the end of the mission as only retrievals in the 200 West Area remain.

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Figure 4-41. Case 4 Single-Shell Tank Retrieval Timing and Sequence.

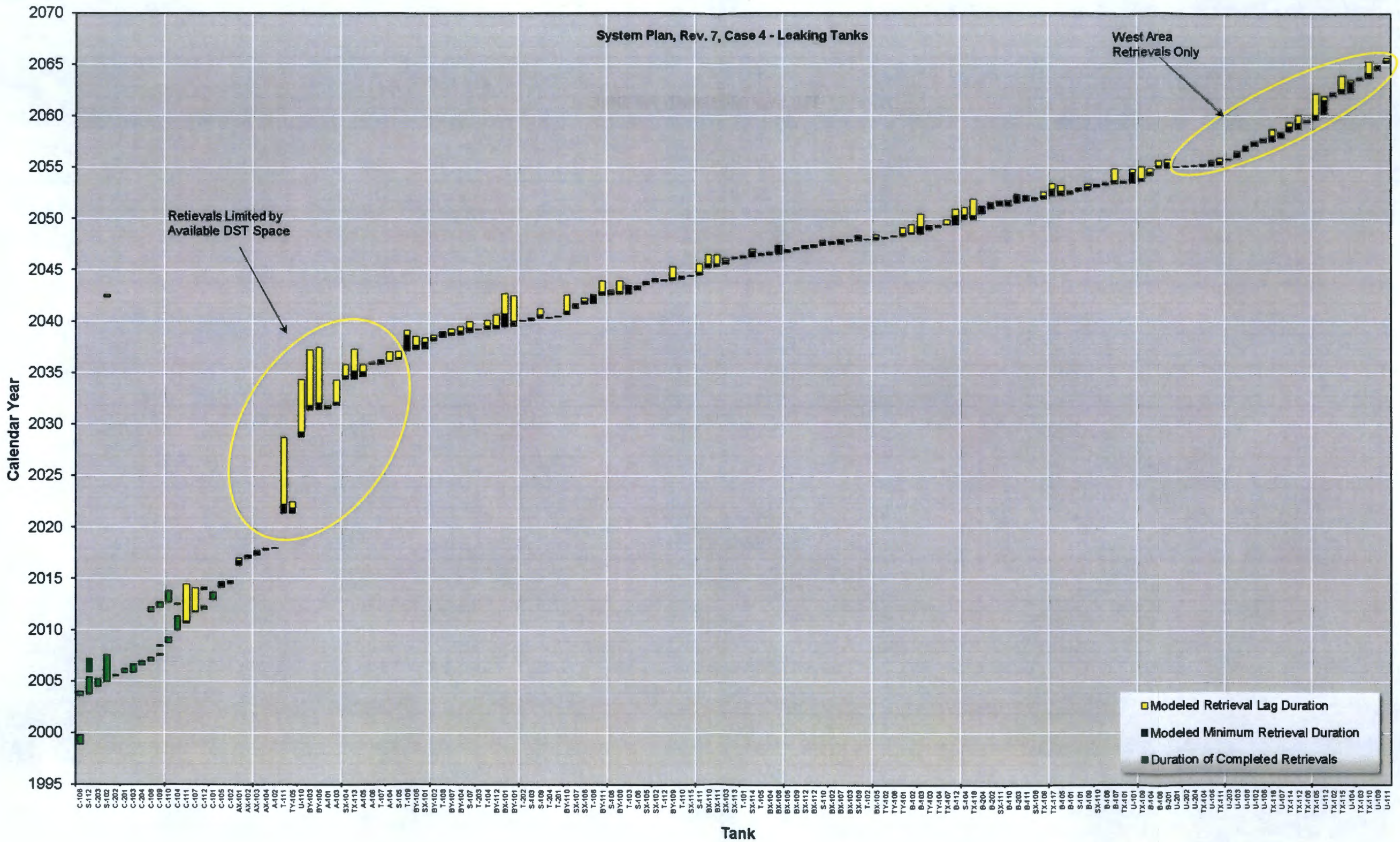

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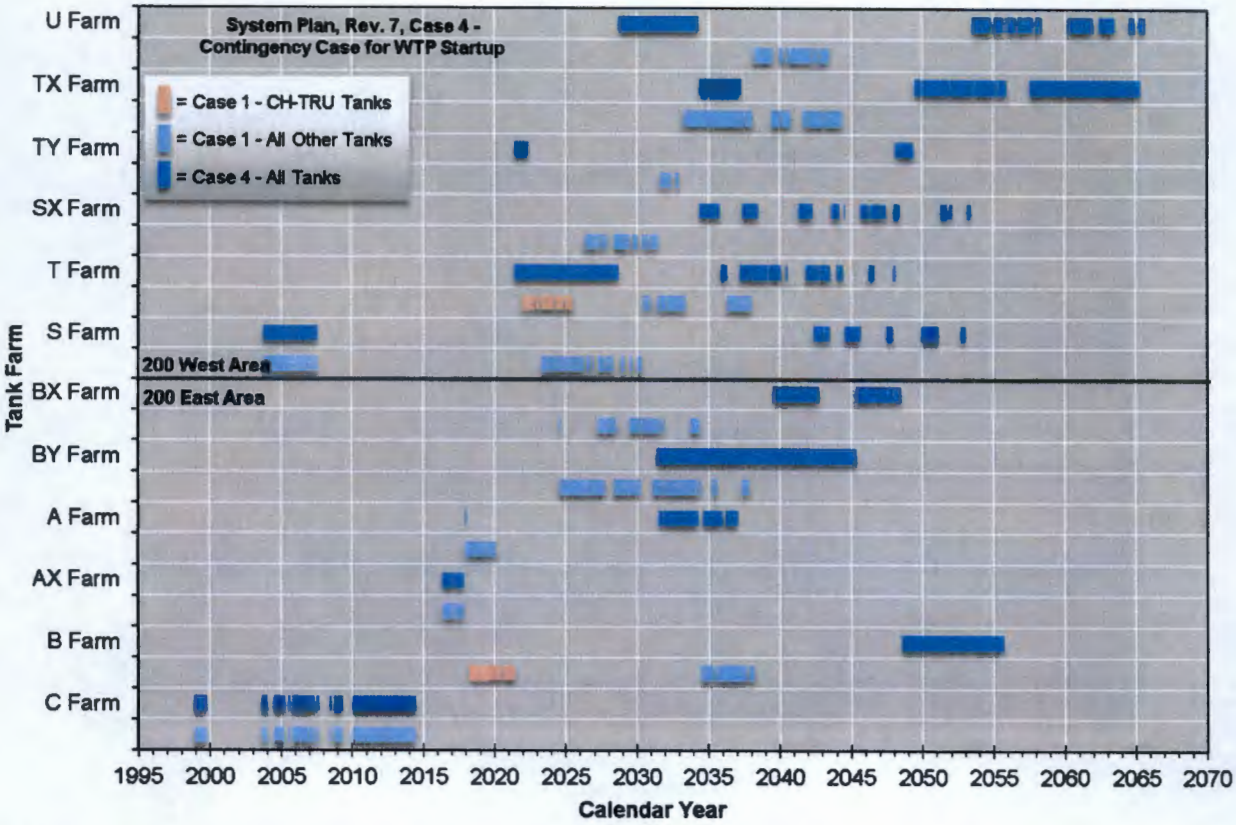
Figure 4-42 shows the general timing of retrievals by tank farm and shows that there is very little SST retrieval activity between 2018 and 2034.

Figure 4-42. Case 4 General Timing of Single-Shell Tank Retrievals by Tank Farm.



4.4.3.3 Double-Shell Tank Space and 242-A Evaporator Operation Results

The allocation of DST space during the waste treatment mission is shown on Figure 4-43.[39] In 2014 the available DST space drops to less than 0.7 Mgal and then increases to 5 Mgal in 2016 as evaporator campaigns are able to free up DST space.

Starting in 2016, certain DSTs are assumed to become leakers, in addition to 241-AY-102, and priority is given to emptying these tanks. Despite these DST losses, evaporator campaigns maintain the available DST space at around 3 Mgal.

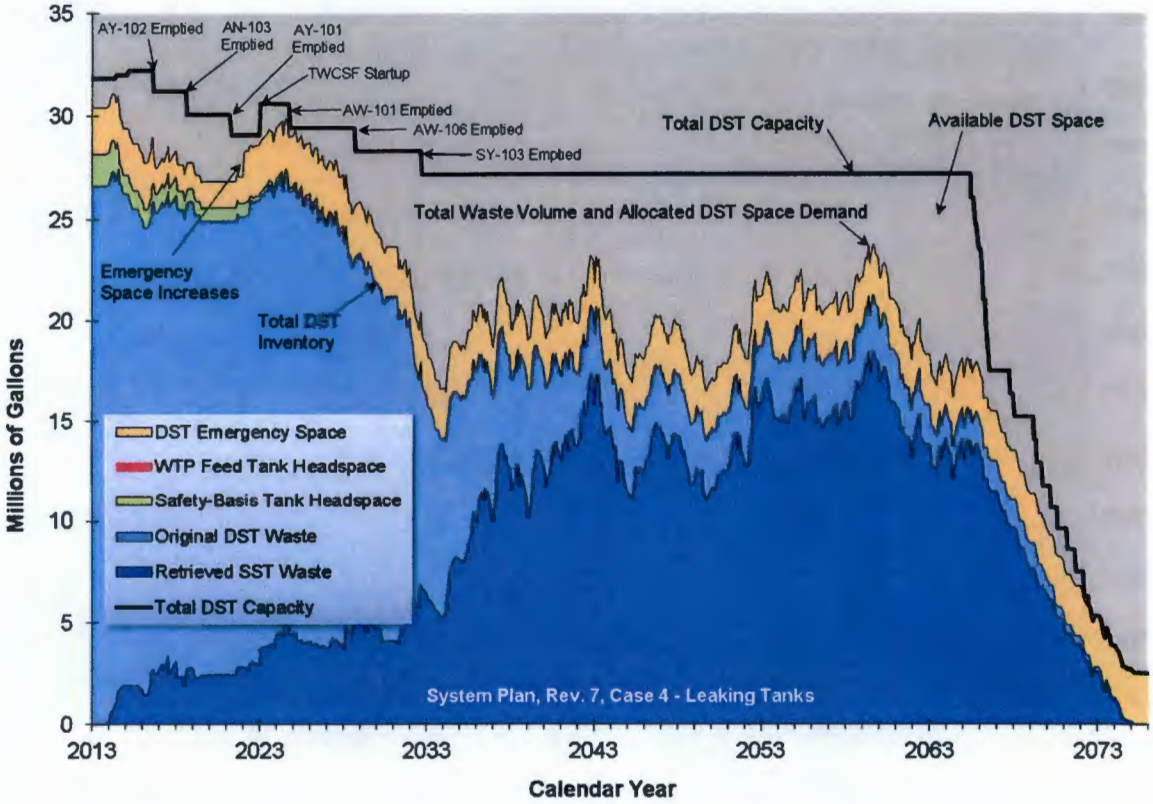
In 2022, the emergency DST storage space is increased from 1.265 to 2.465 Mgal in order to provide emergency space for additional DST leaks. This effectively reduces the available DST storage space by 1.2 Mgal and drops the available DST space to less than 1 Mgal. By March 2025, available DST space is down to less than 0.2 Mgal.

Between 2014 and 2022, the bulk of the available DST space is either distributed among multiple tanks and not readily available, or tied up in various waste mitigation procedures. Very little

[39] Note that the DST emergency space from September 2013 to February 2016 when 241-AY-102 starts being retrieved is increased by 1,001,000 gallons.

space exists in which SST retrievals could be collected without a complicated series of waste transfers. Therefore significant progress on SST retrievals cannot be made.

Figure 4-43. Case 4 Use of Double-Shell Tanks.



Significant DST space recovery begins in the mid-2020s. The startup of the WTP facilities provide the first opportunity to remove stored waste from the DST system, beginning with the LAW Facility in 2022, followed by the HLW Facility in 2025, and the PT Facility in 2028. In addition, a series of evaporator campaigns from 2023 to 2028 free up 14 Mgal of DST space. Parallel operation of the WTP and the 242-A Evaporator results in an average available DST space of more than 7 Mgal, which allow SST retrievals to begin in earnest. For the next approximate 40 years, DST space ranges from 4 to 10 Mgal per year.

Figure 4-44 shows the annual and cumulative DST transfers[40] for Case 4. Case 4 predicts that 4,228 transfers occur among the DSTs with an average of 11 transfers per year prior to the startup of the HLW Facility, increasing to 89 transfers per year after the startup of the HLW Facility, and dropping to 62 transfers per year near the end of the mission.

Use of the 242-A Evaporator to make more available space in the DST system is extremely important for Case 4. The projected demand on the evaporator is shown on Figure 4-45. From

[40] Cumulative DST transfers are defined as transfers from DSTs to DSTs (including cross-site), DSTs to WTP, from WRFs to DSTs, from DSTs to LAWPS, from DSTs to TWCSF, and from TWCSF to WTP (via DFHLW or pretreatment), as applicable. Transfers to or from the 242-A Evaporator are not included, but are included in each 242-A Evaporator campaign.

FY 2014 to the end of the mission, Case 4 is projected to have 79 evaporator campaigns. This correlates to more than 96 Mgal of waste, reducing the stored volume by 46 Mgal over the mission duration.

Figure 4-44. Case 4 Projected Double-Shell Tank Transfer Demand.

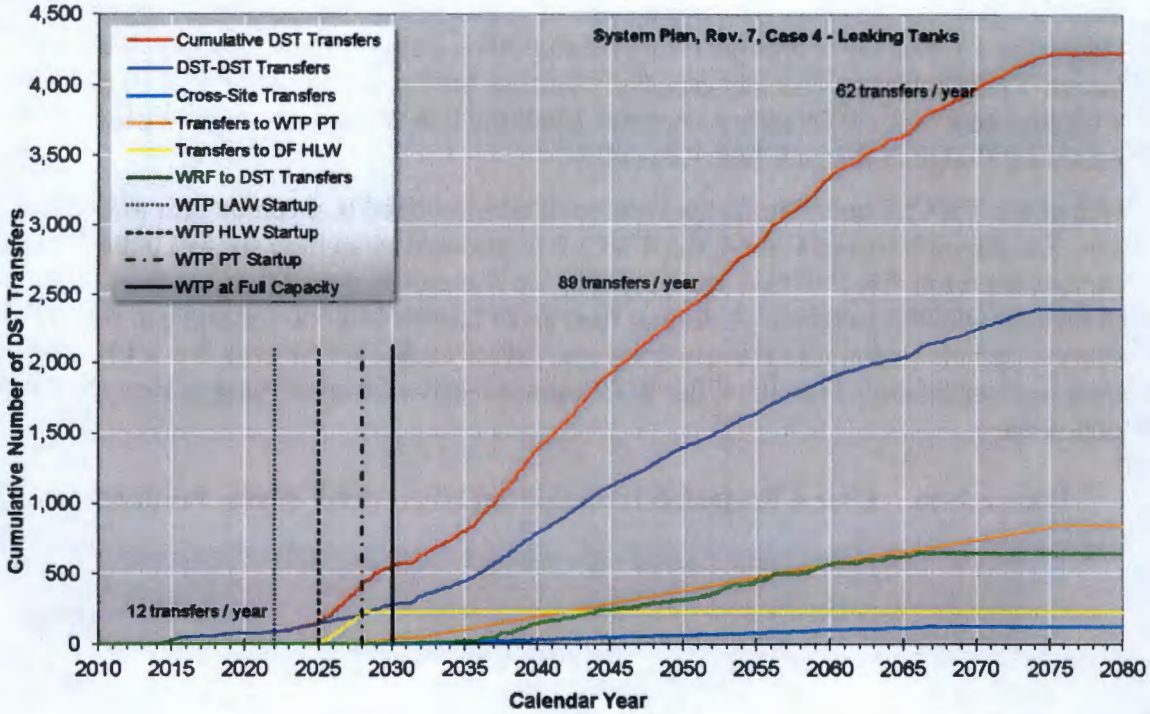
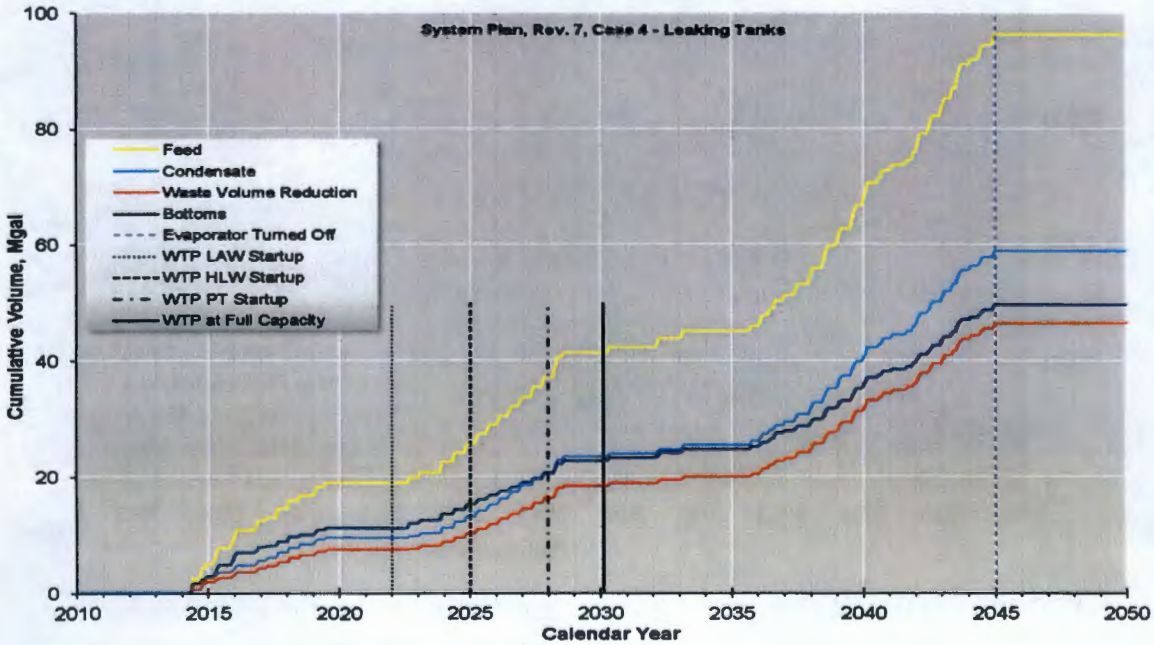


Figure 4-45. Case 4 Projected Operations of the 242-A Evaporator.



4.4.3.4 Glass Production Results

Figure 4-46 shows the Case 4 IHLW glass production compared to the assumed net capacity, as well as the Case 1 glass production. The HLW Facility in Case 4 produces 10,791 IHLW canisters within a 50-year mission life. From 2025 to 2028, IHLW production is limited by the tank farm's capability to accept returned secondary liquid waste. This problem is alleviated in 2028 when the PT Facility is brought online. After 2028, IHLW production is limited by the undersized TWCSF tanks. This can especially be seen between 2030 to 2032 as there are no HLW batches sent to the PT Facility. Around 2065, the IHLW production rate falls further as the remaining sludge in the tank farms dwindles.

The size of the TWCSF tanks limits the volume of certified feed that can be sent to the PT Facility. For the purposes of Case 4, the TWCSF is assumed to include six 250,000-gal tanks. At this size, each full TWCSF tank can only provide two certified feed batches consisting of approximately 106,000 gal each. A normal feed batch targets 140,000 gal and can sustain HLW vitrification operations for approximately a week. Since each TWCSF tank has a 190-day sampling and certification wait time, the WTP cannot receive adequate feed to sustain the target production rates.

Figure 4-46. Case 4 Projected Immobilized High-Level Waste Production.

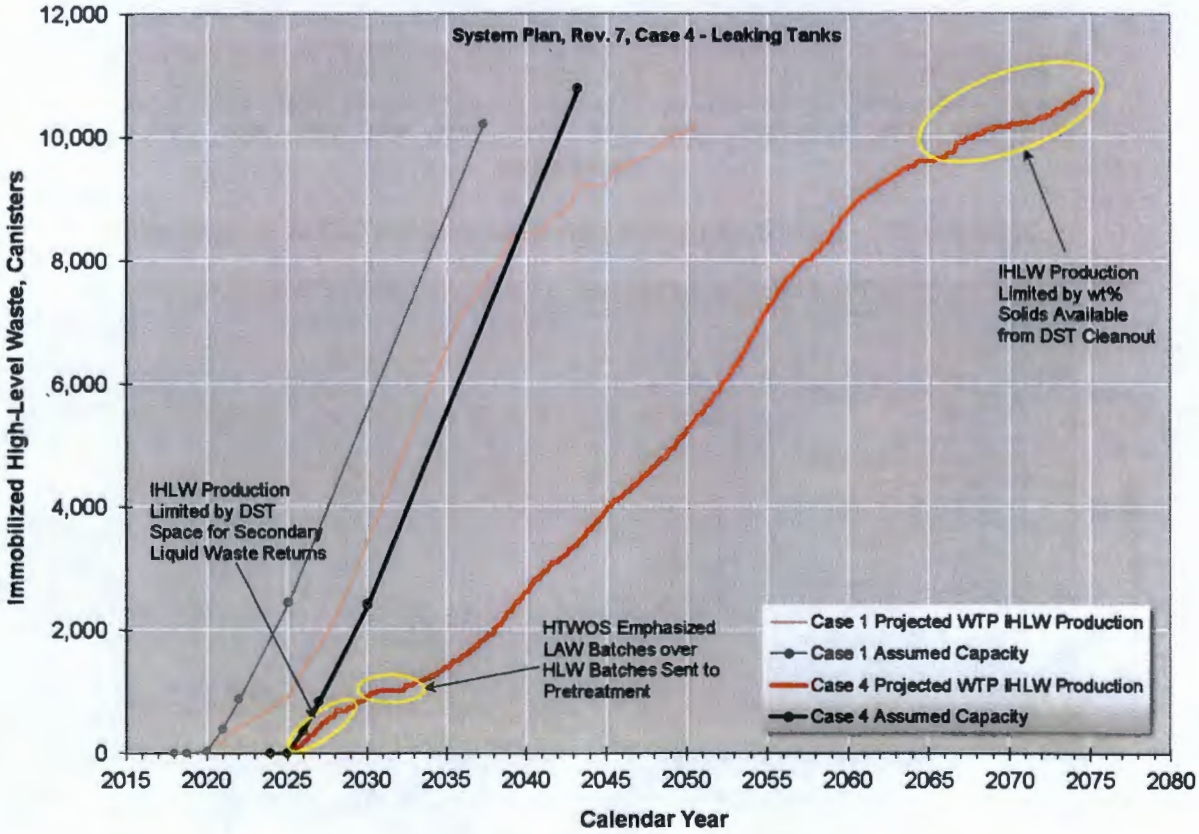
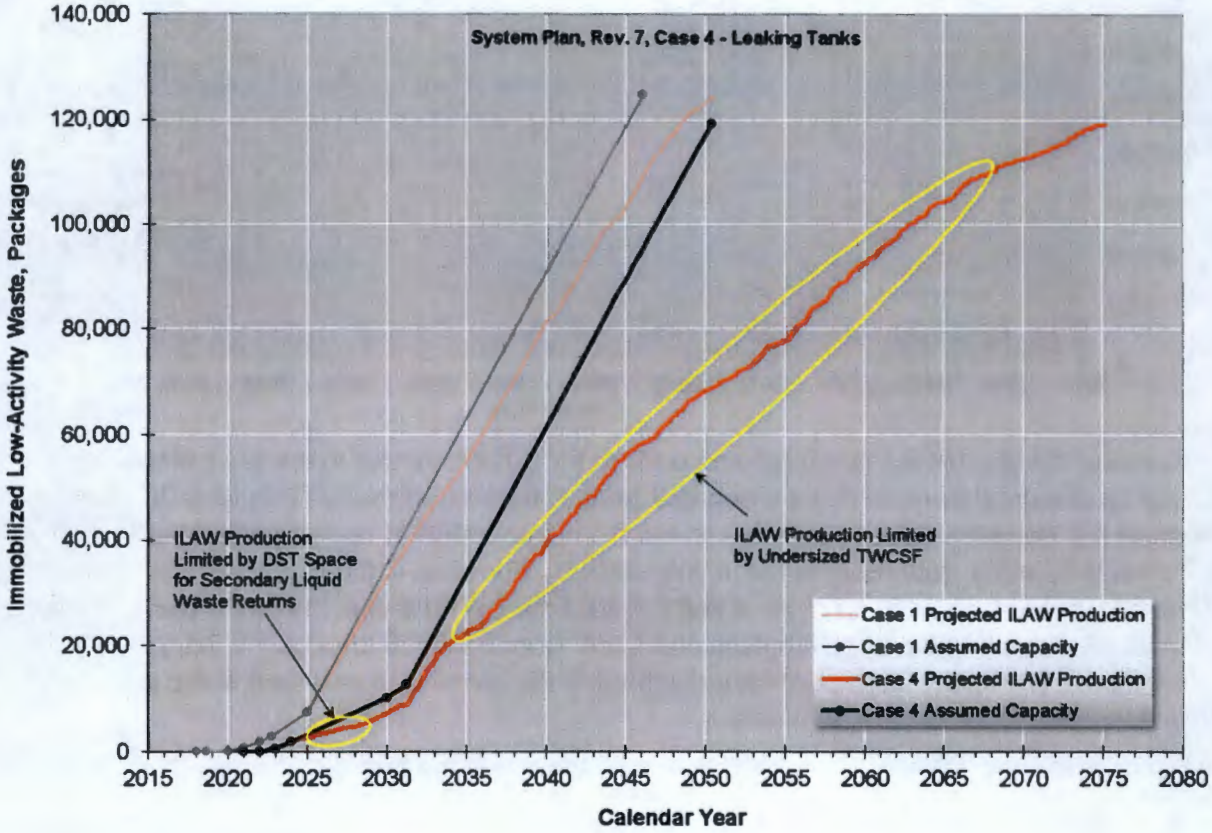


Figure 4-47 shows the ILAW glass production in Case 4 compared to the assumed net. The LAW Facility in Case 4 produces 119,169 ILAW containers within a 53-year mission life. From 2025 to 2028, ILAW production is limited by the tank farm's capability to accept returned secondary liquid waste. This problem is alleviated in 2028 when the PT Facility is brought

online. After 2028, ILAW production is limited by the undersized TWCSF tanks since LAW feed (other than DFLAW batches) is derived from the volume of feed received into the PT Facility until the supplemental LAW facility becomes operational. There is an increase in ILAW production after the supplemental LAW facility becomes fully operational in 2031.

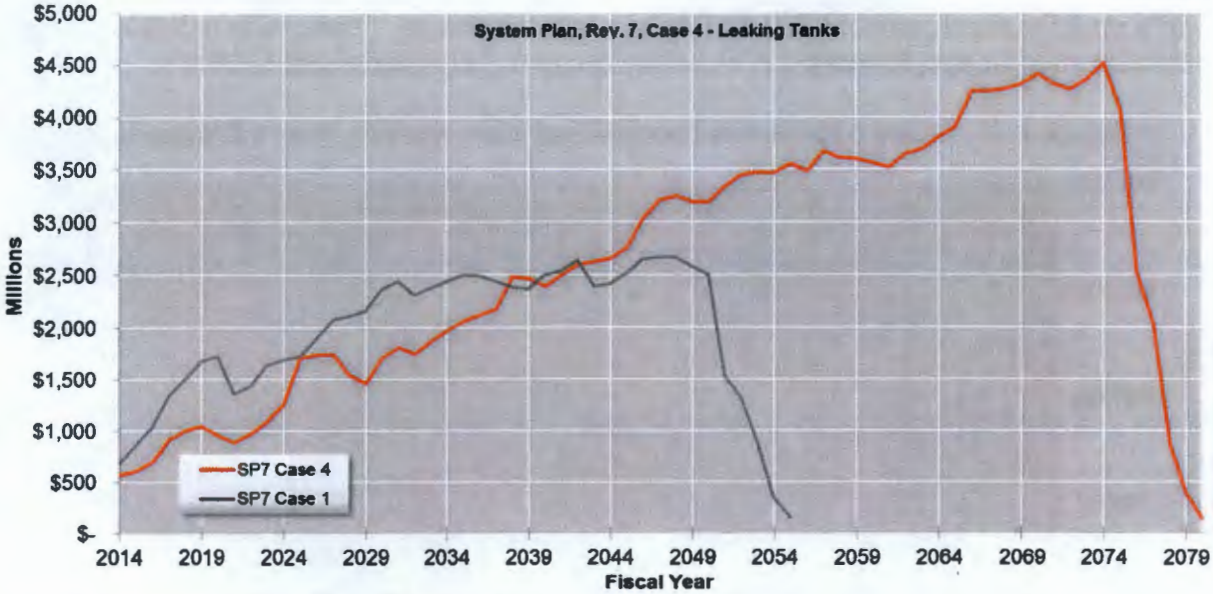
Figure 4-47. Case 4 Projected Immobilized Low-Activity Waste Production.



4.4.4 Cost and Schedule Impact

The projected schedule and lifecycle cost profile for Case 4 is significantly different from Case 1. The net schedule effect is a lifecycle mission duration of 25 years longer than Case 1. The lifecycle cost for Case 4 is approximately $91 billion more than the Case 1 ($179 billion versus $87 billion or about 105 percent). As can be seen on Figure 4-48, the majority of the increase occurs between 2054 and 2080. Case 4 meets the near-term funding targets noted in Appendix B for both FY 2014 and FY 2015 by 7 percent and 15 percent, respectively. Case 4 exceeds the $61.5 billion lifecycle cost noted in Appendix B by approximately 191 percent.

Figure 4-48. Case 4 Lifecycle Cost Profile.



Assessing the cost profile graph (above) prior to FY 2019 indicates that Case 1 includes a ramp up of capital projects that are required prior to the start of the WTP in May 2018. Case 4 instead has staggered facility start dates, which leads to a shift of capital project budgets in order to meet the facility need dates noted in Appendix B. For Case 4, the first significant capital cost expenditures occur between FY 2015 and FY 2021 for LAWPS and TWCSF. The next large capital cost expenditure is for supplemental LAW from FY 2022 through FY 2028. During this time the HLW Facility starts operating resulting in the increase in cost seen in the graph until the supplemental LAW facility is complete.

Differences in Case 4 versus Case 1 are caused by the following high-level items:

- Early mission costs for Case 1 exceed those for Case 4 because:
  - Case 1 DST retrieval equipment costs start in FY 2014 with all equipment being installed prior to the end of January 2030. Case 4 DST retrieval equipment costs start in FY 2014 with all equipment being installed prior to August 2037.
  - The cost of closing the WMA-C and the cost of the 241-SX Tank Farm barrier are expended prior to 2019 in Case 1 versus 2022 for Case 4.
  - Project costs for SLWT, upgrades to DST farms for HLW staging, and completion of a dedicated LAW transfer system for 241-AP Tank Farm are all expended prior to the end of May 2018 for Case 1. Case 4, on the other hand, extends the dates so they are completed prior to the facilities' need dates (LAW Facility, HLW Facility, or PT Facility, as applicable).
  - Infrastructure for waste form and melter disposal is all completed prior to the end of May 2018 for Case 1, yet is staggered to be finished based on applicable facility start dates for Case 4.
  - Expenses for transition to the WTP are all completed prior to the start of operations of the PT Facility and the LAW and HLW Facilities at the end of May 2018 in Case 1,

versus expenses spanning a 2-year duration prior to the startup of the LAW Facility and up to operations of the HLW Facility for Case 4.

- Cost for packaging and shipping CH-TRU waste to WIPP (completed in FY 2024) is included in Case 1; however, it is not included in Case 4 since CH-TRU waste is processed at the WTP.
- Costs for full WTP operations of LAW and HLW vitrification start in FY 2019 for Case 1 versus FY 2025 for Case 4.

- Overall mission costs for Case 4 exceed those for Case 1 because:
  - Activities that occurred later experience increased cost caused by escalation. This applies to the following subitems, as well as the items mentioned above:
    - Earlier processing in WTP for Case 1 results in costs for retrievals occurring earlier than in Case 4.
    - Retrieval costs for Case 4 exceed those for Case 1 since the retrieval duration for each retrieval is longer and many of the retrievals in Case 4 are executed later.
    - Case 4 shows 51 percent more cumulative DST transfers[41] and 33 percent less evaporator campaigns than Case 1.
    - Facility start dates for Case 4 are later than in Case 1 (see Appendix B for the assumptions governing the facility start dates).
  - SST retrievals and accompanying farm closures are completed approximately 21 years later than in Case 1. This results in a higher cost since the cost ramp-down of site infrastructure and personnel is related to the number of active tank farms and active facilities.
  - Capital and operating costs are included in Case 4 for LAWPS and TWCSF that are not included in Case 1.
  - Processing time of HLW in Case 4 is extended resulting in a higher cost over time because the HLW Facility is unable to reach full production capacity as it is constrained by throughput restrictions in TWCSF.

Although there is also a cost increase caused by processing the CH-TRU waste in the WTP in Case 4, it is difficult to quantify the net increase or decrease in cost over packaging CH-TRU as is included in Case 2 since the facility processing start dates vary between the cases. SP6 cases, with and without CH-TRU processing, have noted approximately 1 year of additional WTP processing when directing CH-TRU to be processed through WTP versus being packaged and shipped offsite.

[41] It should be noted that for Cases 2 through 5, there is an inconsistency in how transfers are priced that originates at TWCSF. Prior to operations of the PT Facility, the transfers are assumed to be part of TWCSF operational costs. However, after the PT Facility starts operating, transfers from TWCSF to the PT Facility are priced as DST transfers.

4.4.5 Key Issues and Vulnerabilities

Key issues detailed in SP6, Section 7.0, and the corresponding issues identified in the three-volume IWFDP (RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3), along with the associated risks in the WRPS R&OMP (TFC-PLN-39), continue to be applicable in SP7. Case 4, as defined by the assumptions in Appendix B and presented in this section, include a number of risks and challenges that will need to be addressed for it to become a practical scenario. The following items highlight the key issues and vulnerabilities:

- Necessary facilities are assumed to be available on time to support operations. In addition, solid waste disposal issues are assumed to be resolved.
- The TWCSF, as defined in the assumptions, creates a bottleneck in feeding the HLW Facility, which extends the time required to retrieve and treat all tank waste.
- Lack of available DST space and limited 242-A Evaporator capacity during DFLAW operations creates a strain in being able to receive the WTP effluent returns and keep SST retrievals active. The loss of DST 241-AY-102 as a viable tank exacerbates this issue.
- Success of direct feed operations and of the mission depends on the efficient operation of the 242-A Evaporator, which creates a single point-of-failure.
- Spent IX resin proposed for use in the LAWPS facility may not meet the IDF disposal criteria of LAW and does not currently have a disposal pathway identified (Assumption B4.2.3.1.6).
- Effluent being returned from WTP to the tank farms during the direct feed period is assumed to meet all tank farm acceptance criteria and corrosion specification limits (Assumption B4.2.5.1.3). Since the flowsheet for this case does not include intermediate tanks to collect the effluent and verify/correct effluent chemistry, a method for doing this in-line must be developed or collection points must be established (e.g., WTP tanks).
- As modeled for Case 4, the time required to treat all tank waste exceeds the 40-year design life of WTP (Assumption B3.4.1.1).
- Screening of feed delivered to the PT Facility was performed per Assumption B3.4.1.12 and indicated that some batches do not meet all of the acceptance criteria, as modeled for Case 4. Additional analyses must be performed and strategies developed to allow as much flexibility in the acceptance criteria as possible, and to ensure that waste prepared for delivery meets all applicable criteria. It should be noted that DFLAW and DFHLW batches are screened per Assumption B4.4.4.3.1 and are found to be in compliance with the applicable criteria.
- As modeled, DSTs 241-AZ-101 and 241-AZ-102 exceed nine fill-mix-empty cycles (Assumption B3.3.3.13). Approximately 17 cycles are performed in each tank, which may exceed the amount of fatigue allowed. A newer HLW hot commissioning tank would need to be selected, or a fatigue analysis performed to show that the nine-cycle limit can be safely extended in 241-AZ Tank Farms.

4.4.6 U.S. Department of Energy Observations

Several key features and assumptions associated with Case 4 make this case challenging:

- Although the funding targets for FY 2014 and FY 2015 were met, in subsequent years the cost increased sharply, exceeding $1 billion for the first time in FY 2019, dipping slightly, and then exceeding $1 billion each year starting from FY 2022 through FY 2078. The Case 4 lifecycle cost is $179 billion.
- There are uncertainties associated with the volume, composition and disposition of DFLAW and DFHLW effluent. The disposition of this effluent during DFLAW and DFHLW operation may impact DST space, the timing of SST retrievals and the ability to continue delivering feed to the WTP; or may require alternative pathways to recycle or purge these streams.
- Assumed size of the vessels in the TWCSF was too small, creating a bottleneck in the feed qualification and delivery process which reduced the HLW glass production rate by approximately 50 percent, increasing the total mission duration and cost.

4.5 CASE 5 – CONSEQUENCES OF LIMITED FUNDING

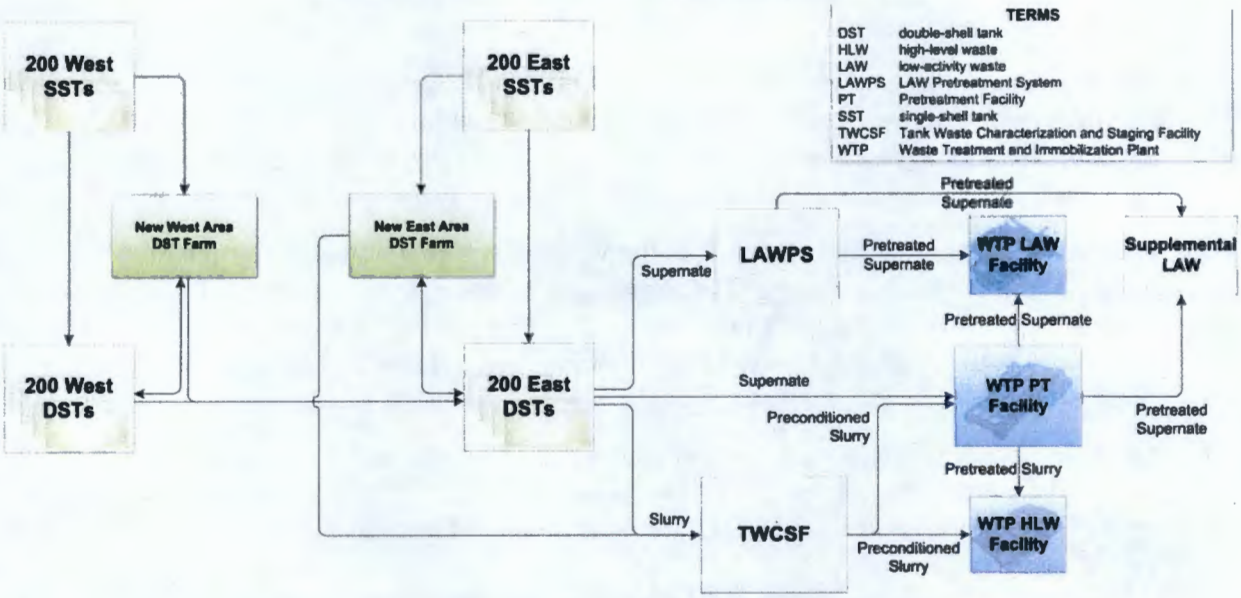
Selected and Defined by: Ecology

Purpose: Case 5 evaluates impacts on the RPP mission based on the allocation of a limited amount of funding.

4.5.1 System Description

The flowsheet used for Case 5 is the same as that used for Case 2 (refer to Figure 4-38) except that two new tank farms are included: One with four tanks in the 200 East Area and one with four tanks in the 200 West Area (Figure 4-49). As with Case 2, Case 5 also includes DFHLW and DFLAW capabilities. Two new systems support these capabilities: LAWPS supports DFLAW and TWCSF supports DFHLW. They are described in Sections 4.4.1.1 and 4.4.1.2, respectively. Also, modifications will be necessary at the WTP (not included in the cost for Case 5) to accept the waste directly from these facilities rather than through the PT Facility. Additionally, Case 5 processes all potential CH-TRU waste as HLW, eliminating the supplemental TRU treatment system, and treating the CH-TRU waste at the WTP.

Figure 4-49. Case 5 Simplified Flowsheet.



4.5.1.1 Low-Activity Waste Pretreatment System

The concept of directly feeding waste to the WTP vitrification facilities would allow some tank waste treatment to begin prior to resolution of the technical issues that are currently delaying progress on the PT Facility design and construction. In order to accomplish this, some pretreatment of the waste would be necessary prior to transferring waste to WTP. LAWPS is envisioned as a partial substitute for the PT Facility. It would encompass many of the same waste processing capabilities and would be sized to support feeding two LAW melters operating at 30 MTG/day at 70 percent TOE.

LAWPS is described in detail in Section 4.2.1.1. A diagram of the proposed LAWPS is shown on Figure 4-14.

4.5.1.2 Tank Waste Characterization and Staging Facility

Whereas Cases 2 through 4 included a provision of 250,000-gal tanks for TWCSF, Case 5 embraces the same predecisional concept, shown on Figure 4-15; however, as discussed in Section 4.5.2.1, the size of the tanks was increased to be consistent with RPP-RPT-44860, *Mission Analysis Report Waste Feed Delivery Projects East Area Waste Retrieval Facility*. Thus, six[42] 500,000-gal tanks in a vault configuration enable the full WTP IHLW production rate to be met. As with Cases 2 through 4, the TWCSF contains mixing, transfer, and sampling capabilities.

TWCSF's potential location, as well as a summary of its functions and requirements, are included in Section 4.2.1.2.

[42] Note that final selection on the number of tanks will be determined as requirements are further defined.

4.5.2 Planning Bases

Planning for Case 5 was conducted in three steps. For step one, Ecology's initial assumptions and success criteria for SP7 modeling were documented in 14-TPD-0003, "Contract No. DE-AC27-08RV14800 – Approval to Use Washington State Department of Ecology's Appendix B, 'Key Assumptions and Success Criteria,' for the ORP-11242, River Protection Project System Plan, Rev. 7." For step two, these assumptions and success criteria were further refined and are documented for Case 5 in Appendix B, Section B4.5. Assumptions in Appendix B provide initial guidance, but were required to be further refined based on the funding limitations noted in the success criteria in Appendix B. For step three, assumptions were further refined to ensure that annual funding levels were not exceeded. Refer to Section 4.5.2.1 for details.

Outside of the meetings with Ecology, as with Case 1, SSTs 241-C-102 and 241-C-105 retrieval durations and the 241-C-102 raw water estimate were adjusted to meet the 241-C Tank Farm retrieval Consent Decree milestone.

4.5.2.1 Defining Assumptions to Be In-Line with Funding Limits

In preparation for meetings with Ecology to further define the assumptions for Case 5 to be in line with funding limits, the existing LCM (SVF-2361, "System Plan Rev 6 Lifecycle Cost Model Results.xlsx" developed in FY 2011) was used in conjunction with planned activities and discussions with Ecology to determine initial priorities for spending within the funding constraints. Proposed funding levels were developed by Ecology for WTP-related activities that are outside the TOC scope in order to provide a means to allocate funding between the WTP contract and the TOC. Activities were scheduled to stay within the funding limits as a combined total between the WTP contract and the TOC.

The following is a list of the outcomes from the discussions with Ecology:

- Consistent with the escalation applied per year for each activity in the TOC scope, the funding limits, as specified in Appendix B, were also escalated per year.
- Starting in FY 2016, the combined budget between the TOC and the WTP Contract could be allocated to either the TOC or the WTP at the discretion of Ecology regardless of the type of congressional allocation.
- When WTP construction and commissioning complete, the budget for WTP would continue to be available for TOC activities, operating costs, etc.
- If a significant decrease in funding is identified for either the TOC or the WTP requiring project interruption, the increased project cost and duration would be accommodated by increasing the budget for the activity by 20 percent when the project is restarted. The delay in schedule would be commensurate with the length of time the project was suspended.
- Once the LAW Facility and/or HLW Facility are online, there can be no suspension of that activity.
- A list of considerations for the SST retrieval sequence was provided by Ecology to include specific farms to be prioritized before others in each northern or southern area of

each of the 200 East and 200 West Areas, as well as specific tanks to retrieve first in selected tank farms.

- A conceptual list of priorities was defined with:
  1. LAWPS and the LAW Facility as the top priorities, thus funding is assigned for these projects in preference to others.
  2. TWCSF and the HLW Facility as the next priorities.
  3. A new four DST farm in the 200 East Area that can be used as cross-site receivers, retrieval receivers, or any other required function to enable the WTP to continue operating at the highest throughput.
  4. WRFs for both B Complex and T Complex at the same priority.
  5. The PT Facility next, where the operational date is closely linked to the finish of the new four-DST farm in the 200 East Area and the WRFs to ensure waste is available to the WTP continuously.
  6. The supplemental LAW facility.
  7. A new four-DST farm in the 200 West Area.
- Facility start dates were initially projected based on the output of the existing LCM developed in FY 2011 (SVF-2361) and then added to MMR-14-038, *System Plan 7 Case 5 – Consequences of Limited Funding*. Based on updating the LCM to reflect the available FY 2014 cost and schedule information and restricting DST feed delivery equipment projects to be completed just in time to facilitate consistent melter feed capability, these facility start dates were modified to give the best chance at staying under the annual funding limits. Table 4-8 contains the final facility/activity operational start dates that were included in MMR-14-038.

Table 4-8. Case 5 List of Facility and Activity Operational Start Dates.

Facility and Activity Name	Operational Start Date
LAW Pretreatment System	10/01/2022
LAW Facility	10/01/2022
Tank Waste Characterization and Staging Facility	10/01/2024
HLW Facility	07/01/2026
Four New 200-East-Area DSTs	10/01/2030
B Complex Waste Receiving Facility	10/01/2028
T Complex Waste Receiving Facility	10/01/2037
Pretreatment Facility	10/01/2029
Supplemental LAW Facility	10/01/2032
Four New 200-West-Area DSTs	10/01/2037

DST double-shell tank
HLW high-level waste
LAW low-activity waste

4.5.3 Results

Table 1-1 and Table 4-9 show the key mission metrics, including lifecycle cost, for Case 5 compared to Case 1. It should be noted that there are no total mission duration lifecycle cost goals for Case 5. In addition, the near-term funding target/profile through FY 2015 is different for Case 5 than it is for Case 1. The mission metrics that were met for Case 5 include:

- Near-term funding target/profile through 2015
- Complete 241-C Tank Farm retrievals
- Start five additional SST retrievals.

However, the success criteria for Case 5 are only based on meeting the funding profile limits per year from FY 2014 to FY 2030 as defined in Section 4.5.2.1. Case 5 meets the funding profile limits from FY 2014 to FY 2030; however, it does require the use of management reserve and a shift of WTP-to-TOC funding in FY 2014 to meet the funding limits set in Assumption B4.5.1.1.

The following subsections give additional details regarding the results of Case 5. Section 4.5.3.1 contains an assessment of Case 5 against the planning bases' items and assumptions. Section 4.5.3.2 contains SST retrieval results. Section 4.5.3.3 contains DST space and evaporator operation results. Section 4.5.3.4 contains WTP and supplemental LAW production results.

Table 4-9. Case 5 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 5 – Consequences of Limited Funding
Lifecycle Cost, FY 1997 to End of Mission[a]	$87.5B	$115.3B
Meets Near-Term Funding Targets through 2015[b]	$1,526M	$940M
Meets Near-Term Funding Profile through 2015	No	Yes
Complete 241-C Tank Farm Retrievals (B-1)[c]	September 2014	September 2014
Start Five Additional SST Retrievals (B-3)	November 2017	September 2017
Close WMA-C (M-045-83)	June 2019	February 2036
Complete Nine Additional SST Retrievals (B-4)	July 2019	August 2027
Complete 241-A-103 SST Waste Retrieval Project (M-045-15)	February 2020	July 2029
Complete all SST Retrievals (M-045-70)	May 2044	May 2047
Close all SSTs (M-045-00)	December 2048	August 2051
Treat all Tank Waste (M-062-00)	August 2050	August 2058
Close all DSTs (M-042-00A)	August 2055	May 2063
Complete Potential TRU Tank Waste Packaging	July 2025	N/A
HLW Glass Mass (MTG)	30,845	33,205
HLW Glass Canisters	10,214	10,996
HLW Glass WOL	35%	35%
LAW Glass Mass (MTG)	687,187	663,345
LAW Glass Containers	124,753	120,425
LAW Glass Sodium Oxide Loading	16%	16%
Sodium Reporting to LAW Glass (MT)	79,056	78,829
Potential TRU Tank Waste Drums	8,285	0

Notes:

All projected results are contingent on favorable resolution of the key issues and uncertainties associated with each scenario.

Lifecycle costs for Cases 1 through 5 were developed using the Tank Operations Contract cost model. Lifecycle cost figures are used in the System Plan for comparative purposes only, and do not reflect the currently approved PMB.

SP7, Lifecycle Cost Model is based on PMB output from FY 2014.

[a] Lifecycle cost success criteria applies to Cases 1 through 4 and the SP6 Baseline Case, not Case 5.

[b] Near-term funding targets for Cases 1 through 4 and the SP6 Baseline Case are: FY 2014 = $610 million; FY 2015 = $710 million. Total FY 2014 through FY 2015 = $1,320 million. Near-term funding targets for Case 5 are: FY 2014 = $460 million; FY 2015 = $510 million. Total FY 2014 through FY 2015 = $970 million. Values for Case 5 do not include ORP costs or Effluent Treatment Facility costs. It was required to transfer $35 million from the WTP contract to the TOC to meet the FY 2014 target.

[c] The 241-C Tank Farm retrievals were modeled assuming they would be completed by the end of FY 2014 per SP7 Assumption B4.1.1.2.

DST	double-shell tank	MTG	metric tons of glass	SP7	System Plan, Rev. 7
FY	fiscal year	N/A	not applicable	SST	single-shell tank
HLW	high-level waste	PMB	Performance Measurement Baseline	TRU	transuranic
LAW	low-activity waste			WMA-C	C Farm Waste Management Area

Table 4-9. Case 5 Key Mission Metrics.

Metric (Milestone)	Case 1 – Consent Decree Compliant Case	Case 5 – Consequences of Limited Funding

MT metric ton SP6 System Plan, Rev. 6 WOL waste oxide loading

4.5.3.1 Assessment of Case 5 Results Versus Planning Bases and Assumptions

This section evaluates Case 5 results against the items listed in the planning bases as well as gives an assessment of Case 5 against the assumptions listed in Appendix B, Section B4.5, and Sections B3.1 through B3.X (as applicable). The following list assesses Case 5 results against the planning bases' items:

- As much as necessary of the combined budget between the TOC and the WTP Contract was allocated to either the TOC or the WTP Contract to ensure the scheduled activities are funded after FY 2016. However, an allocation of $24 million from the WTP Contract to the TOC was required for FY 2014 and $3.5 million for FY 2015 as the original allocated funding exceeded the budget for FY 2014 and FY 2015. After making this adjustment, the funding for activities from FY 2014 to FY 2030 were under the established funding limits.
- There were no project interruptions requiring project-restart funding.
- Once the LAW Facility and/or the HLW Facility are online, they keep producing glass with only one melter idle time (as measured by the time between two sequential canisters produced) of 2 months prior to 2057. Although not desirable from a production perspective, idling a melter is common practice for short durations of up to a month or more in commercial industry and thus was not perceived as a shutdown of the melter.
- SST retrieval sequence considerations were incorporated.
- Facility/activity operational start dates were executed as noted in Table 4-8. These dates are consistent with the conceptual list of priorities, except that the B Complex WRF was completed prior to the four 200-East-Area DSTs. Also, the T Complex WRF was delayed to be in-line with the four 200-West-Area DSTs. These changes were made to ensure waste feed to the WTP was consistently available and the funding profile limits were not exceeded.

The following list assesses Case 5 results against the Appendix B assumptions; all the assumptions were met as written in Appendix B, Section B4.5, except the following:

- Case 5 TWCSF contains six 500,000-gal tanks versus the 250,000-gal tanks (Assumption B4.5.3.2.2).
- TWCSF was not paused prior to the startup of the PT Facility (Assumption B4.5.3.2.3). DFHLW continued to operate until the PT Facility was online. Preparing waste in the PT Facility; however, caused a 2-month pause in IHLW canister production.
- Vitrification of LAW was not paused for 2 months prior to the startup of the PT Facility (Assumption B4.5.5.4.4). As the PT Facility requires time to stage feed into HLW and LAW batches, there is no reason to add an additional pause in melter production while batches are being prepared.

All the assumptions were met as written in Appendix B, Sections B3.1 through B3.7, except the following:

- RPP-40149-VOL1 and RPP-40149-VOL2 (Assumptions B3.1.1.2 and B3.3.3.13) were followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2. The types of equipment installed were followed except for Figure 3-2 of RPP-40149-VOL1 and Table 6-1 of RPP-40149-VOL2, which do not require sluicing equipment for 241-AN-101 and 241-AN-106. Also, no mixer pumps are noted as being required for 241-AP-102 and 241-AP-106. Tank 241-AN-101 and 241-AN-106 will require sluicing equipment to remove the deep sludge down to a level where mixer pumps can mobilize the waste. For Case 5, this is incorporated in the cost and schedule for 241-AN-106 and 241-AN-101. In addition, sludge waste is added to 241-AP-102 and 241-AP-106, thus the cost and schedule for Case 5 incorporates mixer pump installation for these tanks. Equipment installation dates for the DSTs were also modified from those noted on Figure 3-2 of RPP-40149-VOL1.
- Tanks 241-C-102 and 241-C-105 minimum retrieval durations defined in RPP-PLAN-40145 and SVF-1647 (Assumptions B3.1.1.3, B3.1.1.4, and B3.3.3.4) are reduced to meet the 241-C Tank Farm retrieval Consent Decree milestone, as was done in the modeling for Case 1. In addition, the raw water required for 241-C-102 retrieval is reduced from the amount predicted in SVF-1647 to be in-line with previous retrieval efforts.
- Feed control list actions in HNF-SD-WM-OCD-015 (Assumptions B3.3.2.7 and B3.4.1.10) are followed except for items 2, 5, and 7:
  - Item 2 is replaced with the transfer of the 241-AY-102 waste to 241-AP-102 where it is the HLW commissioning feed for DFHLW.
  - Item 5 defines blending of 241-AZ-101 waste with waste from Tanks 241-AW-103, 241-AN-106, and 241-AP-103 resulting in an HGR below the limit. This specific blending was not performed; instead the near-term transfers modeled for Case 5 result in a reduced radiolytic heat load for 241-AZ-101. The HLW feed batches are all within the HGR limits, thus the intent of this feed control item has been met.
  - Item 7 is not completed. The assumptions for this case change the requirement to package and ship TRU waste separately to processing TRU waste in the WTP.
- DST 241-AY-101 exceeds nine fill-mix-empty cycles (Assumption B3.3.3.13). In order to ensure that 241-AY-101 is available for an increased number of fill-mix cycles, a fatigue study would be required potentially recommending some of the equipment in the tank be removed. This cost was not included in the lifecycle analysis for this case.
- Case 5 decreases the 4-month period for 242-A Evaporator sampling/analysis/process control plan preparation (Assumption B3.3.4.2) to 2 months for waste coming from the WTP offgas condensate prior to the PT Facility operations noting that the variability in this waste stream should be within a tolerance range that would allow for more continuous evaporator processing of this waste stream.
- Case 5 does not start WTP hot commissioning in May 2018 ending in December 2019, with delivery of the first LAW and HLW batch on May 2018, and WTP operations start

on or before December 31, 2019 (Assumptions B3.4.1.4, B3.4.1.5, B3.4.1.6, and B3.4.1.7). Hot commissioning and delivery of feed are completed to enable the facility start dates noted in Table 4-8.

- For the first 20 days of HLW Facility operations, less than 4.2 MTG/day (Assumption B3.4.3.2) are produced. The ramp rate in Assumption B4.5.5.3.2 is used. No modification of the ramp rate was made in order to ensure 84 MT of HLW glass was produced by the end of commissioning. In addition, no commissioning duration was defined for Cases 2 through 5.
- For the first 20 days of LAW Facility operations, less than 24 MTG/day (Assumption B3.4.4.3) was produced. The ramp-up rate in Assumption B4.5.5.4.2 was used. No modification of the ramp-up rate was completed to ensure 480 MTG of ILAW was produced by the end of commissioning. In addition, no commissioning duration was defined for Cases 2 through 5.

4.5.3.2 Single-Shell Tank Retrieval Results

Figure 4-50 shows the overall SST retrieval progress for Case 5. SSTs are projected to be retrieved by January 2047 with 241-C Tank Farm retrievals being completed in September 2014. Since there is limited funding to complete retrievals, install equipment in DSTs, and expend capital costs for new facilities, and that DSTs are being used to stage waste for DFLAW and DFHLW, there is a gap of time from 2018 to 2026 where there are no retrievals. Once DFHLW operations are in process, DST space starts becoming available and retrievals commence. After the start of full operations of the WTP, the opening of four new DSTs in the 200 East Area, and the startup of supplemental LAW operations, the available DST space increases allowing a significant rise in the SST retrieval rate. After 2042, retrievals slow down, possibly because (1) the PT Facility is not processing LAW fast enough, and (2) after 2044, Tank 241-AP-107 stops feeding LAWPS. Both of these activities result in less LAW being delivered to supplemental LAW, and thus less DST space available for retrievals.

Figure 4-50. Case 5 Overall Single-Shell Tank Retrieval Progress.

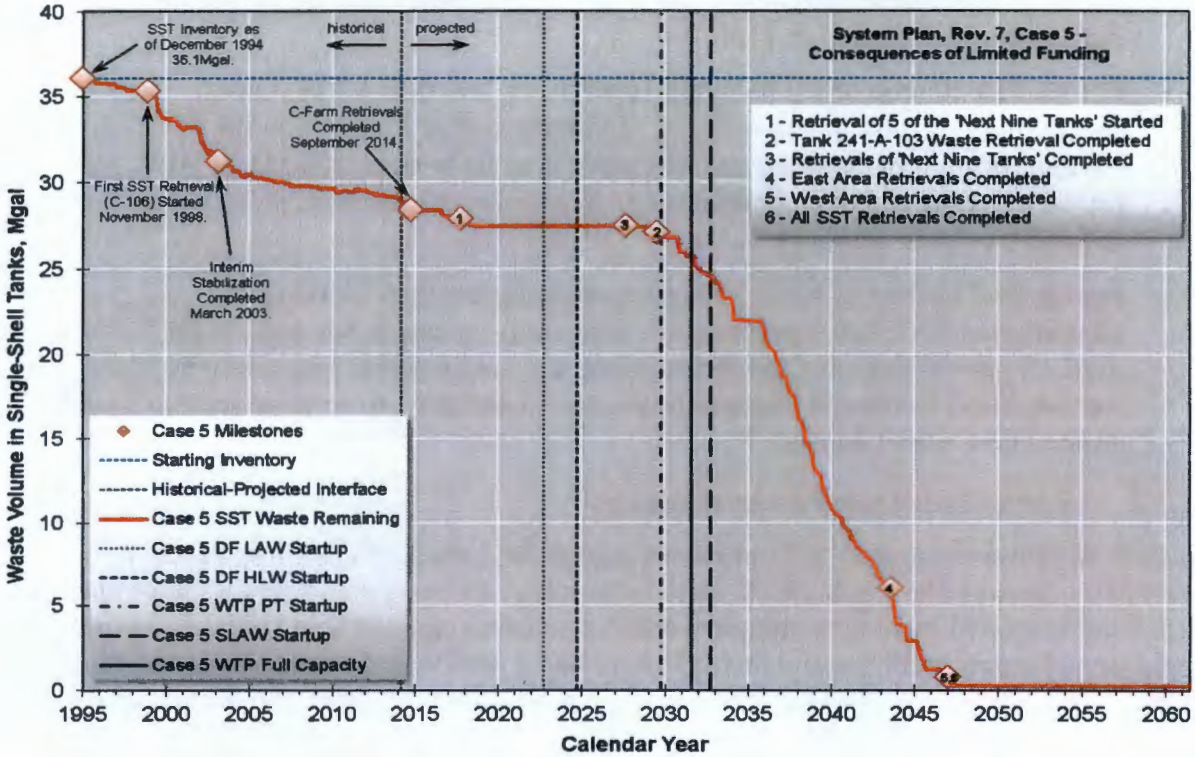
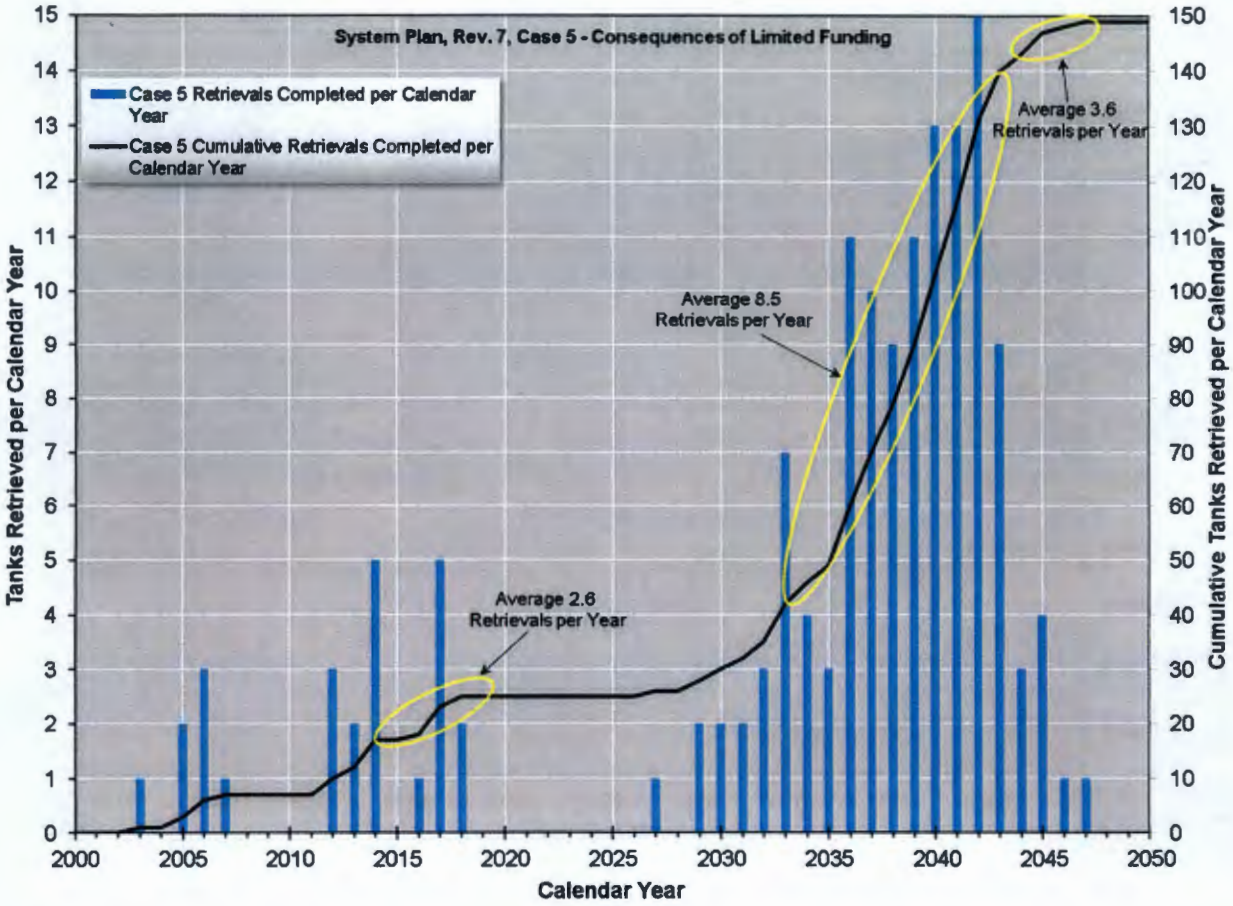


Figure 4-51 shows the number of retrievals that were completed or are projected to be completed during each calendar year. Between 2014 and 2018 the average number of retrievals completed per year is 2.6. This includes the rest of the tanks in the 241-C Tank Farm, the 241-AX Tank Farm, and four tanks in the 241-A Tank Farm. After all treatment facilities are running at their full capacity, the average increases significantly to 8.5 retrievals per year between 2033 and 2042. For the remainder of the SST retrievals mission (2043 through 2047), the average retrievals per year is reduced to 3.6 as only two tanks are left to retrieve in the 200 East Area and only one tank farm in the 200 West Area remains.

Figure 4-51. Case 5 Single-Shell Tank Retrievals Completed per Calendar Year.



The sequence and timing of all SST retrievals is shown on Figure 4-53. Figure 4-53 shows that when DST space is limited during the time period from 2026 to 2035, the retrievals of 12 SSTs (241-A-105, 241-A-103, 241-BY-102, 241-BY-103, 241-BY-104, 241-BY-105, 241-BY-112, 241-U-108, 241-BY-111, 241-BY-110, 241-BY-106, and 241-BY-101) are projected to take significantly longer than their minimum retrieval duration (defined as more than 100 days over the minimum retrieval duration). There is a balance between providing the WTP with enough feed by continuing retrievals and the constraints of the available DST space needed to support 242-A Evaporator operations. This case did not optimize delaying the start of retrievals to ensure continuous melter operation. This may be done if the desire is to shorten retrieval durations. It should be noted that cost is only incurred while the retrieval is in operation, not for the time the retrieval is delayed caused by a lack of DST space. The reason for the increased retrieval durations after 2042 is discussed in reference to Figure 4-51.

For Case 5, the assumed CH-TRU waste in the T Complex and B Complex are retrieved with the other T Complex and B Complex waste. Figure 4-53 shows the general timing of the SST retrievals by tank farm.

Figure 4-52. Case 5 General Timing of Single-Shell Tank Retrievals by Tank Farm.

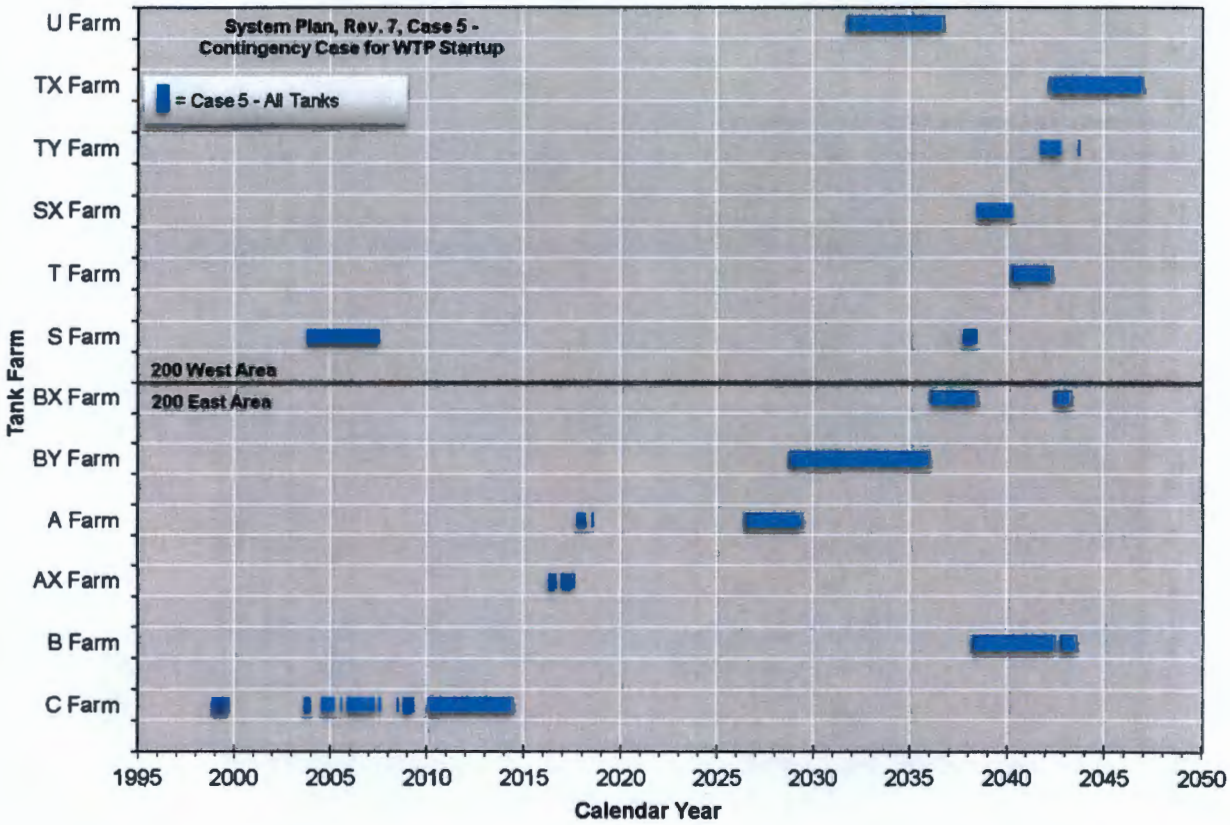
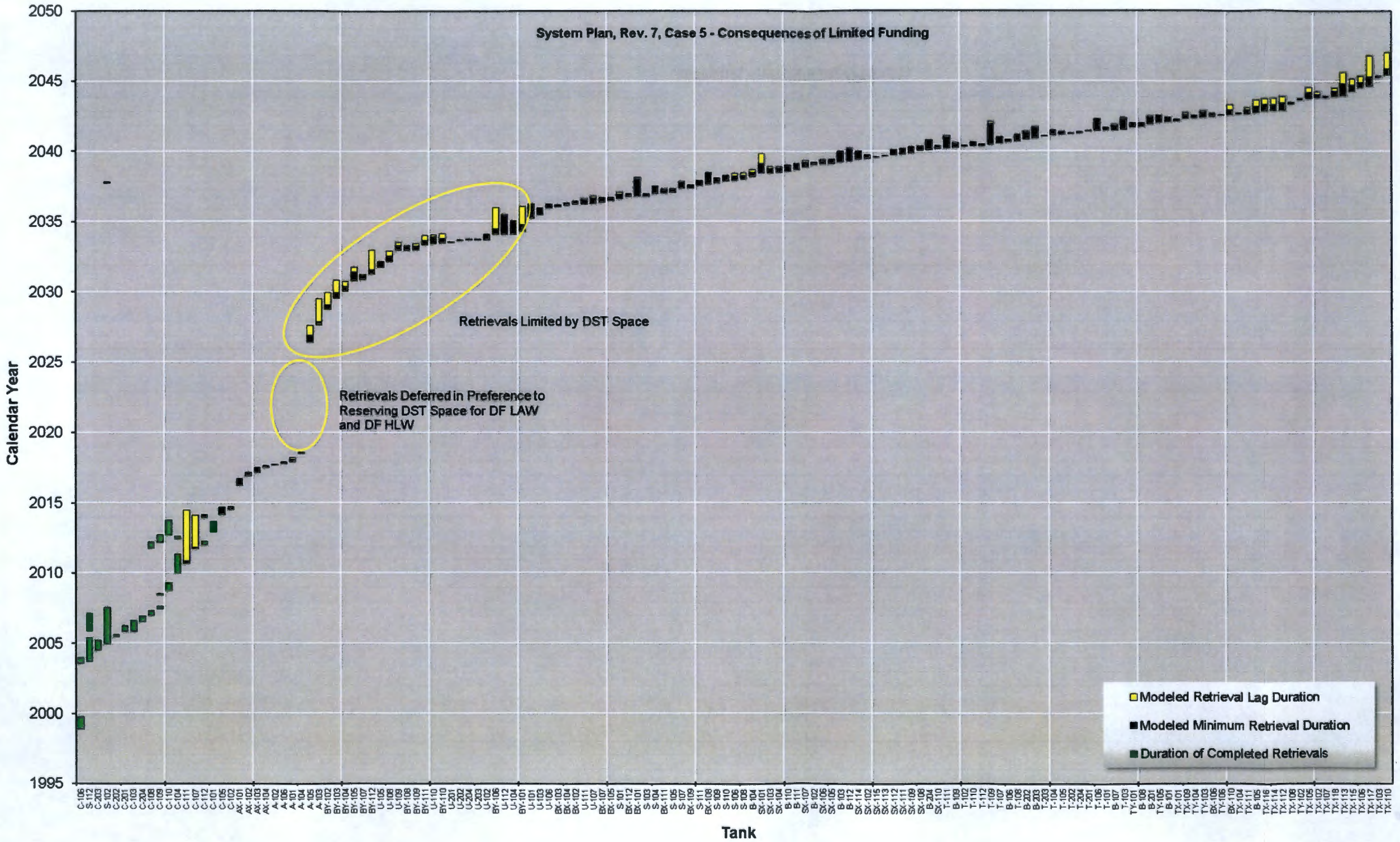


Figure 4-53. Case 5 Single-Shell Tank Retrieval Timing and Sequence.



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4.5.3.3 Double-Shell Tank Space and 242-A Evaporator Operation Results

Figure 4-54[43] shows the allocation of DST space during the waste treatment mission. The lack of DST space starting in 2013 is a result of no evaporator campaigns having been conducted since 2010, and a new restriction on the available DST space caused by DSGRE concerns, which temporarily increased the safety basis tank headspace. However, during this time retrievals continue. Thus, in 2014 the available DST space drops to approximately 0.7 Mgal. Case 5 shows that the DST space increases starting in 2014 as the DSGRE restrictions are released and evaporator campaigns commence.

From 2015 through 2029 the available DST space averages 3 Mgal as the DSTs are primarily used to (1) stage waste to DFLAW and DFHLW; (2) receive high cesium-137 waste from LAWPS; and (3) concentrate WTP offgas condensate returns using the 242-A Evaporator. This is not a lot of DST space given that 3 Mgals of additional space is added in 2024 from the TWCSF. In addition, the waste from 241-AY-102 is retrieved and transferred to a DST in 2016 resulting in 241-AY-102 no longer being available as DST space. From 2030 to 2038, equipment is incrementally available in many of the DSTs allowing for mitigation of challenging wastes (e.g., Group A, 241-C-104 blending, complexed concentrates, strontium/TRU precipitation, high zirconium), after which those DSTs can be used for SST retrievals. Waste mitigation in the DSTs inherently underutilizes the DSTs while they are being mitigated. Since many DSTs are used for waste mitigation activities from 2030 to 2038, there is a copious amount of unusable headspace, which is included in the 10.6 Mgals of available space. Thus, although marked as available space, it is not available for SST retrievals until the DST waste mitigation activities have been completed. It should be noted that four new DSTs are available in 200 East Area during this time to facilitate the mitigations and still allow feed to be transferred to the WTP for processing. From 2039 through 2046 the average available DST space decreases to 7.6 Mgals caused by the high number of retrievals occurring during this time (even though four new DSTs are available in the 200 West Area). A more in-depth discussion on the DST system is provided in Section 3.1.2.

[43] The DST emergency space from September 2013 to February 2016, when DST 241-AY-102 starts being retrieved, increased by 1,001,000 gal.

Figure 4-54. Case 5 Use of the Double-Shell Tanks.

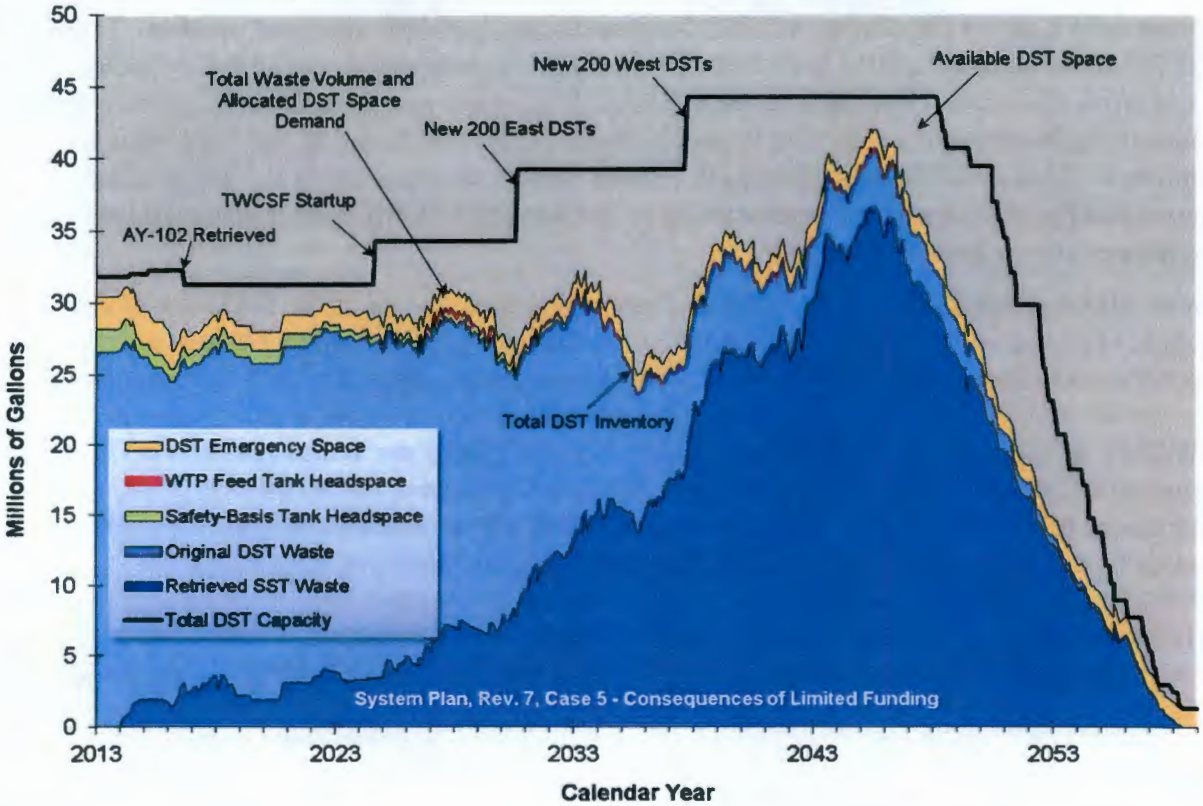


Figure 4-55 shows the cumulative number of DST transfers[44] from FY 2014 to the end of the waste treatment mission. Case 5 predicts 4,006 transfers will occur among the DSTs with an average of eight transfers per year prior to the startup of the HLW Facility and increasing to 143 transfers per year after the startup of the PT Facility. Throughout the mission, numerous transfers occur between DSTs to support evaporator operations, perform DST mitigating actions, support staging of feed to the WTP, and to support SST retrievals.

[44] Cumulative DST transfers are defined as transfers from DSTs to DSTs (including cross-site), DSTs to WTP, from WRFs to DSTs, from DSTs to LAWPS, from DSTs to TWCSF, and from TWCSF to WTP (via DFHLW or pretreatment), as applicable. Transfers to or from the 242-A Evaporator are not included, but are included in each 242-A Evaporator campaign.

Figure 4-55. Case 5 Projected Double-Shell Tank Transfer Demand.

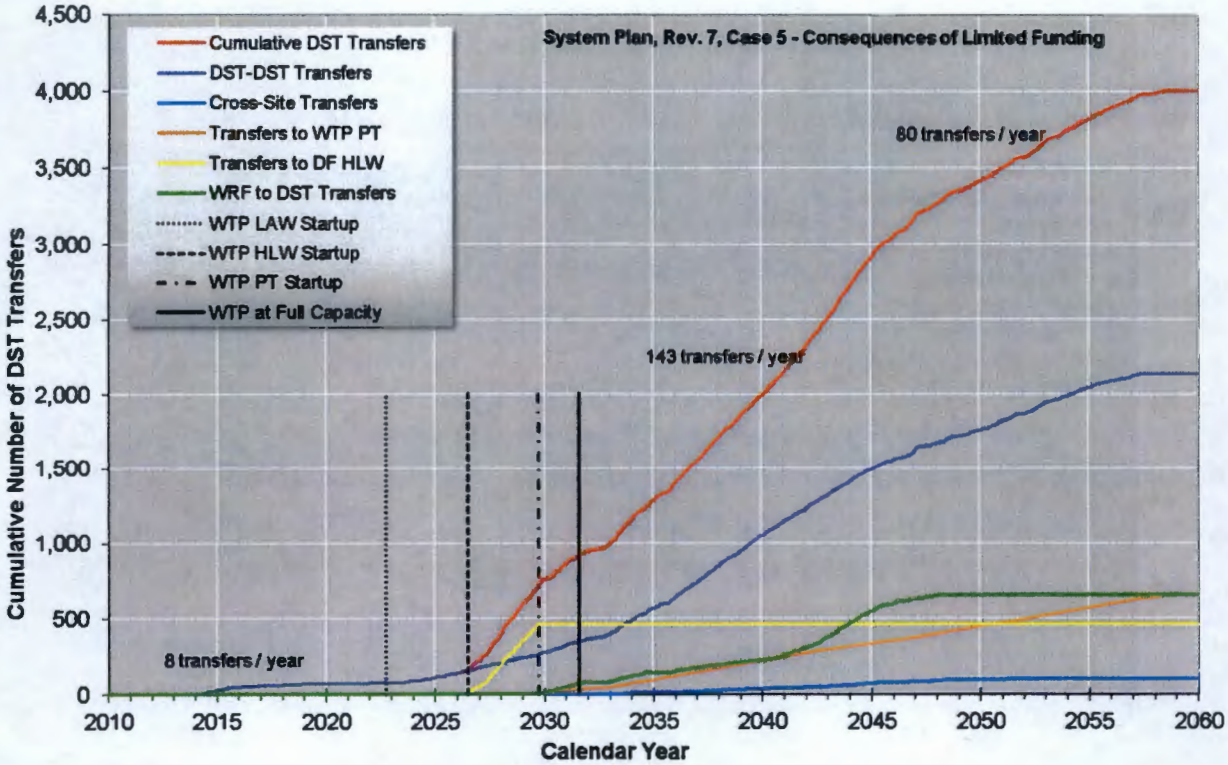
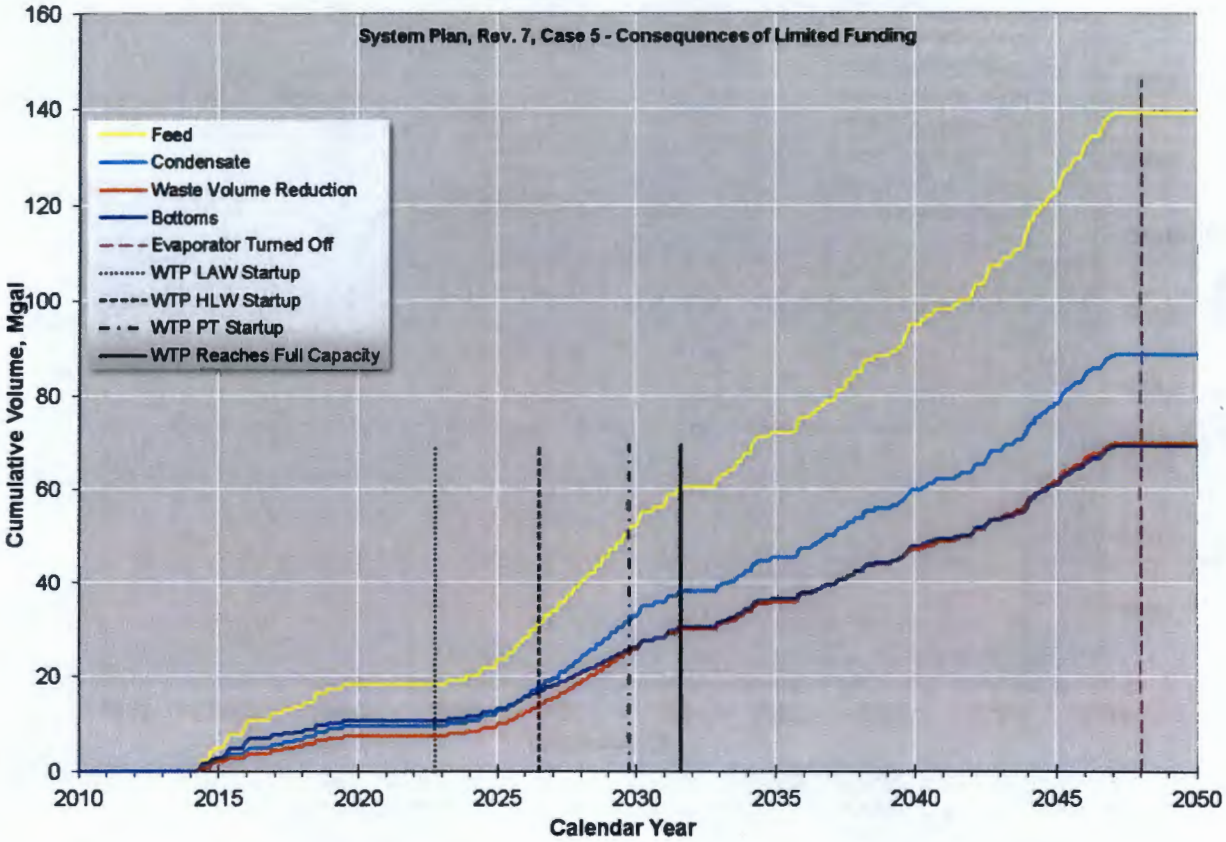


Figure 4-56 shows the cumulative volume of waste that is processed through the 242-A Evaporator. From 2019 to 2023, the 242-A Evaporator is inactive since the waste has been concentrated as much as possible by 2019. Consequently, returns from the WTP offgas systems and the LAWPS can be accommodated in the 200 East Area DSTs starting in 2022. From the time washed HLW batches are able to be moved to TWCSF until 2047, there is an average of approximately four evaporator campaigns per year. From FY 2014 to the end of the mission, Case 5 is projected to have 111 evaporator campaigns. This correlates to more than 139 Mgal of waste that is fed to the 242-A Evaporator, reducing the waste volume stored in the DSTs by almost 70 Mgal from FY 2014 to the end of the mission.

Figure 4-56. Case 5 Projected Operations of the 242-A Evaporator.



4.5.3.4 Glass Production Results

Figure 4-57 shows the projected IHLW production for Case 5. Case 5 produced 10,996 IHLW canisters. The notable observation in the graph is the slow processing rate prior to 2035. Prior to October 2029, this slow processing rate is greatly influenced by the lack of available DST space caused by the returns from the LAWPS and WTP offgas condensate. When the PT Facility comes online, ILAW production limits the production of IHLW because LAW is generated during the pretreatment of HLW. Once the supplemental LAW facility is ramped up to its full capacity in 2035, the production of IHLW begins to take over as the mission-limiting step. During the last 10 years of the mission, the amount of solids left in the DST system has been reduced, but there still remains a substantial amount of LAW. This results in several batches of HLW being delivered to the PT Facility, which are low in solids, thus reducing the rate of HLW vitrification feed.

Figure 4-58 shows the combined ILAW production for Case 5. From the start of DFLAW up to the start of supplemental LAW operations, ILAW production is at the theoretical production rate. From 2035 to 2044, ILAW production starts to deviate from the theoretical production rate since IHLW production is the mission-limiting step as described above. After 2044, although not desired, HTWOS stops LAWPS from feeding supplemental LAW, which causes a decrease in ILAW production.

Figure 4-57. Case 5 Projected Immobilized High-Level Waste Production.

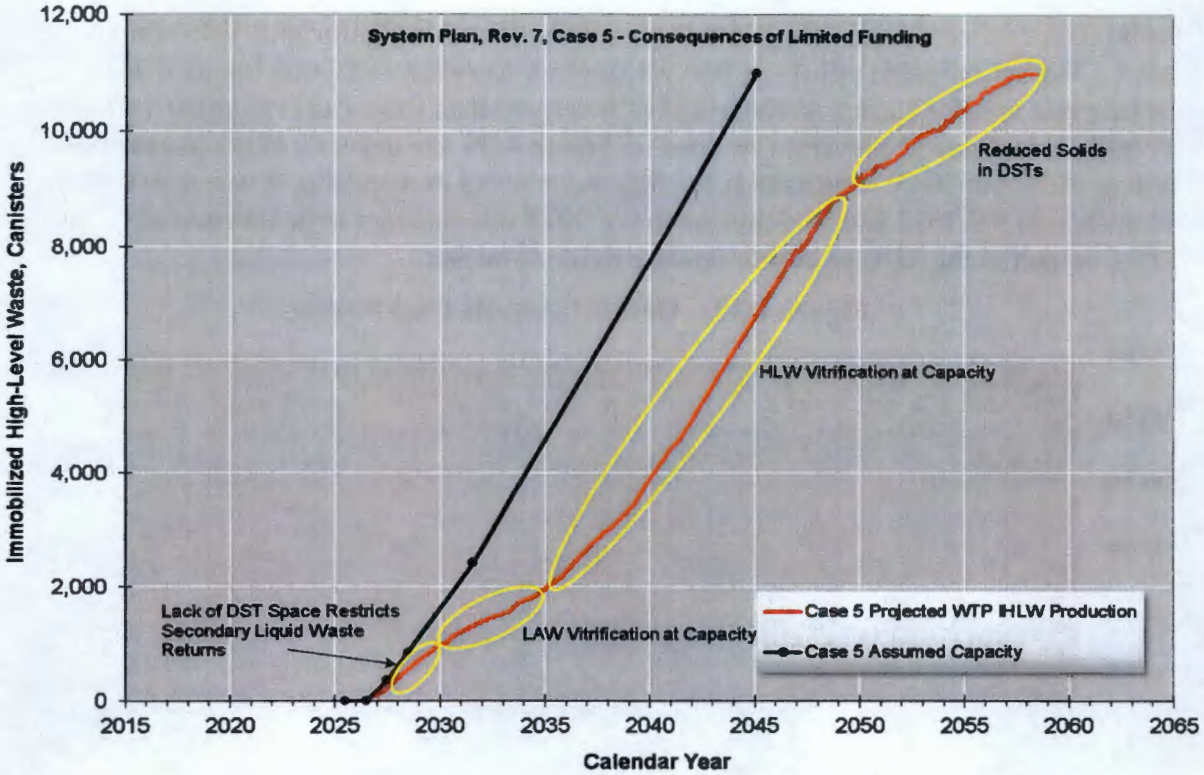
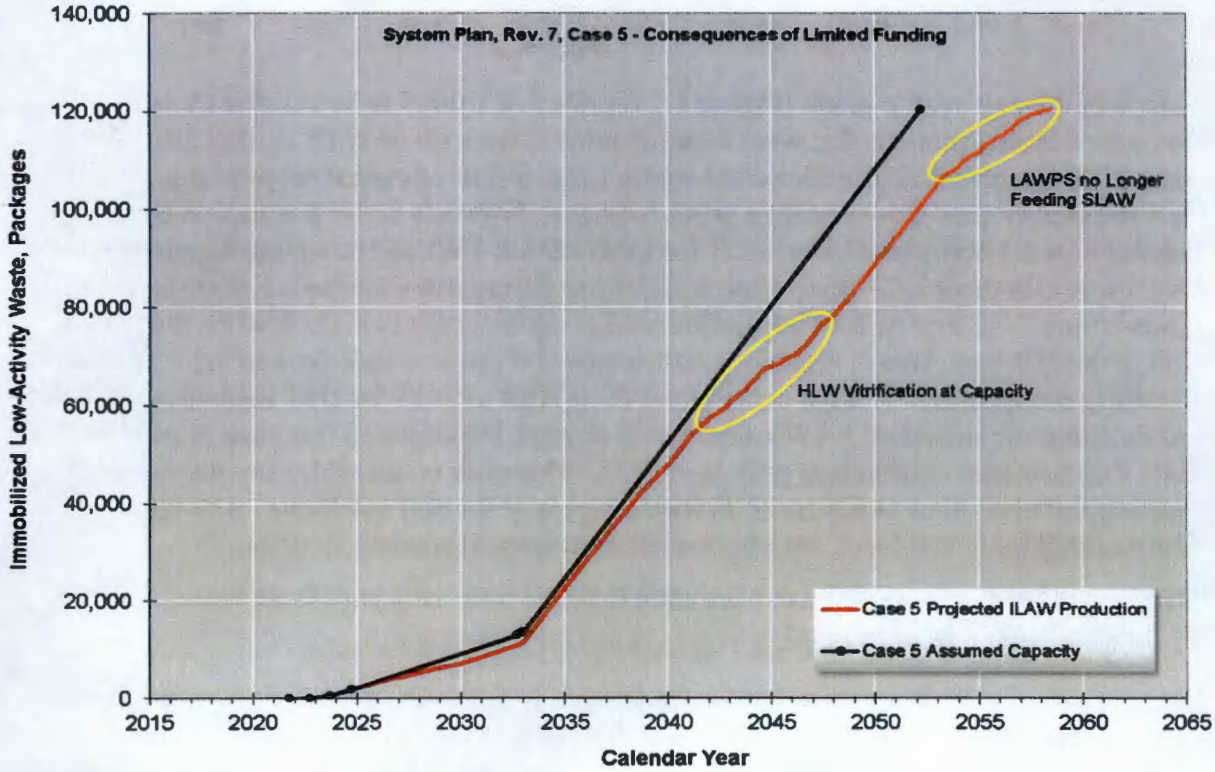


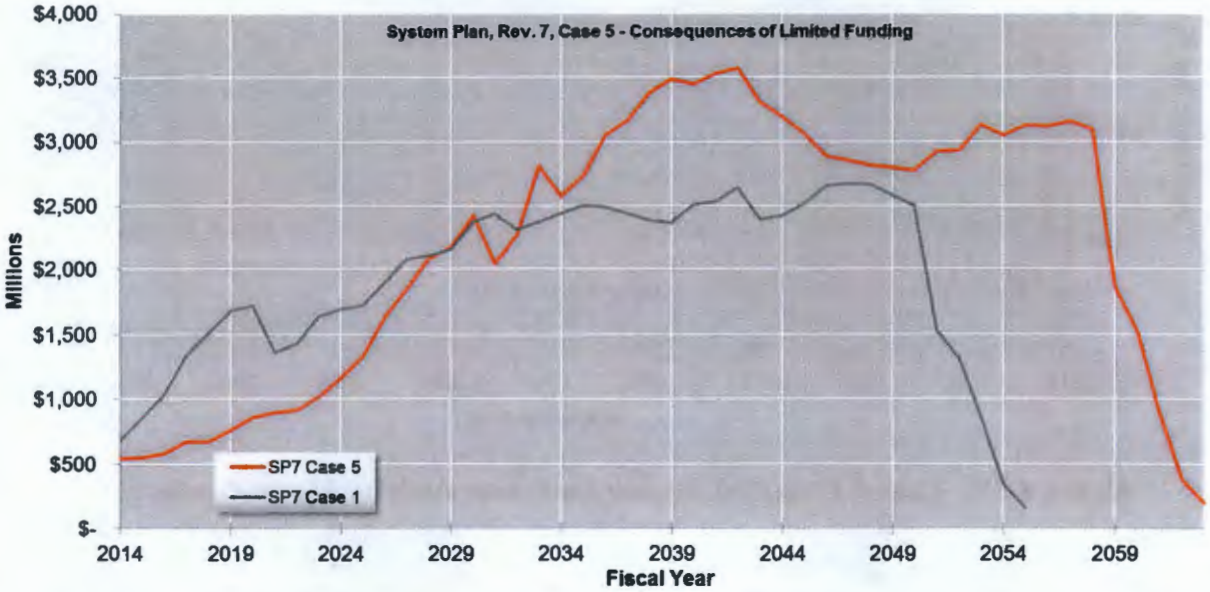
Figure 4-58. Case 5 Projected Immobilized Low-Activity Waste Production.



4.5.4 Cost and Schedule Impact

The projected schedule and lifecycle cost profile for Case 5 is significantly different from Case 1. The net schedule effect is a lifecycle mission duration of 8 years longer than Case 1. The lifecycle cost for Case 5 is nearly $28 billion more than Case 1 ($115 billion versus $87 billion, or about 32 percent). As seen on Figure 4-59, the majority of the increase occurs between 2033 and 2063. The overall funding target noted in Appendix B was met; however, $24 million in FY 2014 and $3.5 million in FY 2015 was required to be transferred from the WTP Contract to the TOC to enable funding limits to be met.

Figure 4-59. Case 5 Lifecycle Cost Profile.



Assessing the cost profile graph (Figure 4-59) prior to FY 2019 indicates that Case 1 includes a ramp up of capital projects that were required prior to the start of WTP in May 2018. Case 5 instead has staggered facility start dates which led to a shift of capital project budgets in order to meet the facility need dates noted in Section 4.5.2.1. For Case 5, the first capital cost expenditures are between 2015 to 2021 for LAWPS and TWCSF; however, because there are very few retrievals or DST equipment installations during that time period, there is no peak of expenditures. The first peak of expenditures seen on the graph is in 2030 when the new tank farm in the 200 East Area is finishing construction and the new tank farm in the 200 West Area is starting construction. A large expenditure from 2029 to 2033 for DST equipment installations and finishing supplemental LAW construction in 2031 contribute to this peak in expenditures as well. The next cost expenditure peak is in 2033. This peak is caused by supplemental LAW reaching full operations commensurate with a high cost for SST retrievals. SST retrievals decrease slightly in 2034 and 2035 before increasing again starting in 2036.

Differences in Case 5 versus Case 1 are caused by the following high-level items:

- Early mission costs for Case 1 exceed those for Case 5 because:
  - Case 1 DST retrieval equipment costs start in FY 2014 with all equipment installed prior to the end of January 2030. Aside from 241-AY-102 (retrieved by the end of 2017), Case 5 DST retrieval equipment costs start in FY 2017 with equipment for 22

of the DSTs installed prior to the end of September 2038. The other five DSTs have equipment installed starting after October 2038.

- Cost for closure of WMA-C and the cost of the 241-SX Tank Farm barrier are expended prior to 2019 in Case 1 versus 2031 for Case 5.
- Project costs for SLWT, upgrades to DST farms for HLW staging, and completion of a dedicated LAW transfer system for 241-AP Tank Farm are all expended prior to the end of May 2018 for Case 1. Case 5, on the other hand, extends the dates so they are completed prior to the facilities' need dates (LAW Facility, HLW Facility, or PT Facility, as applicable).
- Infrastructure for waste form and melter disposal is all completed prior to the end of May 2018 for Case 1, yet is staggered to be finished based on applicable facility start dates for Case 5.
- Expenses for transition to the WTP are all completed prior to the start of operations of the PT Facility and the LAW and HLW Facilities at the end of May 2018 in Case 1, versus expenses spanning a 2-year duration prior to the startup of the LAW Facility and up to operations of the HLW Facility for Case 5.
- The cost for packaging and shipping CH-TRU waste to WIPP (completed in FY 2024) is included in Case 1; however, it is not included in Case 5 since CH-TRU waste is processed at the WTP for Case 5.
- Costs for full WTP operations of LAW and HLW vitrification start in FY 2019 for Case 1 versus FY 2026 for Case 5.

- Overall mission costs for Case 5 exceed those for Case 1 because:
  - Activities occurring later experience increased cost caused by escalation. This applies to the following four subitems as well as the items mentioned above:
    - Earlier processing in WTP for Case 1 results in cost for retrievals being moved earlier than in Case 5.
    - Retrieval costs for Case 5 exceed those for Case 1 since the retrieval duration for each retrieval is longer and many of the retrievals in Case 5 are executed later.
    - Case 5 predicts 43 percent more cumulative DST transfers[45] and 7 percent fewer evaporator campaigns (111 versus 119) than Case 1.
    - Facility start dates for Case 5 are later than in Case 1 (see Section 4.5.2.1 for the assumptions governing the facility start dates).
  - SST retrievals and accompanying farm closures are completed approximately 2.5 years later than in Case 1 resulting in a higher cost since the cost ramp-down of

[45] It should be noted that for Cases 2 through 5 there is an inconsistency in how costs are applied for transfers that originates at TWCSF. Prior to operations of the PT Facility, the transfers are assumed to be part of TWCSF operational cost, however, after the PT Facility starts operating, costs for transfers from TWCSF to the PT Facility are included as DST transfers.

site infrastructure and personnel is related to the number of active tank farms and active facilities.

- Capital and operating costs are included in Case 5 for LAWPS, TWCSF, and new DSTs that are not included in Case 1 costs.

4.5.5 Key Issues and Vulnerabilities

The key issues detailed in SP6, Section 7.0, and the corresponding issues identified in the three-volume IWFDP (RPP-40149-VOL1, RPP-40149-VOL2, and RPP-40149-VOL3), along with the associated risks in the WRPS R&OMP (TFC-PLN-39), continue to be applicable in SP7. Noting the current status of the WTP and the TOC, Case 5 has the highest chance of being accomplished if the funding is limited. All the other cases require significant amounts of expenditure to be completed in the next 5 to 10 years. The following items highlight the key issues and vulnerabilities for Case 5:

- Necessary facilities are assumed to be available on time to support operations. In addition, solid waste disposal issues are assumed to be resolved.
- The major setback (other than capital cost outlay) to both the LAWPS and the TWCSF as part of the DFLAW and DFHLW flowsheets is the amount of effluent returned to the DSTs from the WTP offgas systems. Since production of ILAW and IHLW is dependent on the offgas systems being in operation, and a significant amount of effluent is sent to the DSTs for processing through the 242-A Evaporator, the production rate of ILAW and IHLW is affected any time there is a lack of DST space. This can be seen prior to the time the PT Facility is online when the production rate on Figure 4-57 and Figure 4-58 show less than the theoretical rate of ILAW and IHLW being produced.
- Performing feed preparation activities in the DSTs for DFLAW and DFHLW operations prior to delivery to the WTP uses DST space such that decisions are required whether to prioritize waste preparation or SST retrieval activities until the time when the PT Facility starts. In addition, there is not enough space available in the DSTs to ensure the high cesium-137 waste returned back to the DSTs can be segregated, instead modeling for Cases 2 through 5 shows that some of the high cesium-137 waste is recycled back to the LAW feed that is delivered to the LAWPS.
- Prior to supplemental LAW availability at full capacity, ILAW production limits IHLW production since more LAW is produced from the PT Facility than the LAW Facility melters can process.
- Spent IX resin proposed for use in the LAWPS facility and the PT Facility may not meet the IDF disposal criteria and does not currently have a disposal pathway identified (Assumption B4.2.3.1.6).
- The effluent being returned from the WTP offgas systems to the tank farms during the direct feed period is assumed to meet all tank farm waste feed acceptance criteria and corrosion specification limits (Assumption B4.2.5.1.3). Similar to Case 2, there are no intermediate tanks in Case 5 to collect the effluent and to verify/correct effluent chemistry. Thus, Cases 2 through 5 are modeled with an in-line chemical adjustment. Neither option has been included in the LCM or in the WTP contract or TOC scope.

- Screening of feed delivered to the PT Facility was performed per Assumption B3.4.1.12 and indicated that some batches did not meet all of the waste feed acceptance criteria, as modeled for Case 5.

4.5.6 U.S. Department of Energy Observations

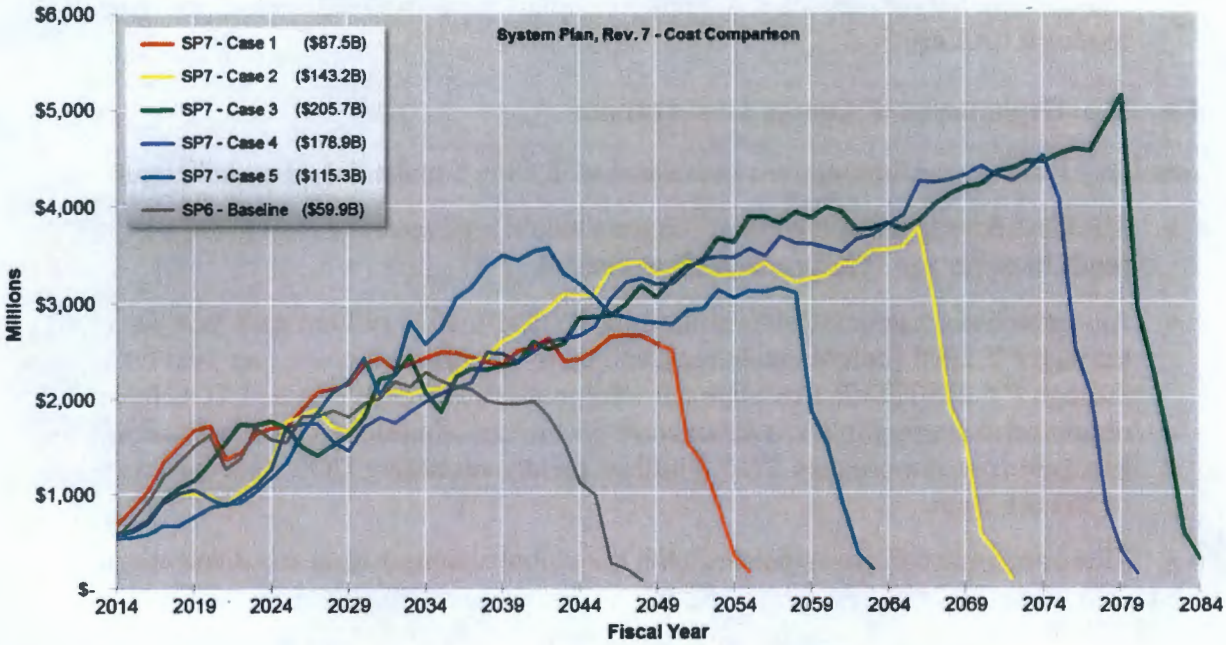
Several key features and assumptions associated with Case 5 make this case challenging:

- The Case 5 budget assumed that Congress would reallocate the total (TOC plus WTP) funds to either the TOC or the WTP as needed.
- Assumed budget targets ($460 million for FY 2014, $510 million each year for FY 2015 through FY 2025 [before escalation], and up to 10 percent increase per year for FY 2026 through FY 2030 [before escalation]) were met. However, the annual TOC budget requirement starting in FY 2023 exceeds $1 billion. Additionally, Case 5 had a mission lifecycle cost of more than $115.3 billion, greatly exceeding DOE's lifecycle cost target of $61.5 billion.
- There are uncertainties associated with the volume, composition and disposition of DFLAW and DFHLW effluent. The disposition of this effluent during DFLAW and DFHLW operation may impact DST tank space, the timing of SST retrievals and the ability to continue delivering feed to the WTP; or may require alternative pathways to recycle or purge these streams.

4.6 CASES 1 THROUGH 5 LIFECYCLE COST COMPARISON

Lifecycle cost profiles were generated for SP7 Cases 1 through 5, and are shown individually in each case results summary section (Figure 4-11, Figure 4-26, Figure 4-37, Figure 4-48, and Figure 4-59, respectively). Refer to those figures and Sections 4.n.4 (*n* representing the case number) for detailed cost analysis of each case. However, in order to gain an overall perspective on the relative cost and schedule impacts, Figure 4-60 presents the lifecycle cost profiles for all five SP7 cases, plus the SP6 Baseline Case. Additionally, Table 4-10 shows the key factors influencing the lifecycle cost.

Figure 4-60. Lifecycle Cost Comparison.



In all cases, where activity schedules experience delayed starts or extended durations, costs increase with escalation. The later a facility starts and the longer it operates, the higher the lifecycle cost.

The planned start dates for the three WTP waste processing facilities are pivotal to long-term costs and schedules. Not only do the costs directly associated with the WTP facilities increase when start dates are delayed, the costs associated with supporting facilities also increase because their construction and operations schedules are tied to the dates the WTP facilities are needed. The lifecycle cost model output data has been summarized in SVF-4005, "SP7 Lifecycle Cost Model Output."

Table 4-10. Key Factors Affecting Lifecycle Cost.

Key Cost Variance Factors	System Plan, Rev. 6 Baseline	System Plan, Rev. 7				
		Case 1	Case 2	Case 3	Case 4	Case 5
SST/DST Items						
SST Retrieval Water Usage	SVF-1647 Rev. 3d (Basis)	SVF-1647 Rev. 5 (Increase)	SVF-1647 Rev. 5 (Increase)	SVF-1647 Rev. 5 (Increase)	SVF-1647 Rev. 5 (Increase)	SVF-1647 Rev. 5 (Increase)
SST Retrieval Timing	Basis	Projected to Start Later	Projected to Start Later	Projected to Start Later	Projected to Start Later	Projected to Start Later
Farm Closure Timing	Basis	Projected to End Later	Projected to End Much Later (Tied to TWCSF Size)	Projected to End Much Later (Tied to TWCSF Size)	Projected to End Much Later (Tied to TWCSF Size)	Projected to End Later
DST 241-AY-102 Retrieval Included	No	Yes	Yes	Yes	Yes	Yes
Loss of DSTs for Use (Other than 241-AY-102)	N/A	N/A	N/A	N/A	5	N/A
New DSTs	No	No	No	42	No	8
DST Equipment Installation Timing	Basis	Slight Delay	Slight Delay	Slight Delay	Slight Delay	Significant Delay
Waste Treatment Items						
WTP Startup	Together	Together	Staggered	Staggered	Staggered	Staggered
Timing of WTP Startup	Basis	Basis	Delay	Significant Delay	Delay	Delay
LAWPS/TWCSF Included	No	No	Yes	Yes	Yes	Yes
TWCSF Tank Size	N/A	N/A	250 kgal	250 kgal	250 kgal	500 kgal
Treatment Duration (PT to End[a])	23 years	31 years	39 years	47 years	47 years	29 years
Model and Cost Basis Items						
Modeling Assumptions Basis	FY 2011	FY 2014	FY 2014	FY 2014	FY 2014	FY 2014
PMB Used	FY 2011	FY 2014	FY 2014	FY 2014	FY 2014	FY 2014
Mission Duration (Starting FY 2014)	34 years	42 years	57 years	70 years	66 years	49 years

[a] Cases 2 through 5 start partial treatment (WTP LAW) earlier than PT Facility operation. The duration between the start of LAW Facility operations and the start of PT Facility operations is as follows: Case 2 = 6 years, Case 3 = 5 years, Case 4 = 6 years, Case 5 = 7 years.

DST	double-shell tank
FY	fiscal year
LAW	low-activity waste
LAWPS	Low-Activity Waste Pretreatment System
N/A	not applicable
PMB	performance measurement baseline
PT	Pretreatment (Facility)
SST	single-shell tank
TWCSF	Tank Waste Characterization and Staging Facility
WTP	Waste Treatment and Immobilization Plant

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5.0 CONTINGENCY PLAN

Milestone M-062-40 requires that:

> The [System] Plan will identify and consider possible contingency measures to address ...risks...

This section is a contingency discussion focused on six specific risks stated in milestone M-062-40, listed in Table 5-1. While the language of the milestone does not require that the contingency measures are based on scenarios or sensitivity analysis, all five scenarios selected for SP7 address contingency planning. Contingency measures may include changes to the overall mission flowsheet, such as adding or removing a facility, increasing capacity, improving glass formulations, or other actions.

Table 5-1. Risks from Milestone M-062-40 Addressed by System Plan, Rev. 7.

Risk	Supporting Cases
SST Integrity	Case 1, Case 3, Case 4, Case 5
Retrievals Take Longer	Case 3, Case 4, Case 5
DST Space	Case 1, Case 2, Case 3, Case 4, Case 5
Delayed WTP Cold Commissioning	Case 1A, Case 2, Case 2A, Case 3, Case 4, Case 5
Delayed WTP Hot Start	Case 1A, Case 2, Case 2A, Case 3, Case 4, Case 5
WTP Treatment Rates	Case 1A, Case 2, Case 2A, Case 3, Case 4, Case 5

DST double-shell tank
SST single-shell tank
WTP Waste Treatment and Immobilization Plant

ORP performs contingency planning using a formal risk and opportunity management process (TFC-PLN-39). However, this section is not intended to provide as much detail as the WTP or WRPS R&OMPs (TFC-PLN-39), and it is not an all-inclusive mission contingency plan. This section is a compilation of the contingency measures that were identified and considered in SP7 with a focus on milestone M-062-40 requirements.

Note that for the purposes of SP7, only Case 1 was intended to meet Consent Decree milestone dates. In general, Cases 2 through 5 were never intended to meet those milestones (although Case 3 was intended to meet the SST retrieval completion date), but they still present opportunities to address contingency planning.

5.1 SINGLE-SHELL TANK INTEGRITY

Milestone M-062-40 language:

> The [System] Plan will identify and consider possible contingency measures to address the following risks:
>
> - Results from SST integrity evaluations.

5.1.1 Identification of Possible Contingency Measures

If results from SST integrity evaluations indicate a change in tank integrity status, possible contingency measures might include:

- Continuing the SSTIP (Cases 1 through 5)
- Transferring waste from a leaking tank to a WRF for temporary storage (Cases 1 through 5)
- Permitting, designing, constructing, and operating new DSTs (Case 3 and Case 5)
- Adjusting waste retrieval plans to accommodate emergent leaks in SSTs (Case 4).

5.1.2 Consideration of Possible Contingency Measures

The scope of all five cases incorporates the current results of the SSTIP (for details, refer to Section 3.1.1), which provides for the monitoring and inspection of the Hanford SSTs, in order to identify tanks that may be experiencing liquid intrusion or leakage. Waste retrieval operations necessarily involve the addition of some liquid to the tank to mobilize the waste. However, retrieval methods for each tank are selected based, in part, on the integrity of the tank; retrieval technologies that require less water are expected to be deployed in tanks where the risk of leakage is higher. This approach incorporates the results of SST integrity evaluations in waste retrieval planning and execution in accordance with the milestone, and is included in HTWOS modeling for the System Plan.

All five cases include design, construction, and operation of WRFs in the 200 East Area, and four of the five cases include WRFs in the 200 West Area. The only exception is Case 3, in which new DSTs are built in the 200 West Area instead of constructing a WRF. These WRFs could be used to provide temporary storage for waste retrieved from a leaking tank.

Case 3 evaluated the effectiveness of constructing and operating new DSTs in the 200 West Area to support SST retrievals in T Complex and 241-U Tank Farm, in the event that the startup of the WTP is delayed (refer to Section 4.3). New DSTs could also be considered a contingency measure for SST integrity evaluations that indicate compromised tank integrity for SSTs in T Complex or 241-U Tank Farm. The major trade-off of this option is the lifecycle cost impact, which is estimated to be $4.3 billion for the design, construction, and permitting of 42 new DSTs. Although not explicitly modeled, it can be inferred that if a new evaporator were built in conjunction with the new DSTs, fewer DSTs may be necessary.

Case 4 evaluated the impact of emergent leaking SSTs during the course of the RPP mission.[46] For emergent leaking SSTs located in farms being actively retrieved at the time the leak is discovered, contingency measures include installation of waste retrieval equipment within 18 months and moving the tank up in the retrieval queue to be the next tank retrieved in that farm. For emergent leaking SSTs *not* located in farms being actively retrieved at the time the leak is discovered, contingency measures include installation of a water impermeable surface barrier over the affected portion of the farm.

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[46] Case 4 also evaluated the impact of emergent leaking DSTs. For details regarding contingency planning for this aspect of Case 4, refer to Section 5.3.

Cases 3, 4, and 5 also included a case-specific assumption that differs from the model starting assumptions regarding simultaneous retrievals. For the purposes of these cases, up to six simultaneous SST retrievals were allowed at one time,[47] whereas model starting assumption B3.3.3.3 aligns with RPP-PLAN-40145, which allows only two or three simultaneous retrievals. Increasing the number of simultaneous retrievals allowed helps to accelerate the overall SST retrievals schedule (provided DST receivers are available), and would likely allow emergent leaking SSTs to be emptied earlier than originally planned.

5.1.3 Status of Contingency Measures

Possible loss of SST integrity is a known risk and is addressed by the Risk and Opportunities Management Program. Section 3.1.1 of this SP7 provides additional information on the SSTIP, which is ongoing.

The pursuit of new DSTs as a contingency measure would require additional detailed engineering analysis, in compliance with DOE O 413.3B. The decision to construct additional tanks may need to be made as much as 8 years prior to the desired operational date to allow sufficient time for permitting, design, construction, and startup testing.

Accelerating the installation of waste retrieval equipment on an emergent leaking tank, and accelerating the schedule for executing retrieval activities for that tank, would likely be dependent upon project resource availability at the time.

The cost and schedule impacts of installing water impermeable surface barriers over underground tanks in Case 4 were estimated based on the actual cost and schedules required to install interim surface barriers over 241-T Tank Farm in 2008 and 241-TY Tank Farm in 2010. To date, no retrievals have been conducted through those interim barriers, so the impact of an interim surface barrier on future retrievals is unknown.

Opportunities to increase the number of simultaneous retrievals will be evaluated via future revisions of RPP-PLAN-40145 and future System Plans, with consideration of available resources, physical limitations within the tank farms, and available DST receipt capacity within the RPP system.

5.2 RETRIEVALS TAKE LONGER

Milestone M-062-40 language:

> The [System] Plan will identify and consider possible contingency measures to address the following risks:
>
> - If retrievals take longer than originally anticipated and there is a potential impact to the schedule for retrieving specified tanks under this agreement.

5.2.1 Identification of Possible Contingency Measures

This risk focuses on the time required to retrieve the waste from a given SST. A lengthy retrieval may be a symptom of a retrieval technology that is not efficient at mobilizing and

[47] For Cases 3, 4, and 5, refer to Assumptions B4.3.4.3.3, B4.4.4.3.2, and B4.5.4.3.2, respectively.

retrieving the waste in that particular tank. At that point, it would be appropriate to consider deploying a different, more suitable technology.

5.2.2 Consideration of Possible Contingency Measures

A variety of waste retrieval technologies have been deployed in 241-C Tank Farm (refer to Table 3-2). Several tanks were only successfully retrieved after two, or even three different technologies were deployed. This is indicative of the complexity of the waste itself, and is a situation likely to be repeated as retrieval operations move into other farms.

All cases use the latest revision of RPP-PLAN-40145, which identifies waste depths per SST over which each of the identified retrieval technologies is anticipated to be successful.

5.2.3 Status of Contingency Measures

As more information becomes available from SST retrievals, RPP-PLAN-40145 will be updated to give the greatest possibility of successful retrievals. This information is integrated into System Plans, with consideration of available resources, physical limitations within the tank farms, and available DST receipt capacity within the RPP system.

5.3 DOUBLE-SHELL TANK SPACE

Milestone M-062-40 language:

> The [System] Plan will identify and consider possible contingency measures to address the following risks:
>
> - If DST space is not sufficient or is not available to support continued retrievals on schedule.

5.3.1 Identification of Possible Contingency Measures

If existing DST space is not sufficient, possible contingency measures might include:

- Sending potential CH-TRU waste to a supplemental treatment facility, and not to the WTP (Case 1 and Case 2)
- Permitting, designing, constructing, and operating new DSTs in 200 West Area (Case 3)
- Adjusting waste retrieval plans to accommodate emergent leaks in DSTs (Case 4)
- Permitting, designing, constructing, and operating new DSTs in 200 East Area and 200 West Area (Case 5)
- Decreasing the sampling hold time for the evaporator feed from 120 days to 60 days for dilute waste anticipated to be well characterized (Case 5)
- Reevaluating current restrictions on DST fill limits.

5.3.2 Consideration of Possible Contingency Measures

In Cases 1 and 2, the potential CH-TRU waste currently stored in 11[48] SSTs is retrieved and treated in a proposed supplemental TRU treatment facility, then disposed of offsite. If implemented, this disposition path would allow approximately 1,265 kgal (HNF-EP-0182, Rev. 316.) of waste to be treated and disposed outside of the RPP system, thereby not impacting limited DST space.

In Case 3, 42 new DSTs were predicted to be needed to support SST retrievals in the T Complex and 241-U Tank Farm. The major trade-off of this option is the lifecycle cost impact, which is estimated to be $4.3 billion for the design, construction, and permitting of 42 new DSTs. Although not explicitly modeled, it can be inferred that if a new evaporator were built in conjunction with the new DSTs, fewer DSTs may be necessary.

In Case 4, contingency measures for emergent leaking DSTs include removing the affected tank from service, and transferring the tank inventory to another DST or to the TWCSF, as appropriate. This necessarily reduces the available storage capacity in the DST system. During some periods, 242-A Evaporator operations can compensate for the lost space. However, when DST receiver space is not available, the SST retrieval schedule may be extended.

In Case 5, two new DST farms are built: a DST farm in the 200 East Area with four DSTs to be used as cross-site transfer receivers, SST retrieval receivers, or any other required function to enable WTP to operate at the highest throughput; and a DST farm in the 200 West Area with four DSTs to support SST retrievals there.

In addition, increasing DST space may be facilitated by more quickly concentrating dilute waste. Case 5 notes that the WTP offgas effluent is a well characterized stream, such that the 242-A Evaporator hold time can be reduced, allowing DST space to be recovered more quickly prior to the start of PT Facility operations.

All cases added more than 70 inches of settled solids to 241-AN-101 and 241-AN-106 for 241-C Tank Farm waste retrieval. It may be possible to add more settled solids to some DSTs than is currently allowed. However, this would have to be formally evaluated within the boundaries of the Waste Compatibility Program, with consideration of emergency space requirements, and in light of additional future expenses related to the purchase, installation, operation, and eventual decommissioning of incrementally, insertable mixer pumps.

5.3.3 Status of Contingency Measures

A project to design the proposed supplemental TRU treatment facility was put on standby in 2005. Resumption of project activities will require additional resources. Refer to Section 3.2.1 for additional details.

The pursuit of the new DSTs as a contingency measure would require additional detailed engineering analysis, in compliance with DOE O 413.3B. The decision to construct additional tanks may need to be made as much as 8 years prior to the desired operational date to allow sufficient time for permitting, design, construction, and startup testing.

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[48] Refer to Assumption B3.5.2.2 for the list of tanks

Consolidation of waste from an emergent leaking DST into a sound DST or TWCSF tank would be subject to compliance with existing waste transfer compatibility assessments, space availability, and other requirements. Compensatory operation of the 242-A Evaporator is also subject to current facility requirements, and may, or may not, be sufficient to balance the lost space.

Enabling additional settled solids volumes in additional DSTs would be subject to mixing studies, physical limitations within the tank farms, and available DST receipt capacity within the RPP system.

5.4 DELAYED WASTE TREATMENT AND IMMOBILIZATION PLANT COLD COMMISSIONING

Milestone M-062-40 language:

> The [System] Plan will identify and consider possible contingency measures to address the following risks:
>
> - If any portion of the WTP does not initiate cold commissioning on schedule.

5.4.1 Identification of Possible Contingency Measures

Contingency measures for a delay in cold commissioning are identified with regard to their impact on hot commissioning, if the delay cascades to affect the WTP hot start (see Section 5.5.1).

5.4.2 Consideration of Possible Contingency Measures

See Section 5.5.2.

5.4.3 Status of Contingency Measures

See Section 5.5.3.

5.5 DELAYED WASTE TREATMENT AND IMMOBILIZATION PLANT HOT START

Milestone M-062-40 language:

> The [System] Plan will identify and consider possible contingency measures to address the following risks:
>
> - If any portion of the WTP does not complete hot start on schedule.

5.5.1 Identification of Possible Contingency Measures

If any portion of WTP does not complete hot start on schedule, possible contingency measures might include:

- Improving the HLW and LAW GFMs (Cases 1A and Case 2A)
- Implementing direct feed flowsheets (Case 2, Case 3, Case 4, and Case 5)

- Permitting, designing, constructing, and operating new DSTs (Case 3 and Case 5).

5.5.2 Consideration of Possible Contingency Measures

Sensitivity Case 1A and Sensitivity Case 2A illustrate the processing improvements that may be possible if better glass formulations are developed. These two cases mirrored the flowsheets presented in Case 1 and Case 2, respectively, except that the LAW Facility and the HLW Facility glass outputs were predicted using the advanced GFMs (refer to Appendix C for more details). Advanced GFMs predicted that the total number of IHLW canisters and ILAW containers would be reduced, and the mission length correspondingly shortened (refer to Sections 4.1.6 and 4.2.6).

Case 2, Case 3, Case 4, and Case 5 illustrate four variations of a *direct feed* flowsheet, in which the start of radioactive operations for LAW vitrification, HLW vitrification, and pretreatment at the WTP are staggered (as opposed to the simultaneous startup of all three facilities as envisioned in Case 1 and Case 1A). This approach to startup would have several benefits:

- Waste processing through the LAW Facility and the HLW Facility could begin prior to resolution of the technical issues associated with the PT Facility.
- Resources can be focused on starting one facility at a time.
- Personnel would be able to gain operating experience in the (comparatively) less complex LAW Facility before moving on to the progressively more complex HLW Facility, and then the PT Facility.

The possible availability of new DSTs could provide some additional support for SST retrievals, DST waste mitigations (required for many of the existing DSTs prior to being used to store additional supernate or SST waste), and 242-A Evaporator operations. However, building new DSTs would come at considerable expense of both time and funding.

5.5.3 Status of Contingency Measures

The 2009 GFM for HLW glass and the 2004 GFM for LAW glass are still the default models in HTWOS, but two advanced GFMs, one for LAW glass and one for HLW glass, have been added. The new models incorporate data from a wider variety of simulated waste glasses than were previously available and utilize a forward-looking approach to the development of future glass formulation technology. This allows the models to formulate projected WTP waste glasses over a wider range of compositions and properties than was formerly possible. Refer to Appendix C for additional details.

The direct feed flowsheet for the RPP system is a departure from the current Baseline, as described in SP6. ORP provided a preliminary description of direct feed processing in the Framework document (DOE 2013) and Ecology elected to incorporate it in four of their five cases for SP7.

Case 3 and Case 5 include new DSTs. The pursuit of new DSTs as a contingency measure would require additional detailed engineering analysis, in compliance with DOE O 413.3B. The decision to construct additional tanks may need to be made as much as 8 years prior to the desired operational date to allow sufficient time for permitting, design, construction, and startup testing.

5.6 WASTE TREATMENT AND IMMOBILIZATION PLANT TREATMENT RATES

Milestone M-062-40 language:

> The [System] Plan will identify and consider possible contingency measures to address the following risks:
>
> - If operation of the WTP does not meet treatment rates that are adequate to complete retrievals under the schedule in this agreement. For example, the contingency measures will address estimated pretreatment facility throughput as affected by ultrafiltration capacity and oxidative leaching requirements.

5.6.1 Identification of Possible Contingency Measures

If operation of the WTP does not meet anticipated treatment rates, contingency measures might include:

- Improving the glass formulation to increase the waste oxide loading (Case 1A and Case 2A)
- Implement direct feed flowsheets (Case 2, Case 3, Case 4, and Case 5).

5.6.2 Consideration of Possible Contingency Measures

The SP6 Baseline Case addressed changes to the pretreatment ultra-filter capacity and oxidative leaching requirements as outlined in the milestone language.

Sensitivity Case 1A and Sensitivity Case 2A illustrate the processing improvements that may be possible if better glass formulations are developed. These two cases mirrored the flowsheets presented in Case 1 and Case 2, respectively, except that the LAW Facility and the HLW Facility glass outputs were predicted using the advanced GFMs (refer to Appendix C for more details). The advanced GFMs predicted that the total number of IHLW canisters and ILAW containers would be reduced, and the mission length correspondingly shortened (refer to Sections 4.1.6 and 4.2.6).

Case 2, Case 3, Case 4, and Case 5 illustrate four variations of a *direct feed* flowsheet, in which the start of radioactive operations for LAW vitrification, HLW vitrification, and pretreatment at the WTP are staggered (as opposed to the simultaneous startup of all three facilities as envisioned in Case 1 and Case 1A). This approach requires the addition of two new facilities, the LAWPS and the TWCSF, to provide pretreatment to the tank waste before it can be delivered to either the LAW Facility or the HLW Facility, respectively. However, even after the PT Facility begins operating, the LAWPS would remain in standby mode, ready to provide waste pretreatment capacity in the event that the PT Facility is unable to do so (e.g., a planned outage). As configured, the TWCSF would also remain online as the required location for all waste (other than from the dedicated LAW DSTs) prior to delivery to the PT Facility. The advantage of continued use of the TWCSF is more complete mixing and sampling prior to delivery of waste slurry to the WTP facilities. The long-term availability of the LAWPS and the TWCSF are expected to offset or eliminate downturns in PT Facility throughput by allowing waste to be staged to feed the LAW Facility or the HLW Facility directly, if needed.

5.6.3 Status of Contingency Measures

The 2009 GFM for HLW glass and the 2004 GFM for LAW glass are still the default models in HTWOS, but two advanced GFMs, one for LAW glass and one for HLW glass, have been added. The new models incorporate data from a wider variety of simulated waste glasses than were previously available and utilize a forward-looking approach to the development of future glass formulation technology. This allows the models to formulate projected WTP waste glasses over a wider range of compositions and properties than was formerly possible. Refer to Appendix C for additional details.

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6.0 REFERENCES

04-TPD-059, 2004, "Request for Exception to the Hanford Federal Facility Agreement and Consent Order (HFFACO) Waste Retrieval Criteria, Retrieval Data Reports for Single-Shell Tank 241-C-106; HFFACO Milestones M-45-00 and M-45-05H, and Target Dates M-45-05L-T01 and M-45-05M-T01," (letter from R. J. Schepens to M. A. Wilson, June 3), U.S. Department of Energy, Office of River Protection, Richland, Washington.

07-TPD-027, 2007, "Submittal of Retrieval Data Report (RDR) for Single Shell Tank 241-C-103, RPP-RPT-33060, Revision 0," (letter from S. J. Olinger to M. A. Bussell, May 22), U.S. Department of Energy, Office of River Protection, Richland, Washington.

07-TPD-066, 2007, "Submittal of Retrieval Data Report (RDR) for Single-Shell Tank 241-S-112, RPP-RPT-35112, Revision 0," (letter from S.J. Olinger to J. Hedges, December 21), U.S. Department of Energy, Office of River Protection, Richland, Washington.

10-TPD-163, 2010, "Completion of Interim Stabilization (IS) of Single-Shell Tank (SST) 241-S-102 Under Interim Stabilization Consent Decree Case No. CT-99-5076-EFS," (letter from D.A. Brockman to J.A. Hedges, December 9), U.S. Department of Energy, Office of River Protection, Richland, Washington.

12-NWP-178, 2012, "Department of Ecology Response to the United States Department of Energy's Letter 12-TF-0037, dated September 4, 2012, and Practicability Evaluation Request to Forego a Third Retrieval Technology for Tank 241-C-108, RPP-52290, Rev. 1," (letter from J.A. Hedges to T.W. Fletcher, November 16), Washington State Department of Ecology, Olympia, Washington.

12-TF-0037, 2012, "Request for Ecology Agreement that the U.S. Department of Energy (DOE), Office of River Protection (ORP) May Forego Implementing a Third Technology in Tank 241-C-108," (letter from T.W. Fletcher to J.A. Hedges, September 4), U.S. Department of Energy, Office of River Protection, Richland, Washington.

13-TF-0018, 2013, "The US Department of Energy, Office of River Protection Submits the Retrieval Completion Certification and Report for Tank 241-C-104," (letter from T.W. Fletcher to J.A. Hedges, March 21), U.S. Department of Energy, Office of River Protection, Richland, Washington.

13-TF-0025, 2013, "The US Department of Energy, Office of River Protection Submits the Retrieval Completion Certification Report for Tank 241-C-108," (letter from T.W. Fletcher to J.A. Hedges, May 1), U.S. Department of Energy, Office of River Protection, Richland, Washington.

13-TF-0037, 2013, "The US Department of Energy (DOE), Office of River Protection (ORP) Submits the Retrieval Completion and (sic) Report for Tank 241-C-109," (letter from K.W. Smith to J.A. Hedges, June 4), U S. Department of Energy, Office of River Protection, Richland, Washington.

13-TF-0120, 2013, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Data Report for Tank 241-C-108," (letter from K.W. Smith to J.A. Hedges,

November 27), U.S. Department of Energy, Office of River Protection, Richland, Washington.

13-TPD-0070, 2013, "Completion of Hanford Federal Facility Agreement and Consent Order Milestone M-062-40C, to Select a Minimum of Three Scenarios and Partial Completion of Milestone M-062-40," (correspondence from K.W. Smith and J.A. Hedges to D. A. Faulk, December 12), U.S. Department of Energy, Office of River Protection, Richland, Washington.

14-TF-0007, 2014, "The US Department of Energy (DOE), Office of River Protection Submits the Retrieval Completion Certification and (sic) Report for Tank 241-C-110," (letter from K.W. Smith to J.A. Hedges, January 29), U.S. Department of Energy, Office of River Protection, Richland, Washington.

14-TF-0012, 2014, "Request for Washington State Department of Ecology Agreement that the U.S. Department of Energy, Office of River Protection May Forego Implementing a Third Retrieval Technology in Tank 241-C-101," (letter from K.W. Smith to J.A. Hedges, February 18), U.S. Department of Energy, Office of River Protection, Richland, Washington.

14-TF-0013, 2014, "The U.S. Department of Energy, Office of River Protection Submits the Retrieval Data Report for Tank 241-C-104," (letter from K.W. Smith to J.A. Hedges, February 18), U.S. Department of Energy, Office of River Protection, Richland, Washington.

14-TF-0020, 2014, "The US Department of Energy (DOE), Office of River Protection (ORP) Submits the Retrieval Data Report for Tank 241-C-109," (letter from K.W. Smith to J.A. Hedges, March 13), U S. Department of Energy, Office of River Protection, Richland, Washington.

14-TPD-0003, 2014, "Contract No. DE-AC27-08RV14800 – Approval to Use Washington State Department of Ecology's Appendix B, 'Key Assumptions and Success Criteria,' for the ORP-11242, *River Protection Project System Plan*, Rev. 7," (letter from T.W. Fletcher to W.C. Clark, February 11), U.S. Department of Energy, Office of River Protection, Richland, Washington.

78 FR 15358, 2013, "DOE's Preferred Alternative for Certain Tanks Evaluated in the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington," *Federal Register*, Vol. 78, No. 47, pp. 15358-15359 (March 11).

78 FR 75913, 2013, "Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington: Record of Decision," *Federal Register*, Vol. 78, No. 240, pp. 75913-75919 (December 13).

99-AMPD-006/CCN 9952261 A, 1999, "Contract No. DE-AC06-96RL13200 – Planning Guidance Revisions for Development of Contract Deliverables Required by Performance Agreement TWR1.3.5," (letter from W.J. Taylor to R.D. Hanson, Fluor Daniel Hanford, Inc., April 1), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

24590-WTP-ICD-MG-01-019, 2013, *ICD 19 – Interface Control Document for Waste Feed,* Rev. 6, Bechtel National, Inc., Richland, Washington.

24590-WTP-RPT-PET-10-005, 2010, *Feed Receipt Vessel Mixing Design Best Value Study – Tank Farms Transfers*, Rev. 0, Bechtel National, Inc., Richland, Washington.

24590-WTP-RPT-PT-02-005, 2013, *Flowsheet Bases, Assumptions, and Requirements*, Rev. 7, Bechtel National, Inc., Richland, Washington.

0075083, 2008, "Department of Ecology Letter of Completion for Retrieval Data Reports (RDR) for Single-Shell Tanks (SST) 241-C-103, 241-C-201, 241-C-202, 241-C-203, and 241-C-204," (letter from J. J. Lyon to S. J. Olinger, January 7), Washington State Department of Ecology, Olympia, Washington.

Atomic Energy Act of 1954, 42 U.S.C. 2011, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

Consent Decree, 2010, State of Washington v. DOE, Case No. 08-5085-FVS (October 25), Eastern District of Washington.

Consent Decree – First Amendment, 1999, State of Washington, Department of Ecology v. United States Department of Energy, Case No. CT-99-5076-EFS (September 29), Eastern District of Washington.

Contract No. DE-AC27-01RV14136, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, U.S. Department of Energy, Washington, D.C., as amended through A164 (April 5, 2010).

Contract No. DE-AC27-08RV14800, *Tank Operations Contract*, conformed through modification 234, U.S. Department of Energy, Office of River Protection, Richland, Washington.

Contract No. DE-AC27-10RV15051, *Laboratory Analytical Services and Testing Contract*, conformed through contract modification 032, Advanced Technologies and Laboratories International, Inc., U.S. Department of Energy, Office of River Protection, Richland, Washington, as amended.

Dhaliwal, T.K., 2014-02-12, "Demarcation Date," (email to M.N. Wells), Washington River Protection Solutions LLC, Richland, Washington.

DOE 2013, *Hanford Tank Waste Retrieval, Treatment, and Disposition Framework*, <http://energy.gov/downloads/hanford-tank-waste-retrieval-treatment-and-disposition-framework>, U.S. Department of Energy, Washington, D.C., September 24

DOE M 435.1-1 Chg 2, 2011, *Radioactive Waste Management Manual*, U.S. Department of Energy, Washington, D.C.

DOE O 413.3B, 2010, *Program and Project Management for the Acquisition of Capital Assets*, Change 1, U.S. Department of Energy, Washington, D.C.

DOE O 435.1, 1999, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

DOE/EIS-0391, 2012, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, U.S. Department of Energy, Office of River Protection, Richland, Washington.

DOE/RL-2007-06, 2007, *Work Plan for Disposal of Hanford Waste at the Environmental Restoration Disposal Facility*, Rev. 0, U.S. Department of Energy, Richland, Washington.

DOE/RL-2012-57, 2012, *Annual Summary of the Integrated Disposal Facility Performance Assessment 2012*, U.S. Department of Energy, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

HNF-EP-0063, 2011, *Hanford Site Solid Waste Acceptance Criteria*, Rev. 16, CH2M HILL Plateau Remediation Company, Richland, Washington.

HNF-EP-0182, 2014, *Waste Tank Summary Report for Month Ending April 30, 2014*, Rev. 316, Washington River Protection Solutions LLC, Richland, Washington.

HNF-SD-RE-TI-178, 2005, *Single-Shell Tank Interim Stabilization Record*, Rev. 9, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-SD-WM-OCD-015, 2011, *Tank Farms Waste Transfer Compatibility Program*, Rev. 23, Washington River Protection Solutions LLC, Richland, Washington.

MMR-14-038, 2014, *System Plan 7 Case 5 – Consequences of Limited Funding*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

National Environmental Policy Act of 1969, 42 U.S.C. 4321, et seq.

Nuclear Waste Policy Act of 1982, 42 U.S.C. 10101, et seq.

PBS ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition"

HG-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository"

ORP-11242, 2011, *River Protection Project System Plan*, Rev. 6, U.S. Department of Energy, Office of River Protection, Richland, Washington.

OSD-T-151-00007, 2013, "Operating Specifications for the Double-Shell Storage Tanks," Rev. 12, Washington River Protection Solutions LLC, Richland, Washington.

OSD-T-151-00031, 2014, "Operating Specifications for Tank Farm Leak Detection and Single-Shell Tank Intrusion Detection," Rev. 5, Washington River Protection Solutions LLC, Richland, Washington.

PNNL-18196, 2009, *Hanford Site Secondary Waste Roadmap*, Pacific Northwest National Laboratory, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

RPP-6213, 2005, *Hanford Waste Tank Bump Accident and Consequence Analysis*, Rev. 4, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-7771, 2001, *Flammable Gas Safety Issue Resolution*, Rev. 0A, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-13033, 2014, *Tank Farms Documented Safety Analysis*, Rev. 5E, Washington River Protection Solutions LLC, Richland, Washington.

RPP-17152, 2014, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.7 Model Design Document*, Rev. 9, Washington River Protection Solutions LLC, Richland, Washington.

RPP-20110, 2004, *Stage 1 Retrieval Data Report for Single-Shell Tank 241-C-106*, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-20577, 2007, *Stage II Retrieval Data Report for Single-Shell Tank 241-C-106,* Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-22393, 2013, *241-C-102, 241-C-104, 241-C-107, 241-C-108, and 241-C-112 Tanks Waste Retrieval Work Plan,* Rev. 7, Washington River Protection Solutions LLC, Richland, Washington. (Also refer to Change Notice 2014-02, received by Ecology June 5, 2014.)

RPP-23584, 2004, *Safety Evaluation of Waste Gel in the Tank Farms*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-32681, 2013, *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington.

RPP-33715, 2014, *Double-Shell and Single-Shell Tank Inventory Input to the Hanford Tank Waste Operation Simulator Model – 2014 Update*, Rev. 6, Washington River Protection Solutions LLC, Richland, Washington.

RPP-34544, 2008, *Cost Benefit Analysis for Immobilized High-Level Waste Storage*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-40149-VOL1, 2012, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Strategy*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington, January.

RPP-40149-VOL2, 2012, *Integrated Waste Feed Delivery Plan, Volume 2 – Campaign Plan*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington, January.

RPP-40149-VOL3, 2012, *Integrated Waste Feed Delivery Plan, Volume 3 – Project Plan*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington, January.

RPP-40545, 2014, *Quantitative Assumptions for Single-Shell Tank Waste Retrieval Planning*, Rev. 3, Washington River Protection Solutions LLC, Richland, Washington.

RPP-51303, 2012, *River Protection Project Functions and Requirements*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-51471, 2013, *One System IPT Charter*, Rev. 4, Washington River Protection Solutions LLC, Richland, Washington.

RPP-53359, 2012, *One System River Protection Project Mission Functional Analysis*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-53823, 2013, *Retrieval Completion Certification for Tank 241-C-104*, Rev. 2A, Washington River Protection Solutions LLC, Richland, Washington.

RPP-53824, 2013, *Retrieval Completion Certification Report for Tank 241-C-109*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-53869, 2013, *Retrieval Completion Certification and Report for Tank 241-C-108*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington.

RPP-55849, 2014, *Practicability Evaluation Request to Forego a Third Retrieval Technology for Tank 241-C-101*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-56214, *2014, Retrieval Completion Certification Report for Tank 241-C-110,* Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-56408, 2013, *Selected Scenarios for the River Protection Project System Plan, Revision 7*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-40145, 2014, *Single-Shell Tank Waste Retrieval Plan*, Rev. 4, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-41977, 2009, *Single-Shell Tank System Component Identification and Proposed Closure Strategy*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-48151, 2012, *Interim Hanford Storage Project Execution Plan*, Rev. 01A, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-55113, 2013, *March 2013 Single-Shell Tank Waste Level Decrease Evaluation*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-55220, 2013, *241-AY-102 Pumping Plan,* Rev. A, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-56634, 2014, *One System Plan for Developing and Managing the Tank Waste Disposition Integrated Flowsheet*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-24887, 2007, *The Long-Term Management of Tank Waste at Hanford*, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-26475, 2007, *Retrieval Data Report for Single-Shell Tank 241-C-203*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-29095, 2006, *Retrieval Data Report for Single-Shell Tank 241-C-202*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-30181, 2006, *Retrieval Data Report for Single-Shell Tank 241-C-201*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-31148, 2007, *Composite Liquid Mitigation Report*, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-33060, 2007, *Retrieval Data Report for Single-Shell Tank 241-C-103*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-34062, 2007, *Retrieval Data Report for Single-Shell Tank 241-C-204*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-35112, 2007, *Retrieval Data Report for Single-Shell Tank 241-S-112*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-42231, 2009, *Summary of Twenty-Five Miscellaneous Tanks Associated with the Single-Shell Tank System*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-43116, 2009, *Expert Panel Report for Hanford Site Single-Shell Tank Integrity Project*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-44860, 2010, *Mission Analysis Report Waste Feed Delivery Projects East Area Waste Retrieval Facility*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-48092, 2011, *Supplement Treatment Program Technology Readiness Assessment*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-48340, 2011, *Evaluation of Alternative Strontium and Transuranic Separation Processes*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-50024, 2011, *Treatment Project T4S01 Conceptual Design Report*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-50488, 2011, *Project T3W14 Interim Hanford Storage (IHS) Alternative Decision Document*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-50799, 2013, *Suspect Water Intrusion in Hanford Single-Shell Tanks*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-51127, 2012, *Value Engineering Report for Secondary Liquid Waste Treatment Project*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-52176, 2012, *Interim Hanford Storage (T3W14) Conceptual Design Report*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-52480, 2012, *Retrieval Completion Report for Modified Sluicing of Tank 241-C-112*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-54072, 2014, *Retrieval Data Report for Single-Shell Tank 241-C-104,* Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-54964, 2013, *Evaluation of Tank 241-T-111 Level Data and In-Tank Video Inspection*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-54981, 2013, *Evaluation of Fourteen Tanks with Decreasing Level Baselines Selected for Review in RPP-PLAN-55113, Revision 1*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-55263, 2013, *Evaluation of Tank 241-TY-105 Level Data and In-Tank Video Inspection*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-55264, 2013, *Evaluation of Tank 241-T-203 and 241-T-204 Level Data and In-Tank Video Inspection*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-55265, 2013, *Evaluation of Tank 241-B-203 and 241-B-204 Level Data and In-Tank Video Inspection*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-55284, 2014, *Retrieval Data Report for Single-Shell Tank 241-C-109,* Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-55896, 2013, *Retrieval Data Report for Single-Shell Tank 241-C-108*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-56516, 2013, *One System River Protection Project Mission Analysis Report*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-SPEC-56967, 2014, *Project T5L01 Low Activity Waste Pretreatment System Specification,* Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

SVF-1647, 2011, "SVF-1647 Rev 3D Calculation of SST Retrieval Volumes and Durations.xlsx," Rev. 3D, Washington River Protection Solutions LLC, Richland, Washington.

SVF-1647, 2014, "SVF-1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx," Rev. 5, Washington River Protection Solutions LLC, Richland, Washington.

SVF-2361, 2011, "System Plan Rev 6 Lifecycle Cost Model Results.xlsx," Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

SVF-2404, 2014, "SVF-2404 Rev 1 Calculation of Selected SST Retrieval Parameters.xlsx," Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

SVF-4005, 2014, "SP7 Lifecycle Cost Model Output," Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

TF-13-01, 2013, *Justification for Continued Operation for Potential Large Spontaneous Gas Release Event in Deep Sludge*, Washington River Protection Solutions LLC, Richland, Washington.

TFC-ENG-CHEM-D-42, "Tank Leak Assessment Process," Washington River Protection Solutions LLC, Richland, Washington.

TFC-ESHQ-Q_C-C-01, "Problem Evaluation Request," Washington River Protection Solutions LLC, Richland, Washington.

TFC-PLN-39, "Risk and Opportunity Management Plan," Washington River Protection Solutions LLC, Richland, Washington.

TFC-PLN-143, "River Protection Project System Integration Management Plan," Washington River Protection Solutions LLC, Richland, Washington.

Toxic Substances Control Act of 1976, 15 U.S.C. §2601, et seq.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

Waste Isolation Pilot Plant Land Withdrawal Act, HR 3230 (104th Congress), et seq.

WRPS-57232, 2014, *Enterprise Risk and Opportunity Management (EROM) Framework,* Rev. 0, Washington River Protection Solutions LLC, Richland, Washington, June.

WRPS-0900637, 2009, "Contract number DE-AC27-08RV14800 – Washington River Protection Solutions LLC Reaffirmation of Mission Need for Hanford Shipping Facility," (letter from W. J. Johnson to S. J. Olinger, May 6), Washington River Protection Solutions LLC, Richland, Washington.

WRPS-1003366 R1, 2011, "Contract Number DE-AC27-08RV14800 – Washington River Protection Solutions LLC Dedicated Law Transfer System Evaluation Plan, RPP-PLAN-48536, Revision 0," (letter from WRPS to ORP, May 6), Washington River Protection Solutions LLC, Richland, Washington.

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APPENDIX A – GLOSSARY

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APPENDIX A – GLOSSARY

Term or Abbreviation	Definition or Expansion
Assumed Leaker	The integrity classification of a waste storage tank for which surveillance data indicates a loss of liquid attributed to a breach of integrity in the past.
Baseline Case	In System Plan, Rev. 6, the Baseline Case is a mission scenario that forms the technical basis for both the near-term baseline and the out-year planning estimate range. For purposes of System Plan, Rev. 7, the term "Baseline Case" refers to a reference case that is modified with additional Washington State Department of Ecology-defined assumptions to define additional scenarios. System Plan, Rev. 7 does not form the technical basis for either the near-term baseline or the out-year planning estimate range because of uncertainties in the baseline as a result of currently unresolved technical issues at the Waste Treatment Plant (WTP).
Bulk Retrieval	The retrieval of waste down to any hard-to-remove heel encountered in the tank.
Buoyant Displacement Gas Release Event (BDGRE)	Tank waste generates flammable gases through the radiolysis of water and organic compounds, thermolytic decomposition of organic compounds, and corrosion of the carbon steel tank walls. Under certain conditions, this gas may accumulate in a settled solids layer until the waste becomes hydrodynamically unstable (less dense waste near the bottom of the tank). A BDGRE is the rapid release of this gas, partially restoring hydrodynamic equilibrium. The release may result in the temporary creation of a flammable mixture in the headspace of the tank, depending on the size of the release relative to the size of the tank headspace and capacity of the ventilation system. BDGREs are generally associated with tanks containing low-shear strength salt slurry.
Caustic Leach Factor	The fraction of an analyte in previously washed solids that will go into solution by caustic leaching. The term, caustic leach factor, as used in this System Plan, Rev. 7, is technically a *differential* caustic leach factor.
Closure	*Closure* is defined as the deactivation and stabilization of a radioactive waste facility intended for long-term confinement of waste (per DOE M 435.1-1, *Radioactive Waste Management Manual*). *Final closure* of the operable units (tank farms) shall be defined as regulatory approval of completion of closure actions and commencement of post-closure actions. For the purpose of this document, all units located within the boundary of each tank farm will be closed in accordance with WAC 173-303-610, "Dangerous Waste Regulations."
Cold Commissioning	This refers to a facility making production runs using agreed-upon simulant waste.
Cross-Site Transfer	The Hanford waste tanks are located in two physically separated areas called *East Area* and *West Area*, about 7 miles apart. The cross-site transfer system is a pair of transfer pipelines and ancillary equipment that is used to transfer supernate and slurry from the West Area to the East Area.
Disposal	Emplacement of waste in such a manner that ensures protection of the public, workers, and the environment with no intention of retrieval and that requires deliberate action to regain access to the waste (DOE M 435.1-1).
Deep Sludge Gas Release Event (DSGRE)	A postulated mechanism for a gas release event in a tank storing a significant depth of high-shear strength sludge waste.

Term or Abbreviation	Definition or Expansion
Facility Availability Factor	Estimates of the total time to treat all tank wastes, with no reliability/availability/maintainability/inspectability failures applied, divided by the total time to treat all tank wastes, with all reliability/availability/maintainability/inspectability failures applied. (Refer to WTP Contract No. DE-AC27-01RV14136, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, Mod 304, Section C, page C-94.)
Feed Vector	The feed vector is a list of the individual feed batches projected to be delivered to a facility (e.g., WTP) and includes the associated waste composition and caustic leach factors.
Gas Release Event	Flammable gases, primarily hydrogen, are generated by tank waste. Hydrogen is generated via hydrolysis of water and organics, thermolytic decomposition of organic compounds, and corrosion of the tank's steel walls. A gas release event is said to occur when flammable gases are released from the waste over an identifiable period of time at rates far exceeding that of gas generation. See also definitions for BDGRE and DSGRE in this Glossary (refer to RPP-13033, *Tank Farms Documented Safety Analysis*, Rev. 5, Section 3.3.2.4.1).
Group A Tank	A tank, because of its waste composition and quantities, has the potential for a spontaneous BDGRE and is conservatively estimated to contain enough flammable gas within the waste that if all were released into the tank headspace, the concentration of the flammable gas would be a flammable mixture.
Hard-to-Remove Heel (HTRH)	A large solid mass or group of large solids not easily removed from the bottom of some large tanks.
High-Level Waste (HLW)	As used in this System Plan, Rev. 7, the term HLW refers to the fraction of the tank waste containing most of the radioactivity that will be immobilized into glass and disposed of at an offsite repository. This includes the solids remaining after pretreatment plus certain separated radionuclides.
High-Level Waste (HLW) Feed	This refers to the slurry stream (sludge plus supernate) that is delivered to a treatment facility (i.e., PT Facility, Tank Waste Characterization and Staging Facility, etc.). Any solids remaining after pretreatment will go to the HLW Facility, along with separated radionuclides.
Hot Commissioning	The phase in which a facility does production runs using actual tank waste.
In-Tank Vehicle	A tracked vehicle used in conjunction with the mobile retrieval system to push or spray tank waste toward the vacuum head inlet for retrieval of single-shell tank waste.
Incidental Blending	This refers to the blending that occurs during the retrieval, staging, storage, and delivery of feed without any special effort other than single-shell tank sequencing. It is sometimes called unavoidable blending.
Intentional Blending	Any blending that is specifically orchestrated and, therefore, requires additional effort. Examples of intentional blending include pairwise blending (blending two tanks at a time), metered blending (where small amounts of a problematic waste are blended into a number of successive feed batches), and the blending of different wastes first segregated according to limiting constituents.

Term or Abbreviation	Definition or Expansion
Interim Stabilized	A tank that contains less than 50,000 gal of drainable interstitial liquid and less than 5,000 gal of supernatant. If the tank was jet pumped to achieve interim stabilization, then the jet pump flow or saltwell screen inflow must also have been at or below 0.05 gallon per minute before interim stabilization criteria are met (refer to CT-99-5076-EFS, *First Amendment to the Consent Decree*).
Landfill-Close	Tanks will be stabilized and an engineered modified RCRA Subtitle C barrier will be put in place followed by post-closure care (refer to DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, Vol. 1, Ch 9.).
Limits of Technology	The recovery rate of a retrieval technology for a tank that is, or has become, limited to such an extent that it extends the retrieval duration to the point at which continued operation of the retrieval technology is not practicable, with the consideration of practicability to include matters such as risk reduction, facilitating tank closures, costs, the potential for exacerbating leaks, worker safety, and the overall impact on the tank waste retrieval and treatment mission. (Consent Decree No. 08-5058-FVS, Appendix C, page 37, lines 16-22.)
Low-Activity Waste (LAW)	Waste that remains following the process of separating as much of the radioactivity as is practicable from HLW. When solidified, LAW may be disposed of as low-level waste in a near-surface facility.
Low-Activity Waste (LAW) Feed	This refers to the liquid stream (supernate plus a small amount of entrained solids) that is delivered to a treatment facility (i.e., PT Facility, Low-Activity Waste Pretreatment System, etc.). After removal of key radionuclides, this supernate and the supernate from the HLW feed will then go to the LAW Facility.
Low-Level Waste (LLW)	Radioactive waste not classified as HLW, transuranic waste, spent nuclear fuel, or byproduct material, as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*.
Mixed Waste	Mixed waste contains both radioactive and chemically hazardous components.
Mobile Arm Retrieval System (MARS)	A robotic arm used to retrieve tank waste, and designed to be able to access all areas of a tank (unless obstructed by an air lift circulator). (Additional details are provided in RPP-PLAN-40145, *Single-Shell Tank Waste Retrieval Plan*.)
Mobile Retrieval System	A vacuum retrieval system used in conjunction with an in-tank vehicle to push or spray waste toward the vacuum head inlet for retrieval of SST waste. (Additional details are provided in RPP-PLAN-40145.)
Modified RCRA Subtitle C Barrier	Landfill cover described by RCRA regulations that also accounts for the unique climatic conditions at the Hanford Site. The design includes layers for foundation and slope, gas collection, drainage, and a low-permeability barrier and cover soil. (Refer to DOE/EIS-0391, Vol. 1, Ch 9.)

Term or Abbreviation	Definition or Expansion
Modified Sluicing	Modified sluicing refers to the addition of water or supernate to a tank for the purposes of dissolving and retrieving salt or retrieving sludge: • Modified sluicing for sludge removal with supernate consists of directing a stream of supernate from one tank onto the sludge of another tank in order to mobilize the slurry and push the slurry to the inlet of a pump. The pump transfers the slurry to a double-shell tank (DST) where the sludge settles out and the liquid is returned to the tank for reuse. • Modified sluicing for sludge removal with water is similar to using supernate, except that a DST pump, shielded transfer lines to the SST, and shielded sluicing equipment are not required. Liquid added to the DST system will require evaporation following retrieval. • Modified sluicing for saltcake dissolution is similar to sluicing with water, except that the solution may have a longer residence time in the tank in order to promote effective saltcake dissolution. (Additional details are provided in RPP-PLAN-40145.)
Retrieval	The process of removing, to the maximum extent practical, all the waste from a given underground storage tank. The retrieval process is selected specific to each tank and accounts for the waste type stored and the access and support systems available. In accordance with OSD-T-151-00031, "Operating Specifications for Tank Farm Leak Detection and Single-Shell Tank Intrusion Detection," a tank is officially in *retrieval status* if one of two conditions is met: (1) waste has been physically removed from the tank by retrieval operations, or (2) preparations for retrieval operations are directly responsible for rendering the leak or intrusion monitoring instrument *out-of-service*.
Retrieval Duration Factor (RDF)	The ratio of the retrieval operating time divided by what the operating time would have been if operations had occurred at 100 percent operating efficiency every shift between retrieval startup and when retrieval was halted (RPP-40545, *Quantitative Assumptions for SST Waste Retrieval Planning*).
Rotary Microfiltration	Membrane-mounted disks rotating at high speeds induce vortex flow near the membrane surfaces, which cause insoluble solids to separate from the waste stream (RPP-RPT-48092, *Supplement Treatment Program Technology Readiness Assessment*, page v).
Saltcake	Saltcake is a mixture of crystalline sodium salts that originally precipitated when alkaline liquid waste from the various processing facilities was evaporated to reduce waste volume. Saltcakes are comprised primarily of the sodium salts of nitrate, nitrite, carbonate, phosphate, and sulfate. Concentrations of transition metals such as iron, manganese, and lanthanum and heavy metals (e.g., uranium and lead) are generally small. Saltcake typically contains a small amount of interstitial liquid. The bulk of the saltcake will dissolve if contacted with sufficient water.

Term or Abbreviation	Definition or Expansion
Sludge	Sludge is a mixture of metal hydroxides and oxyhydroxides that originally precipitated when acid liquid waste from the various reprocessing facilities was made alkaline with sodium hydroxide. Sludge is comprised primarily of the hydroxides and oxyhydroxides of aluminum, iron, chromium, silicon, zirconium, and uranium, plus the majority of the insoluble radionuclides such as strontium-90 and the plutonium isotopes. Sludge typically contains a significant amount of interstitial liquid (up to nominal 40 weight percent water). Sludge is mostly insoluble in water; however, a significant amount of aluminum and chromium will dissolve if leached with sufficient quantities of sodium hydroxide.
Slurry	The term slurry is used in two different contexts: • A mixture of solids, such as sludge or undissolved saltcake, suspended in a liquid. For example, a slurry results when the sludge and supernate in a tank are mixed together. Slurries can be used to transfer solids by pumping them through a pipeline. • A waste produced at Hanford that results from evaporating supernate originally removed from tanks containing saltcake so that aluminum salts begin to precipitate in addition to the sodium salts. This material, called *double-shell slurry* or *double-shell slurry feed*, is present in the DSTs (specifically 241-AN-103, 241-AN-104, 241-AN-105, and 241-AW-101). For simplicity, this System Plan, Rev. 7 will use the term *settled salts* or *saltcake* instead of slurry in this context.
Small-Column Ion Exchange (SCIX)	Ion-exchange technology achieves cesium removal through a selective ion-exchange process, resulting in a LAW stream that could be used to feed a supplemental immobilization facility (RPP-RPT-48092, page vii).
Sound	The integrity classification of a waste storage tank for which surveillance data indicates no loss of liquid from a breach of integrity.
Success Criteria	Metrics that are used to determine how well a scenario meets overall mission goals or requirements, including schedule- and cost-based metrics.
Supernate	Supernate is technically the liquid floating above a settled solids layer. At Hanford, it is typically used to refer to any noninterstitial liquid in the tanks, even if no solids are present. Supernate is similar to saltcake in composition and contains many of the soluble radionuclides such as cesium-137 and technetium-99.
Tank Bump	A tank bump is a postulated event in which gases, primarily water vapor, are suddenly emitted from the waste causing the tank headspace to pressurize from the vaporization of locally superheated liquid.
Tank Waste Treatment Complex	This complex comprises all of the existing and future facilities, pipelines, and infrastructure needed for the storage, retrieval, and treatment of the Hanford tank waste.
Total Operating Efficiency	A measure of the net throughput of a process, facility, or system relative to its design capacity. This can either be estimated from an operations research model, from operating data, or established as a goal. Total operating efficiencies may be reported on a variety of bases, depending on the specific process, facility, or system.

Term or Abbreviation	Definition or Expansion
Transition	In the transition phase of retrieval, the waste slurry concentration steadily declines as the remaining waste volume in the tank is reduced. The transition ends when the waste slurry concentration is reduced to the point at which retrieval with the current equipment is no longer effective, or when additional equipment or technology is deployed to increase the retrieval rate.
Vacuum Retrieval	The VR-200 process, previously used in some tanks in the 241-C Tank Farm, used a mast arm capable of in-and-out, back-and-forth, and rotational motion, which was inserted through a riser near the tank perimeter. A vacuum head covered by a protective screen was used to retrieve waste from the SSTs to a DST. (Additional details are provided in RPP-PLAN-40145.)
Validation	The evaluation of the model to confirm that the model meets the process design requirements, the data accurately reflect the process being simulated, and the model produces results in the range of its intended use.
Verification	Includes the review or testing performed at the completion of a model run or change implementation to confirm that the information has been correctly implemented and that the model executed properly.
Waste Oxide Loading (WOL)	A measure of the quantity of pretreated waste that can be incorporated into a unit mass of glass. The quantity of pretreated waste is on a nonvolatile oxide basis, with all components in their most prevalent oxide form, plus any halogens.
Waste Receiving Facility (WRF)	A future facility used to support the retrieval of waste involving slurry transfers from SSTs that are located too far away to be readily retrieved directly into a DST. The WRF, located near the SSTs, would accumulate and condition retrieved waste before transfer to a DST. Note: The WRF was once referred to as a waste retrieval facility.
Water Wash Factor	The fraction of an analyte in a solid waste phase that dissolves on contact with water either during retrieval or subsequent processing.

APPENDIX B – KEY ASSUMPTIONS AND SUCCESS CRITERIA

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B1.0 GENERAL INFORMATION

The five scenarios presented in System Plan, Rev. 7 (SP7) were selected and defined by the Washington State Department of Ecology (Ecology). Each scenario and its associated assumptions form five cases, listed in Table B-1 that were further developed, modeled, and analyzed. The assumptions used in the system planning effort form a hierarchy, from upper-level assumptions regarding the purpose and intent of a case, down to detailed modeling assumptions and programming techniques. The selected scenarios, including the underlying and scenario-specific assumptions that defined the five cases, were identified and released in RPP-56408, *Selected Scenarios for the River Protection Project System Plan, Revision 7*. The Ecology-selected and -defined cases were transmitted to the U.S. Environmental Protection Agency on December 12, 2013 (13-TPD-0070, "Completion of Hanford Federal Facility Agreement and Consent Order Milestone M-062-40C, to Select a Minimum of Three Scenarios and Partial Completion of Milestone M-062-40").

Table B-1. Cases Selected and Defined by the Washington State Department of Ecology.

Case 1*	Consent Decree Compliant
Case 2*	Direct Feed Low-Activity Waste and Direct Feed High-Level Waste Flowsheet
Case 3	Contingency Case for Waste Treatment and Immobilization Plant Startup Uncertainty
Case 4	Leaking Tanks
Case 5	Consequences of Limited Funding

* An additional sensitivity case has been selected that includes a minor analysis of a variation to the primary case.

Each System Plan is based upon a detailed set of key assumptions and success criteria for each case. The primary set of assumptions defined for SP7 include those defined in the Baseline Case for System Plan, Rev. 6 (SP6) with model improvements and updates which formed the Model Starting Assumptions (Section B3.0). The cases were then further developed by Washington River Protection Solutions LLC with input from Ecology to define the case-specific key assumptions outlined in Section B4.0. This appendix documents Ecology's key assumptions and success criteria for SP7.

The schedule-based success criteria, listed in the Case 1 write-up in Section 4.0 and the case-specific key assumption set for Case 1 in Section B4.0, are a subset of the *Hanford Federal Facility Agreement and Consent Order* and Consent Decree milestones. The funding targets for fiscal year (FY) 2010 through FY 2015 were provided by the U.S. Department of Energy, Office of River Protection (ORP) (Basche 2010) and are consistent with the most recent budget planning guidance and briefing materials. After FY 2015, a reasonable ramp-up could be assumed.

Any changes made by Ecology or at the direction of Ecology to the key assumptions and success criteria outlined in this appendix are discussed on a case-by-case basis and included in the individual case write-ups in Section 4.0 except for the following items that applied to more than a single case:

1. The term Interim Pretreatment System was changed to Low-Activity Waste Pretreatment System (LAWPS)
2. The 2013 glass formulation model (GFM) was renamed from *Enhanced* to *Advanced* GFM
3. Other facility names may have been adjusted to be consistent with the main document and Hanford Tank Waste Operations Simulator (HTWOS) naming scheme
4. Section number references from RPP-17152, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.7 Model Design Document* may have been adjusted to accommodate the final release of Rev. 9.

B2.0 SUCCESS CRITERIA

B2.1 CASE 1

Success criteria are metrics used to evaluate if, or how well, each case meets its intended purpose and includes schedule- and funding-based objectives. For SP7, only Case 1 was required to meet a certain set of success criteria. Changes to process variables, facility capacities, the timing of certain activities, etc. were needed to meet the success criteria and are discussed in the specific case write-up in Section 4.0.

B2.2 CASES 2 THROUGH 5

Cases 2 through 5, however, are not required to meet the success criteria and no changes were made to the assumptions (unless specified in the case discussions in Section 4.0) in order to meet them. Results from Cases 2 through 5 will be compared to the schedule-based success criteria and ORP-provided funding guidance identified in Case 1. The funded and unfunded contingency for Cases 2 through 5 will be held constant (equal to that of Case 1) for purposes of estimating the total lifecycle costs for SP7.

B3.0 MODEL STARTING ASSUMPTIONS

The following set of key assumptions defines the Model Starting Assumptions, and, unless explicitly stated otherwise in Sections B4.1 through B4.5, these assumptions apply to all cases analyzed in SP7.

B3.1 KEY ASSUMPTIONS

Implementation of this set of assumptions into the HTWOS model is described in detail in RPP-17152, Rev. 9, and associated data package, RPP-RPT-56722, *Hanford Tank Waste Operations Simulator Model Data Package for the River Protection Project System Plan Revision 7.*

B3.1.1 Model Starting Assumption Alignment

The Model Starting Assumptions for SP7 align with the following items.

B3.1.1.1 The current Waste Treatment and Immobilization Plant (WTP) flowsheet (24590-WTP-RPT-PT-02-005, *Flowsheet Bases, Assumptions, and Requirements* Rev. 7).

B3.1.1.2 RPP-40149-VOL1, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Strategy*, and RPP-40149-VOL2, *Integrated Waste Feed Delivery Plan, Volume 2 – Campaign Plan.*

B3.1.1.3 RPP-PLAN-40145, *Single-Shell Tank Waste Retrieval Plan*, Rev. 4.

B3.1.1.4 SVF-1647, "SVF-1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx."

B3.1.1.5 High-level waste (HLW) GFM (PNNL-18501, *Glass Property Data and Models for Estimating High-Level Waste Glass Volume*).

B3.1.1.6 Addition of a new dedicated feed line for low-activity waste (LAW) transfers to the WTP.

B3.2 TANK WASTE TREATMENT COMPLEX

The Tank Waste Treatment Complex comprises all existing and future facilities, pipelines, and infrastructure needed to manage, retrieve, process, and dispose of tank waste, and manage system-generated waste. The overall configuration and process flow varies for each case modeled for SP7; refer to each individual case in Section 4.0 for assumptions regarding the Tank Waste Treatment Complex modeled.

B3.3 TANK FARMS

B3.3.1 Single-Shell Tanks

B3.3.1.1 The integrity of the 149 single-shell tanks (SST) is described in HNF-EP-0182, *Waste Tank Summary Report for Month Ending April 30, 2014*, Rev. 316, with pending changes as agreed to with Ecology, ORP, and the Tank Operations Contract (TOC) contractor.

B3.3.1.2 It is assumed that timely approval will be received to support interim closure (tank isolation and filling with grout) of each SST sometime after retrieval of that tank is complete, as further defined in RPP-PLAN-40761, *Integrated Single-Shell Tank Waste Management Area Closure Plan.* Although cost and schedule information for closure activities is reflected in the performance measurement baseline (PMB), closure activities are not modeled in HTWOS.

B3.3.1.3 It is assumed that timely approval will be received to support full closure of each tank farm sometime after all tanks in that farm are closed in the interim.

B3.3.2 Double-Shell Tanks

B3.3.2.1 The integrity of the 28 double-shell tanks (DST) is described in HNF-EP-0182. It is assumed that DSTs will remain fully operational for the duration of the waste treatment mission, with the exception of DST 241-AY-102.

B3.3.2.2 The maximum modeled operating liquid levels for the DSTs are the *normal operating limits* provided in OSD-T-151-00007, *Operating Specifications for the Double-Shell Storage Tanks*, with the exception that the maximum modeled operating level for all 241-AP Tank Farm tanks is increased to 454 inches (1.2465 Mgal). The normal operating limits for Tanks 241-AP-101, 241-AP-103, 241-AP-105, and 241-AP-108 have already been increased to 454 inches It is assumed that the other 241-AP Tank Farm tanks will successfully pass the in-service leak testing required to use this increased operating level (refer to RPP-17152, Section 4.3.4, for more details).

B3.3.2.3 The volume of DST space allocated for tank farm emergencies and emergency returns from WTP is 1.265 Mgal (HNF-3484, *Double-Shell Tank Emergency Pumping Guide*). This space may be distributed among multiple DSTs.

B3.3.2.4 No DST space will be reserved for nonemergency returns of pretreated LAW to the DST system. No DST space will be reserved for nonemergency returns of liquid effluents to the DST system.

B3.3.2.5 Insoluble solids retrieved from SSTs are assumed to settle to approximately 40 weight percent (wt%) solids in the DSTs, except for 241-C Tank Farm. Insoluble solids retrieved from 241-C Tank Farm are assumed to settle to a solids loading comparable to that in the source SST. The solids settling endpoints in HTWOS may be refined. Any refinements completed are documented in of RPP-17152, Section 4.3.5.

B3.3.2.6 The solids management strategy for the DSTs is to operate the DSTs so that they do not become Group A tanks (i.e., stay within acceptable Buoyant Displacement Gas Release Event [BDGRE] criteria). For mission planning purposes, the following simplified proxy limits will be used:

- Existing BDGRE controls are assumed to apply to DSTs containing an accumulation of settled salts, including:
  - Restrictions on the use of currently existing Group A tanks will continue to be followed for those tanks until the waste has been retrieved.
  - Assumption B3.3.4.4 is intended to prevent future accumulations of salts that might result in classifying a DST as Group A under existing BDGRE controls.

- The depth of settled sludge accumulated in 241-AN-101 and 241-AN-106 will be maintained in accordance with 1300075, "Contract No. DE-AC27-08RV14800 – Approval of Tank Farms Justification For Continued Operation (JCO) for Potential Large Spontaneous Gas Release Event in Deep Sludge (TF-13-01)" (13-NSD-0006 to M.D. Johnson, President and Project Manager, Washington River Protection Solutions LLC, March 7). The depth of settled sludge accumulated in the other DSTs will be maintained less than 170 inches per unreviewed safety question (USQ) (EM-RP-WRPS-TANKFARM-2012-0014, "Potential for a Large Spontaneous Gas Release Event in Deep Settled Solid Waste Sludge," Washington River Protection Solutions LLC December 3, 2012, as updated January 21, 2013).

B3.3.2.7 The waste blending and segregation controls in the feed control list (HNF-SD-WM-OCD-015, *Tank Farms Waste Transfer Compatibility Program*, Rev. 30, Table A-1) will be followed. Waste blending required to address each issue in Table A-1, may differ from the current controls, and will be addressed in the analysis of this report, where changes are required.

B3.3.2.8 Enhanced blending of sludge will be used to help reduce the projected mass of HLW glass to meet the success criteria for the completion date of waste treatment and SST retrievals. Blending strategies include:

- Significant heels in the DSTs and in the HLW melter increase <u>incidental blending</u>.
- The delivery of partial batches to the HLW feed staging tanks (as defined in RPP-17152, Table 4-1, and shown on Figures 4-1 and 4-2) and the delivery of partial batches from the HLW feed staging tanks to the HLW feed tanks may optionally be used to provide <u>intentional blending</u>.
- The remote-handled transuranic waste solids from Tanks 241-AW-103 and 241-AW-105 may be blended with other HLW solids to reduce the zirconium concentration, if possible and beneficial.

B3.3.2.9 The strontium and transuranic constituents will be removed from the Envelope C supernate currently stored in Tanks 241-AN-102 and 241-AN-107 in the DST system using strontium nitrate and sodium permanganate strikes based on the in-tank precipitation process described in RPP-24809, *Strontium and TRU Separation Process in the DST System*, as adopted by RPP-17152, Section 12.0.

B3.3.2.10 It is assumed that the blending strategy concept described in RPP-RPT-43828, *Refined Use of AN Farm for C Farm Single-Shell Tank Retrieval*, Rev. 1, will successfully mitigate the uranium enrichment issues with Tank 241-C-104 solids.

B3.3.3 Waste Retrievals and Transfers

B3.3.3.1 The next group of SSTs to be retrieved in the near-term will be the 241-C Tank Farm tanks.

B3.3.3.2 The modeling goal for sequencing the retrieval of SST waste is to minimize the waste treatment mission duration, which is asserted to significantly reduce the risk to human health and the environment, by attempting to provide sufficient HLW or LAW feed to

keep the limiting facilities operating at or near assumed capacity and by maintaining as high an average waste oxide loading (WOL) of the limiting facility product as reasonably achievable. In addition, the sequencing should be operationally tractable.

B3.3.3.3 The retrieval of the SSTs will be sequenced using a staggered, overlapping, farm-by-farm approach, described in RPP-PLAN-40145, which considers the following:

- Simultaneous retrieval constraints resulting from infrastructure or operational considerations.
- Retrieval technologies and performance, including learning curves and anticipated difficulty in retrieval based on unique tank and waste conditions.
- Available DST space.
- Special handling for the contact-handled transuranic (CH-TRU) waste.
- Providing a balanced feed to WTP, such that composition and relative quantities of the feed allow facilities to operate as close to the assumed production curves as is practical minimizing the overall duration of waste treatment. Priority is given to feeding the more limiting facility.
- Retrieving 241-A/AX Tank Farms' tanks after completion of 241-C Tank Farm.
- Using dedicated receiver tanks for 241-A/AX Tank Farm retrievals. If the specific receiver tanks noted in RPP-PLAN-40145 are not available, other tanks may be selected as dedicated receiver tanks.

B3.3.3.4 Updated SST retrieval assumptions (assumed technology, minimum retrieval duration, and as-retrieved waste volumes) are provided by SVF-1647.

B3.3.3.5 Waste retrieved from B Complex (241-B, 241-BX, and 241-BY Tank Farms), not including waste handled as CH-TRU waste (see Assumption B3.5.2.2), will be transferred to a tank in the B Complex Waste Receiving Facility (WRF), with supernate routed back and forth from the WRF tank to the SST as required. Retrieved waste will be transferred from the WRF tank to DST storage via new double-encased hose-in-hose transfer line (HIHTL) or stainless steel lines (RPP-PLAN-40145).

B3.3.3.6 Waste retrieved from T Complex (241-T, 241-TX, and 241-TY Tank Farms), not including waste handled as CH-TRU waste (see Assumption B3.5.2.2), will be transferred to a tank in the T Complex WRF, with supernate routed back and forth from the WRF tank to the SST as required. Retrieved waste will be transferred from the WRF tank to DST storage via new double-encased HIHTLs or stainless steel lines (RPP-PLAN-40145).

B3.3.3.7 Each WRF will consist of six tanks, each tank with a 150,000-gal operating volume, along with all needed ancillary equipment per RPP-17152, Section 3.2.2.1.

B3.3.3.8 Per the Project Lifecycle Schedule, the B Complex WRF will be available for operations in June 2022. The T Complex WRF will be available for operations in May 2021. These dates may be adjusted to meet success criteria.

B3.3.3.9 All other SSTs (except those specifically retrieved into WRFs or those handled as CH-TRU waste) will be retrieved directly into the DST system.

B3.3.3.10 During retrieval of waste from SSTs to the DST system, sodium hydroxide and sodium nitrite will be added, as needed, so that the as-retrieved liquid phase composition satisfies the DST waste chemistry limits given in Table 3-9 of HNF-SD-WM-OCD-015. Caustic additions for intra-DST transfers and for depletion of caustic over time are not modeled.

B3.3.3.11 Allow a minimum of 210 days for waste settling (180 days per 24590-WTP-ICD-MG-01-019, *ICD 19 – Interface Control Document for Waste Feed*) and to mix and sample (30 days) the feed staged in a DST and verify compliance with permits and the safety authorization basis before delivery to WTP, starting when each staging tank (DST) is filled with feed, but no earlier than the availability of suitable mixing and sampling capability.

B3.3.3.12 Subsequent deliveries of feed to the WTP will be timed and sequenced to balance the production of HLW glass and LAW glass.

B3.3.3.13 The use of the DSTs to receive retrieved SST waste, manage stored waste, and stage and deliver feed to the WTP in RPP-40149-VOL1 incorporates information from RPP-PLAN-40145. Key aspects of RPP-40149-VOL1 include:

- Planned configuration of each DST.
- Timing of upgrades to each DST.
- Entrained solids concentrations or quantities for supernate transfers.
- The maximum settled solids level that can be effectively mobilized and well-mixed using two mixer-pumps without incremental insertion capability is 70 inches.
- Mixer pumps with incremental insertion capability (12-feet [ft] vertical stroke) can accommodate settled solid layers up to 200 inches mixing in 70 inches increments.
- Deep sludge tanks with more than 200 inches of settled solids will require another technology, such as sluicing, to retrieve solids down to the 200-inches limit. The use of the second technology, however, is not explicitly modeled at this time.
- After retrieval of the next nine SSTs after 241-C Tank Farm, the goal is to minimize the creation of additional deep sludge DSTs (greater than 70 inches of settled solids).
- During normal operations, mixer pumps will not be operated with less than 72 inches of waste in the tank for deliveries of HLW feed to the WTP to ensure well-mixed feed.
- During normal operations, mixer-pumps will not be operated with less than 36 inches of waste in the tank for DST-to-DST transfers to prevent damage to the pumps.

- When used to stage HLW solids, the DSTs in 241-AZ and 241-AY Tank Farms will each be limited to a maximum of nine complete fill-mix-empty cycles to avoid fatigue damage to in-tank components, not including final DST cleanout (Leonard 2010). This enabling assumption is not explicitly modeled; however, the model results will be compared to the assumption.
- Key transfers are needed to prepare the initial batches of feed for delivery to the WTP and to position the DST system to continue waste feed delivery operations.
- With the possible exception of the LAW hot commissioning feed, all LAW transfers from tank farms to the WTP originate in a subset of 241-AP Tank Farm tanks and are transferred through a dedicated LAW feed line, thereby minimizing HLW solids in the LAW transfers to the WTP (Charboneau 2010).
- When a slurry transfer from a deep sludge DST occurs, a 30-day delay will be imposed prior to a subsequent slurry transfer from the same source tank to allow for equipment installation.[49]

B3.3.3.14 All HLW batches delivered to the WTP should be no greater than 145,000 gal including line flushes (24590-WTP-ICD-MG-01-019) and contain between 10 and 200 gm of unwashed solids per liter of slurry (DE-AC27-01RV14136, *Design Construction and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*). In addition, HLW batches are maintained at a maximum of 10 wt% of undissolved solids to meet mixing constraints in the HLW feed receipt tank (per pulse-jet mixer operating constraints as defined in 24590-WTP-MRR-PET-10-001, *WTP Mission Assessment of the Design and Operating Changes Expected to Resolve PJM Mixing in PT Vessels*).

B3.3.3.15 The residual waste remaining in the SSTs and DSTs after retrieval is complete will be estimated as follows:[50, 51, 52]

- The residual inventory in a 200-series SST will be Best-Basis Inventory data for that SST where waste retrieval actions have already been completed, when that information is available, or will be estimated as 25 ft^3 of residual containing 83 wt% water-washed solids with liquids at 5E-4 times the concentration (moles/liter) of the bulk as-retrieved supernate.

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[49] This is an enabling assumption pending additional detail on resource requirements needed to change mixer and transfer pump heights in a DST (Haigh 2010).

[50] The residual volumes are conservatively assumed to be the maximum allowed by the HFFACO or TPA, adjusted downward for a nominal 20% estimating uncertainty (per RPP-37110, *Computer/ CAD Modeling System Test Results*), until better estimates can be developed. The residual volume estimate is not meant to define the limits of any particular retrieval technology nor replace the procedures established in Appendix H of the TPA.

[51] The weight percent solids and liquid remaining in the residual is based on an informal review of post-retrieval waste volume estimates for tanks 241-C-103, 241-C-106, 241-S-112, 241-C-201, 241-C-202, 241-C-203, and 241-C-204 (Sasaki 2008).

[52] The reduction in liquid-phase concentration relative to the pre-rinse composition is based on rinsing the 100-series residual with three rinses, each of 10,000 gal, and on rinsing the 200-series residual with three rinses, each of 833 gal. The pre-rinse composition is assumed to equal the bulk as-retrieved liquid phase composition. These are placeholder assumptions until better estimates are developed.

- The residual waste inventory in a 100-series SST will be Best-Basis Inventory data for that SST where waste retrieval actions have already been completed, when that information is available, or will be estimated as 300 ft^3 of residual containing 83 wt% water-washed solids with liquids at 5E-4 times the concentration (moles/liter) of the bulk as-retrieved supernate.
- DSTs: Residual waste is rinsed three times (if greater than or equal to 300 ft^3 solids) or two times (if less than 300 ft^3 solids) with 10 kgal of water. The liquid is decanted after each rinse. The final residual waste volume is 300 ft^3.[53] (RPP-17152, Section 4.3.17)

B3.3.3.16 For modeling purposes, no waste is assumed to leak from the SSTs during retrieval in order to ensure that the maximum waste inventory is modeled through the Tank Waste Treatment Complex.

B3.3.4 Tank Farm Waste Evaporator (242-A)

B3.3.4.1 The 242-A Evaporator will be available, as needed, to support SST retrieval and to attempt to maintain the sodium concentration in the delivered feed within WTP feed specifications. The evaporator will not be available during scheduled maintenance outages.

B3.3.4.2 A four-month period is allocated for the sampling and analysis of dilute feed staged in one or more DSTs, and for preparation of the process control plan before that feed can be run through the evaporator (RPP-17152, Section 5.3.3). This assumes that the sampling and analysis effort is given high priority.

B3.3.4.3 The 242-A Evaporator processes waste at a slurry rate of 30 to 70 gpm, between a minimum waste volume reduction of 15 percent and a maximum boil-off rate of 40 gpm.

B3.3.4.4 Dilute waste will be concentrated until it reaches a bulk concentration of 1.43 g/mL; feed will not be evaporated if it would achieve less than a 15 percent waste volume reduction at 1.43 g/mL or at 80 percent of the maximum product source term (RPP-17152, Section 5.3.2).

B3.3.4.5 The composition of process condensate from the 242-A Evaporator and the releases from the condenser to the atmosphere will be estimated using the formulas, partition coefficients, and split factors given in RPP-17152, Section 5.2. The volume of process condensate will be 1.27 times the waste volume reduction to account for the vacuum system steam jets (RPP-17152, Sections 5.2 and 5.3.8).

B3.4 WASTE TREATMENT AND IMMOBILIZATION PLANT

The assumptions for the performance of the WTP used in this SP7 are consistent with the ORP assessment of the potential performance of the WTP after specific enhancements in design, flowsheet, or operating modes have been made.

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[53] The 300 ft^3 DST residual volume is a simplifying assumption that is consistent with SST residual waste requirements, and is not based on any evaluation of DST waste retrieval capability.

B3.4.1 General

B3.4.1.1 The WTP will be operable for 40 years, from the start of hot commissioning through 2058.

B3.4.1.2 The balance of facilities, Analytical Laboratory, and other support facilities are assumed to be capable of supporting the WTP. The WTP sampling and analysis times are assumed to support production.

B3.4.1.3 The integrated total operating efficiency (TOE) of the WTP is assumed to be 70 percent (this is known as the integrated facility availability in DE-AC27-01RV14136).[54]

B3.4.1.4 Hot commissioning will begin in May 2018, and end in December 2019 (Consent Decree [08-05085-FVS] milestones A-4, A-9, and A-16). Detailed hot commissioning plans, however, are not explicitly modeled.

B3.4.1.5 Delivery of the first batch of LAW feed will begin in May 2018 (RPP-17152, Section 6.3.1).

B3.4.1.6 Delivery of the first batch of HLW feed will begin in May 2018 (RPP-17152, Section 6.3.2).

B3.4.1.7 Per the Consent Decree milestone A-17, routine WTP operations will begin on or before December 31, 2019, and continue until the end of the treatment mission.

B3.4.1.8 The WTP is assumed to not return any waste streams or wastewater back to the tank farms.

B3.4.1.9 The technical issues previously identified in several design oversight reviews, external reviews, and a comprehensive independent review either have been resolved or are assumed to be resolved without adverse impact to the assumed performance of or the schedule for the WTP.

B3.4.1.10 It is assumed that the delivered feed and internal WTP material flows and accumulations will be consistent with the WTP authorization basis.[55]

B3.4.1.11 This enabling assumption states that the temperature of LAW feed delivered to the WTP is assumed to be less than 120°F; the temperature of HLW feed delivered to the WTP is assumed to be less than 150°F per 24590-WTP-ICD-MG-01-019. Minimum temperature limits have not been established.

B3.4.1.12 Feed projected to be delivered to the WTP will be screened[56] against several sets of requirements to proactively identify potential issues for future resolution. These

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[54] This assumption is implemented by a reduction in LAW and HLW melter rates (Assumptions B3.4.3.3 and B3.4.4.4.) and a reduction in the PT rate such that the overall plant availability for the WTP approximates the results of 24590-WTP-RPT-PE-12-002, *2012 WTP Operations Research Assessment.*

[55] It is assumed that the integrated management process for ICD-19 (24590-WTP-ICD-MG-01-019), as described in 24590-WTP-PL-MG-01-001, *Interface Management Plan*, will be used to successfully address any feed not consistent with this assumption. New tank-specific controls, if any, would be incorporated into the feed control list. For example, the feed control list (HNF-SD-WM-OCD-015, Table A-1) already requires blending of the solids in DST 241-AZ-101 to reduce the HGR and blending of the solids in SST 241-C-104 to reduce the concentration of uranium-233.

screenings are not directly suitable for safety basis or design decisions—they serve to identify areas of further inquiry. Screening is performed on point estimates of the as-delivered feed composition and associated parameters. The criteria sets to be used are the following:

- Specification 7: LAW envelope definition from DE-AC27-01RV14136, Section C.
- Specification 8: HLW envelope definition from DE-AC27-01RV14136, Section C.
- Table 7, Waste Feed Acceptance Criteria from 24590-WTP-ICD-MG-01-019. Only the subset[57] of waste feed acceptance criteria with action limits that are currently tracked in HTWOS will be used for screening purposes.

B3.4.1.13 Key features of the WTP that will be modeled for purposes of mission planning and estimation of secondary waste streams include the following:

- PT Facility
  - LAW feed receipt tanks (combined)
  - HLW feed receipt tank
  - Front-end evaporators:
    - Recycle evaporator
    - Feed evaporator (modeled, but turned off per Assumption B3.4.1.14)
  - Two ultrafilter process trains (full-cycle):
    - Caustic leach
    - Concentration
    - Post-leach wash
    - Oxidative leach
    - Post-oxidative leach wash
    - Final solids concentration
    - Solids discharge

[56] Based on previous feed screening, some delivered feed is expected to fall outside of the screening criteria and may require multiple iterations with ORP, BNI, and WRPS over several years to fully define an acceptable set of feed requirements and to update the process strategy in RPP-40149-VOL1 to ensure that projected feed batches comply with the final WAC.

[57] The subset is comprised of Maximum Bulk Density, Minimum Slurry pH, Maximum Solids wt% (LAW feed only), Maximum Solids g/L (HLW feed only), Maximum LAW Feed Unit Dose, Maximum HLW Feed Unit Dose, Maximum TOC, Maximum Pu to Metals Loading Ratio (criticality safety limit [CSL] 8.1), Maximum Pu to Metals Loading Ratio (CSL 8.4), Maximum U fissile to U total (CSL 8.2 Liquid), Maximum U fissile to U total (CSL 8.2 Solid), Maximum Pu Concentration of Liquids (CSL 8.3), Maximum Na Molarity, Maximum HGR (LAW), and Maximum HGR (HLW). Screening for these parameters is currently performed by SVF-2455, "SVF-2455_R0_WTP DQO Feed Screening.xlsm."

    - Filter rinse or acid cleaning
  - Pretreated HLW lag storage tanks
  - The three permeate collection vessels (UFP-VSL-00062A/B/C) and the cesium ion-exchange caustic rinse collection vessel (CXP-VSL-00004) are modeled as a single tank with equivalent volume (24590-WTP-MDD-PR-01-002, *Dynamic (G2) Model Design Document*)
  - Cesium ion exchange:
    - Four-column carousel
    - Resin replacement, regeneration, and acid recovery simplified
  - Back-end evaporator (treated LAW evaporation process system) and pretreated LAW storage
  - Plant waste disposal system, which processes recycle from the cesium ion-exchange process, ultrafiltration process, HLW canister decontamination process, and the HLW offgas system back to the front-end evaporator
  - The radioactive liquid waste disposal system collects process condensate from the front-end and back-end evaporator condensers and routes the process condensate to the ultrafiltration process; excess process condensate is sent to the Liquid Effluent Retention Facility (LERF)/Effluent Treatment Facility (ETF). Liquid streams from the LAW offgas caustic scrubbers and the cesium ion-exchange resin addition process are routed through the radioactive liquid waste disposal system and sent directly to LERF/ETF.
- HLW Vitrification Facility
  - Both melter trains are combined
  - Both offgas treatment systems are combined
  - HLW melter feed preparation (simplified: uses 2009 HLW GFM)
  - HLW melter
  - HLW canister
  - HLW melter offgas system
  - Recycle of HLW condensate (from submerged bed scrubber, wet electrostatic precipitator, and high-efficiency mist eliminator) and canister wash-water and decontamination chemicals to the front-end recycle evaporator via the plant wash disposal system.
- LAW Facility
  - Both melter trains are combined
  - Both offgas treatment systems are combined
  - LAW melter feed preparation (simplified)
  - LAW melter

  - LAW container
  - LAW melter offgas system
  - Recycle of both LAW submerged bed scrubber and wet electrostatic precipitator condensate to the back-end evaporator
  - Discharge of LAW caustic scrubber effluent and evaporator condensate to the LERF/ETF via the radioactive liquid waste disposal system.
- General
  - Internal equipment and line flush not modeled
  - Facility and process vessel vents not modeled
  - Sample hold times not modeled
  - Aqueous and solid phase densities (use tank farms assumptions rather than WTP)
  - TOE includes downtime for major facility equipment change-out (e.g., LAW and HLW melters).

B3.4.1.14 The basis for WTP flowsheet (equipment configuration, capacities, chemical reactions and extents, operating modes and logic, process splits and decontamination factors) used for mission modeling will be based on 24590-WTP-RPT-PT-02-005. Flowsheet and operating mode modifications will be made as needed to implement the other assumptions in this SP7. Additional details for modeling are in 24590-WTP-MDD-PR-01-002.

B3.4.2 Pretreatment

B3.4.2.1 When the WTP requests delivery of HLW feed, the HLW feed receipt tanks at the WTP will have sufficient space to receive no greater than 145,000 gal (549 m^3) of HLW feed including associated transfer line flushes from the DST system without interruption per 24590-WTP-ICD-MG-01-019, Section 2.2.4.2. (See RPP-17152, Section 6.4.2, for additional details on targeted batch sizes.)

B3.4.2.2 When the WTP requests delivery of LAW feed, the LAW feed receipt tanks at the WTP will have sufficient space to receive a nominal 1 Mgal of feed from the DST system plus associated transfer line flushes without interruption in order to avoid deliveries of small batches tying up a DST for extended periods.[58]

B3.4.2.3 The PT Facility will be configured so that a portion of concentrated pretreated LAW from the treated LAW concentrate tank can be transferred to a supplemental LAW facility as feed. This is downstream of the point to which LAW submerged bed scrubber/wet electrostatic precipitator condensate is recycled, so the feed to a supplemental LAW facility will include a proportional fraction of recycled

[58] The WTP Contract (DE-AC27-01RV14136) requires that 1.5 Mgal of space is provided to receive and store LAW feed from the DST system. Space allocated from receiving feed is 1.125 Mgal, while the remaining 0.375 Mgal is reserved for storage.

condensate from both LAW facilities. The treated LAW concentrate tank feeds the LAW Facility as its first priority, with excess going to a supplemental LAW facility.

B3.4.2.4 The pretreatment configuration will reflect 24590-WTP-MDD-PR-01-002, which operates the ultrafiltration process and cesium ion-exchange system at 50°C. Under this configuration, the three permeate collection vessels (UFP-VSL-00062A/B/C) and the cesium ion-exchange caustic rinse collection vessel (CXP-VSL-00004) operate in a recirculation loop, which is modeled as one tank with equivalent volume.

B3.4.2.5 The ultrafiltration process will operate in the "back-end" leaching mode. Back-end leaching is defined as caustic leaching in the ultrafiltration feed vessels (UFP-VSL-00002A/B) as opposed to front-end leaching, where caustic leaching occurs in the ultrafiltration preparation vessels (UFP-VSL-00001A/B).

B3.4.2.6 For planning purposes, all of the solids in each ultrafilter feed batch will be fully caustic leached.

B3.4.2.7 The extent of sludge dissolved by caustic leaching is defined by the Integrated Solubility Model as described in RPP-17152, Section 2.6.

B3.4.2.8 An oxidative leach process that removes chromium from the HLW sludge will be implemented in the ultrafilter process system per RPP-17152, Sections 6.4.11 and 6.4.12.

B3.4.2.9 The number of times the cesium ion exchange resin is replaced will be tracked.

B3.4.2.10 The constituents that remain on the spent cesium ion-exchange resin are assumed to be negligible for system planning purposes and will not be modeled at this time.

B3.4.3 High-Level Waste Vitrification

B3.4.3.1 The vitrification of HLW at the WTP will begin at the average hot commissioning rate no later than September 2018.

B3.4.3.2 During hot commissioning, the WTP will produce 84 MT of HLW glass. DE-AC27-01RV14136, Standard 5, (g)(4) and (g)(5), requires that 4.2 MT/day of HLW glass be produced for 20 days. For modeling purposes, the average glass production rate during hot commissioning is set so that the contract goal (rounded up to the next whole canister) is met by the end date for hot commissioning.

B3.4.3.3 After hot commissioning, the net HLW Facility capacity will be ramped as follows:

Starting On	Rate (MTG/day)
12/31/2019	3.0
01/01/2021	4.0
01/01/2022	4.2[59]
02/06/2025	5.25

[59] DE-AC2-701RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the HLW Vitrification Facility will support a combined design capacity of 6 MTG/day with the original two melters and 7.5 MTG/day with two replacement melters, with a minimum integrated TOE of 70%. The capability of the HLW Facility to support this increase is evaluated in 24590-HLW-RPT-PE-07-001, *High Level Waste Vitrification Plant Capacity Enhancement Study*.

B3.4.3.4 The average bulk density of immobilized high-level waste (IHLW) glass will be 2.66 kg/L at 20°C; the average density of the molten glass used in the melter will be 2.40 kg/L.[60]

B3.4.3.5 The mass of glass contained in a filled IHLW canister will be estimated using an average bulk density of 2.66 kg/L (24590-WTP-RPT-PT-02-005, Section 4.2.3.6).

B3.4.3.6 On the average, each canister of IHLW will be filled to 40.088 ft^3 (1.1352 m^3)[61] and will contain 3.02 MT of HLW glass on the average.[62]

B3.4.3.7 The composition, properties, and WOL of HLW glass will be estimated using the 2009 GFM documented in PNNL-18501. For modeling purposes, the glass-forming chemicals are assumed to be supplied as pure oxides rather than impure minerals. For planning purposes, the allowable glass-forming chemicals are Al_2O_3, B_2O_3, Fe_2O_3, Li_2O, Na_2O, and SiO_2.[63]

B3.4.3.8 One HLW melter is assumed to be replaced every 2.5 years on the average and contains approximately 823 gal (110 ft^3) of glass.[64] The time required to change out spent HLW melters is not explicitly modeled; however, the replacement of spent melters is already accounted for in the net production capacity assumptions.

B3.4.4 Low-Activity Waste Vitrification

B3.4.4.1 The vitrification of LAW at the LAW Facility will begin at the average hot commissioning rate no later than August 2018.

B3.4.4.2 The LAW Facility will receive all of its feed from the PT Facility.

B3.4.4.3 During hot commissioning, the WTP will produce 480 MT of LAW glass. DE-AC27-01RV14136, Standard 5, (g)(4) and (g)(5), requires that 24 MT/day of LAW glass be produced for 20 days. For modeling purposes, the average glass production rate during hot commissioning is set so that the contract goal (rounded up to the next whole canister) is met by the end date for hot commissioning.

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[60] This is based on crucible density data and estimated volume percent void content per 24590-WTP-RPT-PT-02-005, Section 4.2.3.6 and 4.2.3.2, respectively.

[61] DE-AC27-01RV14136, Section C, Specification 1, Section 1.2.2.1.2, requires that on average, the canisters will be filled to 95 percent of the volume of an empty canister; the corresponding glass volume for nominal canister dimensions is estimated by Appendix C of 24590-HLW-M0C-30-00003, *HLW Glass Canister Weight and Volume Calculations*. This is also consistent with the estimate provided in 24590-HLW-M0-30-00001001, *HLW Test Canister Assembly*.

[62] This is based on filling a canister with 3/8-inch thick walls to 95 percent fill (40.088 ft3 or 1.135 m^3) of glass with a bulk density of 2.66 kg/L.

[63] The HTWOS implementation of the 2009 GFM allows the user to specify which glass-forming chemicals may be used. In addition to the six stated above, the user can specify CaO, MgO, TiO_2, ZnO, and ZrO_2. However, for this revision of the System Plan, the allowable glass-forming chemicals are being aligned to those used by Bechtel National, Inc. per Gimpel (2009).

[64] This assumes two melters, each with a 5-year minimum design life per 24590-HLW-3PS-AE00-T0001, *Engineering Specification for High Level Waste Melters*. The volume of glass in the melter is assumed to reflect the 25-in. heel remaining after the maximum pour and includes an allowance for increased volume caused by corrosion of the refractory (Hall 2004); other contributions to the source term are neglected. No credit is taken for purging the melter with *cold* glass prior to removal from service.

B3.4.4.4 After hot commissioning, the net LAW Facility capacity will be ramped as follows for all cases:

Starting On	Rate (MTG/day)
12/31/2019	9.0
01/01/2021	18.0
01/01/2022	21.0[65]

B3.4.4.5 The average bulk density of immobilized low-activity waste (ILAW) glass will be 2.58 kg/L at 20°C; the average density of the molten glass will be 2.45 kg/L.[66]

B3.4.4.6 The mass of glass contained in a filled ILAW container will be estimated using an average bulk density of 2.58 kg/L (24590-WTP-RPT-PT-02-005, Section 3.2.3.7).

B3.4.4.7 On the average, each package of ILAW will be filled to 564 gal (75 ft^3) [67] and will contain 5.51 MT of LAW glass.[68]

B3.4.4.8 The total sodium loading of LAW glass from pretreated feed will be determined using the *DOE 2004* model (D-03-DESIGN-004, *An Assessment of the Factors Affecting the Ability to Increase the Na2O Loading in the Waste Treatment and Immobilization Plant (WTP) Low Activity Waste (LAW) Glass*), which maximizes the sodium oxide loading in the LAW glass subject to the following constraints:[69]

$[Na_2O] \leq 20\ wt\ \%$

$[SO_3] \leq 0.8\ wt\ \%$

B3.4.4.9 The composition of the LAW glass will be estimated using a glass recipe model similar to that described in Table B-2 of 24590-WTP-MRQ-PO-04-0065, *Model Run Request, Supplemental LAW Data Collection.*

B3.4.4.10 One LAW melter is assumed to be replaced every 2.5 years on the average and contains approximately 1,875 gal (251 ft^3) of glass.[70] The time required to change out spent LAW melters is not explicitly modeled, however, the replacement of spent melters is already accounted for in the net production capacity assumptions.

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[65] This rate assumes two LAW melters, each 15 MTG/day designed at a 70 percent TOE. DE-AC27-01RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the LAW Facility will support a combined design capacity of 30 MTG/day, with a minimum integrated TOE of 70 percent.

[66] This is based on crucible density data and estimated volume percent void content per 24590-WTP-RPT-PT-02-005, Section 3.2.3.2 and 3.2.3.7, respectively.

[67] DE-AC27-01RV14136, Section C, Specification 2, Section 2.2.2.5, requires that the packages will be filled to at least 90 percent of the volume of an empty package; the corresponding volume is obtained from 24590-WTP-RPT-PT-02-005, Section 3.2.3.7.

[68] This is based on filling a package to 90 percent (2.135 m^3) of glass with a bulk density of 2.58 kg/L.

[69] The LAW glass formulation work reviewed in D-03-DESIGN-004 suggests that the sodium loading projected by the DOE model can be achieved. Ongoing glass formulation work in the DOE complex suggests that glass formulations with even higher sodium oxide loadings may be achievable.

[70] This assumes two melters, each with a five-year minimum design life per 24590-LAW-3PS-AE00-T0001, *Engineering Specification for Low Activity Waste Melters*. The volume of glass in the melter does not include an allowance for increased volume caused by corrosion of the refractory and reflects the heel remaining after the maximum pour; other contributions to the source term are neglected. No credit is taken for purging melter with *cold* glass prior to removal from service.

Additionally, spent melters will be managed and disposed of at the IDF as mixed low-level waste (MLLW).

B3.5 SUPPLEMENTAL TREATMENT

B3.5.1 Second Low-Activity Waste Vitrification Facility

B3.5.1.1 For purposes of this SP7, supplemental LAW treatment capacity is assumed to be provided by a supplemental LAW vitrification facility, located in 200 East Area adjacent to the WTP.

B3.5.1.2 The supplemental LAW facility is assumed to have the same technical assumptions as the LAW Facility.

B3.5.1.3 The supplemental LAW facility will receive *excess* pretreated LAW from the PT Facility per Assumption B3.4.2.3.

B3.5.1.4 An evaporator at the back-end of the supplemental LAW offgas system will be used to concentrate condensate from the submerged bed scrubber and wet electrostatic precipitator. The resulting concentrated stream will be recycled to a supplemental LAW facility feed tank. Evaporator condensate will be discharged directly to the LERF/ETF. The evaporator supporting the supplemental LAW facility will be modeled using the same assumptions as the pretreatment back-end evaporator.

B3.5.1.5 Caustic scrubber effluent will be discharged directly to the LERF/ETF.

B3.5.1.6 A. The net capacity of a supplemental LAW facility will be selected with the goal that the combined LAW vitrification capacity will be large enough so as to not drive the mission duration.
B. The supplemental LAW facility will complete hot commissioning in September 2022 (hot commissioning will not be modeled) and begin routine operations in October 2022. The facility will be ramped as follows:

Starting On	Rate (MTG/day)
10/01/2022	9.0
01/01/2025	Per Assumption B3.5.1.6A

B3.5.1.7 One LAW melter is assumed to be replaced every X[71] years on the average and contains approximately 1,875 gal (251 ft^3) of glass.[72] The time required to change out spent LAW melters is not explicitly modeled; however, the replacement of spent melters is already accounted for in the net production capacity assumptions. Additionally, spent melters will be managed and disposed of at the IDF as MLLW.

[71] Each melter is assumed to have a 5-year design life (24590-LAW-3PS-AE00-T0001) and, therefore, the average replacement period, X, will be 5 years divided by the number of melters.
[72] The volume of glass in the melter does not include an allowance for increased volume caused by corrosion of the refractory and reflects the heel remaining after the maximum pour; other contributions to the source term are neglected. No credit is taken for purging melter with *cold* glass prior to removal from service.

B3.5.2 Supplemental Transuranic Sludge Treatment

B3.5.2.1 Per the lifecycle PMB, the supplemental CH-TRU waste treatment and packaging process will be available in April 2018 and will treat a maximum of 8,040 gal (1,075 ft^3) per day of CH-TRU slurry from retrieved CH-TRU tank waste at a 1:1 dilution of solids with water at 67 percent TOE (RPP-21970, *CH-TRUM WPU&SE 11-Tank Material Balance*, Section 3.0).

B3.5.2.2 The SSTs assumed to provide CH-TRU sludge are [241-B-201, 241-B-202, 241-B-203, 241-B-204], [241-T-201, 241-T-202, 241-T-203, 241-T-204], 241-T-111, 241-T-110, and 241-T-104, in the stated order except that the tank order within the [brackets] can be changed to match the order reflected in the PMB (RPP-21970, Sections 3.0 and 5.0, Assumption 2).

B3.5.2.3 The supplemental CH-TRU waste treatment and packaging system for CH-TRU waste will first be located near 241-B Tank Farm and then moved to 241-T Tank Farm. There will be a minimum 10-day outage between tanks and a minimum 180-day outage to move equipment between farms.

B3.5.2.4 Waste previously assumed to be remote-handled transuranic waste (SSTs 241-T-105, 241-T-107, 241-T-112, 241-B-107, 241-B-110, and 241-B-111 and DSTs 241-SY-102, 241-AW-103, and 241-AW-105) will be retrieved and treated at the WTP together with the HLW (Harp 2008, "HTWOS model assumption").

B3.5.2.5 The process flowsheet for the CH-TRU sludge treatment is described in the material balance for the CH-TRU waste tanks and is assumed to use the "dry batch mode" (RPP-21970). For modeling purposes, the two dryers may be combined into one continuous dryer of equivalent treatment capacity. Additional modeling details and simplifications are provided in RPP-17152, Section 13.

B3.5.2.6 The dried waste product from the CH-TRU waste process is assumed to be packaged in 55-gal drums containing 620 lb product per drum (RPP-21970).

B3.5.2.7 Although not explicitly modeled, the CH-TRU waste drums are assumed to be stored onsite at the Central Waste Complex (CWC) until their final disposition has been determined.

B3.5.2.8 Liquid effluent will either be transferred to the LERF via tank truck or recycled to the retrieval project. For planning purposes, it will be assumed that the liquid effluent is transferred only to LERF (no recycle) and will be modeled as a continuous pipeline transfer.

B3.6 INTERFACING FACILITIES

B3.6.1 Liquid Effluents

B3.6.1.1 The capacities and capability of the ETF, LERF, State-Approved Land Disposal Site, and 200 Area Treated Effluent Disposal Facility will be driven by the needs of the waste treatment mission and are assumed to be available when needed. If the treatment mission requires a new secondary liquid waste treatment facility or that changes be made to the ETF, LERF, State-Approved Land Disposal Site, or Treated

Effluent Disposal Facility or their operating plans, ORP is assumed to successfully drive the changes.

B3.6.1.2 The Secondary Liquid Waste Treatment Project will determine how best to provide the needed treatment capability for the secondary liquid waste — options may include, but are not limited to, upgrades to ETF or the use of other technologies. Meanwhile, for modeling purposes, this SP7 assumes that the project will select ETF upgrades to provide the needed capability.

B3.6.1.3 The LERF consists of three basins, each with an operating volume of 7.8 Mgal (HNF-SD-WM-SAD-040, *Liquid Effluent Retention Facility Final Hazard Category Determination*), which are used to provide lag storage of liquid effluent. For planning purposes, only two of the basins will be allocated to supporting the waste treatment mission; the third basin will be reserved for *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* effluents.

B3.6.1.4 The ETF will be modeled as a black box. Overall partitioning of feed into solid waste and treated effluent will be approximated per HNF-4573, *Liquid Effluent Retention Facility Basin 44 Process Test Post-Report*, Appendix A. Chemicals (e.g., those for bulking or stabilization of the solid waste form) will not be tracked.

B3.6.1.5 The State-Approved Land Disposal Site will not be modeled.

B3.6.1.6 The 200 Area Treated Effluent Disposal Facility will not be modeled.

B3.6.2 Central Waste Complex

B3.6.2.1 The CWC is assumed to support the needs of the waste treatment mission and is assumed to be available when needed. The demand on the CWC will not be modeled.

B3.6.2.2 The packaged CH-TRU waste is assumed to be stored at the CWC until the final disposition of CH-TRU waste has been determined.

B3.6.2.3 The lifecycle cost for implementing the final disposition of CH-TRU waste (yet to be determined) from the CWC is assumed to be similar to the costs that were allocated for disposal at Waste Isolation Pilot Plant directly from the CH-TRU waste packaging facility.

B3.6.3 Interim Hanford Storage

B3.6.3.1 The Interim Hanford Storage (IHS) will receive and temporarily store canisters of IHLW, with the canisters eventually retrieved and transported to the Hanford Shipping Facility (HSF) in preparation for shipment to a potential national repository (WRPS-1003700; RPP-23674, *Immobilized High-level Waste Interim Storage Facility System Specification*).

B3.6.3.2 The IHS Facility will be located in the 200 East Area in the proximity of the HLW Facility and will provide interim storage for a minimum of 4,000 IHLW canisters. The IHS Facility will be expandable in increments of 2,000 canisters up to a maximum of 16,000 canisters, if needed, to mitigate the risk associated with the availability of offsite geologic storage (RPP-23674).

B3.6.3.3 The need date for the IHS will be the date on which the first radioactive HLW canister leaves the WTP (Assumption B3.6.3.4). As of November 2010, the summary lifecycle baseline schedule (Work Breakdown Structure 5.03.06.06, "Hanford IHLW Storage Project") reflects:

- December 30, 2010: CD-0.
- November 21, 2018: First 2,000 canister module operational. This date is set such that it does not constrain HLW production per B.3.4.3.3.
- January 2, 2020: Second 2,000 canister module operational. This date is set such that it does not constrain HLW production.
- Each additional module operational 1.5 years in advance of projected need date. This date is set such that it does not constrain HLW production.
- Decision to construct each additional module made four years in advance of the projected operational need date.

B3.6.3.4 The following factors will be considered when determining the time between when a HLW canister is poured and when it must be shipped out of the WTP to the IHS Facility.

- The HLW canister pour handling system canister cooling rack provides 24 positions for placement of canisters (24590-HLW-3YD-HPH-00001, *System Description for HLW System HPH Canister Pour Handling*, Section 6.2.1.4). This capacity does not constrain HLW production. Instead, this capacity provides information to identify when the IHS Facility and HSF are required.
- The HLW Canister Storage Cave in WTP has 46 storage rack slots (24590-HLW-3YD-HEH-00001, *System Description for the HLW System HEH Canister Export Handling*), but one slot under the viewing window is designated for canister grapple recovery. This capacity does not constrain HLW production. Instead, this capacity provides information to identify when the IHS Facility and HSF are required.

B3.6.3.5 The disposition of nonconforming canisters has not yet been determined.

B3.6.3.6 The average canister receipt and retrieval capability of the IHS Facility will each be 800 canisters per year (approximately 25 percent above the average net production capacity required), with a peak handling rate of three canisters per day (RPP-23674). This capacity does not constrain HLW production. Instead, this capacity provides information to identify when the IHS Facility and HSF are required.

B3.6.4 Hanford Shipping Facility

B3.6.4.1 It is assumed that on or before June 2022, a decision will be made either to continue to build additional canister storage modules or to construct the HSF. For planning purposes, the outcome of this decision is assumed to be that the HSF will be constructed and HLW canisters are shipped to an offsite final disposal alternative (see Assumption B3.6.5). This capacity does not constrain HLW production. Instead, this

capacity provides information to identify when the IHS Facility and HSF are required.

B3.6.4.2 The HSF will be located in the 200 East Area either as a standalone facility or a module attached to the IHS Facility. It will provide for shipping HLW canisters to a potential national repository.

B3.6.4.3 The canister shipping capability of the HSF is assumed to match the retrieval capability of the IHS Facility in Assumption B3.6.3.6. If and when the HSF begins shipping, the first priority will be given to shipping newly created IHLW canisters beyond those stored at the IHS Facility, and second priority will be given to emptying the IHS facility after HLW vitrification is finished. Shipping needs will be estimated with the IHS Facility being operated at approximately 1,000 canisters less than capacity in order to decouple receipt of WTP canisters from shipping to a national repository. This capacity does not constrain HLW production. Instead, this capacity provides information to identify when the IHS Facility and HSF are required.

B3.6.5 Final Disposal Alternative

B3.6.5.1 The final disposal alternative for HLW glass canisters is assumed to be at an unidentified offsite national repository.

B3.6.5.2 As an enabling assumption, the final disposal alternative will have the same WAC as the Yucca Mountain national repository WAC. It is assumed that the HLW GFM (PNNL-18501) results in canisters that meet the WAC of the final disposal alternative.

B3.6.6 Integrated Disposal Facility

B3.6.6.1 It is assumed the IDF will be operational when needed and will provide permanent disposal for the ILAW, other MLLW, and low-level waste.

B3.6.6.2 Per the PMB, the IDF will receive LAW glass packages from the WTP; solid waste from the WTP, including spent LAW melters;[73] and solid waste from the ETF from treating liquid effluent. Only that portion of the primary and secondary waste streams directly related to treatment of the tank waste will be cumulatively modeled (e.g., the cumulative inventory that is retained on disposable filters will be modeled, but the mass, composition, and overall volume of the filter media will not be tracked).

B3.6.6.3 For planning purposes, the IDF can be expanded as needed to support the mission without interference from other users.

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[73] The final disposition of spent HLW melters has not yet been determined. The alternatives evaluated in DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* , assume that these spent HLW melters will be packaged in an overpack and stored at the IHS until they can be removed for disposition and final disposal. For planning purposes, the final disposition of the HLW melters is assumed to be at the IDF to maintain consistency with the current PMB. Plans will be updated as needed after a ROD that addresses HLW melter disposal is published.

B3.6.7 222-S Laboratory

B3.6.7.1 It is assumed that the laboratory services required to support waste characterization for TOC projects and operations are available and provided in a timely manner.

B3.6.7.2 Any required facility life-extension upgrades will be aligned with the PMB.

B3.6.7.3 The 222-S Laboratory is assumed to transfer 5 kgal/year of waste (see Assumption B3.7.1.3) to the tank farms before the startup of the WTP, and 10 kgal/year thereafter.

B3.6.8 Waste Encapsulation and Storage Facility

B3.6.8.1 Cesium and strontium capsules are assumed to be dispositioned outside of the WTP and tank farm facilities by the U.S. Department of Energy, Richland Operations Office.

B3.6.9 Waste Isolation Pilot Plant

B3.6.9.1 Permitting and operational requirements to accept Hanford CH-TRU tank waste at Waste Isolation Pilot Plant will not impact the schedule's critical path, if it is determined that the final disposition of the packaged CH-TRU tank waste is disposal at Waste Isolation Pilot Plant.

B3.6.10 Other Hanford Site Facilities

B3.6.10.1 Sludge generated from the cleanup of the K Basins is assumed to be dispositioned outside of the WTP and tank farms' facilities by the U.S. Department of Energy, Richland Operations Office.

B3.6.10.2 The Plutonium Uranium Extraction Plant is assumed to transfer a one-time 15 kgal of waste circa 2025 (see Assumption B3.7.1.3) to the tank farms as part of its deactivation.

B3.6.10.3 The T Plant Facility is assumed to transfer a one-time 15 kgal of waste circa 2025 (see Assumption B3.7.1.3) to the tank farms as part of its deactivation. The transfer will include a flush equal to 22 volume percent of the waste transferred.

B3.6.10.4 Waste from the retrieval of the miscellaneous underground storage tanks (see Assumption B3.7.1.3) will be transferred to the tank farms in a series of transfers between 2020 and 2030, or sooner if practical. The intent is to eventually update the Project Lifecycle schedule with this information.

B3.7 CROSS-CUTTING ASSUMPTIONS

B3.7.1 General

B3.7.1.1 The decay date used for reporting all radionuclides is January 1, 2008, unless explicitly stated otherwise (RPP-33715, *Double-Shell and Single-Shell Tank Inventory Input to the Hanford Tank Waste Operation Simulator Model – 2014 Update*).

B3.7.1.2 In general, the inventory for tanks with waste intrusive activities are updated in the Tank Waste Information Network System once per quarter. The tank inventory update for SP7, is completed by:

- Downloading the solid and liquid inventory from Tank Waste Information Network System for each tank after January 1, 2014.
- Adjustments are made to assign specific compounds to or make improvements in the solid/liquid allocation of bound hydroxide and oxygen.
- Adjustments are made to speciate aluminum and chromium into specific compounds based on RPP-RPT-47306, *Waste Type Analysis for Aluminum Leachability Estimates of All Non-Retrieved Hanford Tank Wastes,* and WTP-RPT-117, *Oxidative-Alkaline Leaching of Washed 241-SY-102 and 241-SX-101 Tank Sludges*, respectively.
- Tanks with waste intrusive activities since the effective date for each tank are then reviewed and any transfers completed after the effective date for each tank in the downloaded inventory and the demarcation date, estimated to be March 2014, are included in SP7, as historical transfers.

B3.7.1.3 Estimates of the inventory for the miscellaneous underground storage tanks, the waste resulting from deactivation of other Hanford facilities, and operation of the 222-S Laboratory are provided in RPP-33715.

B3.7.1.4 All solubility activities (including water wash and caustic leaching) will be modeled using the Integrated Solubility Model as described in RPP-17152, Section 2.6.

B3.7.1.5 For modeling purposes, the approximations to waste chemistry in the tank farms are described in RPP-17152, Section 2.9.7.

B3.7.1.6 Liquid density and specific gravity will be estimated using the correlations described in RPP-17152, Section 2.7.1.

B3.7.1.7 For modeling purposes, solid particulate density is assumed to be a constant 3 g/mL per RPP-17152, Section 2.7.9.

B3.7.1.8 The portion of total organic carbon from oxalate will be tracked as oxalate rather than total organic carbon to avoid double-counting and will not be further speciated. However, for modeling purposes, the remaining total organic carbon will be treated as carbon once it enters the WTP to allow for reaction stoichiometry (RPP-17152, Section 2.9.3).

B3.7.1.9 The modeled composition of waste retrievals from SSTs will be homogeneous. The modeled composition of waste transferred from a DST will reflect the overall composition of the specific layers (e.g., supernate, dissolved salts, mobilized solids) being transferred. This is a simplifying assumption required for a tractable model.

B3.7.1.10 The design, flowsheet, operating modes, and operating plans of all facilities or processes will drive the permit conditions, and the permits will be modified as the processes evolve. Permits are assumed to be issued by regulatory agencies in a timely fashion. Permit preparation activities of external agencies are not modeled.

B3.7.1.11 The Consent Decree Compliant case is assumed to be consistent with and bounded by the outcome of the *National Environmental Policy Act of 1969* process.

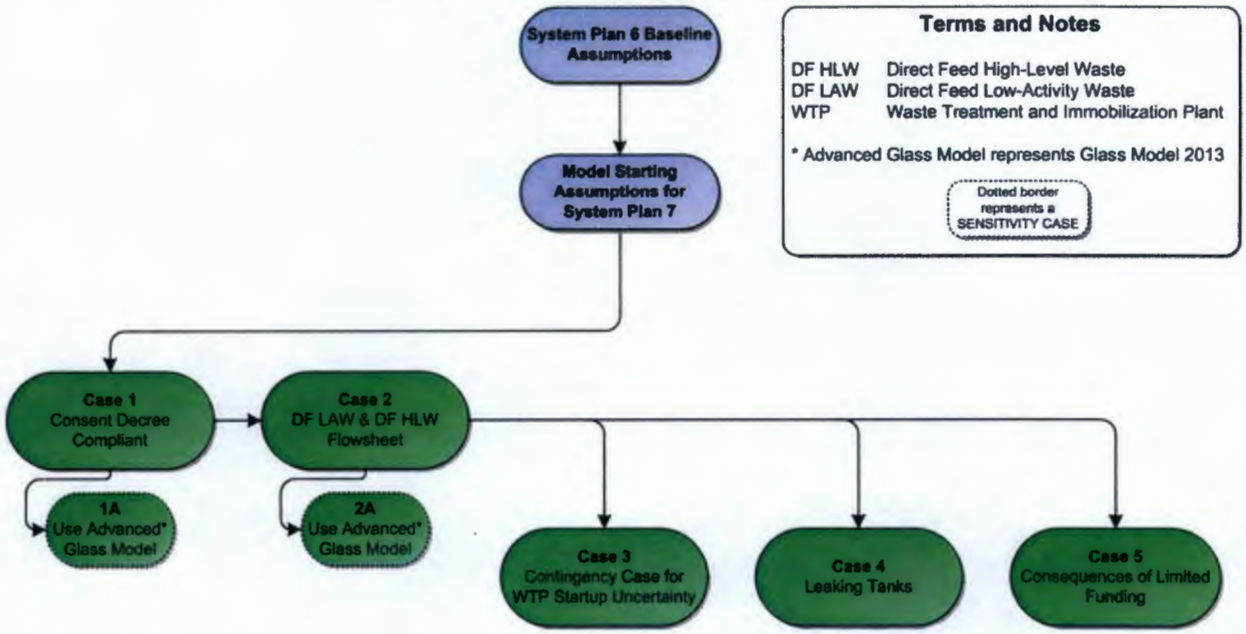
B3.7.1.12 The Consent Decree Compliant case is assumed to be consistent with and bounded by the appropriate facility authorization basis.

B3.7.1.13 When appropriate, CD-2 must be approved before permitting can begin. Assume 33 to 36 months for permitting activities (McDonald 2013). Note: Permitting activities are not explicitly modeled in HTWOS; they will be tracked manually.

B4.0 CASE-SPECIFIC KEY ASSUMPTIONS

The assumption sets for the five cases selected and defined by Ecology are detailed in this section. The sets of key assumptions for the five cases outlined below include only those assumptions that differ from the Model Starting Assumptions listed in Section B3.0. Figure B-1 shows the interrelationships between the cases and the flowdown of assumptions for scenario development. To assist the reader, the table layout defining the assumptions for the five cases cross-references the assumption from which it was developed.

Figure B-1. The Relationships of System Plan, Rev. 7, Cases Selected and Defined by the Washington State Department of Ecology.



B4.1 CASE 1 – CONSENT DECREE COMPLIANT

The purpose of Case 1 is to model a Consent Decree compliance perspective; the current version of the model used in this SP7 is described in Appendix C. The assumptions for Case 1 are consistent with the Model Starting Assumptions (Section B3.0), with the exception of those outlined below.

CASE SPECIFIC ASSUMPTIONS		STARTING ASSUMPTION
B4.1.1	**CONSENT DECREE DATES/SUCCESS CRITERIA**	N/A
B4.1.1.1	**This case will be considered successful if it is consistent with the *Hanford Federal Facility Agreement and Consent Order* and Consent Decree milestones for key mission activities identified in Assumption B4.1.1.2 and the ORP-provided funding guidance in Assumption B4.1.1.3. In the event that the guidance cannot reasonably be met within the degrees of freedom discussed in the Assumption B4.1.1.5, the reasons will be identified.**	N/A
B4.1.1.2	**The following schedule-based success criteria are a subset of the *Hanford Federal Facility Agreement and Consent Order* and Consent Decree milestones. Case 1 will meet the dates listed in Table B-2.**	N/A

Table B-2. Schedule-Based Success Criteria. N/A

Metric	Success Criteria	Milestone Number
Complete 241-C Farm Retrievals	09/30/2014	B-1
Start Five Additional SST Retrievals[a]	12/31/2017	B-3
Close Waste Management Area C	06/30/2019	M-045-83
Complete Nine Additional SST Retrievals	09/30/2022	B-4
Complete All SST Retrievals	12/31/2040	M-045-70
Close All SSTs	01/31/2043	M-045-00
Treat All Tank Waste	12/31/2047	M-062-00
Close All DSTs	09/30/2052	M-042-00A

[a] Not including any tanks with waste that is packaged as TRU waste.

DST double-shell tank
SST single-shell tank
TRU transuranic

B4.1.1.3 **Case 1 will meet the ORP-provided funding targets (Basche 2010) for FY 2010 through FY 2015 (Table B-3). These targets are consistent with the most recent budget planning guidance and briefing materials. After FY 2015, a reasonable ramp-up may be assumed.** N/A

Table B-3. Near-Term Funding Targets.

Fiscal Year	Target ($M)
2014	610
2015	710

B4.1.1.4 **The total lifecycle cost[74] of Case 1, including funded and unfunded contingency, will not exceed $61.5B (consistent with SP6) measured from the start of FY 1997 through the end of the RPP mission.** N/A

B4.1.1.5 **The timing of activities in the Consent Decree Compliant case may be shifted as needed to satisfy the guidance dates, even if this requires deviation from other programmatic assumptions, including deviating from the funding guidance.** N/A

B4.1.2 **CASE 1 ASSUMPTION ALIGNMENT**

B4.1.2.1 **N/A** N/A

B4.1.3 **TANK WASTE TREATMENT COMPLEX**

B4.1.3.1 **N/A** N/A

B4.1.4 **TANK FARMS**

B4.1.4.1 **Single-Shell Tanks**

B4.1.4.1.1 N/A N/A

[74] In this context, the total lifecycle cost refers specifically to project baseline summary ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition Project," and HQ-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository."

B4.1.4.2	**Double-Shell Tanks**	
B4.1.4.2.1	The BDGRE restrictions imposed by the Justification for Continued Operation (JCO) and USQ are assumed to be lifted on July 29, 2014 to allow for residual 241-C Tank Farm tank retrieval to be completed in compliance with the Consent Decree date. Specifically, the primary tank maximum waste liquid levels for 241-AN-101 and 241-AN-106 will return to the normal operating limit of 416 inches and the maximum authorized limit of 422 inches (as noted in OSD-T-151-00007, Table 1.1.1). All other DSTs will also return to their normal operating limits per Base Assumption B3.3.2.2.	Same as Base Assumption B3.3.2.6
B4.1.4.2.2	Double-shell tank 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220, *241-AY-102 Pumping Plan,* Rev. A. The start date for the retrieval will be coordinated so as not to conflict with 241-AX Tank Farm retrievals. The estimated start date of supernatant transfer from DST 241-AY-102 is prior to 08/20/2014. The estimated start date of sludge retrieval is prior to 03/30/2016.[75]	N/A
B4.1.4.3	**Waste Retrievals and Transfers**	
B4.1.4.3.1	DST feed tank(s) for WTP hot commissioning will be chosen at the modeler's discretion to ensure the tank feed will meet WTP WAC in compliance with ICD-19 (24590-WTP-ICD-MG-01-019).	N/A
B4.1.4.4	**Tank Farm Waste Evaporator (242-A)**	
B4.1.4.4.1	N/A	N/A
B4.1.5	**WASTE TREATMENT AND IMMOBILIZATION PLANT**	
B4.1.5.1	**General**	
B4.1.5.1.1	N/A	N/A
B4.1.5.2	**Pretreatment**	
B4.1.5.2.1	N/A	N/A

[75] Dates shown are for modeling and do not reflect ORP direction.

B4.1.5.3 High-Level Waste Vitrification

B4.1.5.3.1	The composition, properties, and WOL of HLW glass will be estimated using the 2009 GFM documented in PNNL-18501.	Same as Base Assumption B3.4.3.7
B4.1.5.3.2	After hot commissioning, the net HLW Facility capacity will be ramped as follows:	Same as Base Assumption B3.4.3.3

Starting On	Rate (MTG/day)
12/31/2019	3.0
01/01/2021	4.0
01/01/2022	4.2[76]
02/06/2025	5.25

B4.1.5.4 Low-Activity Waste Vitrification

B4.1.5.4.1	The total sodium loading of LAW glass from pretreated feed will be determined using the "DOE 2004" model (D-03-DESIGN-004[77]), which maximizes the sodium oxide loading in the LAW glass subject to the following constraints: $[Na_2O] \leq 20\ wt\ \%$ $[SO_3] \leq 0.8\ wt\ \%$	Same as Base Assumption B3.4.4.8
B4.1.5.4.2	After hot commissioning, the net LAW Facility capacity will be ramped as follows for all cases:	Same as Base Assumption B3.4.4.4

Starting On	Rate (MTG/day)
12/31/2019	9.0
01/01/2021	18.0
01/01/2022	21.0[78]

[76] DE-AC2-701RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the HLW Facility will support a combined design capacity of 6 MTG/day with the original two melters and 7.5 MTG/day with two replacement melters, with a minimum integrated TOE of 70 percent. The capability of the HLW Facility to support this increase is evaluated in 24590-HLW-RPT-PE-07-001.

[77] The LAW glass formulation work reviewed in D-03-DESIGN-004 suggests that the sodium loading projected by the DOE model can be achieved. Ongoing glass formulation work in the DOE complex suggests that glass formulations with even higher sodium oxide loadings may be achievable.

[78] This rate assumes two LAW melters, each 15 MTG/day design at a 70 percent TOE. DE-AC27-01RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the LAW Facility will support a combined design capacity of 30 MTG/day, with a minimum integrated TOE of 70 percent.

B4.1.6	**SUPPLEMENTAL TREATMENT**	
B4.1.6.1	**Second Low-Activity Waste Vitrification Facility**	
B4.1.6.1.1	The supplemental LAW Facility will be ramped as follows: Starting On — Rate (MTG/day) 10/01/2022 — 9.0 01/01/2025 — Per Assumption B3.5.1.6A	Same as Base Assumption B3.5.1.6
B4.1.6.2	**Supplemental Transuranic Sludge Treatment**	
B4.1.6.2.1	N/A	N/A
B4.1.7	**INTERFACING FACILITIES**	
B4.1.7.1	**Liquid Effluents**	
B4.1.7.1.1	N/A	N/A
B4.1.7.2	**Central Waste Complex**	
B4.1.7.2.1	N/A	N/A
B4.1.7.3	**Interim Hanford Storage**	
B4.1.7.3.1	N/A	N/A
B4.1.7.4	**Hanford Shipping Facility**	
B4.1.7.4.1	N/A	N/A
B4.1.7.5	**Final Disposal Alternative**	
B4.1.7.5.1	N/A	N/A
B4.1.7.6	**Integrated Disposal Facility**	
B4.1.7.6.1	N/A	N/A
B4.1.7.7	**222-S Laboratory**	
B4.1.7.7.1	N/A	N/A
B4.1.7.8	**Waste Encapsulation and Storage Facility**	
B4.1.7.8.1	N/A	N/A

B4.1.7.9	**Waste Isolation Pilot Plant**	
B4.1.7.9.1	N/A	N/A
B4.1.7.10	**Other Hanford Site Facilities**	
B4.1.7.10.1	N/A	N/A
B4.1.8	**CROSS-CUTTING ASSUMPTIONS**	
B4.1.8.1	**General**	
B4.1.8.1.1	N/A	N/A
B4.1.9	**SENSITIVITY ANALYSIS**	
B4.1.9.1	**High-Level Waste Vitrification**	
B4.1.9.1.1	The composition, properties, and WOL of HLW glass will be determined using the 2013 Advanced GFM (RPP-17152, Section 2.7.6.1).	Modifies Case 1 Assumption B4.1.5.3.1
B4.1.9.2	**Low-Activity Waste Vitrification**	
B4.1.9.2.1	The total sodium loading of LAW glass from pretreated feed will be determined using the 2013 Advanced GFM (RPP-17152, Section 2.7.6.2).	Modifies Case 1 Assumption B4.1.5.4.1

B4.2 CASE 2 – DIRECT FEED LOW-ACTIVITY WASTE AND DIRECT FEED HIGH-LEVEL WASTE FLOWSHEET

The purpose of Case 2 is to accommodate the need to address the current status of the PT Facility and to determine the impacts on throughput when bypassing the PT Facility; the impact of DF on DSTs; the efficiency and effectiveness of the LAWPS; and, the impact of the advanced GFMs during DF operations. The assumptions for Case 2 are consistent with the Model Starting Assumptions (Section B3.0), with the exception of those outlined below.

CASE SPECIFIC ASSUMPTIONS		STARTING ASSUMPTION
B4.2.1	**CONSENT DECREE DATES/SUCCESS CRITERIA**	
B4.2.1.1	**Case 2 does not contain specific success criteria. Instead, the results of Case 2 will be compared to the results of Case 1 to determine the impacts.**	N/A
B4.2.1.2	**Case 2 will meet the ORP-provided funding targets (Basche 2010) for FY 2014 through FY 2015 (Table B-3). These targets are consistent with the most recent budget planning guidance and briefing materials. After FY 2015, a reasonable ramp-up may be assumed.**	Same as Case 1 Assumption B4.1.1.3
B4.2.1.3	**The total lifecycle cost[79] of Case 2, including funded and unfunded contingency, will not exceed $61.5B (consistent with SP6) measured from the start of FY 1997 through the end of the RPP mission.**	Same as Case 1 Assumption B4.1.1.4
B4.2.2	**CASE 2 ASSUMPTION ALIGNMENT**	
B4.2.2.1	**N/A**	N/A
B4.2.3	**TANK WASTE TREATMENT COMPLEX**	
B4.2.3.1	**Low-Activity Waste Pretreatment System**	
B4.2.3.1.1	The LAWPS will have a capacity (at 70 percent TOE) to provide feed from the tank farms to the WTP to support two LAW melters operating at 30 MTG/day.	N/A
B4.2.3.1.2	The LAWPS operates at 70 percent TOE.	N/A

[79] In this context, the total lifecycle cost refers specifically to the project baseline summary ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition Project," and HQ-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository."

B4.2.3.1.3	The LAWPS consists of an rotary microfiltration system and a small-column ion exchange (SCIX) system with two columns.	N/A
B4.2.3.1.4	The LAWPS contains three 75,000-gal LAW feed staging tanks.	N/A
B4.2.3.1.5	Separated solids and SCIX eluate are returned to the tank farms. The eluate is chemically adjusted in the LAWPS to meet the tank farms corrosion specifications prior to being returned.	N/A
B4.2.3.1.6	Resin usage in the SCIX system is tracked; however, spent resin is assumed to contain no contaminants, and disposal of the spent resin is not modeled. Operation of the SCIX is described in RPP-17152, Section 4.2.3.	N/A
B4.2.3.2	**Tank Waste Characterization and Staging Facility**	
B4.2.3.2.1	The Tank Waste Characterization and Staging Facility (TWCSF) is in place and on time to meet hot commissioning of the HLW Facility as stated in Assumption B4.2.5.3.2.	N/A
B4.2.3.2.2	The TWCSF consists of six 250,000-gal tanks.	N/A
B4.2.3.2.3	When PT Facility starts up, the TWCSF will pause for two months to allow changeover from DF to PT Facility feed. Residual waste greater than 10 wt% solids will be diluted to less than 10 wt%.	N/A
B4.2.4	**TANK FARMS**	
B4.2.4.1	**Single-Shell Tanks**	
B4.2.4.1.1	N/A	N/A
B4.2.4.2	**Double-Shell Tanks**	
B4.2.4.2.1	The BDGRE restrictions imposed by the JCO and USQ are assumed to be lifted on July 29, 2014 to allow for residual 241-C Tank Farm tank retrieval to be completed in compliance with the Consent Decree date. Specifically, the primary tank maximum waste liquid levels for 241-AN-101 and 241-AN-106 will return to the normal operating limit of 416 inches and the maximum authorized limit of 422 inches (as noted in OSD-T-151-00007, Table 1.1.1). All other DSTs will also return to their normal operating limits per Base Assumption B3.3.2.2.	Same as Case 1 Assumption B4.1.4.2.1 Modifies Base Assumption B3.3.2.6

B4.2.4.2.2	Double-shell tank 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220. The start date for the retrieval will be coordinated so as not to conflict with 241-AX Tank Farm retrievals. The estimated start date of supernatant transfer from 241-AY-102 is prior to 08/20/2014. The estimated start date of sludge retrieval is prior to 03/30/2016.[80]	Same as Case 1 Assumption B4.1.4.2.2
B4.2.4.2.3	A DST will be set aside as a feed tank to the LAWPS (241-AP-107 has been selected by DOE-ORP).	N/A
B4.2.4.2.4	Double-shell tank 241-AP-107 is out of service for six months at some point within the two years prior to LAWPS startup to allow for equipment installation.	N/A
B4.2.4.2.5	The HLW feed will be washed in the tank farms prior to delivery to the TWCSF.	N/A
B4.2.4.2.6	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned to the tank farms.	Replaces Base Assumption B3.3.2.4
B4.2.4.3	**Waste Retrievals and Transfers**	
B4.2.4.3.1	DST feed tank(s) for WTP hot commissioning will be chosen at the modeler's discretion to ensure the tank feed will meet WTP WAC in compliance with ICD-19 (24590-WTP-ICD-MG-01-019) when the PT Facility is in use. It is assumed that the same criteria for WTP WAC that is in compliance with ICD-19 (24590-WTP-ICD-MG-01-019) will be applicable to DFLAW and DFHLW.	Modifies Case 1 Assumption B4.1.4.3.1
B4.2.4.4	**Tank Farm Waste Evaporator (242-A)**	
B4.2.4.4.1	The 242-A Evaporator operates within permit limits (i.e., no more than 180 continuous days).	N/A
B4.2.5	**WASTE TREATMENT AND IMMOBILIZATION PLANT**	
B4.2.5.1	**General**	
B4.2.5.1.1	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned directly to the tank farms.	Replaces Base Assumption B3.4.1.8

[80] Dates shown are for modeling and do not reflect ORP direction.

B4.2.5.1.2	A portion of the effluent returned from the WTP during DF operations will be used to dilute the LAW melter feed. This is done to reduce the sodium concentration (and, therefore increase throughput).	N/A
B4.2.5.1.3	It is assumed that the effluent being returned to the tank farms contains all necessary anti-corrosion chemicals and can be accepted by the tank farms.	N/A
B4.2.5.2	**Pretreatment**	
B4.2.5.2.1	The PT Facility will begin operations on 01/01/2028.	N/A
B4.2.5.2.2	When the PT Facility starts up, it will be the primary source of feed for the supplemental LAW facility. The LAWPS will provide additional feed to supplemental LAW, as needed.	N/A
B4.2.5.3	**High-Level Waste Vitrification**	
B4.2.5.3.1	The composition, properties, and WOL of the HLW glass will be calculated using the 2009 GFM documented in PNNL-18501.	Same as Case 1 Assumption B4.1.5.3.1
B4.2.5.3.2	The vitrification of HLW will begin on 01/01/2025 with the following ramp rates. Hot commissioning is not modeled separately. Starting On — Rate (MTG/day) 01/01/2025 — 3.0 01/01/2026 — 4.0 01/01/2027 — 4.2[81] 02/06/2030 — 5.25	Modifies Base Assumptions B3.4.3.1, B3.4.3.3 Modifies Case 1 Assumption B4.1.5.3.2

[81] DE-AC2-701RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the HLW Facility will support a combined design capacity of 6 MTG/day with the original two melters and 7.5 MTG/day with two replacement melters, with a minimum integrated TOE of 70 percent. The capability of the HLW Facility to support this increase is evaluated in 24590-HLW-RPT-PE-07-001.

B4.2.5.4 Low-Activity Waste Vitrification

B4.2.5.4.1	The total sodium loading of LAW glass from pretreated feed will be determined using the "DOE 2004" model (D-03-DESIGN-004[82]), which maximizes the sodium oxide loading in the LAW glass subject to the following constraints: $[Na_2O] \leq 20\ wt\ \%$ $[SO_3] \leq 0.8\ wt\ \%$	Same as Base Assumption B3.4.4.8
B4.2.5.4.2	The vitrification of LAW will begin on 1/1/2022 with the following ramp rates. Hot commissioning is not modeled separately. Starting On — Rate (MTG/day) 01/01/2022 — 9.0 01/01/2023 — 18.0 01/01/2024 — 21.0	Modifies Base Assumptions B3.4.4.1, B3.4.4.4 Modifies Case 1 Assumption B4.1.5.4.2
B4.2.5.4.3	During the DF period, the LAW Facility will receive all of its feed from the LAWPS.	Modifies Base Assumption B3.4.4.2
B4.2.5.4.4	The vitrification of LAW will pause for two months prior to the startup of the PT Facility to allow changeover from DF operations to PT Facility feed.	N/A

B4.2.6 SUPPLEMENTAL TREATMENT

B4.2.6.1 Second Low-Activity Waste Vitrification Facility

B4.2.6.1.1	The supplemental LAW facility will begin operations on 10/01/2024 with the following ramp rates:[83] Starting On — Rate (MTG/day) 10/01/2024 — 9.0 01/01/2026 — Per Assumption B3.5.1.6A	Modifies Base Assumption B3.5.1.6 Modifies Case 1 Assumption B4.1.6.1.1

[82] The LAW glass formulation work reviewed in D-03-DESIGN-004 suggests that the sodium loading projected by the DOE model can be achieved. Ongoing glass formulation work in the DOE complex suggests that glass formulations with even higher sodium oxide loadings may be achievable.

[83] During modeling, it was determined that the supplemental LAW facility start date of October 1, 2024, was impractical since it occurred prior to the startup of the PT Facility (January 1, 2028). The actual start date used in modeling was adjusted to January 1, 2030, with a rate of 9.0 MTG/day. The facility was ramped up per Assumption B3.5.1.6 on April 1, 2031.

B4.2.6.2	**Supplemental Transuranic Sludge Treatment**	
B4.2.6.2.1	N/A	N/A
B4.2.7	**INTERFACING FACILITIES**	
B4.2.7.1	**Liquid Effluents**	
B4.2.7.1.1	N/A	N/A
B4.2.7.2	**Central Waste Complex**	
B4.2.7.2.1	N/A	N/A
B4.2.7.3	**Interim Hanford Storage**	
B4.2.7.3.1	N/A	N/A
B4.2.7.4	**Hanford Shipping Facility**	
B4.2.7.4.1	N/A	N/A
B4.2.7.5	**Final Disposal Alternative**	
B4.2.7.5.1	N/A	N/A
B4.2.7.6	**Integrated Disposal Facility**	
B4.2.7.6.1	N/A	N/A
B4.2.7.7	**222-S Laboratory**	
B4.2.7.7.1	N/A	N/A
B4.2.7.8	**Waste Encapsulation and Storage Facility**	
B4.2.7.8.1	N/A	N/A
B4.2.7.9	**Waste Isolation Pilot Plant**	
B4.2.7.9.1	N/A	N/A
B4.2.7.10	**Other Hanford Site Facilities**	
B4.2.7.10.1	N/A	N/A

B4.2.8	**CROSS-CUTTING ASSUMPTIONS**	
B4.2.8.1	**General**	
B4.2.8.1.1	N/A	N/A
B4.2.9	**SENSITIVITY ANALYSIS**	
B4.2.9.1	**High-Level Waste Vitrification**	
B4.2.9.1.1	The composition, properties, and WOL of HLW glass will be determined using the 2013 Advanced GFM (RPP-17152, Section 2.7.6.1).	Replaces Base Assumption B4.1.5.3.1 Same as Case 1 Assumption B4.1.9.1.1
B4.2.9.2	**Low-Activity Waste Vitrification**	
B4.2.9.2.1	The total sodium loading of LAW glass from pretreated feed will be determined using the 2013 Advanced GFM (RPP-17152, Section 2.7.6.2).	Replaces Base Assumption B4.1.5.4.1 Same as Case 1 Assumption B4.1.9.2.1

B4.3 CASE 3 – CONTINGENCY CASE FOR WASTE TREATMENT AND IMMOBILIZATION PLANT STARTUP UNCERTAINTY

The purpose of Case 3 is to evaluate the number of new DSTs that would be needed in the 200 West Area in order to continue to support SST retrievals consistent with Consent Decree milestones if the WTP is not fully operational until 2033, and to provide possible project schedule dates for constructing the DSTs. The assumptions for Case 3 are consistent with the Model Starting Assumptions (Section B3.0), with the exception of those outlined below.

CASE SPECIFIC ASSUMPTIONS		STARTING ASSUMPTION
B4.3.1	**CONSENT DECREE DATES/SUCCESS CRITERIA**	
B4.3.1.1	**Case 3 does not contain specific success criteria. Instead, the results of Case 3 will be compared to the results of Case 1 to determine the impacts.**	N/A
B4.3.1.2	**Case 3 will meet the ORP-provided funding targets (Basche 2010) for FY 2014 through FY 2015 (Table B-3). These targets are consistent with the most recent budget planning guidance and briefing materials. After FY 2015, a reasonable ramp-up may be assumed.**	Same as Case 1 Assumption B4.1.1.3
B4.3.1.3	**The total lifecycle cost[84] of Case 3, including funded and unfunded contingency, will not exceed $61.5B (consistent with SP6), measured from the start of FY 1997 through the end of the RPP mission.**	Same as Case 1 Assumption B4.1.1.4
B4.3.2	**CASE 3 ASSUMPTION ALIGNMENT**	
B4.3.2.1	**N/A**	N/A
B4.3.3	**TANK WASTE TREATMENT COMPLEX**	
B4.3.3.1	**Low-Activity Waste Pretreatment System**	
B4.3.3.1.1	The LAWPS will have a capacity (at 70 percent TOE) to provide feed from the tank farms to the WTP to support two LAW melters operating at 30 MTG/day.	Same as Case 2 Assumption B4.2.3.1.1
B4.3.3.1.2	The LAWPS operates at 70 percent TOE.	Same as Case 2 Assumption B4.2.3.1.2

[84] In this context, the total lifecycle cost refers specifically to the project baseline summary ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition Project," and HQ-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository."

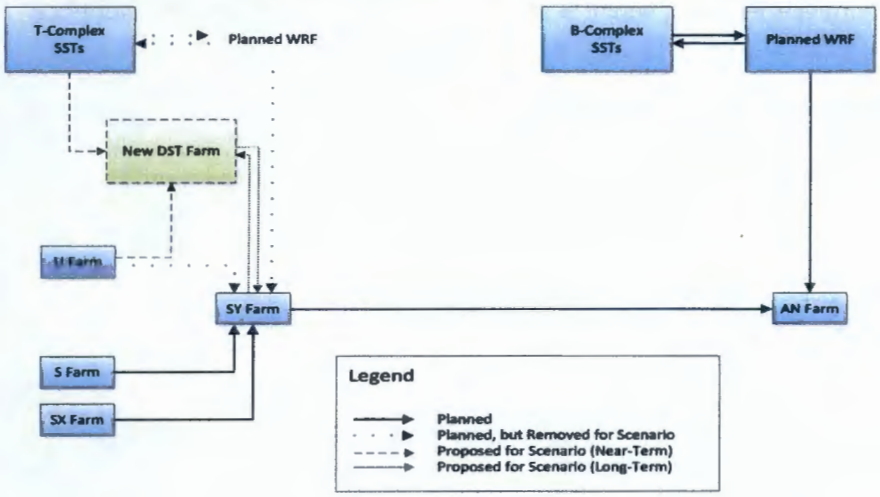
B4.3.3.1.3	The LAWPS consists of an rotary microfiltration system and a SCIX system with two columns.	Same as Case 2 Assumption B4.2.3.1.3
B4.3.3.1.4	The LAWPS contains three 75,000-gal LAW feed staging tanks.	Same as Case 2 Assumption B4.2.3.1.4
B4.3.3.1.5	Separated solids and SCIX eluate are returned to the tank farms. The eluate is chemically adjusted in the LAWPS to meet the tank farms corrosion specifications prior to being returned.	Same as Case 2 Assumption B4.2.3.1.5
B4.3.3.1.6	Resin usage in the SCIX system is tracked; however spent resin is assumed to contain no contaminants, and disposal of the spent resin is not modeled. Operation of the SCIX is described in RPP-17152, Section 4.2.3.	Same as Case 2 Assumption B4.2.3.1.6
B4.3.3.2	**Tank Waste Characterization and Staging Facility**	
B4.3.3.2.1	The TWCSF is in place and on time to meet hot commissioning of the HLW Facility as stated in Assumption B4.3.5.3.2.	Same as Case 2 Assumption B4.2.3.2.1
B4.3.3.2.2	The TWCSF consists of six 250,000-gal tanks	Same as Case 2 Assumption B4.2.3.2.2
B4.3.3.2.3	When the PT Facility starts up, the TWCSF will pause for two months to allow changeover from DF to PT Facility feed. Residual waste greater than 10 wt% solids will be diluted to less than 10 wt%.	Same as Case 2 Assumption B4.2.3.2.3
B4.3.4	**TANK FARMS**	
B4.3.4.1	**Single-Shell Tanks**	
B4.3.4.1.1	Retrievals of SSTs continue at a pace to meet the Consent Decree milestone for completion of SST retrievals by 12/31/2040. The pace is to be determined by HTWOS model logic.	N/A
B4.3.4.1.2	The SST retrieval sequence (by farm) is as follows: 241-C-Tank Farm, 241-A/AX Tank Farms, T Complex, 241-U Tank Farm, B Complex, others. HTWOS logic will determine specific retrieval sequence of tanks within each farm, and within B and T Complexes.	N/A

B4.3.4.2 Double-Shell Tanks		
B4.3.4.2.1	The BDGRE restrictions imposed by the JCO and USQ are assumed to be lifted on July 29, 2014 to allow for residual 241-C Tank Farm tank retrieval to be completed in compliance with the Consent Decree date. Specifically, the primary tank maximum waste liquid levels for 241-AN-101 and 241-AN-106 will return to the normal operating limit of 416 inches and the maximum authorized limit of 422 inches (as noted in OSD-T-151-00007, Table 1.1.1). All other DSTs will also return to their normal operating limits per Base Assumption B3.3.2.2.	Same as Case 1 Assumption B4.1.4.2.1 Same as Case 2 Assumption B4.2.4.2.1
B4.3.4.2.2	Double-shell tank 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220. The start date for the retrieval will be coordinated so as not to conflict with 241-AX Tank Farm retrievals. The estimated start date of supernatant transfer from DST 241-AY-102 is prior to 08/20/2014. The estimated start date of sludge retrieval is prior to 03/30/2016.[85]	Same as Case 1 Assumption B4.1.4.2.2 Same as Case 2 Assumption B4.2.4.2.2
B4.3.4.2.3	A DST will be set aside as a feed tank to the LAWPS (241-AP-107 has been selected by DOE-ORP).	Same as Case 2 Assumption B4.2.4.2.3
B4.3.4.2.4	241-AP-107 is out of service for six months at some point within the two years prior to LAWPS startup to allow for equipment installation.	Same as Case 2 Assumption B4.2.4.2.4
B4.3.4.2.5	The HLW feed will be washed in the tank farms prior to delivery to the TWCSF.	Same as Case 2 Assumption B4.2.4.2.5
B4.3.4.2.6	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned to the tank farms.	Same as Base Assumption B3.3.2.4

[85] Dates shown are for modeling and do not reflect ORP direction.

B4.3.4.2.7	Additional DSTs will be built in the 200 West Area to support SST waste retrieval from T Complex and 241-U Tank Farm, see Figure B-2 below.	N/A

Figure B-2. Simple Schematic for New Double-Shell Tanks.



B4.3.4.2.8	The necessary DST capacity of the additional DSTs will be determined by the modeler.	N/A
B4.3.4.2.9	For project estimation purposes, assume new DSTs will be designed and built in two-pack increments.	N/A
B4.3.4.2.10	The project scope will include transfer line(s) between T Complex and the DSTs, and between 241-U Tank Farm and the DSTs.	N/A
B4.3.4.2.11	Transfer line(s) from the new DSTs to 241-SY Tank Farm will be added as needed to accommodate facility startup dates, such as, to support transfer of waste from the DSTs to the 200 East Area and the WTP.	N/A
B4.3.4.2.12	Project milestones will be estimated in accordance with DOE O 413.3B.	N/A

B4.3.4.3 Waste Retrievals and Transfers

B4.3.4.3.1	The DST feed tank(s) for WTP hot commissioning will be chosen at the modeler's discretion to ensure the tank feed will meet WTP WAC in compliance with ICD-19 (24590-WTP-ICD-MG-01-019). It is assumed that the same criteria for WTP WAC that is in compliance with ICD-19 (24590-WTP-ICD-MG-01-019) will be applicable to DFLAW and DFHLW.	Same as Case 1 Assumption B4.1.4.3.1

B4.3.4.3.2	Per the Project Lifecycle schedule, the B Complex WRF will be available for operations in June 2022. The date may be adjusted to meet success criteria.	Replaces Base Assumption B3.3.3.8
B4.3.4.3.3	The retrieval sequence of the SSTs will allow up to six simultaneous retrievals of SSTs, which is an increase over that allowed in RPP-PLAN-40145. These simultaneous retrievals may be from adjacent tanks.	Replaces the first bullet under Base Assumption B3.3.3.3
B4.3.4.3.4	The CH-TRU waste will be treated at the WTP. Waste retrieved from the B Complex (241-B, 241-BX, and 241-BY Tank Farms), including waste designated as CH-TRU waste (see Assumption B3.4.2.2), will be transferred to a tank in the B Complex WRF, with supernate routed back and forth from the WRF tank to DST storage via new double-encased HIHTL or stainless steel lines.	Replaces Base Assumption B3.3.3.5
B4.3.4.3.5	Waste retrieved from the T Complex (241-T, 214-TX, and 241-TY Tank Farms), including waste designated as CH-TRU waste (see Assumption B3.4.2.2), will be transferred to a tank in the additional DSTs built in the 200 West Area to support SST waste retrieval from the T Complex and the 241-U Tank Farm, with supernate routed back and forth from the new DSTs to the SST as required. Retrieved waste will be transferred from the new DSTs to DST storage via new double-encased HIHTLs or stainless steel lines.	Replaces Base Assumption B3.3.3.6
B4.3.4.3.6	All other SSTs (except those specifically retrieved into WRFs) will be retrieved directly into the DST system.	Replaces Base Assumption B3.3.3.9
B4.3.4.4	**Tank Farm Waste Evaporator (242-A)**	
B4.3.4.4.1	The 242-A Evaporator operates within permit limits (i.e., no more than 180 continuous days).	Same as Case 2 Assumption B4.2.4.4.1
B4.3.5	**WASTE TREATMENT AND IMMOBILIZATION PLANT**	
B4.3.5.1	**General**	
B4.3.5.1.1	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned directly to the tank farms.	Same as Case 2 Assumption B4.2.5.1.1

B4.3.5.1.2	A portion of the effluent returned from the WTP during DF operations will be used to dilute the LAW melter feed. This is done to reduce the sodium concentration (and, therefore, increase throughput).	Same as Case 2 Assumption B4.2.5.1.2
B4.3.5.1.3	It is assumed that the effluent being returned to the tank farms contains all necessary anti-corrosion chemicals and can be accepted by the tank farms.	Same as Case 2 Assumption B4.2.5.1.3
B4.3.5.2	**Pretreatment**	
B4.3.5.2.1	The PT Facility radioactive operations start 10/01/2033.[86]	N/A
B4.3.5.2.2	When the PT Facility starts up, it will be the primary source of feed for the supplemental LAW facility. The LAWPS will provide additional feed to supplemental LAW, as needed.	Same as Case 2 Assumption B4.2.5.2.2
B4.3.5.3	**High-Level Waste Vitrification**	
B4.3.5.3.1	The composition, properties, and WOL of the HLW glass will be calculated using the 2009 GFM documented in PNNL-18501.	Same as Case 1 Assumption B4.1.5.3.1
B4.3.5.3.2	Direct feed HLW radioactive operations will start 10/01/2030. Hot commissioning is not modeled separately. Starting On — Rate (MTG/day) 10/01/2030 — 3.0 10/01/2031 — 4.0 10/01/2032 — 4.2 11/06/2035 — 5.25	N/A

[86] During modeling, the start of the PT Facility was modeled as January 10, 2033, instead of October 1, 2033, as stated in the assumption. This date was not corrected during modeling because of limited resources; however, it is not anticipated to have a significant impact on the end of the mission.

B4.3.5.4 Low-Activity Waste Vitrification

B4.3.5.4.1	The total sodium loading of LAW glass from pretreated feed will be determined using the "DOE 2004" model (D-03-DESIGN-004[87]), which maximizes the sodium oxide loading in the LAW glass subject to the following constraints: $[Na_2O] \leq 20\ wt\ \%$ $[SO_3] \leq 0.8\ wt\ \%$	Same as Base Assumption B3.4.4.8
B4.3.5.4.2	Direct feed LAW radioactive operations will start 10/01/2027. Hot commissioning is not modeled separately.	N/A

Starting On	Rate (MTG/day)
10/01/2027	9.0
10/01/2028	18.0
10/01/2029	21.0

B4.3.5.4.3	During the DF period, the LAW Facility will receive all of its feed from the LAWPS.	Same as Base Assumption B3.4.4.2
B4.3.5.4.4	The vitrification of LAW will pause for two months prior to the startup of the PT Facility to allow changeover from DF operations to WTP feed.	Same as Case 2 Assumption B4.2.5.4.4

B4.3.6 SUPPLEMENTAL TREATMENT

B4.3.6.1 Second Low-Activity Waste Vitrification Facility

B4.3.6.1.1	The supplemental LAW facility will begin operations on 07/01/2030 with the following ramp rates:[88]	Same as Base Assumption B3.5.1.6

Starting On	Rate (MTG/day)
07/01/2030	9.0
10/01/2031	Per Assumption B3.5.1.6A

[87] The LAW glass formulation work reviewed in D-03-DESIGN-004 suggests that the sodium loading projected by the DOE model can be achieved. Ongoing glass formulation work in the DOE complex suggests that glass formulations with even higher sodium oxide loadings may be achievable.

[88] During modeling, it was determined that the supplemental LAW facility start date of July 1, 2030, was impractical since it occurred prior to the start of the PT Facility (January 10, 2033). The actual start date in modeling was adjusted to October 1, 2035, with a rate of 9.0 MTG/day. The facility was ramped up per Assumption B3.5.1.6 on January 1, 2037.

B4.3.6.2	**Supplemental Transuranic Sludge Treatment**	
B4.3.6.2.1	Waste previously assumed to be CH-TRU waste (241-B-201, 241-B-202, 241-B-203, 241-B-204, 241-T-201, 241-T-202, 241-T-203, 241-T-204, 241-T-111, 241-T-110, and 241-T-104) will be retrieved and treated at the WTP.	Replaces Base Assumptions B3.5.2.1, B3.5.2.2, B3.5.2.3, B3.5.2.5, B3.5.2.6, B3.5.2.7, and B3.5.2.8
B4.3.7	**INTERFACING FACILITIES**	
B4.3.7.1	**Liquid Effluents**	
B4.3.7.1.1	N/A	N/A
B4.3.7.2	**Central Waste Complex**	
B4.3.7.2.1	Delete Assumptions B3.6.2.2 and B3.6.2.3.	N/A
B4.3.7.3	**Interim Hanford Storage**	
B4.3.7.3.1	N/A	N/A
B4.3.7.4	**Hanford Shipping Facility**	
B4.3.7.4.1	N/A	N/A
B4.3.7.5	**Final Disposal Alternative**	
B4.3.7.5.1	N/A	N/A
B4.3.7.6	**Integrated Disposal Facility**	
B4.3.7.6.1	N/A	N/A
B4.3.7.7	**222-S Laboratory**	
B4.3.7.7.1	N/A	N/A
B4.3.7.8	**Waste Encapsulation and Storage Facility**	
B4.3.7.8.1	N/A	N/A
B4.3.7.9	**Waste Isolation Pilot Plant**	
B4.3.7.9.1	Delete Assumption B3.6.9.1.	N/A
B4.3.7.10	**Other Hanford Site Facilities**	
B4.3.7.10.1	N/A	N/A

B4.3.8	**CROSS-CUTTING ASSUMPTIONS**	
B4.3.8.1	**General**	
B4.3.8.1.1	N/A	N/A

B4.4 CASE 4 – LEAKING TANKS

The purpose of Case 4 is to evaluate the impacts of emergent leaking tanks at a specified frequency which will require immediate, unplanned retrieval. The assumptions for Case 4 are consistent with the Model Starting Assumptions (Section B3.0), with the exception of those outlined below.

Five (5) more leaking SSTs are identified and retrieved, or a barrier installed, before 12/31/2022. Specific tanks and leak confirmation dates are shown in the table below.

For newly found leaking SSTs from farms or farm complexes being actively retrieved, it is assumed that it will take 18 months to put the retrieval equipment in place. Eighteen months after the leak confirmation date, the HTWOS model will place the leaking SST next in the queue for retrieval from that area (unless the tank has already started retrieval). The HTWOS model will then start retrieval from that tank when the next retrieval in that area starts.

For newly found leaking SSTs not from farms or farm complexes being actively retrieved, the farm that the leaking SSTs is in will have a water impermeable surface barrier placed over the entire farm to reduce risk of surface water transporting contaminants further into the soil. For costing purposes, the cost of the surface barrier will be borne on the year of the leak confirmation.

CASE SPECIFIC ASSUMPTIONS		**STARTING ASSUMPTION**
B4.4.1	**CONSENT DECREE DATES/SUCCESS CRITERIA**	
B4.4.1.1	**Case 4 does not contain specific success criteria. Instead, the results of Case 4 will be compared to the results of Case 1 to determine the impacts.**	Same as Case 2 Assumption B4.2.1.1
B4.4.1.2	**Case 4 will meet the ORP-provided funding targets (Basche 2010) for FY 2014 through FY 2015 (Table B-3). These targets are consistent with the most recent budget planning guidance and briefing materials. After FY 2015, a reasonable ramp-up may be assumed.**	Same as Case 1 Assumption B4.1.1.3 Same as Case 2 Assumption B4.2.1.2

B4.4.1.3	**The total lifecycle cost[89] of Case 2, including funded and unfunded contingency, will not exceed $61.5B (consistent with SP6), measured from the start of FY 1997 through the end of the RPP mission.**	Same as Case 1 Assumption B4.1.1.4 Same as Case 2 Assumption B4.2.1.3
B4.4.2	**CASE 4 ASSUMPTION ALIGNMENT**	
B4.4.2.1	**N/A**	N/A
B4.4.3	**TANK WASTE TREATMENT COMPLEX**	
B4.4.3.1	**Low-Activity Waste Pretreatment System**	
B4.4.3.1.1	The LAWPS will have a capacity (at 70 percent TOE) to provide feed from the tank farms to the WTP to support two LAW melters operating at 30 MTG/day.	Same as Case 2 Assumption B4.2.3.1.1
B4.4.3.1.2	The LAWPS operates at 70 percent TOE.	Same as Case 2 Assumption B4.2.3.1.2
B4.4.3.1.3	The LAWPS consists of an rotary microfiltration system and a SCIX system with two columns.	Same as Case 2 Assumption B4.2.3.1.3
B4.4.3.1.4	The LAWPS contains three 75,000-gal LAW feed staging tanks.	Same as Case 2 Assumption B4.2.3.1.4
B4.4.3.1.5	Separated solids and SCIX eluate are returned to the tank farms. The eluate is chemically adjusted in the LAWPS to meet the tank farms' corrosion specifications prior to being returned.	Same as Case 2 Assumption B4.2.3.1.5
B4.4.3.1.6	Resin usage in the SCIX system is tracked; however, spent resin is assumed to contain no contaminants, and disposal of the spent resin is not modeled. Operation of the SCIX is described in RPP-17152, Section 4.2.3.	Same as Case 2 Assumption B4.2.3.1.6
B4.4.3.2	**Tank Waste Characterization and Staging Facility**	
B4.4.3.2.1	The TWCSF is in place and on time to meet hot commissioning of the HLW Facility as stated in Assumption B4.2.5.3.2.	Same as Case 2 Assumption B4.2.3.2.1

[89] In this context, the total lifecycle cost refers specifically to the project baseline summary ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition Project," and HQ-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository."

B4.4.3.2.2	The TWCSF consists of six 250,000-gal tanks.	Same as Case 2 Assumption B4.2.3.2.2
B4.4.3.2.3	When the PT Facility starts up, the TWCSF will pause for two months to allow changeover from DF operations to PT Facility feed. Residual waste greater than 10 wt% solids will be diluted to less than 10 wt%.	Same as Case 2 Assumption B4.2.3.2.3
B4.4.4	**TANK FARMS**	
B4.4.4.1	**Single-Shell Tanks**	
B4.4.4.1.1	241-C Tank Farm retrievals will be completed by 09/30/2015.	N/A
B4.4.4.1.2	Single-shell tank RDFs used will be adjusted downwards so that no RDF is greater than 0.25.	Modifies Base Assumption B3.1.1.4
B4.4.4.1.3	The number of simultaneous SST retrievals allowed will not exceed six.	Modifies Base Assumption B3.3.3.3
B4.4.4.1.4	Delay will result in not initiating the startup of retrieval from five additional tanks by 12/31/2017 (Consent Decree milestone B-3). Therefore, assume this retrieval startup occurs by 12/31/2018.	Modifies Case 1 Assumption B4.1.1.2
B4.4.4.1.5	Complete retrieval of 241-T-111 by 12/31/2022.	May modify Base Assumption B3.5.2.2
B4.4.4.1.6	Complete retrieval of 241-TY-105 by 12/31/2022.	N/A
B4.4.4.1.7	Specific tanks will be confirmed as leakers. The following lists those tanks, the leak confirmation dates, and the dates that retrieval equipment has been completed and the tank is available for retrieval. • 241-BY-103 06/30/2014 12/31/2015 • 241-BY-105 06/30/2016 12/31/2017 • 241-TX-113 06/30/2018 12/31/2019 • 241-U-110 06/30/2020 12/31/2021 • 241-SX-104 06/30/2022 12/31/2023 • 241-T-107 12/31/2022 06/30/2024 • 241-BY-106 12/31/2027 06/30/2029 • 241-BY-102 12/31/2032 06/30/2034 • 241-BX-101 12/31/2037 06/30/2039 • 241-BX-110 12/31/2042 06/30/2044	Modifies Base Assumption B3.3.1.1

B4.4.4.1.8	For newly found leaking SSTs from farms or farm complexes being actively retrieved, it is assumed that it will take 18 months to put the retrieval equipment in place. Eighteen months after the leak confirmation date, HTWOS will put the leaking SST next in the queue for retrieval from that area. The HTWOS model will then start retrieval from that tank when the next retrieval in that area starts. Tanks 241-U-110 and 241-SX-104 are close enough to 241-SY Tank Farm to be considered retrievable at any time.	N/A
B4.4.4.1.9	For newly found leaking SSTs not from farms or farm complexes being actively retrieved (thought to be everything but 241-A/AX and 241-S/SX Tank Farm complexes through 2022), the farm that the leaking SSTs is in will have a water impermeable surface barrier placed over the entire farm. For costing purposes, the cost of the surface barrier will be borne on the year of the leak confirmation.	N/A
B4.4.4.2	**Double-Shell Tanks**	
B4.4.4.2.1	The BDGRE restrictions imposed by the JCO and USQ are assumed to be lifted on July 29, 2014 to allow for residual 241-C Tank Farm tank retrieval to be completed in compliance with the Consent Decree date. Specifically, the primary tank maximum waste liquid levels for 241-AN-101 and 241-AN-106 will return to the normal operating limit of 416 inches and the maximum authorized limit of 422 inches (as noted in OSD-T-151-00007, Table 1.1.1). All other DSTs will also return to their normal operating limits per Base Assumption B3.3.2.2.	Same as Case 2 Assumption B4.2.4.2.1 Same as Case 1 Assumption B4.1.4.2.1 Modifies Base Assumption B3.3.2.6
B4.4.4.2.2	DST 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220. The start date for the retrieval will be coordinated so as not to conflict with 241-AX Tank Farm retrievals. The estimated start date of supernatant transfer from 241-AY-102 is prior to 08/20/2014. The estimated start date of sludge retrieval is prior to 03/30/2016.[90]	Same as Case 2 Assumption B4.2.4.2.2 Same as Case 1 Assumption B4.1.4.2.2
B4.4.4.2.3	A DST will be set aside as a feed tank to the LAWPS (241-AP-107 has been selected by DOE-ORP).	Same as Case 2 Assumption B4.2.4.2.3
B4.4.4.2.4	241-AP-107 is out of service for six months at some point within the two years prior to LAWPS startup to allow for equipment installation.	Same as Case 2 Assumption B4.2.4.2.4

[90] Dates shown are for modeling and do not reflect ORP direction.

B4.4.4.2.5	The HLW feed will be washed in the tank farms prior to delivery to the TWCSF.	Same as Case 2 Assumption B4.2.4.2.5
B4.4.4.2.6	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned to the tank farms.	Same as Case 2 Assumption B4.2.4.2.6 Modifies Base Assumption B3.3.2.4
B4.4.4.2.7	Starting in 2022, the emergency DST space is increased to 2.465 Mgal for potential DST and/or SST leaks. Retrieval from leaking DSTs or SSTs, will be allowed to use this emergency space, but all other SST retrievals will be halted until the 2.465 Mgal emergency DST space is reclaimed (by evaporator campaigns or transfers to the WTP).	Modifies Base Assumption B3.3.3.2
B4.4.4.2.8	One DST becomes unfit for use every four (4) years, starting on 08/31/2016. Specific tanks and leak confirmation dates are shown below. • 241-AN-103 08/31/2016 • 241-AY-101 08/31/2020 • 241-AW-101 08/31/2024 • 241-AW-106 08/31/2028 • 241-SY-103 08/31/2032	Modifies Base Assumption B3.3.2.1
B4.4.4.2.9	Once a DST is confirmed as leaking, the DST is taken out of service for leaking and immediately becomes unavailable to receive waste transfers.	N/A
B4.4.4.2.10	If the newly confirmed leaking DST is being used to receive transfers, current transfers are rerouted to another available DST.	N/A
B4.4.4.2.11	If the newly confirmed leaking DST is setup for transferring waste out, the waste in the tank is immediately transferred to another DST.	N/A
B4.4.4.2.12	If the newly confirmed leaking DST is not setup for transferring waste out, the waste will be transferred to another DST starting in 24 months. These transfers take precedence over all other activities.	N/A
B4.4.4.2.13	If the newly confirmed leaking DST is a sludge tank, the content of the tank may be transferred to the TWCSF.	N/A

B4.4.4.3	**Waste Retrievals and Transfers**	
B4.4.4.3.1	The DST feed tank(s) for WTP hot commissioning will be chosen at the modeler's discretion to ensure the tank feed will meet WTP WAC in compliance with ICD-19 (24590-WTP-ICD-MG-01-019). It is assumed that the same criteria for WTP WAC that is in compliance with ICD-19 (24590-WTP-ICD-MG-01-019) will be applicable to DFLAW and DFHLW.	Same as Case 2 Assumption B4.2.4.3.1 Modifies Case 1 Assumption B4.1.4.3.1
B4.4.4.3.2	The retrieval sequence of the SSTs will allow up to six simultaneous retrievals of SSTs, which is an increase over that allowed in RPP-PLAN-40145. These simultaneous retrievals may be from adjacent tanks.	Replaces the first bullet under Base Assumption B3.3.3.3
B4.4.4.3.3	The CH-TRU waste will be treated at the WTP. Waste retrieved from the T Complex (241-T, 214-TX, and 241-TY Tank Farms), including waste designated as CH-TRU waste (see Assumption B3.4.2.2), will be transferred to a tank in the T Complex WRF, with supernate routed back and forth from the new DSTs to the SST as required. Retrieved waste will be transferred from the new DSTs to DST storage via new double-encased HIHTLs or stainless steel lines.	Replaces Base Assumption B3.3.3.6
B4.4.4.3.4	All other SSTs (except those specifically retrieved into WRFs) will be retrieved directly into the DST system.	Replaces Base Assumption B3.3.3.9
B4.4.4.3.5	Waste retrieved from the B Complex (241-B, 241-BX, and 241-BY Tank Farms), including waste designated as CH-TRU waste (see Assumption B3.4.2.2), will be transferred to a tank in the B Complex WRF, with supernate routed back and forth from the WRF tank to DST storage via new double-encased HIHTL or stainless steel lines.	Replaces Base Assumption B3.3.3.5
B4.4.4.4	**Tank Farm Waste Evaporator (242-A)**	
B4.4.4.4.1	The 242-A Evaporator operates within permit limits (i.e., no more than 180 continuous days).	Same as Case 2 Assumption B4.2.4.4.1

B4.4.5	**WASTE TREATMENT AND IMMOBILIZATION PLANT**	
B4.4.5.1	**General**	
B4.4.5.1.1	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned directly to the tank farms.	Same as Case 2 Assumption B4.2.5.1.1 Modifies Base Assumption B3.4.1.8
B4.4.5.1.2	A portion of the effluent returned from the WTP during DF operations will be used to dilute the LAW melter feed. This is done to reduce the sodium concentration (and, therefore, increase throughput).	Same as Case 2 Assumption B4.2.5.1.2
B4.4.5.1.3	It is assumed that the effluent being returned to the tank farms contains all necessary anti-corrosion chemicals and can be accepted by the tank farms.	Same as Case 2 Assumption B4.2.5.1.3
B4.4.5.2	**Pretreatment**	
B4.4.5.2.1	The PT Facility will begin operations on 01/01/2028.	Same as Case 2 Assumption B4.2.5.2.1
B4.4.5.2.2	When the PT Facility starts up, it will be the primary source of feed for the supplemental LAW facility. The LAWPS will provide additional feed to supplemental LAW, as needed.	Same as Case 2 Assumption B4.2.5.2.2

B4.4.5.3 High-Level Waste Vitrification

B4.4.5.3.1	The composition, properties, and WOL of the HLW glass will be calculated using the 2009 GFM documented in PNNL-18501.	Same as Case 2 Assumption B4.2.5.3.1 Modifies Case 1 Assumption B4.1.5.3.1
B4.4.5.3.2	The vitrification of HLW will begin on 01/01/2025 with the following ramp rates. Hot commissioning is not modeled separately. Starts On — Rate (MTG/day) 01/01/2025 — 3.0 01/01/2026 — 4.0 01/01/2027 — 4.2[91] 02/06/2030 — 5.25	Same as Case 2 Assumption B4.2.5.3.2 Modifies Case 1 Assumption B4.1.5.3.2 Modifies Base Assumptions B3.4.3.1, B3.4.3.3

B4.4.5.4 Low-Activity Waste Vitrification

B4.4.5.4.1	The total sodium loading of LAW glass from pretreated feed will be determined using the "DOE 2004" model (D-03-DESIGN-004[92]), which maximizes the sodium oxide loading in the LAW glass subject to the following constraints: $[Na_2O] \leq 20\ wt\ \%$ $[SO_3] \leq 0.8\ wt\ \%$	Same as Case 2 Assumption B4.2.5.4.1 Same as Case 1 Assumption B4.1.5.4.1 Same as Base Assumption B3.4.4.8
B4.4.5.4.2	The vitrification of LAW will begin on 01/01/2022 with the following ramp rates. Hot commissioning is not modeled separately. Starts On — Rate (MTG/day) 01/01/2022 — 9.0 01/01/2023 — 18.0 01/01/2024 — 21.0	Same as Case 2 Assumption B4.2.5.4.2 Modifies Case 1 Assumption B4.1.5.4.2 Modifies Base Assumptions B3.4.4.1, B3.4.4.4

[91] DE-AC2-701RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the HLW Facility will support a combined design capacity of 6 MTG/day with the original two melters and 7.5 MTG/day with two replacement melters, with a minimum integrated TOE of 70 percent. The capability of the HLW Facility to support this increase is evaluated in 24590-HLW-RPT-PE-07-001.

[92] The LAW glass formulation work reviewed in D-03-DESIGN-004 suggests that the sodium loading projected by the DOE model can be achieved. Ongoing glass formulation work in the DOE complex suggests that glass formulations with even higher sodium oxide loadings may be achievable.

B4.4.5.4.3	During the DF period, the LAW Facility will receive all of its feed from the LAWPS.	Same as Case 2 Assumption B4.2.5.4.3 Modifies Base Assumption B3.4.4.2
B4.4.5.4.4	The vitrification of LAW will pause for two months prior to the startup of the PT Facility to allow changeover from DF operations to PT Facility feed.	Same as Case 2 Assumption B4.2.5.4.4
B4.4.6	**SUPPLEMENTAL TREATMENT**	
B4.4.6.1	**Second Low-Activity Waste Vitrification Facility**	
B4.4.6.1.1	The supplemental LAW facility will begin operations on 10/01/2024 with the following ramp rates:[93] Starts On — Rate (MTG/day) 10/01/2024 — 9.0 01/01/2026 — Per Assumption B3.5.1.6A	Same as Case 2 Assumption B4.2.6.1.1 Modifies Case 1 Assumption B4.1.6.1.1 Modifies Base Assumption B3.5.1.6
B4.4.6.2	**Supplemental Transuranic Sludge Treatment**	
B4.4.6.2.1	Waste previously assumed to be CH-TRU waste (241-B-201, 241-B-202, 241-B-203, 241-B-204, 241-T-201, 241-T-202, 241-T-203, 241-T-204, 241-T-111, 241-T-110, and 241-T-104) will be retrieved and treated at the WTP.	Replaces Base Assumptions B3.5.2.1, B3.5.2.2, B3.5.2.3, B3.5.2.5, B3.5.2.6, B3.5.2.7, and B3.5.2.8
B4.4.7	**INTERFACING FACILITIES**	
B4.4.7.1	**Liquid Effluents**	
B4.4.7.1.1	N/A	N/A
B4.4.7.2	**Central Waste Complex**	
B4.4.7.2.1	Delete Assumptions B3.6.2.2 and B3.6.2.3.	N/A
B4.4.7.3	**Interim Hanford Storage**	
B4.4.7.3.1	N/A	N/A

[93] During modeling, it was determined that the supplemental LAW facility start date of October 1, 2024, was impractical since it occurred prior to the start of the PT Facility (January 1, 2028). The actual start date used in modeling was adjusted to January 1, 2030, with a rate of 9.0 MTG/day. The facility was ramped up per Assumption B3.5.1.6 on April 1, 2031.

B4.4.7.4	**Hanford Shipping Facility**	
B4.4.7.4.1	N/A	N/A
B4.4.7.5	**Final Disposal Alternative**	
B4.4.7.5.1	N/A	N/A
B4.4.7.6	**Integrated Disposal Facility**	
B4.4.7.6.1	N/A	N/A
B4.4.7.7	**222-S Laboratory**	
B4.4.7.7.1	N/A	N/A
B4.4.7.8	**Waste Encapsulation and Storage Facility**	
B4.4.7.8.1	N/A	N/A
B4.4.7.9	**Waste Isolation Pilot Plant**	
B4.4.7.9.1	Delete Assumption B3.6.9.1.	N/A
B4.4.7.10	**Other Hanford Site Facilities**	
B4.4.7.10.1	N/A	N/A
B4.4.8	**CROSS-CUTTING ASSUMPTIONS**	
B4.4.8.1	**General**	
B4.4.8.1.1	N/A	N/A

B4.5 CASE 5 – CONSEQUENCES OF LIMITED FUNDING

The purpose of Case 5 is to evaluate the impacts of limited funding on mission metrics. The assumptions for Case 5 are consistent with the Model Starting Assumptions (Section B3.0), with the exception of those outlined below.

CASE SPECIFIC ASSUMPTIONS	STARTING ASSUMPTION
B4.5.1 CONSENT DECREE DATES/SUCCESS CRITERIA	
B4.5.1.1 This case will be considered successful if it meets the funding profile[94, 95] described below: • **First 12 years (2014-2025, inclusive): Flat funding of $1,135M per year (see bullet below for details).** o **First year = $460 M/year for the tank farms + $625 M/year for WTP = $1,085 M/year combined. (Note: These figures exclude ORP project office funding).** • **Next five years (2026-2030, inclusive): Funding ramp-up not to exceed 10 percent per year (including inflation).** • **Starting in 2031 and continuing through the end of the program, assume funding is provided as needed to finish retrieving SSTs, prepping feed, and operating WTP.** • **The cost estimate in SVF-2313, "SP6 Case 6 Supplemental Cost Estimate.xlxs Rev. 0," can be used to determine design/build costs for new DSTs** • **The minimum funding levels for tank farms is $510M (except for the first year); the minimum funding level for WTP is $625M. The tank farms and WTP budgets are combined and funds for the tank farms and WTP can be reallocated to each other as needed, given appropriate Congressional action.**	

[94] Future annual budget needed to support tank farms and WTP operations will be determined during detailed assumption development between WRPS and Ecology.
[95] It should be noted that tank and transfer system integrity milestones can slip up to 1 year.

B4.5.2	**CASE 5 ASSUMPTION ALIGNMENT**	
B4.5.2.1	**N/A**	N/A
B4.5.3	**TANK WASTE TREATMENT COMPLEX**	
B4.5.3.1	**Low-Activity Waste Pretreatment System**	
B4.5.3.1.1	The LAWPS will have a capacity (at 70 percent TOE) to provide feed from the tank farms to the WTP to support two LAW melters operating at 30 MTG/day.	Same as Case 2 Assumption B4.2.3.1.1
B4.5.3.1.2	The LAWPS operates at 70 percent TOE.	Same as Case 2 Assumption B4.2.3.1.2
B4.5.3.1.3	The LAWPS consists of an rotary microfiltration system and a SCIX system with two columns.	Same as Case 2 Assumption B4.2.3.1.3
B4.5.3.1.4	The LAWPS contains three 75,000-gal LAW feed staging tanks.	Same as Case 2 Assumption B4.2.3.1.4
B4.5.3.1.5	Separated solids and SCIX eluate are returned to the tank farms. The eluate is chemically adjusted in the LAWPS to meet the tank farms' corrosion specifications prior to being returned.	Same as Case 2 Assumption B4.2.3.1.5
B4.5.3.1.6	Resin usage in the SCIX system is tracked; however, spent resin is assumed to contain no contaminants, and disposal of the spent resin is not modeled. Operation of the SCIX is described in RPP-17152, Section 4.2.3.	Same as Case 2 Assumption B4.2.3.1.6
B4.5.3.2	**Tank Waste Characterization and Staging Facility**	
B4.5.3.2.1	The TWCSF is in place and on time to meet hot commissioning of the HLW Facility as stated in Assumption B4.2.5.3.2.	Same as Case 2 Assumption B4.2.3.2.1
B4.5.3.2.2	The TWCSF consists of six 250,000-gal tanks.	Same as Case 2 Assumption B4.2.3.2.2
B4.5.3.2.3	When the PT Facility starts up, the TWCSF will pause for two months to allow changeover from DF operations to PT Facility feed. Residual waste greater than 10 wt% solids will be diluted to less than 10 wt%	Same as Case 2 Assumption B4.2.3.2.2
B4.5.4	**TANK FARMS**	
B4.5.4.1	**Single-Shell Tanks**	

B4.5.4.1.1	N/A	N/A
B4.5.4.2	**Double-Shell Tanks**	
B4.5.4.2.1	The BDGRE restrictions imposed by the JCO and USQ are assumed to be lifted on July 29, 2014 to allow for residual 241-C Tank Farm tank retrievals to be completed in compliance with the Consent Decree date. Specifically, the primary tank maximum waste liquid levels for 241-AN-101 and 241-AN-106 will return to the normal operating limit of 416 inches and the maximum authorized limit of 422 inches (as noted in OSD-T-151-00007, Table 1.1.1). All other DSTs will also return to their normal operating limits per Base Assumption B3.3.2.2.	Replaces Base Assumption B3.3.2.6 Same as Case 1 Assumption B4.1.4.2.1
B4.5.4.2.2	Double-shell tank 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220. The start date for the retrieval will be coordinated so as not to conflict with 241-AX Tank Farm retrievals. The estimated start date of supernatant transfer from DST 241-AY-102 is prior to 08/20/2014. The estimated start date of sludge retrieval is prior to 03/30/2016.[96]	Same as Case 1 Assumption B4.1.4.2.1
B4.5.4.2.3	A DST will be set aside as a feed tank to the LAWPS (241-AP-107 has been selected by DOE-ORP).	Same as Case 2 Assumption B4.2.4.2.3
B4.5.4.2.4	241-AP-107 is out of service for six months at some point within the two years prior to LAWPS startup to allow for equipment installation.	Same as Case 2 Assumption B4.2.4.2.4
B4.5.4.2.5	The HLW feed will be washed in the tank farms prior to delivery to the TWCSF.	Same as Case 2 Assumption B4.2.4.2.5
B4.5.4.2.6	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned to the tank farms.	Replaces Base Assumption B3.3.2.4
B4.5.4.3	**Waste Retrievals and Transfers**	
B4.5.4.3.1	The DST feed tank(s) for WTP hot commissioning will be chosen at the modeler's discretion to ensure the tank feed will meet WTP WAC in compliance with ICD-19 (24590-WTP-ICD-MG-01-019). It is assumed that the same criteria for WTP WAC that is in compliance with ICD-19 (24590-WTP-ICD-MG-01-019) will be applicable to DFLAW and DFHLW.	Replaces Case 1 Assumption B4.1.4.3.1

[96] Dates shown are for modeling and do not reflect ORP direction.

B4.5.4.3.2	The retrieval sequence of the SSTs will allow up to six simultaneous retrievals of SSTs, which is an increase over that allowed in RPP-PLAN-40145. These simultaneous retrievals may be from adjacent tanks.	Replaces the first bullet under Base Assumption B3.3.3.3
B4.5.4.3.3	The CH-TRU waste will be treated at the WTP. Waste retrieved from the B Complex (241-B, 241-BX, and 241-BY Tank Farms), including waste designated as CH-TRU waste (see Assumption B3.4.2.2), will be transferred to a tank in the B Complex WRF, with supernate routed back and forth from the WRF tank to DST storage via new double-encased HIHTL or stainless steel lines.	Replaces Base Assumption B3.3.3.5
B4.5.4.3.4	Waste retrieved from the T Complex (241-T, 214-TX, and 241-TY Tank Farms), including waste designated as CH-TRU waste (see Assumption B3.4.2.2), will be transferred to a tank in the T Complex WRF, with supernate routed back and forth from the new DSTs to the SST as required. Retrieved waste will be transferred from the new DSTs to DST storage via new double-encased HIHTLs or stainless steel lines.	Replaces Base Assumption B3.3.3.6
B4.5.4.3.5	All other SSTs (except those specifically retrieved into WRFs) will be retrieved directly into the DST system.	Replaces Base Assumption B3.3.3.9
B4.5.4.4	**Tank Farm Waste Evaporator (242-A)**	
B4.5.4.4.1	The 242-A Evaporator operates within permit limits (i.e., no more than 180 continuous days).	Same as Case 2 Assumption B4.2.4.4.1
B4.5.5	**WASTE TREATMENT AND IMMOBILIZATION PLANT**	
B4.5.5.1	**General**	
B4.5.5.1.1	During the DF period, all effluent from LAW and HLW melter offgas, canister decontamination, and line flushes will be returned to the tank farms.	Replaces Base Assumption B3.4.1.8
B4.5.5.1.2	A portion of the effluent returned from the WTP during DF operations will be used to dilute the LAW melter feed. This is done to reduce the sodium concentration (and, therefore, increase throughput).	Same as Case 2 Assumption B4.2.5.1.2
B4.5.5.1.3	It is assumed that the effluent being returned to tank farms contains all necessary anti-corrosion chemicals and can be accepted by the tank farms.	Same as Case 2 Assumption B4.2.5.1.3

B4.5.5.2 Pretreatment

B4.5.5.2.1	The PT Facility will begin operations on 01/01/2028.[97]	Same as Case 2 Assumption B4.2.5.2.1
B4.5.5.2.2	Staging of PT Facility and LAWPS feed to the LAW Facility and the supplemental LAW facility may be adjusted, as needed.	Replace Case 2 Assumption B4.2.5.2.2

B4.5.5.3 High-Level Waste Vitrification

B4.5.5.3.1	The composition, properties, and WOL of the HLW glass will be calculated using the 2009 GFM documented in PNNL-18501.	Same as Case 1 Assumption B4.1.5.3.1
B4.5.5.3.2	The vitrification of HLW is anticipated to begin on 01/01/2025 with the following ramp rates. Hot commissioning is not modeled separately.[98]	Replaces Base Assumptions B3.4.3.1, B3.4.3.3

Starting On	Rate (MTG/day)
01/01/2025	3.0
01/01/2026	4.0
01/01/2027	4.2[99]
02/06/2030	5.25

Also Replaces Case 1 Assumption B4.1.5.3.2

B4.5.5.4 Low-Activity Waste Vitrification

B4.5.5.4.1	The total sodium loading of LAW glass from pretreated feed will be determined using the "DOE 2004" model (D-03-DESIGN-004[100]), which maximizes the sodium oxide loading in the LAW glass subject to the following constraints:	Same as Base Assumption B3.4.4.8

$[Na_2O] \leq 20\ wt\ \%$

$[SO_3] \leq 0.8\ wt\ \%$

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[97] Decisions on annual budget needed to support tank farms and WTP operations will be determined during detailed assumption development between WRPS and Ecology and may require that the dates noted in this assumption be changed.

[98] Decisions on annual budget needed to support tank farms and WTP operations will be determined during detailed assumption development between WRPS and Ecology and may require that the dates noted in this assumption be changed.

[99] DE-AC2-701RV14136, Section C.7(b), "Waste Treatment Capacity Requirements," specifies that the HLW Facility will support a combined design capacity of 6 MTG/day with the original two melters and 7.5 MTG/day with two replacement melters, with a minimum integrated TOE of 70 percent. The capability of the HLW Facility to support this increase is evaluated in 24590-HLW-RPT-PE-07-001.

[100] The LAW glass formulation work reviewed in D-03-DESIGN-004 suggests that the sodium loading projected by the DOE model can be achieved. Ongoing glass formulation work in the DOE complex suggests that glass formulations with even higher sodium oxide loadings may be achievable.

B4.5.5.4.2	The vitrification of LAW is anticipated to begin on 01/01/2022 with the following ramp rates. Hot commissioning is not modeled separately.[101] Starting On — Rate (MTG/day) 01/01/2022 — 9.0 01/01/2023 — 18.0 01/01/2024 — 21.0	Replaces Base Assumptions B3.4.4.1, B3.4.4.4 Also replaces Case 1 Assumption B4.1.5.4.2
B4.5.5.4.3	During the DF period, the LAW Facility will receive all of its feed from the LAWPS.	Replaces Base Assumption B3.4.4.2
B4.5.5.4.4	The vitrification of LAW will pause for two months prior to the startup of the PT Facility to allow changeover from DF operations to WTP feed.	Same as Case 2 Assumption B4.2.5.4.4
B4.5.6	**SUPPLEMENTAL TREATMENT**	
B4.5.6.1	**Second Low-Activity Waste Vitrification Facility**	
B4.5.6.1.1	The supplemental LAW facility is anticipated to begin operation on 10/01/2024 with the following ramp rates:[102] Starting On — Rate (MTG/day) 10/01/2024 — 9.0 01/01/2026 — Per Assumption B3.5.1.6A	Replaces Base Assumption B3.5.1.6 Also replaces Case 1 Assumption B4.1.6.1.1
B4.5.6.2	**Supplemental Transuranic Sludge Treatment**	
B4.5.6.2.1	Waste previously assumed to be CH-TRU waste (241-B-201, 241-B-202, 241-B-203, 241-B-204, 241-T-201, 241-T-202, 241-T-203, 241-T-204, 241-T-111, 241-T-110, and 241-T-104) will be retrieved and treated at the WTP.	Replaces Base Assumptions B3.5.2.1, B3.5.2.2, B3.5.2.3, B3.5.2.5, B3.5.2.6, B3.5.2.7, and B3.5.2.8
B4.5.7	**INTERFACING FACILITIES**	
B4.5.7.1	**Liquid Effluents**	
B4.5.7.1.1	N/A	N/A

[101] Decisions on annual budget needed to support tank farms and WTP operations will be determined during detailed assumption development between WRPS and Ecology and may require that the dates noted in this assumption be changed.

[102] Decisions on annual budget needed to support tank farms and WTP operations will be determined during detailed assumption development between WRPS and Ecology and may require that the dates noted in this assumption be changed.

B4.5.7.2	**Central Waste Complex**	
B4.5.7.2.1	Delete Assumptions B3.6.2.2 and B3.6.2.3.	N/A
B4.5.7.3	**Interim Hanford Storage**	
B4.5.7.3.1	N/A	N/A
B4.5.7.4	**Hanford Shipping Facility**	
B4.5.7.4.1	N/A	N/A
B4.5.7.5	**Final Disposal Alternative**	
B4.5.7.5.1	N/A	N/A
B4.5.7.6	**Integrated Disposal Facility**	
B4.5.7.6.1	N/A	N/A
B4.5.7.7	**222-S Laboratory**	
B4.5.7.7.1	N/A	N/A
B4.5.7.8	**Waste Encapsulation and Storage Facility**	
B4.5.7.8.1	N/A	N/A
B4.5.7.9	**Waste Isolation Pilot Plant**	
B4.5.7.9.1	Delete Assumption B3.6.9.1.	N/A
B4.5.7.10	**Other Hanford Site Facilities**	
B4.5.7.10.1	N/A	N/A
B4.5.8	**CROSS-CUTTING ASSUMPTIONS**	
B4.5.8.1	**General**	
B4.5.8.1.1	N/A	N/A

B5.0 REFERENCES

13-NSD-0006, Kevin W. Smith to M.D. Johnson, President and Project Manager, Washington River Protection Solutions, LLC, *Approval of Tank Farms Justification for Continued Operation (JCO) for Potential Large Spontaneous Gas Release Event in Deep Sludge (TF-13-01)*. March 7, 2013.

13-ORP-0286, Kevin W. Smith to David Huizenga, *Request for Approval of the Justification of Mission Need for a Tank Waste Characterization Staging Capability*, October 28, 2014.

24590–HLW-3PS-AE00-T0001, 2009, *Engineering Specification for High Level Waste Melters,* Rev. 5, Bechtel National, Inc., Richland, Washington.

24590-HLW-3YD-HEH-00001, 2011, *System Description for the HLW System HEH Canister Export Handling*, Rev. 3, Bechtel National, Inc., Richland, Washington.

24590-HLW-3YD-HPH-00001, 2010, *System Description for HLW System HPH Canister Pour Handling*, Rev. 3, Bechtel National, Inc., Richland, Washington.

24590-HLW-M0-30-00001001, 2006, *HLW Test Canister Assembly*, Rev. 3, Bechtel National, Inc., Richland, Washington.

24590-HLW-M0C-30-00003, 2008, *HLW Glass Canister Weight and Volume Calculations*, Rev. 0, Bechtel National, Inc., Richland, Washington.

24590-HLW-RPT-PE-07-001, 2007, *High Level Waste Vitrification Plant Capacity Enhancement Study*, Rev. 0, Bechtel National, Inc., Richland, Washington.

24590-LAW-3PS-AE00-T0001, 2009, *Engineering Specification for Low Activity Waste Melters*, Rev. 5, Bechtel National, Inc., Richland, Washington.

24590-HLW-RPT-PE-07-001, *High Level Waste Vitrification Plant Capacity Enhancement Study.*

24590-WTP-ICD-MG-01-019, 2013, *ICD 19 – Interface Control Document for Waste Feed,* Rev. 6, Bechtel National, Inc., Richland, Washington.

24590-WTP-MDD-PR-01-002, 2014, *Dynamic (G2) Model Design Document*, Rev. 13, Bechtel National, Inc., Richland, Washington.

24590-WTP-MRQ-PO-04-0065, 2004, *Model Run Request, Supplemental LAW Data Collection*, Rev. 0, Bechtel National, Inc., Richland, Washington.

24590-WTP-MRR-PET-10-001, 2010, *WTP Mission Assessment of the Design and Operating Changes Expected to Resolve PJM Mixing in PT Vessels*, Rev. 0, Bechtel National, Inc., Richland, Washington.

24590-WTP-PL-MG-01-001, 2012, *Interface Management Plan*, Rev. 6, Bechtel National, Inc., Richland, Washington.

24590-WTP-RPT-PT-02-005, 2013, *Flowsheet Bases, Assumptions, and Requirements*, Rev. 7, Bechtel National, Inc., Richland, Washington.

1300075, 2013, "Contract No. DE AC27-08RV14800 – Approval of Tank Farms Justification for Continued Operation (JCO) for Potential Large Spontaneous Gas Release Event in Deep Sludge (TF-13-01)," (incoming correspondence from K.W. Smith to M.D. Johnson,

March 7 [DOE-ORP: 13-NSD-0006]), Washington River Protection Solutions LLC, Richland, Washington.

Basche, A.D., 2010, "RE: Please send funding targets ASAP," (email to P.J. Certa, Washington River Protection Solutions LLC, February 2), Washington River Protection Solutions LLC, Richland, Washington.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq.

Consent Decree, 2010, *State of Washington v. DOE,* Case No. 08-5085-FVS (October 25), Eastern District of Washington.

Contract No. D-03-DESIGN-004, 2003, *An Assessment of the Factors Affecting the Ability to Increase the Na_2O Loading in the Waste Treatment and Immobilization Plant (WTP) Low Activity Waste (LAW) Glass*, U.S. Department of Energy, Office of River Protection, Richland, Washington.

Contract No. DE-AC27-01RV14136, *Design Construction and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, as amended through A164 (April 5, 2010), U.S. Department of Energy, Office of River Protection, Richland, Washington.

DOE/EIS-0391, 2012, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, U. S. Department of Energy, Office of River Protection, Richland, Washington.Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EM-RP-WRPS-TANKFARM-2012-0014, "Potential for a Large Spontaneous Gas Release Event in Deep Settled Solid Waste Sludge," Washington River Protection Solutions LLC December 3, 2012, as updated January 21, 2013.

Gimpel, R.F., 2009, "Incorporation of HLW Glass Shell V2.0 into the Flowsheets – Supersedes CCN 153245," (Memordandum CCN: 184905 to E. Lee, October 20), Bechtel National, Inc., Richland, Washington.

Hall, M., 2004, "HLW Melter Glass Inventory," (Memorandum CCN: 102476 to Distribution, Bechtel National, Inc., October 14), Bechtel National, Inc., Richland, Washington.

Harp, B.J., 2008, "HTWOS model assumption," (email to P.J. Certa et al., Washington River Protection Solutions LLC, November 21), U.S. Department of Energy, Office of River Protection, Richland, Washington.

HNF-3484, 2009, *Double-Shell Tank Emergency Pumping Guide*, Rev. 10, Washington River Protection Solutions LLC, Richland, Washington.

HNF-4573, 1999, *Liquid Effluent Retention Facility Basin 44 Process Test Post-Report*, Rev. 0A, Waste Management Federal Services of Hanford, Inc., Richland, Washington.

HNF-EP-0182, 2014, *Waste Tank Summary Report for Month Ending April 30, 2014*, Rev. 316, Washington River Protection Solutions LLC, Richland, Washington.

HNF-SD-WM-OCD-015, 2014, *Tank Farms Waste Transfer Compatibility Program*, Rev. 30, Washington River Protection Solutions LLC, Richland, Washington.

HNF-SD-WM-SAD-040, 2001, *Liquid Effluent Retention Facility Final Hazard Category Determination,* Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HQ-HLW-0014X, "Radioactive Liquid Tank Waste Stabilization and Disposition – Storage Operations Awaiting Geologic Repository"

Leonard, M.W., 2010, "RE: Mixer Pump Jet Forces on Internal Equipment in Aging Waste Tanks" (email to P.J. Certa, Washington River Protection Solutions LLC February 2), Washington River Protection Solutions LLC, Richland, Washington.

McDonald, D., 2013-11-14, "Scenario 1 and 2 Summaries – Revised Per Yesterday's Discussion," (email to M. N. Wells, AEM Consulting, LLC, subcontractor to Washington River Protection Solutions LLC), Washington State Department of Ecology, Richland, Washington.

National Environmental Policy Act of 1969, 42 USC 4321, et seq.

ORP-0014, "Radioactive Liquid Tank Waste Stabilization and Disposition Project"

OSD-T-151-00007, 2013, *Operating Specifications for the Double-Shell Storage Tanks*, Rev. 12, Washington River Protection Solutions LLC, Richland, Washington.

PNNL-18501, 2009, *Glass Property Data and Models for Estimating High-Level Waste Glass Volume*, Pacific Northwest National Laboratory, Richland, Washington.

RPP-17152, 2014, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.7 Model Design Document*, Rev. 9, Washington River Protection Solutions LLC, Richland, Washington.

RPP-21970, 2012, *CH-TRUM WPU&SE 11-Tank Material Balance*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-23674, 2012, *Immobilized High-level Waste Interim Storage Facility System Specification*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington.

RPP-24809, 2005, *Strontium and TRU Separation Process in the DST System*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-33715, 2014, *Double-Shell and Single-Shell Tank Inventory Input to the Hanford Tank Waste Operation Simulator Model – 2014 Update*, Rev. 6, Washington River Protection Solutions LLC, Richland, Washington.

RPP-37110, 2008, *Computer/CAD Modeling System Test Results*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-40149-VOL1, 2012, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Strategy*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington, January.

RPP-40149-VOL2, 2012, *Integrated Waste Feed Delivery Plan, Volume 2 – Campaign Plan*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington, January.

RPP-56408, 2013, *Selected Scenarios for the River Protection Project System Plan, Revision 7*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-40145, 2012, *Single-Shell Tank Waste Retrieval Plan*, Rev. 3, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-40761, 2013, *Integrated Single-Shell Tank Waste Management Area Closure Plan*, Rev. 2, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-55220, 2013, *241-AY-102 Pumping Plan,* Rev. A, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-43828, 2012, *Refined Use of AN Farm for C Farm Single Shell-Tank Retrieval,* Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-47306, 2013, *Waste Type Analysis for Aluminum Leachability Estimates of All Non-Retrieved Hanford Tank Wastes*, Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-56722, *Hanford Tank Waste Operations Simulator Model Data Package for the River Protection Project System Plan Revision 7*, Draft, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

Sasaki, L.M., 2008, "RE: SST Residual Stuff," (email from to J.S. Schofield and P.J. Certa, Washington River Protection Solutions LLC, December 10), Washington River Protection Solutions LLC, Richland, Washington.

SVF-1647, 2014, "SVF-1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx," Rev. 5, Washington River Protection Solutions LLC, Richland, Washington.

SVF-2313, 2011, "SP6 Case 6 Supplemental Cost Estimate.xlxs Rev. 0," Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

SVF-2455, 2012, "SVF-2455_R0_WTP DQO Feed Screening.xlsm," Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

WRPS-1003700, 2010, "Contract Number DE-AC27-08RV14800, Washington River Protection Solutions LLC Transmits Justification of Mission Need for the Interim Hanford Storage Facility," (letter from S. M. Sax to S. L. Charboneau, November 8), Washington River Protection Solutions LLC, Richland, Washington.

WTP-RPT-117, 2004, *Oxidative-Alkaline Leaching of Washed 241-SY-102 and 241-SX-101 Tank Sludges*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

APPENDIX C – MODELING TOOLS

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APPENDIX C – MODELING TOOLS

The Tank Operations Contract (TOC) and Waste Treatment and Immobilization Plant (WTP) Contract contractors use a variety of sophisticated computer models to plan and evaluate alternative operating scenarios concerning the River Protection Project (RPP) system at Hanford. Each model serves a purpose based on its strengths. Five of these models are described in this appendix.

Two dynamic models are the primary tools used for flowsheet planning for the RPP system:

- The TOC contractor, Washington River Protection Solutions LLC (WRPS), uses Hanford Tank Waste Operations Similator (HTWOS), a dynamic event-simulation model programmed using the G2®[103] programming language, to track the waste as it moves through storage, retrieval, feed staging, and multiple treatment processes from the present day until the end of the RPP mission. The HTWOS forecasts the outcomes of various proposed operating scenarios, including the quantities and composition of the primary and secondary waste streams, the timing of key process steps, lifecycle system mass balances, and mission end dates (refer to Section C1.1).
- The WTP contractor, Bechtel National, Inc. (BNI), uses the WTP Dynamic (G2) Model to evaluate WTP facility equipment utilization, unit operations, and plant performance, and also to support process and facility design decisions, integration with the tank farms, and other activities (refer to Section C1.2).

Two operations research models are also in use:

- The TOC contractor uses a detailed waste feed delivery (WFD) operations research model based on WITNESS™ software, which addresses equipment reliability, availability, and maintainability for double-shell tanks (DST), the 242-A Evaporator, and the waste transfer systems leading to WTP. This model includes a simplified operations research model of WTP to allow evaluation of the effects of equipment failures on the combined WFD/WTP system (refer to Section C2.1).
- The WTP contractor maintains an operations research model of WTP, also using WITNESS™, which simulates WTP operations. This model is used to estimate the availability of WTP systems (refer to Section C2.2).

The fifth model, the TOC lifecycle cost model (LCM), has been developed that electronically links the HTWOS output database to schedule- and cost-processing software to generate lifecycle cost reports. This allows the U.S. Department of Energy (DOE), Office of River Protection (ORP) to analyze the impact of technical or programmatic changes on RPP budget profiles and projected lifecycle costs and schedules (refer to Section C3.0).

[103] G2 is a registered trademark of Gensym Corporation, Austin, Texas.

C1.0 DYNAMIC MODELS

C1.1 HANFORD TANK WASTE OPERATIONS SIMULATOR MODEL

The HTWOS, using the commercially available Gensym®[104] Corporation G2® software, was developed for ORP as a dynamic flowsheet simulation and mass balance model. The WRPS System Planning and Modeling department currently maintains and operates HTWOS. The HTWOS is a tool used to:

- Simulate the current planned RPP mission
- Evaluate the impact of changes to the RPP mission
- Evaluate integrated sets of technical and programmatic assumptions for internal consistency
- Assist in generating tank-specific single-shell tank (SST) waste retrieval flowsheets
- Support planning for near-term transfers, evaporator operations, baseline change requests, and project development.

The overall configuration of the major systems actively modeled in HTWOS for this System Plan, Rev. 7 (SP7) includes the following.

- 149 SSTs
- Two waste receiving facilities
- 28 DSTs
- 242-A Evaporator
- Tank Waste Characterization and Staging Facility
- WTP process facilities, including the:
  - PT Facility
  - Low-Activity Waste (LAW) Facility
  - High-Level Waste (HLW) Facility
- Supplemental transuranic treatment system
- Low-Activity Waste Pretreatment System
- Supplemental LAW facility
- Liquid Effluent Retention Facility (LERF)/Effluent Treatment Facility (ETF)
- Waste transfer and routing systems, including a dedicated line for LAW Facility feed deliveries.

Additionally, HTWOS can model supplementary systems in order to explore potential effects on the RPP mission, such as supplemental pretreatment in the form of rotary microfiltration and small-column ion exchange or a new DST farm.

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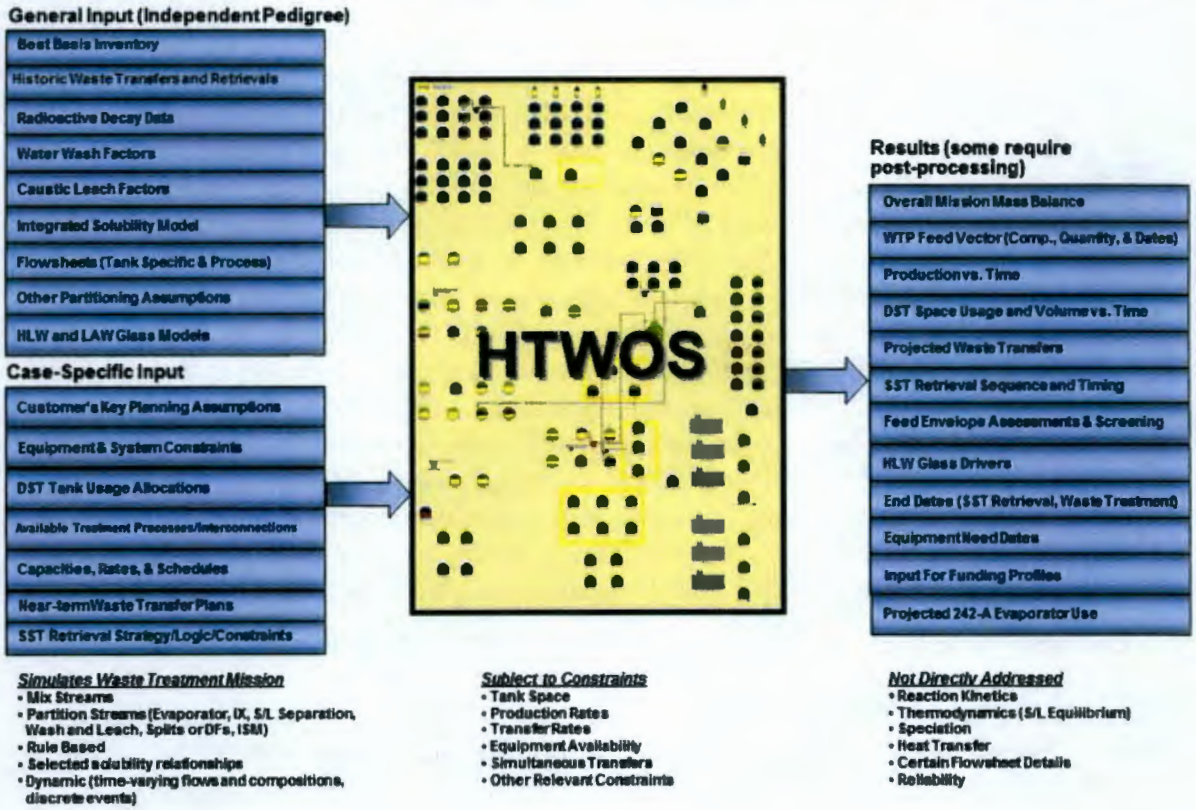
[104] Gensym is a registered trademark of Gensym Corporation, Austin, Texas.

The HTWOS model incorporates about 800 waste treatment vessels and operations and unenumerated transfer- and routing-system segments. Model execution time for a full mission run is currently about 8 hours when not using the Integrated Solubility Model (ISM) feature, or about 13 hours when the ISM is active. The initial waste inventory is established by the Best-Basis Inventory, a compilation of tank waste data derived from historical process records and laboratory analysis. The Best-Basis Inventory is updated quarterly and encompasses 25 chemical constituents and 46 radionuclides, plus numerous supplemental analytes. This data is compiled in Tank Waste Information Network System, along with water wash and caustic leach factors and solubility correlations. Figure C-1 summarizes the capabilities of HTWOS.

Figure C-1. Typical Hanford Tank Waste Operations Simulator Inputs and Outputs.



The model calculates the flow of events occurring during the storage, retrieval, supplemental treatment, pretreatment, and vitrification of Hanford tank waste. Additionally, HTWOS generally models relevant physical constraints (e.g., connections between unit operations, volumes of vessels, flow rates of pumps, capacities, and efficiencies of the equipment) and approximates waste chemistry (e.g., phase equilibriums and reaction extents). Unit operations are based on process flowsheets and/or mass balances when available and include project schedules and net operating capacities. In addition, HTWOS incorporates the programmatic constraints from current plans or strategies, including (but not limited to) facility capacity, waste volume, performance expectations, and dates of facility availability, scheduled outages, and facility commissioning. Some parameters may be modified by customer direction, emerging information, or simplifying assumptions.

Results from the model can be used to prepare flowsheets and mass balances either for the entire mission or for parts of the mission. An overview of general input categories, case-specific input categories, and results categories are provided in Figure C-1. Of particular importance is the generation of the WTP feed vector, which describes the feed that the tank farms will be providing to the WTP under the conditions modeled. The number of batches in a feed vector varies depending on the scenario. In general, each feed batch contains waste from several SSTs and DSTs. Feed vector details for each batch include the DST source where the batch is staged immediately prior to transfer to the WTP, the total waste volume, weight percent solids, waste feed composition data, leach factors, and other information. The feed vector can be used as input to the WTP Dynamic (G2) Model. Additional information on the WTP Dynamic (G2) Model is provided in Section C1.2.

Some significant changes were recently incorporated in HTWOS:

- The ISM, developed specifically for HTWOS, uses a graded approach to predict the solubility of each waste constituent in HTWOS and its impact to the RPP mission (based on each constituent's relative solubility using a set of theoretical waste correlations). For example, the constituent's solubility helps determine the total mass of glass produced and the corresponding mission length. Previously, HTWOS relied primarily on simple wash and leach factors applied with a single temperature and waste pH at specific points in the flowsheet, which is not representative of the range of conditions that the waste will encounter during processing. Wash factors also limited the prediction of phase changes to dissolution reactions only. Implementing the ISM allows HTWOS to calculate the solubility of waste constituents at multiple points in the flowsheet and over a wider range of conditions, which should more accurately reflect the conditions anticipated during waste processing, and will allow HTWOS to predict precipitation reactions as well as dissolutions. This new method replaces the majority of the water wash factors, the leach factors, and the previous solubility equations that were used within HTWOS for waste disturbing activities occurring in the DSTs and during waste processing steps at the WTP.

  The Best-Basis Inventory data is used as the HTWOS starting inventory. However, the Best-Basis Inventory is neither charge balanced or evaluated against the criteria established by the ISM prior to being entered into HTWOS. Thus, there may be dissolution and/or precipitation of components that occur the first time ISM is applied to a DST. Examining the effect of this implementation is beyond the scope of this document.

  The ISM was built by binning chemical components into one of four categories:

  - Category 1 components are either very soluble and assumed to reside exclusively in the liquid phase, or very insoluble and assumed to reside only in the solid phase. Category 1 components have a low impact on the RPP mission. Examples include isotopes of cesium (very soluble) and zirconium (very insoluble).
  - Category 2 components exhibit intermediate solubility and low impact to the RPP mission. Their solubility is best described by the previous wash and leach factors. Examples include bismuth and various isotopes of uranium.
  - Category 3 components have intermediate solubility and high impact to the RPP mission. Phase distribution for these components is determined thermodynamically.

Examples include phosphate and sulfate in the aqueous phase and gibbsite in the solid phase.

- Category 4 concerns kinetic-dependent species, and includes only one component – boehmite (AlOOH), which has been shown to be an inert solid under all conditions except during the caustic leaching step of pretreatment. The amount of solid boehmite dissolved during caustic leaching is predicted using a kinetic dissolution equation.

- Two 2013 *Advanced* glass formulation models (GFM), one for HLW glass and one for LAW glass, were added to HTWOS. The new models incorporate data from a wider variety of simulated waste glasses than were previously available and utilize a forward-looking approach to the development of future glass formulation technology. This allows the models to formulate projected WTP waste glasses over a wider range of compositions and properties than was formerly possible. The 2009 GFM for HLW and the 2004 GFM for LAW glass are still the default models in HTWOS, but the *advanced* 2013 GFMs can be used when requested. Cases 1 and 2, analyzed in this SP7, used the 2013 GFMs as sensitivity studies for comparative analysis:
  - The *advanced* (2013) HLW GFM was developed by Pacific Northwest National Laboratory and builds on the 2009 HLW GFM using updated glass-formulation and melter-testing data. The increased range of successful melter test data used to create this model allows it to take a less conservative approach than previous glass models; this produces higher predicted waste oxide loading in the glass, which reduces the total glass produced. The reduction in glass leads to a shorter overall mission duration compared to the 2009 HLW GFM.
  - The *advanced* (2013) LAW GFM is independent of the 2004 LAW GFM, and is the result of an independent analysis conducted by Pacific Northwest National Laboratory using data from other melter tests. The analysis resulted in a set of *loading rules*, as well as property constraints. A set of component concentration limits was also developed, which encompasses the limits of validity for the model. The new set of constraints developed for the 2013 LAW GFM account for interactions and effects of many more glass components than the DOE 2004 GFM. The increased specificity of the 2013 GFM and the fact that it is based on a large amount of actual melter test data allows it to be less conservative than the DOE 2004 GFM, resulting in higher waste oxide loading and less overall LAW glass produced.

- Based on results generated by 24590-WTP-RPT-PE-12-002, *2012 WTP Operations Research Assessment*, individual facility availability factors have been implemented in the HTWOS for the WTP's Pretreatment (PT) Facility (approximately 81 percent), LAW Facility (approximately 70 percent), and HLW Facility (approximately 83 percent). The LAW and HLW Facilities' availability factors are implemented by reducing the LAW and HLW production capacities to 70 percent of the maximum capacities. Downtime is added to the ultrafiltration cycle time, such that the overall target PT Facility availability

factor is met.[105] The resulting integrated WTP availability factor is at least 70 percent. To calibrate the facility availability factor, the WTP in HTWOS is fed using a fixed feed vector so that variability in tank farms (i.e., SST retrieval schedules, 242-A Evaporator operations, and DST management) does not affect the calculation. For additional details, refer to RPP-17152, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.7 Model Design Document*, Section 6.2.3.10.

In addition to these major improvements, several key changes that had a large impact on the model results were made to HTWOS between System Plan, Rev. 6 (SP6) and SP7. These key changes are described as follows:

- An error was found in the HTWOS LAW 2004 GFM calculation. The error over-predicted the amount of sulfur in each LAW container. The corrected LAW 2004 GFM increased the number of immobilized low-activity waste containers predicted by HTWOS than was previously predicted.
- RPP-PLAN-40145, *Single-Shell Tank Waste Retrieval Plan*, and RPP-40545, *Quantitative Assumptions for Single-Shell Tank Waste Retrieval Planning*, were updated to reflect (1) current Best-Basis Inventory data, and (2) updated retrieval plans for several SSTs in 241-C and 241-A Tank Farms, based on the development and testing of the Extended Reach Sluicing System. Concurrently, supporting spreadsheets SVF-1647, "SVF-1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx," and SVF-2404, "SVF-2404 Rev 1 Calculation of Selected SST Retrieval Parameters.xlsx," were also updated. These updates to the SST retrieval assumptions increased the amount of water and chemical additions associated with retrievals adding a DST volume increase of nearly 16 Mgal.
- In August 2012, visual inspections of the annulus between the primary and secondary tank walls of DST 241-AY-102 identified suspect waste material from the primary containment tank. A formal leak assessment team confirmed that the material discovered on the annulus floor was the result of a leak from a breach in the bottom of the primary tank. The probable cause was identified as accelerated corrosion due to high temperatures, and reduced containment margins resulting from fabrication challenges during tank construction. The SP7 modeling assumes DST 241-AY-102 will be retrieved in accordance with the concept of the plan described in RPP-PLAN-55220, *241-AY-102 Pumping Plan,* Rev. A. After DST 241-AY-102 is retrieved, it is no longer used.

All of these improvements and updates were subjected to a rigorous verification and validation effort to ensure that the HTWOS would continue to perform as expected. Detailed descriptions of the key assumptions and success criteria used to develop this SP7 are provided in Appendix B. RPP-17152 documents how these assumptions were incorporated into the HTWOS model and provides more detailed modeling assumptions and descriptions of how the model works.

[105] The facility availability factors were intended to be implemented into HTWOS v7.7; however, the functionality of this improvement was not used for the case scenarios processed for SP7.

C1.2 WASTE TREATMENT AND IMMOBILIZATION PLANT DYNAMIC (G2) MODEL

Like HTWOS, the WTP Dynamic (G2) Model is based on Gensym® Corporation G2® software. The WTP contractor, BNI, uses this model to:

- Evaluate WTP tank and equipment utilization, unit operation, and plant performance
- Predict reagent demand
- Evaluate WTP process and facility design
- Support preoperational planning assessments
- Support technical integration with the tank farms regarding waste feed staging
- Support product and secondary waste acceptance activities.

In addition to the WTP feed vector from HTWOS, input to the WTP Dynamic (G2) Model includes vessel volumes, pump flow rates, chemical reagents, sampling turnaround times, and appropriate research and technology data (e.g., filter flux data and melter offgas data). Output data includes waste batch delivery predictions; volume history data, with plots for each vessel; sodium molarity and weight percent solids for each process vessel; cumulative mass transfer for every process stream; cumulative glass production; and waste loading and limiting constituents of glasses. These data are interpreted to determine utilization rates for chemical reagents, process condensate, and demineralized water; utilization of cesium ion exchange resin; utilization of mineral glass formers; the volume and composition of pretreated LAW and LAW submerged bed scrubber recycle to a supplemental LAW facility; and the volume and composition of wastewater discharge.

Additional information about the WTP Dynamic (G2) Model is provided in 24590-WTP-MDD-PR-01-002, *Dynamic (G2) Model Design Document*, and the underlying process flowsheet is described in 24590-WTP-RPT-PT-02-005, *Flowsheet Bases, Assumptions, and Requirements*.

C2.0 OPERATIONS RESEARCH MODELS

C2.1 WASTE FEED DELIVERY OPERATIONS RESEARCH MODEL

The TOC contractor is currently developing a WFD operations research model, which will fill a unique niche in long-range planning efforts. The WFD operations research model will focus on uncertainties in tank farms' operations such as random equipment failures, outages, and planned maintenance activities. Specifically, the WFD operations research model is designed to quantify the impact of equipment failures and other constraints on mission duration, determine overall system performance, and identify key bottleneck areas.

The WFD operations research model is being created using WITNESS™, a commercial off-the-shelf process simulation software developed by the Lanner Group. The WFD system specifically includes all 28 DSTs, the 242-A Evaporator, and numerous waste transfer lines, pump pits, valve pits, jumpers, and valves; in all, over 600 system components are represented. The availability data for the various systems and equipment has been derived from actual operating experience at Hanford, from similar experience at Savannah River Site, and from generic reliability databases when no indigenous source could be found. Model development is proceeding in phases:

- Phases 1, 2, and 3 modeled waste movement within the tank farms and conservatively estimated the effects of equipment breakdowns, based on the waste transfer list generated by HTWOS for System Plan, Rev. 5. Phase 1 began in fiscal year (FY) 2009, and Phase 3 completed in FY 2011.
- Phase 3.1 of the WFD operations research model was updated to reflect SP6, as well as other important assumption changes, such as the use of the cross-site slurry transfer line. This phase incorporates a tank farm module and a WTP module:
  - The tank farm module includes waste transfers from SSTs, DSTs, waste receiving facilities, and the 242-A Evaporator, using a waste transfer list generated by HTWOS for SP6. Equipment availability for DST waste transfers and the effects of equipment breakdowns are actively modeled. When equipment fails, the tank farm module will wait for the equipment to be restored, reroute the transfer, or choose the next transfer from the list. Other schedule constraints such as WTP waste acceptance time and DST equipment upgrade schedules are consistent with SP6.
  - The WTP module includes the PT Facility, LAW Facility (including supplemental treatment), and HLW Facility. Details are based on 24590-WTP-RPT-PT-02-005 and HTWOS. This module is not as detailed as BNI's WTP operations research model or the HTWOS WTP model. However, it does reflect HTWOS flowsheet parameters and other key processing assumptions.
- These two modules have been combined in different ways to produce two models:
  - A standalone model, in which the tank farm module uses a deterministic approach to WTP processing times
  - An integrated model, in which the WTP module dynamically determines WTP processing times based on feed availability.

For additional information on the WFD operations research model Phase 3.1, refer to RPP-RPT-51921, *The Phase 3.1 Hanford Waste Feed Delivery Operations Research Model Bases and Assumptions*. Phase 3.1 completed in FY 2012. It is the current WFD operations research model.

- Phase 4 is in development. This phase encompasses the scope of the Phase 3.1 standalone model, with the addition of labor constraints. That is, the Phase 4 model will simulate the tank farm operations and the response to random equipment failures and associated restoration activities in the WFD system. The model will also include the resources required to perform the various equipment restoration activities in the WFD system. This will add another dimension of realism to system planning.

C2.2 WASTE TREATMENT AND IMMOBILIZATION PLANT OPERATIONS RESEARCH MODEL

The WTP contractor maintains an operations research model of the WTP as part of the WTP statement of work, as outlined in the WTP Contract (DE-AC27-01RV14136, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*). Similar to the WRPS WFD operations research model, the BNI WTP operations research model also uses Lanner's WITNESS™ software. The BNI model simulates WTP operations, including the PT Facility, HLW Facility, LAW Facility, Analytical Laboratory, and Glass Former Facility, and is used to estimate the availability of these systems.

C3.0 TANK OPERATIONS CONTRACT LIFECYCLE COST MODEL

The TOC contractor uses HTWOS as a tool to help develop the technical basis for the RPP system. A cost model has been developed to help WRPS more quickly evaluate the near-term and lifecycle cost impacts of proposed operational and flowsheet changes within the RPP system.

Previously, two separate software programs, HTWOS and Primavera Enterprise Project Portfolio Management®[106] (P6), were used jointly to predict cost impacts. The HTWOS tool defines the operating scenario by simulating field operations including waste transfers, retrievals, evaporator operations, and waste treatment processes. Key operating data is transferred from HTWOS into Primavera. Then P6 is used to track project resources, costs, and schedules, including logic ties between related activities, milestone dates, work breakdown structure summaries, and other project management information. The Lifecycle Cost Model (LCM) tool creates an electronic link between HTWOS and P6, which expedites the process and provides more reliable results generated from a verified and validated system. The LCM tool was first used to develop cost profiles for SP6, and was also used to develop cost profiles for SP7.

The LCM scope includes costs for new projects, construction, operations, maintenance, planned upgrades to existing facilities, decontamination and decommissioning, and closure starting in FY 2014 for the following facilities, except as noted:

- 149 SSTs
- Two waste receiving facilities
- 28 DSTs[107]
- New DSTs
- 242-A Evaporator
- 222-S Laboratory
- Low-Activity Waste Pretreatment System[108]
- Tank Waste Characterization and Staging Facility[111]
- Supplemental transuranic treatment system[111, 109]
- WTP facility operations[110]
- Supplemental LAW facility[111]
- LERF/ETF[111, 111]
- Secondary Liquid Waste Treatment Facility at ETF[111]
- Vadose zone
- Interim Hanford Storage[111]

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[106] Primavera Enterprise Project Portfolio Management is a registered trademark of Primavera Systems, Inc. (in the United States).
[107] New DSTs and WRFs do not have final retrieval/closure costs included in the LCM.
[108] These facilities do not include decontamination and decommissioning costs or final tank cleanout costs in the LCM, as applicable.
[109] The LCM includes costs up through shipping to an assumed offsite location, but it does not include the costs to dispose of the waste at that location. Note that this creates some level of inequity when comparing lifecycle costs for potential contact-handled transuranic waste disposed offsite, versus onsite treatment through the WTP with subsequent disposal at the Integrated Disposal Facility, because the onsite costs are quantified.
[110] The LCM includes WTP operating costs only.
[111] The LCM costs for the LERF/ETF begin in FY 2015, when the Richland Operations Office is expected to transfer facility responsibility to the ORP.

- Hanford Shipping Facility[111]
- Central Waste Complex[111, 112]
- ORP support
- General site services
- Waste transfer and routing systems, including a dedicated line for LAW feed deliveries.

Note that costs for the Integrated Disposal Facility, State-Approved Land Disposal Site, and Environmental Restoration Disposal Facility are not included in the LCM, as those costs are expected to be paid by other contractors. For the purposes of SP7, in case-specific flowsheets that did not include particular facilities, the costs associated with those facilities were zeroed out (i.e., costs associated with the new DSTs were zeroed out in Case 1, in which the flowsheet did not call for new DSTs).

C4.0 REFERENCES

24590-WTP-MDD-PR-01-002, 2014, *Dynamic (G2) Model Design Document*, Rev. 13, Bechtel National, Inc., Richland, Washington.

24590-WTP-RPT-PE-12-002, 2012, *2012 WTP Operations Research Assessment*, Rev. 0, Bechtel National, Inc., Richland, Washington.

24590-WTP-RPT-PT-02-005, 2013, *Flowsheet Bases, Assumptions, and Requirements*, Rev. 7, Bechtel National, Inc., Richland, Washington.

Contract No. DE-AC27-01RV14136, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, U.S. Department of Energy, Washington, D.C., as amended.

RPP-17152, 2014, *Hanford Tank Waste Operations Simulator (HTWOS) Version 7.7 Model Design Document*, Rev. 9, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-40145, 2012, *Single-Shell Tank Waste Retrieval Plan*, Rev. 3, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-55220, 2013, *241-AY-102 Pumping Plan,* Rev. A, Washington River Protection Solutions LLC, Richland, Washington.

RPP-RPT-51921, 2012, *The Phase 3.1 Hanford Waste Feed Delivery Operations Research Model Bases and Assumptions*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

SVF-1647, 2014, "SVF-1647 Rev 5 Calculation of SST Retrieval Volumes and Durations.xlsx," Rev. 5, Washington River Protection Solutions LLC, Richland, Washington.

SVF-2404, 2014, "SVF-2404 Rev 1 Calculation of Selected SST Retrieval Parameters.xlsx," Rev. 1, Washington River Protection Solutions LLC, Richland, Washington.

[112] The LCM includes only the packaging and shipping costs associated with potential contact-handled transuranic waste; general facility operating costs are not included.

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APPENDIX D – CROSSWALK OF TRI-PARTY AGREEMENT MILESTONE M-062-40 LANGUAGE VERSUS SYSTEM PLAN, REV. 7

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APPENDIX D – CROSSWALK OF TRI-PARTY AGREEMENT MILESTONE M-062-40 LANGUAGE VERSUS SYSTEM PLAN, REV. 7

The *Hanford Federal Facility Agreement and Consent Order*, or Tri-Party Agreement (TPA), includes legally enforceable milestones for regulatory compliance and environmental remediation. Some TPA milestones were revised, and some new ones were created, when a Consent Decree (Case No. 08-5085-FVS[a]) was issued in 2010. One such milestone, M-062-40, requires the U.S. Department of Energy, Office of River Protection (ORP) to prepare a System Plan every 3 years with its own specific set of requirements. Table D-1 provides a *crosswalk* that demonstrates how System Plan, Rev. 7 (SP7) meets each aspect of the M-062-40 milestone requirements.

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
1	Due Date: Starting October 31, 2010 and every three years thereafter, Ecology and the DOE will each have the right to select a minimum of three scenarios that will be analyzed in the System Plan. Note: Per TPA Change Request M-62-13-02, Selection of Scenarios due on October 31, 2013 is deferred to December 15, 2013.	On December 12, 2013, the ORP and Ecology transmitted letter 13-TPD-0070[b] to the U.S. Environmental Protection Agency, in which the ORP and Ecology stated, "…Ecology has selected to model five priority scenarios; at this time, ORP has elected to exercise its right to not select any scenarios for SP7… Ecology has reviewed, accepted, and approved all of Attachment A, Model Starting Assumptions for SP7."	See Item 5
2	Beginning October 31, 2011, and every 3 years thereafter, issue the System Plan.	The issue date of SP7 is documented on page i, which meets the October 31, 2014 deadline.	Page i
3	Milestone: Submit a System Plan to Ecology describing the disposition of all tank waste managed by ORP, including the retrieval of all tanks not addressed by the Consent Decree 08-5085-FVS and the completion of the treatment mission.	The System Plan addresses the disposition of the tank waste managed by the ORP, specifically the waste contained in the 149 SSTs, the 28 DSTs, and the 60 IMUSTs. The disposition of each fraction is derived from: Fraction — Disposition LAW — ILAW disposed at IDF HLW — IHLW disposed at offsite geologic repository CH-TRU tank waste — Stored at CWC, until final disposal path is determined Secondary liquid waste — Disposed at IDF as solid after treatment Spent LAW melters — Disposed at IDF Spent HLW melters — Assume disposal at IDF Other solid waste — Disposed at IDF Tank residuals — Landfill closure, per TC & WM EIS ROD	LAW: Section 3.2.2 Section 3.2.3 Section 3.4.1 Appendix B, B3.6.6.1 Appendix B, B3.6.6.2 Appendix B, B3.6.6.3 HLW: Section 3.2.2 Section 3.2.3 Appendix B, B3.6.5.1 Appendix B, B3.6.5.2 CH-TRU Tank Waste: Section 3.2.1 Section 4.1.1 Section 4.2.1 Section 4.3.3 Section 4.4.1 Section 4.5.1 Secondary Liquid Waste: Section 3.2.2 Section 3.2.4 Section 3.4.1 Appendix B, Section B3.6.6.2 Spent HLW Melters: Section 3.4.1 Appendix B, Section B3.6.6.2 Footnote 41 Spent LAW Melters: Section 3.4.1 Appendix B, Section B3.4.4.10 Appendix B, Section B3.5.1.7 Appendix B, Section B3.6.6.2 Other Solid Waste: Section 3.3.3 Appendix B, Section B3.6.6.2
4	The [System] Plan will be updated and submitted to Ecology every three years to document any further optimization of retrieval and waste treatment capabilities to, in the case of SST retrievals, complete such retrievals as quickly as is technically feasible (but not later than the date established in milestone M-045-70c), and, in the case of tank waste treatment, complete such treatment as quickly as is technically feasible (but not later than the date established in milestone M-062-00d), both with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission.	The SP6 Baseline Case describes an RPP system flowsheet and schedule that meets TPA milestones. SP7 documents the further optimization of the retrieval and waste treatment capabilities that has occurred since SP6. Single-shell tank retrievals and waste treatment capabilities are completed as quickly as technically feasible. For SST retrievals, this is done in HTWOS by developing assumed minimum durations for future activities in light of past experience, process records, test results, inspections of tanks, model improvements, and best engineering judgment. Similarly for waste treatment, HTWOS simulates the treatment as quickly as feasible, subject to system constraints such as design, flowsheets, rates, capacities, and logistics. The scenarios analyzed in the System Plan were developed and selected "both with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission" as further addressed in Item 5 and Item 14, below.	Milestone Dates: Table 1-1 Section 3.1.1 Section 3.1.2 Process Records: Section 1.5 Section 1.7.1 Section 1.8 Test Results: Section 3.1.1 Section 3.1.2 Model Improvements: Appendix C Inspections of Tanks: Section 3.1.1 Section 3.1.2 Scenario considerations: See Item 5, below

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
5	One year prior to the issuance of the System Plan, DOE and Ecology will each select the scenarios (including underlying common and scenario-specific assumptions) that will be analyzed in the System Plan, with DOE and Ecology each having the right to select a minimum of three scenarios each.	Planning meetings among ORP, Ecology, and WRPS personnel began in June 2013, and continued through November 2013, to establish the scope of SP7. Personnel from WRPS provided guidance and feedback on how best to define scenarios, given the capabilities of the HTWOS model and the time constraint to produce results. Ecology selected and defined five scenarios to be analyzed in SP7; the ORP elected to not select or define any scenarios. The selection process is described in RPP-56408.[e] The final set of selected scenarios is documented in 13-TPD-0070.[c]	History Sheet for Revision 7 Section 1.2 Section 1.4 Section 4.0
6	The [System] Plan will include the following elements: OVERALL MINIMUM REQUIREMENTS The Plan will present the following minimum information for each scenario evaluated: A system description for each system utilized in the planning.	The system descriptions for Cases 1 through 5 describe the physical changes, (e.g., facilities or equipment added or removed, or connectivity changes), technology development needs, and specific actions that would be needed to implement the case as described. The system description for each of these cases is defined by a combination of text, figures, and tables in Sections 4.n.1, "System Description." Note: The Baseline Case was evaluated and detailed results were published in SP6; key results for that case are included in SP7 Table 1-1 for the convenience of the reader. Section 3.0 presents the current status of the facilities needed to support the Baseline Case flowsheet.	Section 3.0 Cases 1 - 5 General: Section 4.0 Case 1: Section 4.1.1 Case 2: Section 4.2.1 Case 3: Section 4.3.1 Case 4: Section 4.4.1 Case 5: Section 4.5.1
7	Planning bases for each case.	The Model Starting Assumptions for SP7 are based on the SP6 Baseline Case assumptions, amended to address emerging programmatic changes (i.e., 241-AY-102 disposition) and recent HTWOS upgrades. For Cases 1 through 5, planning bases include the scope of each scenario as selected and defined by Ecology, with further refinements necessary to create meaningful model input. These include a detailed analysis of the underlying assumptions for each case, and identification of areas where existing assumptions must be modified. The ORP directed its contractor Washington River Protection Solutions LLC to model the five cases selected and defined by the Washington State Department of Ecology for SP7 in accordance with the key assumptions and success criteria also selected by Ecology. Planning bases for the Model Starting Assumptions and all five cases are captured in Appendix B.	Model Starting Assumptions: Appendix B, Sections B1.0, B2.0and B3.0 Case 1: Section 4.1.2 and Appendix B, Section B4.1 Case 2: Section 4.2.2 and Appendix B, Section B4.2 Case 3: Section 4.3.2 and Appendix B, Section B4.3 Case 4: Section 4.4.2 and Appendix B, Section B4.4 Case 5: Section 4.5.2 and Appendix B, Section B4.5
8	A description of key issues, assumptions, and vulnerabilities for each scenario evaluated; a description of how such issues, assumptions, and vulnerabilities are addressed in the evaluation.	For Cases 1 through 5, key issues and uncertainties are captured in Sections 4.n.5, "Key Issues and Vulnerabilities."	Case 1: Section 4.1.5 Case 2: Section 4.2.5 Case 3: Section 4.3.5 Case 4: Section 4.4.5 Case 5: Section 4.5.5
9	Sensitivities analyses of selected key assumptions.	Sensitivity analyses were selected for Case 1 and Case 2. The sensitivity analysis for Case 1 was labeled Case 1A, and the sensitivity analysis for Case 2 was labeled Case 2A. Both sensitivity cases entailed evaluation of the same scope as was presented in the "parent" case, with one notable change – the parent cases used the 2009 HLW GFM and the 2004 LAW GFM, but the sensitivity cases used the Advanced 2013 HLW and LAW GFMs instead. Selected results for both sensitivity cases are presented at the end of the results for the respective parent cases.	Section 4.1.6 Section 4.2.6
10	Estimated schedule impacts of alternative cases relative to the baseline, including cost comparisons for a limited subset of scenarios that DOE and Ecology wish to analyze further.	Table 1-1 shows a comparison of key metrics for each case relative to the success criteria, including both cost and schedule comparisons. Case-specific results are published in Sections 4.n.3, "Results," and Sections 4.n.4, "Cost and Schedule Impacts" that included a lifecycle cost figure. SP7 goes well beyond this requirement in that all cases include cost comparisons, rather than just a limited subset.	Overview: Table 1-1 Case 1: Section 4.1.3 and Section 4.1.4 Case 2: Section 4.2.3 and Section 4.2.4 Case 3: Section 4.3.3 and Section 4.3.4 Case 4: Section 4.4.3 and Section 4.4.4 Case 5: Section 4.5.3 and Section 4.5.4

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
11	Identification of new equipment, technology, or actions needed for the scenario (e.g., new evaporators or DSTs, new retrieval technologies, or waste treatment enhancements or mitigations, such as sodium, sulfate, aluminum, and chrome mitigation measures).	For the Baseline Case, updated equipment needs, facility upgrade needs, and future facilities are addressed in Section 3.0, "State of the RPP System." Additional information is provided in TFC-PLN-39.[g] For Cases 1 through 5, case-specific technology development, equipment, and actions needed are identified in Sections 4.n.1, "System Description."	Baseline Case: Section 3.0 Cases 1 - 5 General: Section 4.0 Case 1: Section 4.1.1 Case 2: Section 4.2.1 Case 3: Section 4.3.1 Case 4: Section 4.4.1 Case 5: Section 4.5.1
12	Identification of issues, techniques, or technologies that need to be further evaluated or addressed in order to accelerate tank retrievals and tank waste treatment.	For Cases 1 through 5, Sections 4.n.5, "Key Issues and Vulnerabilities," reflect issues and opportunities, including techniques and technologies, specific to each case.	Case 1: Section 4.1.5 Case 2: Section 4.2.5 Case 3: Section 4.3.5 Case 4: Section 4.4.5 Case 5: Section 4.5.5
13	Impacts on closure activities for each scenario.	For Cases 1 through 5, impacts on closure activities are addressed as part of Sections 4.n.4, "Results."	Case 1: Section 4.1.3 Case 2: Section 4.2.3 Case 3: Section 4.3.3 Case 4: Section 4.4.3 Case 5: Section 4.5.3
14	TANK WASTE TREATMENT The [System] Plan will evaluate scenarios and identify potential near- and long-term actions to optimize tank waste treatment so that the treatment mission is completed as quickly as is technically feasible but not later than the date established in Milestone M-062-00d, with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission.	The SP7 cases address this requirement. The HTWOS model simulates tank waste treatment as quickly as feasible, subject to system constraints such as design, flowsheets, rates, capacities, and logistics. The cases analyzed in the System Plan were developed and selected "both with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission," as further addressed in Item 5, above. However, the scope of Cases 2 through 5 was intended to predict the impact of certain changes in the RPP System, not necessarily to meet TPA milestone dates. Cases 1 through 5 are described and analyzed in Section 4.0. The Baseline Case was evaluated in detail in SP6. The results of that case indicate that it would be possible to treat all tank waste by the M-062-00 date of 12/31/2047.	Scenario Evaluation of Near- and Long-Term Actions to Optimize Tank Waste Treatment: Table 1-1 Scenario Considerations: See Item 5 Cases 1 - 5 General: Section 4.0
15	The [System] Plan will, at a minimum, describe how the tank waste treatment mission can: Pretreat 100 percent of the retrievable tank waste (at a rate sufficient to operate the HLW Facility, LAW Facility, and supplemental treatment system simultaneously at their estimated average production rates).	The SP6 Baseline Case flowsheet and the SP7 Case 1 flowsheet show tank waste pretreatment occurring at the PT Facility, which would receive both HLW and LAW feed from the tank farms. The PT Facility is described in Section 3.2.2.1. Specific rate assumptions are further detailed in Appendix B, Section B3.4.2. An alternative flowsheet is explored in SP7 Cases 2, 3, 4, and 5 in which: Supernate is fed from the DST system to a new LAWPS before being transferred to the LAW Facility. Also, slurry is fed from the DST system to a new TWCSF, before being transferred to the HLW Facility. SP7 Cases 3, 4, and 5 account for 100 percent pretreatment of tank waste in that no CH-TRU waste is diverted to other treatment facilities. Estimated average production rates vary over time and reflect the complex interactions among the assumed facility capacity and delivered feed composition, retrieval, blending, various pretreatment, and vitrification facilities.	Pretreatment: Section 3.2.2.1 Appendix B, Section B3.4.2 Case 1: Section 4.1 Case 2: Section 4.2 Case 3: Section 4.3 Case 4: Section 4.4 Case 5: Section 4.5

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
16	Vitrify 100 percent of the separated HLW stream at estimated average production rates.	The HLW Facility is described in Section 3.2.2.2. Specific rate assumptions are further detailed in Appendix B, Section B3.4.3. Average HLW glass production rates vary over the course of the mission; refer to case-specific figures listed to the right. Estimated average production rates vary over time and reflect the complex interactions between assumed facility capacity and delivered feed composition, retrieval, blending, pretreatment, and vitrification facilities.	HLW Vitrification: Section 3.2.2.2 Appendix B, Section B3.4.3. Case 1: Figure 4-9 Case 2: Figure 4-24 Case 3: Figure 4-35 Case 4: Figure 4-46 Case 5: Figure 4-57
17	Vitrify 100 percent of separated low-activity waste stream at estimated average production rates.	The LAW Facility is described in Section 3.2.2. Specific rate assumptions are further detailed in Appendix B, Section B3.4.4. Supplemental treatment for LAW is described in Section 3.2.3. Specific rate assumptions are further detailed in Appendix B, Section B3.5.1. Estimated average production rates vary over time and reflect the complex interactions between assumed facility capacity and delivered feed composition, retrieval, blending, pretreatment, and vitrification facilities.	LAW Vitrification: Section 3.2.2.3 Appendix B, Section B3.4.4 Supplemental LAW: Section 3.2.3 Appendix B, Section B3.5.1 Average Production Rates: Case 1: Figure 4-10 Case 2: Figure 4-25 Case 3: Figure 4-36 Case 4: Figure 4-47 Case 5: Figure 4-58
18	Appropriately manage secondary waste streams.	Operation of the RPP system produces both liquid and solid secondary waste streams. The management of secondary waste streams is handled within the RPP system, or by supporting onsite facilities. Spent LAW melters will be disposed of at the IDF. Spent HLW melters are assumed to be disposed of at the IDF, but final determination of the disposal path will be made in a future TC & WM EIS ROD.	Liquid Secondary Waste: Section 3.2.4 Section 3.4.2 Appendix B, Section B3.6 Solid Secondary Waste: Section 3.3.3 Section 3.4.1 Section 3.4.3 Appendix B, Section B3.6
19	The [System] Plan will take into account the results from testing of the pretreatment engineering platform and other studies.	Test results from the pretreatment engineering platform were incorporated into the WTP "equipment alternative," which employs a combination of design, flowsheet, and operating mode changes in the PT Facility. Additional details are provided in 24590-WTP-RPT-PET-09-004.[h] These changes were incorporated into the HTWOS model in support of SP6. Additional studies, such as the deep sludge testing at the Cold Test Facility and the vessel mixing studies planned at the Full Scale Test Facility, are ongoing. Results will be incorporated into future System Plans.	Equipment Alternative: SP6, Section 3.2.2.1 Full Scale Test Facility: Section 3.2.2
20	SUPPLEMENTAL TREATMENT The [System] Plan will also describe: How much total sodium will need to be treated.	Sodium management is addressed by HTWOS and is reported for each case under "Results." Within Table 1-1, refer to "LAW Glass Sodium Oxide Loading" and "Sodium Reporting to LAW Glass (MT)."	Baseline Case: SP6, Section 5.6.2.2 Table 1-1

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
21	The needed capacity for supplemental treatment to have all the tank waste treated by a date that is as quickly (sic) as is technically feasible but not later than the date established in milestone M-062-00, with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities and (ii) and impact on the overall cleanup mission.	Supplemental treatment capacity is addressed in Section 3.2.3. Tank waste treatment capabilities are completed as quickly as technically feasible. The HTWOS model simulates the treatment as quickly as feasible, subject to system constraints such as design, flowsheets, rates, capacities, and logistics. The set of scenarios analyzed in the System Plan were developed and selected "both with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission" as further addressed in Item 5 and Item 14, above.	Supplemental Treatment: Section 3.2.3 Milestone Date: Table 1-1 Scenario Considerations: See Item 5 See Item 14
22	The System Plan will outline specific options to treat all the LAW. Such options include: Build and operate a second LAW vitrification facility Build and operate a Bulk Vitrification Facility.	All LAW treatment options considered in SP7 are intended to treat all of the LAW waste. These and other options are addressed in detail by the Supplemental Treatment and Immobilization Program.	Section 3.2.3
23	Not later than the System Plan report due date of 10/31/2014, DOE will submit a one-time Hanford Tank Waste Supplemental Treatment Technologies Report, which will be required if a tank waste supplemental treatment technology is proposed, other than a second LAW vitrification facility. This report will: Describe additional treatment facilities, technologies, and cost, which in combination with the WTP are needed to vitrify all of Hanford's tank waste by a date that is as quickly as is technically feasible but not later than the date established in milestone M-062-00, with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission. Apply the same selection criteria to all options and include a second LAW vitrification facility as an option. Include all the results from all waste form performance data (compared against the performance of borosilicate glass) for all the treatment technologies being considered. Describe the technologies being considered, including size, throughput, sodium loading, quantity of waste to be processed, quantity of final waste forms, secondary waste quantity and nature, technical viability, and life-cycle cost and schedule estimates. Include data from both cold and hot testing if bulk vitrification is to be retained as an option.	This is a separate report that will be prepared in the future, if required. SP7 plays no role in implementing these requirements.	N/A

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
24	TANK WASTE RETRIEVAL The [System] Plan will evaluate scenarios and identify potential near- and long-term actions to optimize tank waste retrieval so that the SST retrievals are completed as quickly as is technically feasible but not later than the date established in milestone M-045-70, with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities and (ii) and impact on the overall cleanup mission.	SP7 Cases 1 through 5 document the further optimization of the retrieval and waste treatment capabilities that have occurred since SP6. Single-shell tank waste retrieval plans modeled in HTWOS are aligned with the assumptions, guidelines, and recommendations for SST retrieval planning described in RPP-PLAN-40145[i] and spreadsheet SVF-1647,[j] except as noted in the case-specific assumptions. These include the retrieval technologies, tank sequencing strategy, waste retrieval methods, as-retrieved waste volumes, minimum retrieval durations, and chemical additions for near-term SST retrievals. The minimum durations for future activities are based on past experience, process records, inspections of tanks, and best engineering judgment. Single-shell tank retrievals and waste treatment are completed as quickly as technically feasible. This is modeled in HTWOS by retrieving the SSTs as fast as possible (but no faster than the minimum retrieval durations and subject to availability of suitable DST space), consistent with the above assumptions, guidelines, and recommendations. The set of scenarios analyzed in the System Plan were developed and selected "both with and without consideration of (i) whether such further optimization would be excessively difficult or expensive within the context of such activities, and (ii) any impact on the overall cleanup mission" as further addressed in Item 5 and Item 14.	SST Retrievals in HTWOS: Appendix C, Section C1.1 Milestone Date: Table 1-1 Planning Improvements: Section 1.8 Section 3-1 Table 3-2 Process Records: Section 1.5 Inspections of Tanks: Section 3-4 Scenario Considerations: See Item 5
25	The Plan will consider: SST integrity information, including the SST integrity assurance review provided under milestone M-045-91 and any further integrity assessments.	The SST Integrity Program and related assessments are addressed in Section 3.1.1. Also, current tank integrity status is reflected in RPP-PLAN-40145[i] and spreadsheet SVF-1647, which provide input to HTWOS and the System Plan assumptions. SP7 Case 4 – Leaking Tanks, was defined specifically to address the possibility of emergent leaks in SSTs (as well as emergent leaking DSTs), and the impact those would have on SST waste retrieval efforts.	Section 3.1.1 Section 4.4
26	Waste retrieval rate sufficient to operate all waste treatment facilities at their full capacities, considering optimized waste feed rates.	For Cases 1 through 5, waste retrieval and processing rates are shown in Sections 4.n.3, "Results."	Case 1: Section 4.1.3 Case 2: Section 4.2.3 Case 3: Section 4.3.3 Case 4: Section 4.4.3 Case 5: Section 4.5.3
27	The effect on waste retrieval rates of the waste retrieval technologies selected through the TWRWP process.	Reports RPP-PLAN-40145[i] and RPP-40545[k] include the retrieval technologies already selected via the TWRWP process for specific tanks, as well as the retrieval technologies anticipated to be chosen for future retrieval efforts in other tanks. The parameters and rates associated with each technology and each tank are included in the updates to HTWOS, and, therefore, underpin the case-specific results presented in SP7. (Note: The waste retrieval information used in HTWOS is for modeling purposes only; the TWRWP process determines which retrieval technologies will be deployed in a given tank.)	Section 1.8 Section 3.1.1.1 Case 1: Section 4.1.3 Case 2: Section 4.2.3 Case 3: Section 4.3.3 Case 4: Section 4.4.3 Case 5: Section 4.5.3 Appendix B, B3.1.1.3 Appendix B, B3.1.1.4

Table D-1. System Plan, Rev. 7, Crosswalk with Tri-Party Agreement Milestone M-062-40. (8 Pages)

Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
28	Sequences for remaining SSTs and DSTs to be retrieved based on a risk prioritization strategy, waste treatment feed optimization as affected by blending, and WMA closure considerations.	Past System Plan experience has revealed that overall risk reduction, waste treatment feed optimization (including blending), and WMA closure considerations are best achieved by implementing an overlapping, farm-by-farm retrieval strategy. Specific guidelines (developed and described in RPP-PLAN-40145[i] and spreadsheet SVF-1647[j]) implemented in HTWOS allow the model to determine a viable tank retrieval sequence consistent within this overall strategy. The SP6 Baseline Case and SP7 Case 1 retrieval sequences implemented the strategy described above. Cases 2, 3, 4 and 5 include two proposed new functions which, if implemented, will further support risk reduction and feed blending. The LAWPS would reduce both near-term and long-term risk. In the near-term, LAWPS would enable the DOE to accelerate the start of LAW treatment by "direct feeding" it to the LAW Facility earlier than would be possible if treatment had to wait until the PT Facility issues are fully resolved, and PT design, construction, and testing are completed. Commissioning and operating the LAWPS and the LAW Facility ahead of the HLW Facility and the PT Facility would also allow workers to gain important experience that could be applied to the HLW Facility and PT Facility later. In the long-term, the LAWPS would reduce risk by providing a backup treatment option that could be implemented in the event that the PT Facility needs an outage. The Tank Waste Characterization and Staging Facility would provide vessels designed to support waste mixing, blending, resizing, sampling, and filtration of HLW solids to provide a more uniform feed to the HLW Facility. Single-shell tank retrieval sequences for each case are available in Section 4.n.3, "Results." DSTs will be emptied and refilled repeatedly during the RPP mission. Final retrievals of the DSTs are planned by HTWOS; details are captured in a spreadsheet in the DST transfer spreadsheet cited in RPP-RPT-56732, *Hanford Tank Waste Operations Simulator Model Data Package for the River Protection Project System Plan, Revision 7.*[1]	Baseline Case: Refer to SP6, Section 5.0 Cases 1 - 5: Model Starting Assumptions apply to all cases, except as noted in case-specific lists below. SST Sequence: Appendix B, B3.1.1.3 Blending: Appendix B, B3.3.2.7 Appendix B, B3.3.2.8 Appendix B, B3.3.2.10 Appendix C, Section C1.1 Closure: Appendix B, B3.3.1 Case 1: SST Sequence: Section 4.1.3, Figure 4-4 Case 2: SST Sequence: Section 4.2.3, Figure 4-18 Case 3: SST Sequence: Section 4.3.3, Figure 4-30 Appendix B, B4.3.4.1 Appendix B, B4.3.4.3 Case 4: SST Sequence: Section 4.4.3, Figure 4-41 Appendix B, B4.4.4.1 Appendix B, B4.4.4.3 DST Sequence: Appendix B, B4.4.4.2 Case 5: SST Sequence: Section 4.5.3, Figure 4-53 Appendix B, B4.5.4.3.2
29	The [System] Plan will also take into account the results from previous waste retrievals and other waste treatment studies. This shall include: The retrieval methodologies that could be employed and estimated waste volumes to be generated for transfer to the DST or other safe storage.	RPP-PLAN-40145[i] takes into account results from previous waste retrievals. Retrieval processes selected for specific tanks are reflected in RPP-PLAN-40145[i] and RPP-40545,[k] which give estimated waste volumes that feed into updating the HTWOS model and the System Plan.	Section 3.1.1 Section 3.1.1.2 Appendix B, B3.3.3.13 Appendix C, Section C1.0
30	DST space evaluations for the waste retrieval sequence.	For SP7 Cases 1 through 5, DST space impacts are discussed in Sections 4.n.3, "Results," and shown in an accompanying figure.	Case 1: Section 4.1.3 and Figure 4-6 Case 2: Section 4.2.3 and Figure 4-21 Case 3: Section 4.3.3 and Figure 4-32 Case 4: Section 4.4.3 and Figure 4-43 Case 5: Section 4.5.3 and Figure 4-54
31	Proposed improvements to reduce waste retrieval durations.	Potential improvements to reduce waste retrieval durations originate in RPP-PLAN-40145,[i] and are	Section 3.1.1.1

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Item	HFFACO Milestone M-062-40 Requirements	Implementation in River Protection Project System Plan, Rev. 7	Cross-Reference
		then incorporated into HTWOS and subsequent System Plan results, as appropriate.	Section 3.1.1.2
32	CONTINGENCY PLANNING The Plan will identify and consider possible contingency measures to address the following risks:	All of the scenarios defined for SP7 explicitly address elements listed in the milestone. For details, refer to Section 5.0.	Section 4.0 Section 5.0
33	Results from SST integrity evaluations.	For details, refer to Section 5.0.	Section 5.1
34	If retrievals take longer than originally anticipated and there is a potential impact to the schedule for retrieving specified tanks under this agreement.	For details, refer to Section 5.0.	Section 5.2
35	If DST space is not sufficient or is not available to support continued retrievals on schedule.	For details, refer to Section 5.0.	Section 5.3
36	If any portion of the WTP does not initiate cold commissioning on schedule.	For details, refer to Section 5.0.	Section 5.4
37	If any portion of the WTP does not complete hot start on schedule.	For details, refer to Section 5.0.	Section 5.5
38	If operation of the WTP does not meet treatment rates that are adequate to complete retrievals under the schedule in this agreement. For example, the contingency measures will address estimated pretreatment facility throughput as affected by ultrafiltration capacity and oxidative leaching requirements.	For details, refer to Section 5.0.	Section 5.6
39	The contingency measures identified for consideration should include, but not be limited to, providing new, compliant tanks with sufficient capacity and in sufficient time to complete retrievals under this agreement, regardless of WTP operational deficiencies or retrieval conditions.	For details, refer to Section 5.0.	Section 5.3

[a] Consent Decree, 2010, State of Washington v. DOE, Case No. 08-5085-FVS (October 25), Eastern District of Washington.
[b] 13-TPD-0070, 2013, "Completion of Hanford Federal Facility Compliance Agreement and Consent Order Milestone M-062-40C, To Select A Minimum Of Three Scenarios And Partial Completion of Milestone M-062-40," (letter, K.W. Smith, U.S. Department of Energy, Office of River Protection and J. A. Hedges, Washington State Department of Ecology, Nuclear Waste Program to D.A. Faulk, U.S. Environmental Protection Agency, Office of Environmental Cleanup, December 12), Richland, Washington.
[c] M-045-070 states, in part, "Complete waste retrieval from all remaining single shell tanks . . . by 12/31/2040, or earlier as established by M-062-45."
[d] M-062-00 states, in part, "Complete pretreatment processing and vitrification of Hanford High Level (HLW) and Low Activity (LAW) Tank Wastes . . . by 12/31/2047."
[e] RPP-56408, 2013, *Selected Scenarios for the River Protection Project System Plan, Revision 7*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.
[f] 14-TPD-0003, 2014, "Contract No. DE-AC27-08RV14800 – Approval To Use Washington State Department of Ecology's Appendix B, "Key Assumptions and Success Criteria" For The ORP-11242, River Protection Project System Plan, Rev. 7," (letter, T.W. Fletcher, U.S. Department of Energy, Office of River Protection to W.C. Clark, Washington River Protection Solutions LLC, February 11), Richland, Washington.
[g] TFC-PLN-39, 2011, "Risk Management Plan," Rev. G, Washington River Protection Solutions LLC, Richland, Washington.
[h] 24590-WTP-RPT-PET-09-004, 2010, *Recommendation of Alternative to Mitigate Solids Precipitation in Ion Exchange Feed*, Rev. 1, Bechtel National, Inc., Richland, Washington.
[i] RPP-PLAN-40145, 2014, *Single-Shell Tank Waste Retrieval Plan*, Rev. 4, Washington River Protection Solutions LLC, Richland, Washington.
[j] SVF-1647, 2014, "Single-Shell Tank Retrieval Assumptions for Mission Modeling, Filename 'SVF-1647 Rev 5.xlsx'," Rev. 5, Washington River Protection Solutions LLC, Richland, Washington.
[k] RPP-40545, 2011, *Quantitative Assumptions for Single-Shell Tank Waste Retrieval Planning*, Rev. 2 Draft, Washington River Protection Solutions LLC, Richland, Washington.
[l] RPP-RPT-56732, 2014, *Hanford Tank Waste Operations Simulator Model Data Package for the River Protection Project System Plan, Revision 7*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

CH-TRU	contact-handled transuranic	HLW	high-level waste	n	corresponds to the Case Number (e.g., for Case 2, n=2)	TC & WM	Tank Closure and Waste Management
CWC	Central Waste Complex	HTWOS	Hanford Tank Waste Operations Simulator	N/A	not applicable	TRU	transuranic
DOE	U.S. Department of Energy	IDF	Integrated Disposal Facility	ORP	U.S. Department of Energy, Office of River Protection	TWCSF	Tank Waste Characterization and Staging Facility
DST	double-shell tank	IHLW	immobilized high-level waste	PT	pretreatment	TWRWP	Tank Waste Retrieval Work Plan
Ecology	Washington State Department of Ecology	ILAW	immobilized low-activity waste	ROD	record of decision	WMA	waste management area
EIS	environmental impact statement	IMUST	inactive miscellaneous underground storage tank	SP6	System Plan, Rev. 6	WRPS	Washington River Protection Solutions LLC
HFFACO	*Hanford Federal Facility Agreement and Consent Order*	LAW	low-activity waste	SST	single-shell tan		