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Initial Single-Shell Tank Retrieval System--Tank Selection

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Abstract: The *Hanford Federal Facility Agreement and Consent Order* (also known as the Tri-Party Agreement), established several milestones associated with the Initial Single-Shell Tank Retrieval System (ISSTRS). It also established that the scope of ISSTRS is the retrieval of a complete tank farm or an equivalent number of tanks. This study selected the single-shell tanks to be included in the ISSTRS work scope.

This study determined that the ISSTRS work scope should consist of four tanks located in the A, AX, and C, tank farms). One of the tanks (Tank 241-AX-103) will be a salt cake retrieval demonstration tank. The other three (Tanks 241-A-102, 241-C-103, and 241-C-105) are 100-series tanks containing high interim storage risk, high long-term hazard waste and are assumed not to be leaking.

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INITIAL SINGLE-SHELL TANK RETRIEVAL SYSTEM- -TANK SELECTION

October 1996

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EXECUTIVE SUMMARY

The U.S. Department of Energy, the U.S. Environmental Protection Agency, and the State of Washington Department of Ecology have entered into an agreement that includes the removal of all chemical and mixed waste from the tanks at the Hanford Site. This Agreement, called the Hanford Federal Facility Agreement and Consent Order *(also known as the Tri-Party Agreement), establishes milestones for the removal of waste from the single-shell tanks (SST). Several of these milestones are associated with the Initial Single-Shell Tank Retrieval System (ISSTRS).*

This study selects the tanks that will be included in the ISSTRS work scope in support of the conceptual design. The results of this study will form the basis for ISSTRS design activities until directed otherwise by the decision maker.

ISSTRS tank selection consists of the following decisions:

1. *Select how many tanks will be included in the ISSTRS work scope.*

2. *Select a salt cake retrieval demonstration tank.*

3. *Select the other ISSTRS tanks.*

Recommendations of this study are as follows:

1. *The number of tanks in the ISSTRS work scope should be four.*

2. *Tanks to be retrieved during Privatization Phase I should be limited to 35 tanks in the southeast and southwest quadrants with small dilute waste volumes.*

3. *The salt cake retrieval demonstration tank should be 241-AX-103.*

4. *The other tanks in the ISSTRS work scope should be 241-A-102, 241-C-103, and 241-C-105.*

Retrieval of the waste in these tanks will make significant progress in reducing safety concerns. The recommended tanks include 3 of the 10 highest risk interim storage tanks and 2 of the 10 highest hazard SSTs.

Other conclusions of this study are as follows:

1. *The baseline Phase II, low-level and high-level waste processing rates must be increased for SST retrieval to comply with the completion date of Tri-Party Agreement Milestone M-45-05. Recommendation of a processing rate is outside the scope of this activity.*

2. *Tri-Party Agreement Milestone M-45-05 targets milestones associated with retrieval during Privatization Phase I that can only be met by the retrieval of tanks with small quantities of dilute (i.e., "as retrieved") waste.*

A decision analysis is needed to assess the programmatic impacts of higher processing rates versus compliance with the retrieval of Tri-Party Agreement target milestones.

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LIST OF TERMS

DOE	U.S. Department of Energy
DST	Double-shell tank
Ecology	State of Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
FY	Fiscal year
HLW	High-level waste
ISSTRS	Initial Single-Shell Tank Retrieval System
LANL	Los Alamos National Laboratory
LDMM	Leak detection monitoring and mitigation
LDUA	Light-duty utility arm
LLW	Low-level waste
ORNL	Oak Ridge National Laboratory
MYPP	Multi-Year Program Plan
RL	U.S. Department of Energy, Richland Operations Office
SST	Single-shell tank
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TWRS	Tank Waste Remediation System

INITIAL SINGLE-SHELL TANK RETRIEVAL SYSTEM--TANK SELECTION

1.0 INTRODUCTION

This study selects the tanks that will be included in the Initial Single-Shell Tank Retrieval System (ISSTRS) work scope in support of the conceptual design. The results of this study will form the basis for ISSTRS design activities until directed otherwise by the decision maker.

ISSTRS tank selection is comprised of two distinct decisions: (1) how many tanks (Section 3.0) and (2) which tanks will be included in the ISSTRS work scope. Selection of which tanks was futher broken into: (a) the selection of a salt cake retrieval demonstration tank (Section 4.3) and (b) selection of the other ISSTRS tanks (Section 4.4). Tank selection required making an assumption of which tanks would be retrieved concurrent with Privatization Phase I (Section 4.2).

2.0 BACKGROUND

High-level radioactive waste has been stored at the Hanford Site since 1944 as a by-product of processing spent nuclear fuel for the recovery of plutonium, uranium, and neptunium. The first single-shell tank (SST) was completed and placed in operation in 1944. An SST has a single shell of carbon steel housed in a concrete wall and dome.

Between 1943 and 1964, 149 SSTs were built for the storage of radioactive wastes at the Hanford Site. The tanks are located in 12 tank farms consisting of 4 to 18 tanks each. The tank farms are loosely grouped into the northern and southern portion of 200 East and 200 West areas resulting in four quadrants. Each quadrant consists of three tank farms.

Sixty-seven SSTs are known or assumed to have leaked radioactive waste to the surrounding soil. In 1968 an interim stabilization program was started to reduce the leak potential of the SSTs. This program removes pumpable liquids resulting in semi-dry sludge and salt cake residue.

Waste remaining in the SSTs varies from ≤ 5 to 100 percent of tank capacity. The two types of waste will be sludge and salt cake, both of which contain chemically hazardous and radioactive constituents. Sludge is a sticky, viscous material with a consistency similar to peanut butter while salt cake is a hard, crystalline material. The major chemical constituents are nitrate and nitrite salts, hydrated metal oxides, and phosphate precipitates. The waste also contains transuranics, and isotopes of cesium, strontium, iodine, and technetium. Mechanical properties of the waste differ considerably depending on the chemical makeup of the wastes.

The U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Washington Department of Ecology (Ecology) have entered into an agreement that includes the removal of chemical and mixed waste from all 149 SSTs at the Hanford Site. The Agreement, called the *Hanford Federal Facility Agreement and Consent Order* , also known as the Tri-Party Agreement, (Ecology et al. 1994) establishes milestones for the Tank Waste Remediation System (TWRS) Program. Milestones applicable to SST retrieval are listed in Table 2-1.

Tri-Party Agreement milestones are divided into two categories, enforceable and target milestones. Enforceable milestones, when not met, can result in legal action from the Ecology. For example, Milestone M-45-05 *Retrieve Waste from All Remaining Single-Shell Tanks* is an enforceable milestone. Target milestones, identified by a "T" in the milestone number, should not result in legal action. These milestones, however, can be turned into enforceable milestones by Ecology and, thus, should be met if possible. Milestones M-45-05-T1 through M-45-05-T15 are target milestones that establish a minimum retrieval schedule.

Plans to privatize waste disposal activities are divided into two phases. During Phase I private contractors will operate waste pretreatment and vitrification demonstration plants. Concurrently, the Management and Integration contractor will be responsible for all waste retrieval activities and the associated Tri-Party Agreement milestones. Tri-Party Agreement milestone compliance requires the initiation of waste retrieval from 35 tanks by September 30, 2010. During Phase II private contractors will operate large scale pretreatment and vitrification facilities, and will retrieve the waste from the remaining SSTs.

Table 2-1. Single-Shell Tank Retrieval Tri-Party Agreement Milestones.

Milestone	Date	Description
M-45-00	09/30/24	Complete closure of all single-shell tank farms
M-45-04A	04/31/97	Complete conceptual design for the initial single-shell tank retrieval systems
M-45-04-T2	12/31/00	Complete design for the initial single-shell tank retrieval systems
M-45-04-T3	06/30/03	Complete construction for the initial single-shell tank retrieval systems
M-45-04A	4/31/97	Complete conceptual design for the initial single-shell tank retrieval systems
M-45-05	09/30/18	Retrieve waste from all remaining single-shell tanks
M-45-05-T1	12/31/03	Initiate tank waste retrieval from one single-shell tank
M-45-05-T2	09/30/04	Initiate tank waste retrieval from two additional single-shell tanks
M-45-05-T3	09/30/05	Initiate tank waste retrieval from three additional single-shell tanks
M-45-05-T4	09/30/06	Initiate tank waste retrieval from four additional single-shell tanks
M-45-05-T5	09/30/07	Initiate tank waste retrieval from five additional single-shell tanks
M-45-05-T6	09/30/08	Initiate tank waste retrieval from five additional single-shell tanks
M-45-05-T7	09/30/09	Initiate tank waste retrieval from seven additional single-shell tanks
M-45-05-T8	09/30/10	Initiate tank waste retrieval from eight additional single-shell tanks
M-45-05-T9	09/30/11	Initiate tank waste retrieval from ten additional single-shell tanks
M-45-05-T10	09/30/12	Initiate tank waste retrieval from twelve additional single-shell tanks
M-45-05-T11	09/30/13	Initiate tank waste retrieval from fourteen additional single-shell tanks
M-45-05-T12	09/30/14	Initiate tank waste retrieval from seventeen additional single-shell tanks
M-45-05-T13	09/30/15	Initiate tank waste retrieval from twenty additional single-shell tanks
M-45-05-T14	09/30/16	Initiate tank waste retrieval from twenty additional single-shell tanks
M-45-05-T15	09/30/17	Initiate tank waste retrieval from twenty additional single-shell tanks
M-45-06-T3	03/31/12	Initiate closure actions on an operable unit or tank farm basis

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3.0 NUMBER OF TANKS

The first decision to be made is how many tanks will be included in the ISSTRS work scope. The three requirements used for making this decision were as follows:

- ISSTRS must provide the systems needed to retrieve a tank farm or an equivalent number of tanks (Tri-Party Agreement Milestone M-45-04-T1).
- Projected funding limitations (Multi-Year Program Plan [MYPP]).
- Life-cycle cost minimization.

Waste from the tanks selected for ISSTRS will not be used as feed for the Phase I vitrification plants (Certa 1996 and Manuel et al. 1996) and, thus, does not need to fall within any of the waste envelopes. Waste composition of the ISSTRS tanks will be important only if it significantly affects any of the metrics (i.e., criteria) used to select the retrieval sequence. The preliminary retrieval sequence report (Certa 1995) showed that variations in the retrieval sequence do not significantly affect the metrics as long as the following general guidelines are used:

- Waste from tanks with high chromium concentrations must blended with waste from tanks with low chromium concentrations to limit the volume of high-level waste (HLW) glass.
- Waste from tanks with high phosphate concentrations must blended with waste from tanks with low phosphate concentrations to limit the volume of HLW glass.

Other metrics such as the retrieval completion date will be evaluated using an integrated disposal model during tank selection.

Tank Farm Size. Tri-Party Agreement Milestone M-45-04-T01 states that the initial SST retrieval system "will provide retrieval systems for an entire SST farm or an equivalent number of tanks." There are 12 SST farms containing 149 tanks resulting in an average of 12 tanks per farm. Tank farm sizes, however, range from a minimum of four tanks in the AX Tank Farm to 18 tanks in the TX Tank Farm. Therefore, the number of tanks included in the ISSTRS work scope must be within the range of 4 to 18 tanks.

Funding Limitations. ISSTRS detailed design will start in FY 1997 and, according to Tri-Party Agreement Milestone 45-04-T2, will be completed no later than December 31, 2000. Funds for ISSTRS will come from the portion of the Retrieval Engineering budget that is not designated for on-going projects. Retrieval program budget, not including funding for on-going projects, in FY 1996 is $10,175,000. This is projected to decline to $6,185 in FY 1997 and $4,700 in FY 1998. Increased funding is projected starting in FY 1999 with a projected increase to $9,258. Because significant costs are associated with waste retrieval from each tank, ISSTRS Project costs can be minimized by limiting the number of tanks within its scope. To help ensure that funds will be available, ISSTRS detailed design costs must be minimized.

Life-Cycle Cost. Per the mission analysis (Hertzel 1996), ISSTRS will only provide sluicing systems. The Acquire Commercially Available Technology (ACTR) program is investigating alternatives to sluicing for retrieving SST waste. Other, more cost effective technologies, if identified, can be deployed as early as possible by minimizing the number of tanks included in the ISSTRS work scope.

In summary, Tri-Party Agreement Milestone M-45-04-T01 requires ISSTRS to be a "tank farm or an equivalent number of tanks." Since tank farms range in size from 4 to 18 tanks, ISSTRS must provide retrieval systems for at least four tanks. Projected funding limitations require the number of tanks included in the ISSTRS work scope to be minimized. In addition, a qualitative assessment shows that life-cycle costs may be minimized by limiting the number of tanks included in the ISSTRS work scope while alternative retrieval technologies are being investigated by ACTR. Therefore, the number of tanks included in the ISSTRS work scope should be limited to four tanks.

4.0 INITIAL SINGLE-SHELL TANK RETRIEVAL SYSTEM TANK SELECTION

This section selects the SSTs to be included in the ISSTRS work scope and is broken down into the following subsections:

- **Section 4.1.** A sensitivity study to evaluate the sensitivity of SST retrieval completion date to the retrieval sequence

- **Section 4.2**. Identification of an assumed list of 35 tanks to be retrieved concurrent with Phase I privatization. The ISSTRS tanks will be selected from this list.

- **Section 4.3**. Selection of a salt cake retrieval demonstration tank.

- **Section 4.4**. Selection of the rest of the tanks to be included in the ISSTRS work scope.

4.1 RETRIEVAL SENSITIVITY STUDY

A sensitivity analysis was performed to assess how the retrieval sequence affects completion of SST retrieval. This study was performed using an updated version of the TWRS Integrated Disposal Model (Wittman 1996). Updates included incorporation of the PhaseI and Phase II privatization assumptions. In addition, the number of waste receiver facilities (WRFs) was reduced from 4 to 2. The use of one WRF in each quadrant was recommended by the Technical Options Report (Boomer et al. 1993). The W-320 project design has established that individual SSTs can be retrieved directly to a DST. It has been further assumed by this study that all of the SSTs in the southeast and southwest quadrants (i.e., the A, AX, C, S, SX, and U Tank Farms) can be retrieved directly to a DST, and thus, WRFs for these quadrants were eliminated. An engineering study is recommended to validate this assumption.

Other updates included incorporation of the waste compatibility rules (Fowler 1995) and the reassignment the tasks to be performed for each DST after the waste in it has been retrieved (Figure 4-1). These assignments are preliminary and subject to change as the Phase I low-level waste (LLW) and HLW feed staging plans are developed in more detail. Specific DST assignments, however, will not impact SST retrieval as long as tanks are available to perform key tasks (e.g., sluicing receiver sludge wash and cross-site receiver) when needed. Cases run with the updated model for this study are summarized in Table 4-1.

Table 4-1. Summary of Cases Run Using Updated Model.

Case	Sequence #	Type of sludge washing	Simultaneous retrieval/ quadrant (PhaseI/II)	Notes	Tanks retrieved (Phase I)
P01	2C3-0000	In-Tank	2	Baseline privatization model	9
P02	2C3-0000	Out-of-Tank	4	Same as P01 with simulated out-of-tank sludge wash and increased number of simultaneous retrievals.	10
P04	2C3-0000	Out-of-Tank	4	Same as P02 with HLV processing rate increased 150 percent and no shutdown time for mixer pumps.	10
P05	2C3-0000	Out-of-Tank	4	Same as P04 with sluicing rate increased from 7.2 kgal/day to 10.0 kgal/day.	14
P07	2C3-0000	Out-of-Tank	4	Same as P05 with tank start dates as soon as possible.	11
P08	2C3-00P1	Out-of-Tank	4	Reference model. Same as P04, queing changed to look more frequently for retrieved waste.	5
P09	2S1-0000	Out-of-Tank	4	Reference model, interim storage risk sequence	6
P10	2S2-0000	Out-of-Tank	4	Reference model, long term hazard sequence	7
P11	2S3-0000	Out-of-Tank	4	Reference model, minimum volume first sequence	37
P12	2S4-0000	Out-of-Tank	4	Reference model, ISSTRS tanks first, Then remainder of 36 minimum volume tanks in A and S Tank Farms.	37
P13	2S3-0001	Out-of-Tank	4	Reference model, corrected indexing error in Case P11	38
P14	2S4-0001	Out-of-Tank	4	Reference model, 36 minimum volume tanks in A and S Tank Farms first except AX-101 added to first 36.	35 except AX-101
P15	2S4-0002	Out-of-Tank	2 / 4	Same as P14 with 2 simultaneous retrievals during Phase I and 4 simultaneous retrievals during Phase II. Changed from 1 ft heel to no heel left in tank.	35 except AX-101
P21	2S4-0005	Out-of-Tank	2 / 4	Same as P15 with 1.5 MT Na/day/plant before 2011 and 2.025 MT Na/day/plant after 2010 (new RFP rate).	37 including AX-101

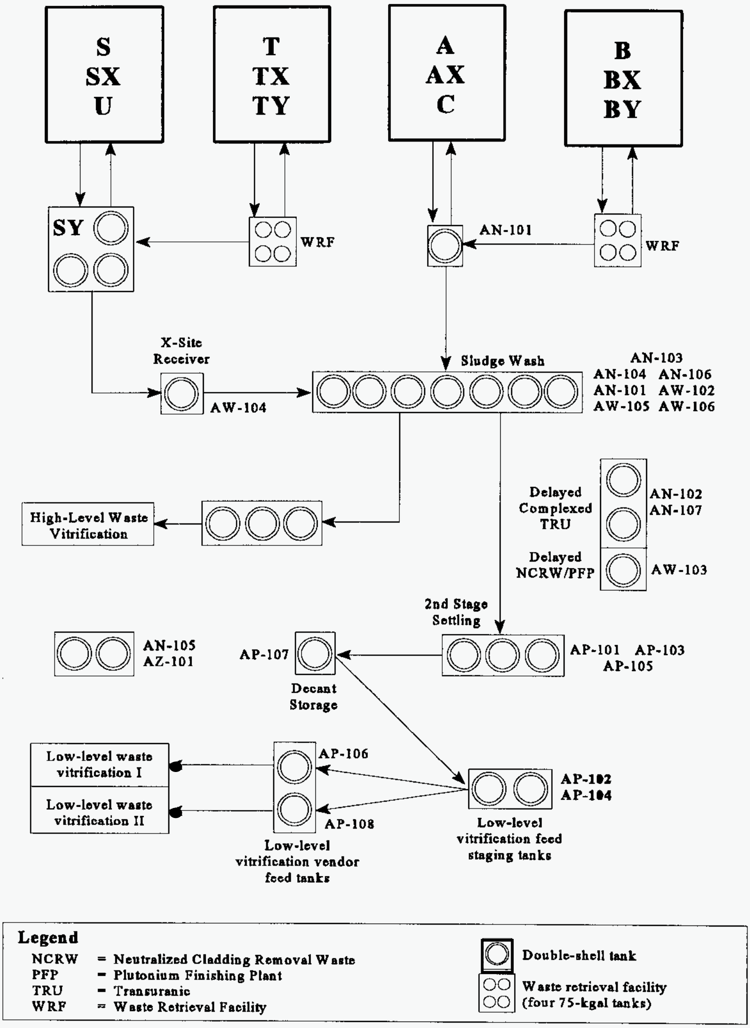
4.1.1 Impact of Modeling Updates

The baseline sequence (2C3) reported in the FY 1995 retrieval sequence and blending strategy (Certa 1995) was analyzed (Case P10) using the updated model to determine the effects of the update.

Results from the updated model are compared with two cases (Case 50 and 92) from the 1995 study in Figure 4-2. None of the cases meet the enforceable Tri-Party Agreement milestone for completion of SST retrieval by 2018. The baseline case (Case 50) completed retrieval the earliest, but contained an error that stored washed solids with no interstitial or free liquids. This error provided more space for storing washed solids than will be available. This error was corrected for Case 92 resulting in additional delay of the completion date.

The new baseline case (Case P01) shows an additional delay in the completion of retrieval. An evaluation of the modeling results for Case P01 showed that SST retrieval was constrained by supernate storage space during Phase I and sludge washing during Phase II. The lack of supernate storage space was caused by a LLW demonstration facility processing rate that was insufficient to stay ahead of SST retrieval activities. Sludge washing during Phase II was limited by the long settling times required to separate solids from the supernate.

Figure 4-1. Double-Shell Tank Processing Assignments for Initial Single-Shell Tank Retrieval System Tank Selection Study.



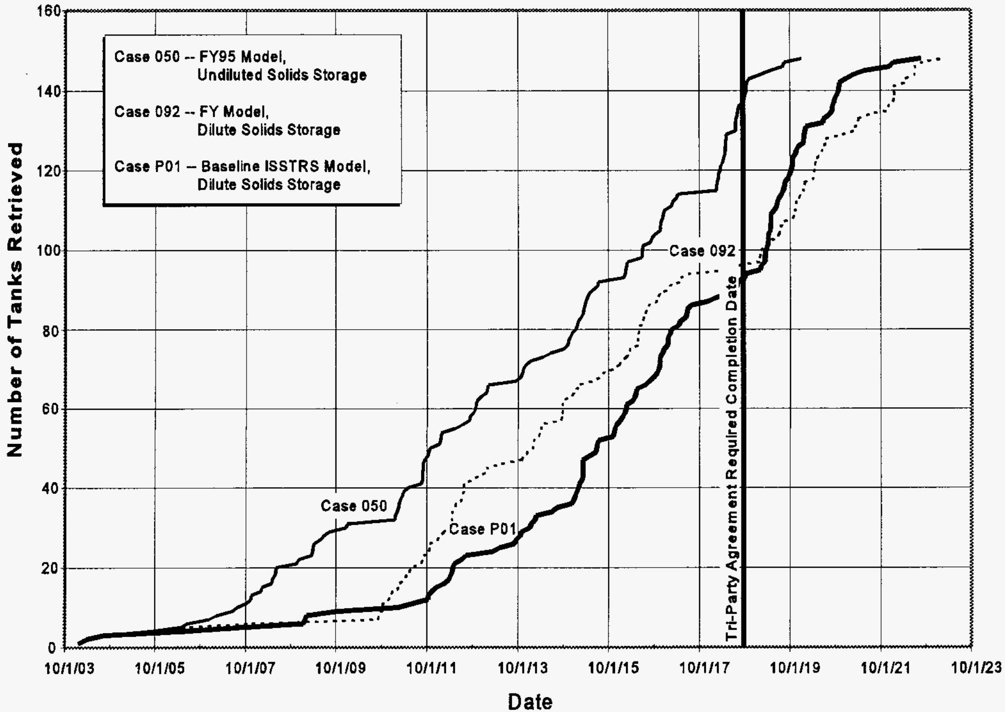


Figure 4-2. Cumulative Number of Tanks Retrieved.
(FY 1995 Baseline Retrieval Sequence - 2C3)

4.1.2 Sensitivity of Completion Date

None of the FY 1995 cases, nor the new baseline case, meet the required completion date. This was inadequate for ensuring the tanks selected for ISSTRS would support meeting this date. It was, therefore, necessary to further evaluate what was constraining retrieval and to develop a reference scenario that meets the required date.

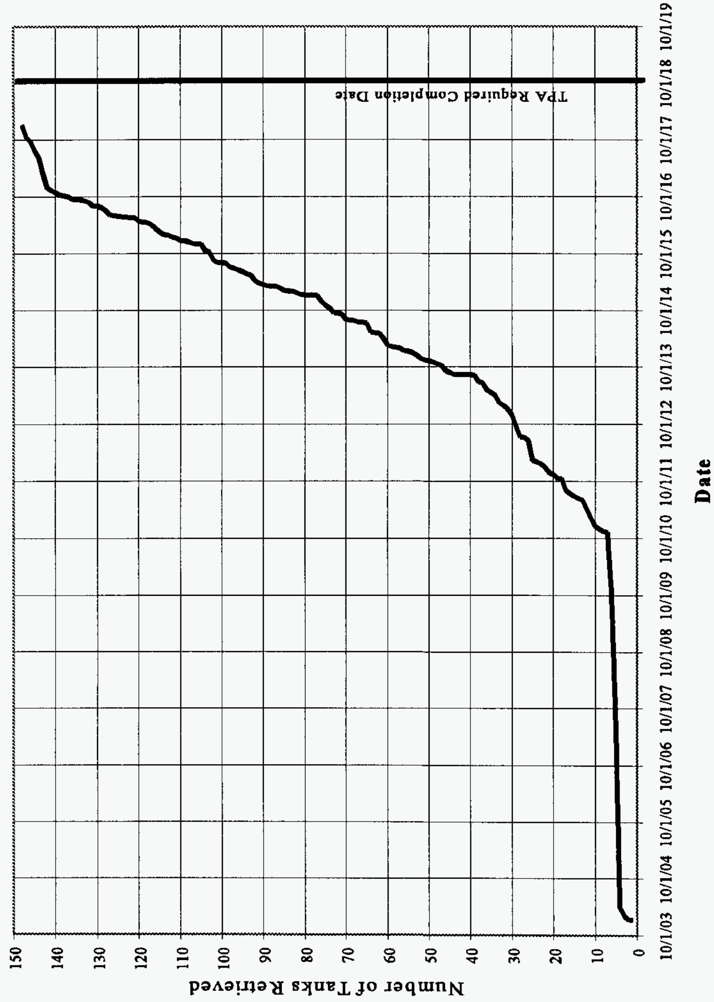
Changes implemented to create the reference scenario (Case P08) are listed in Table 4-2. The Phase I assumptions obtained from the preliminary privatization Request for Proposal (RFP) (DOE-RL 1995) and were assumed to be non-negotiable and, thus, were not changed. The listed changes were only used to facilitate this study and must not be construed as recommended changes to the Disposal Program baseline. Additional studies will be necessary before making any recommendations for changing the baseline. Such studies were outside the scope of this study.

Table 4-2 Initial Single-Shell Tank Retrieval System Tank Selection Modeling Assumption Changes.

1. Simulation of in-facility sludge washing • 5-day settle time and 10-day caustic wash • No mixer pump change out for sludge-washing tanks
2. Low-level waste vitrification processing feed availability • 1-day shutdown of low-level waste vitrification processing while the associated feed tank is refilled (preferable that low-level waste vitrification be designed to continue operation while the feed tanks are refilled)
3. High-level waste vitrification processing (Phase II) • Increase capacity to 15 MT glass/day • Start high-level waste vitrification operation in 2011 (privatization assumption was 2013)
4. Single-shell tank retrieval • Four simultaneous retrievals per quadrant (allows a total of 16 simultaneous retrievals) • Increased retrieval rate of 30 percent

The reference scenario (Case P08) meets the required completion date (Figure 4-3), but does not meet the target Tri-Party Agreement milestones. Since compliance with the target Tri-Party Agreement milestones is highly desired, but not required, this model is acceptable for this study. The ability to meet the target milestones will be used as a criterion for evaluating alternate sequences.

Figure 4-3. Cumulative Number of Tanks Retrieved - Case P08



The following three alternate sequences were analyzed using the reference scenario to assess their impacts on Tri-Party Agreement compliance (Table 4-3).

1. **Sequence 2S1 (Case P09)**. Retrieves the high risk storage tanks first (MacFarlane 1995).
2. **Sequence 2S2 (Case P10)**. Retrieves tanks with high, long-term hazard first (Boothe 1995).
3. **Sequence 2S3 (Case P11)**. Retrieves 100 Series tanks containing small waste volumes first (Shelton 1995). This sequence had an error in the tank indexing and was rerun as Case P13.

The completion dates for these three cases and the baseline sequence are on or about the required Tri-Party Agreement milestone date (Figure 4-4). Sequences with the latest completion dates retrieve tanks with large dilute waste volumes at the end of the sequence. Therefore, differences in the completion date probably can be reduced or eliminated by additional customizing of each sequence. In conclusion, the retrieval completion date is not very sensitive to the retrieval sequence. The tank selection study was performed slightly ahead of with the initial sequence (Penwell 1996). The above cases were rerun for the initial sequence analysis with the same results.

4.2 PHASE I RETRIEVAL

Of the cases used in the sensitivity study, only the minimum volume sequence (Case P13) met the target Tri-Party Agreement milestones. All of the other cases retrieve tanks with large dilute waste volumes concurrent with Phase I. As a result, the retrieved SST waste volume quickly fills the available DST storage space stopping retrieval until more space becomes available as the waste is processed.

Figure 4-5 shows the cumulative retrieved (i.e., dilute) waste volume for case P13. There are several plateaus during Phase I where SST retrieval is shutdown due to a lack of storage space. Retrieval resumes as operation of the demonstration plants makes more DST storage space available. Plots for the other cases are similar, but are not shown for clarity. The final Phase I plateau occurs for a retrieved volume of 30,283 m^3 (8 Mgal) with 37 SSTs retrieved. Case P13 results show that a low volume retrieval sequence can meet the retrieval Tri-Party Agreement target milestones.

Case P13 did not limit retrieval activities to ensure tanks with the smallest dilute waste volumes were retrieved first. In addition, it allowed up to 8 simultaneous retrievals during Phase I and 16 during Phase II. Multiple simultaneous retrievals have the potential to utilize all DST storage space with multiple SSTs partially retrieved. Reduction of the number of simultaneous retrievals would reduce the number of partially retrieved SSTs and could increase the number of retrievals completed before DST storage space is fully utilized. As a result retrieval of several of the tanks started in Phase I were not completed until Phase II. Case P15 was identical to Case P13 except the number of simultaneous retrievals per quadrant during Phase I privatization was reduced to 2 (4 total). This case confirmed that two simultaneous retrievals was was sufficient for Phase I retrieval. However, the reduction did not increase the total number of tanks retrieved concurrent with Phase I.

Table 4-3. Sequences for Initial Single-Shell Tank Retrieval System Tank Selection Study Sensitivity Analysis. (5 Sheets)

Seq #	Interim storage risk (LANL 1995)			Inhalation hazard (Boothe 1995)		Minimum volume (Shelton 1995)		
	241-Tank #	p-rem/yr	Watch List	241-Tank #	Nonmobile ALIs	241-Tank #	Dilute volume (gal)	Cumulative volume (gal)
1	C-103	0.96	Org.	C-105	1.29e+12	SX-113	9,853	9,853
2	AX-101	0.88	H2	A-101	5.05e+11	AX-104	37,496	47,349
3	A-102	0.44		C-102	4.53e+11	TY-106	44,194	91,543
4	S-102	0.41	H2/Org.	A-102	3.93e+11	A-104	69,470	161,013
5	U-105	0.39	H2/Org.	BX-105	3.77e+11	SX-115	75,956	236,969
6	S-112	0.38	H2	TX-118	3.25e+11	U-101	77,086	314,055
7	C-105	0.35		SX-103	2.96e+11	T-106	83,765	397,819
8	A-101	0.29	H2/Org.	BX-106	2.66e+11	T-112	100,663	498,482
9	C-102	0.29	Org.	S-107	2.22e+11	A-105	101,521	600,003
10	C-107	0.29		A-106	2.19e+11	TY-104	118,757	718,760
11	C-110	0.29		C-104	2.04e+11	T-103	119,576	838,337
12	C-112	0.29	Ferro.	A-104	1.80e+11	T-102	121,876	960,212
13	A-104	0.27		B-110	1.76e+11	U-104	136,285	1,096,497
14	A-105	0.27		BY-103	1.72e+11	B-102	137,186	1,233,682
15	A-106	0.27		SX-111	1.56e+11	B-112	140,539	1,374,221
16	C-104	0.27		SX-114	1.55e+11	BX-104	157,805	1,532,026
17	U-107	0.26	H2/Org.	SX-110	1.22e+11	AX-102	166,157	1,698,183
18	A-103	0.22		A-103	1.15e+11	BX-102	171,377	1,869,560
19	AX-102	0.22	Org.	S-112	1.10e+11	BX-108	185,878	2,055,438
20	AX-103	0.22	H2	SX-105	1.07e+11	A-102	188,894	2,244,332
21	AX-104	0.22		B-101	1.04e+11	T-108	190,199	2,434,531
22	C-101	0.22		SX-108	1.01e+11	C-109	190,746	2,625,277
23	C-108	0.22	Ferro.	SX-107	9.35e+10	C-111	195,266	2,820,543
24	C-109	0.22	Ferro.	BX-101	9.31e+10	TX-107	203,599	3,024,142
25	C-111	0.22	Ferro.	SX-104	9.04e+10	C-108	224,499	3,248,641

Table 4-3. Sequences for Initial Single-Shell Tank Retrieval System Tank Selection Study Sensitivity Analysis. (5 Sheets)

Seq #	Interim storage risk (LANL 1995)			Inhalation hazard (Boothe 1995)		Minimum volume (Shelton 1995)		
	241-Tank #	p-rem/yr	Watch List	241-Tank #	Nonmobile ALIs	241-Tank #	Dilute volume (gal)	Cumulative volume (gal)
26	S-111	0.18	H2/Org.	BX-102	7.81e+10	BX-101	237,772	3,486,413
27	S-101	0.14		S-101	7.25e+10	T-101	251,343	3,737,755
28	SX-101	0.13	H2	C-103	6.45e+10	T-105	279,730	4,017,485
29	SX-102	0.13	H2	SX-112	6.36e+10	B-103	304,601	4,322,086
30	SX-103	0.13	H2/Org.	AX-104	6.09e+10	BX-106	305,084	4,627,170
31	SX-104	0.13	H2	C-107	5.38e+10	T-109	312,134	4,939,304
32	SX-105	0.13	H2	SX-109	5.04e+10	C-112	318,103	5,257,408
33	SX-106	0.13	H2/Org.	AX-101	4.87e+10	TX-104	356,047	5,613,455
34	S-110	0.13		SX-101	4.65e+10	TX-101	367,040	5,980,495
35	S-108	0.12		BY-104	4.63e+10	TY-102	384,415	6,364,910
36	U-103	0.11	H2/Org.	SX-106	4.51e+10	SX-110	384,737	6,749,647
37	U-106	0.11	Org.	U-110	4.44e+10	U-112	387,073	7,136,720
38	S-103	0.11		TY-103	4.31e+10	C-101	391,775	7,528,495
39	S-106	0.11		S-104	3.99e+10	T-107	420,079	7,948,573
40	S-107	0.11		TX-109	3.81e+10	B-108	424,320	8,372,893
41	S-109	0.11		B-202	3.69e+10	SX-112	435,710	8,808,604
42	U-102	0.11		B-103	3.67e+10	TY-105	436,284	9,244,888
43	U-108	0.11	H2	SX-115	3.56e+10	U-110	447,585	9,692,473
44	U-109	0.11	H2	T-112	3.48e+10	B-109	464,853	10,157,326
45	U-110	0.11		TY-101	3.43e+10	C-110	475,461	10,632,787
46	U-111	0.11	Org.	BY-105	2.97e+10	BX-103	488,101	11,120,888
47	SX-107	0.10		T-105	2.92e+10	C-103	488,292	11,609,180
48	SX-108	0.10		T-110	2.67e+10	B-101	496,795	12,105,976
49	SX-109	0.10	H2 (Vent)	C-101	2.53e+10	A-106	513,032	12,619,007
50	SX-110	0.10		T-104	2.32e+10	B-107	525,731	13,144,739
51	SX-111	0.10		AX-102	2.31e+10	AX-103	582,191	13,726,929
52	SX-112	0.10		S-109	2.17e+10	SX-107	594,708	14,321,637
53	SX-114	0.10		C-110	2.15e+10	B-106	611,483	14,933,120
54	S-104	0.08		S-110	2.15e+10	SX-111	613,991	15,547,111
55	S-105	0.08		BY-110	2.12e+10	TY-101	647,908	16,195,019
56	SX-113	0.08		S-108	2.08e+10	SX-108	648,654	16,843,673
57	SX-115	0.08		T-111	2.04e+10	BX-112	682,729	17,526,402
58	U-101	0.08		C-108	1.83e+10	C-107	699,773	18,226,175
59	U-104	0.08		BY-106	1.77e+10	TX-102	730,289	18,956,464

Table 4-3. Sequences for Initial Single-Shell Tank Retrieval System Tank Selection Study Sensitivity Analysis. (5 Sheets)

Seq #	Interim storage risk (LANL 1995)			Inhalation hazard (Boothe 1995)		Minimum volume (Shelton 1995)		
	241-Tank #	p-rem/yr	Watch List	241-Tank #	Nonmobile ALIs	241-Tank #	Dilute volume (gal)	Cumulative volume (gal)
60	U -112	0.08		U -107	1.63e+10	BX-105	749,542	19,706,006
61	BY-106	0.07	Ferro.	B -104	1.60e+10	B-110	759,470	20,465,477
62	BX-106	0.03	Ferro.	BY-108	1.48e+10	B-111	759,491	21,224,967
63	BX-107	0.03		SX-113	1.44e+10	C-105	764,481	21,989,449
64	BX-109	0.03		C -111	1.28e+10	TY-103	775,603	22,765,052
65	BX-110	0.03		TY-105	1.27e+10	BX-110	777,835	23,542,887
66	BX-111	0.03		BX-104	1.27e+10	TX-108	857,294	24,400,181
67	BX-112	0.03		C -112	1.26e+10	BX-107	954,356	25,354,536
68	BY-102	0.03		BY-107	1.16e+10	B-104	1,000,875	26,355,411
69	BY-103	0.03	Ferro.	BX-109	1.14e+10	T-111	1,003,258	27,358,669
70	BY-105	0.03	Ferro.	B -102	9.87e+09	BY-108	1,012,654	28,371,323
71	BY-109	0.03		T -101	9.80e+09	TX-103	1,017,309	29,388,632
72	B -101	0.03		BX-110	9.24e+09	T-110	1,132,656	30,521,289
73	B -102	0.03		BY-111	8.64e+09	TX-109	1,238,938	31,760,227
74	B -103	0.03		BY-101	8.39e+09	U-106	1,260,219	33,020,445
75	B -104	0.03		TX-113	7.92e+09	T-104	1,281,115	34,301,561
76	B -105	0.03		BX-107	7.10e+09	BX-111	1,288,099	35,589,659
77	B -106	0.03		T -107	6.84e+09	S-103	1,292,875	36,882,534
78	B -107	0.03		BX-111	6.83e+09	BY-107	1,389,482	38,272,016
79	B -108	0.03		TX-110	6.66e+09	SX-114	1,470,147	39,742,163
80	B -109	0.03		B -107	6.15e+09	B-105	1,551,865	41,294,028
81	B -110	0.03		B -111	5.73e+09	S-101	1,608,770	42,902,798
82	B -111	0.03		U -111	5.08e+09	S-104	1,625,972	44,528,770
83	B -112	0.03		SX-102	4.81e+09	S-107	1,632,360	46,161,130
84	BX-101	0.03		B -112	4.61e+09	SX-101	1,677,176	47,838,305
85	BX-102	0.03	Ferro.	S -102	4.25e+09	SX-109	1,721,383	49,559,688
86	BX-103	0.03		T -106	3.24e+09	C-104	1,755,852	51,315,540
87	BX-104	0.03		S -105	3.13e+09	U-111	1,759,723	53,075,263
88	BX-105	0.03		S -111	3.00e+09	U-107	1,807,910	54,883,173
89	BX-108	0.03		U -108	2.95e+09	BY-112	1,814,527	56,697,700
90	BY-101	0.03		BY-109	2.72e+09	U-105	1,819,653	58,517,353
91	BY-104	0.03	Ferro.	BY-102	2.43e+09	U-102	1,876,494	60,393,847
92	BY-107	0.03	Ferro.	BX-112	2.16e+09	S-110	1,898,656	62,292,502
93	BY-108	0.03	Ferro.	AX-103	2.12e+09	A-103	1,929,498	64,222,001

Table 4-3. Sequences for Initial Single-Shell Tank Retrieval System Tank Selection Study Sensitivity Analysis. (5 Sheets)

Seq #	Interim storage risk (LANL 1995)			Inhalation hazard (Boothe 1995)		Minimum volume (Shelton 1995)		
	241-Tank #	p-rem/yr	Watch List	241-Tank #	Nonmobile ALIs	241-Tank #	Dilute volume (gal)	Cumulative volume (gal)
94	BY-110	0.03	Ferro.	B -105	1.60e+09	BY-104	2,059,103	66,281,104
95	BY-111	0.03	Ferro.	BY-112	1.57e+09	BY-110	2,083,509	68,364,613
96	BY-112	0.03	Ferro.	TY-104	1.52e+09	BY-102	2,128,388	70,493,001
97	T -101	0.01		TY-106	1.41e+09	TX-118	2,129,184	72,622,184
98	T -104	0.01		B -204	1.19e+09	BX-109	2,159,349	74,781,533
99	T -107	0.01	Ferro.	U -101	1.17e+09	U-108	2,190,888	76,972,420
100	T -110	0.01	H2	B -108	1.15e+09	TX-111	2,247,421	79,219,841
101	T -111	0.01	Org.	T -103	9.54e+08	U-103	2,302,684	81,522,525
102	TX-105	0.01	Org.	TX-114	7.92e+08	BY-101	2,327,537	83,850,062
103	TX-118	0.01	Ferro./Org	BX-108	7.10e+08	U-109	2,331,743	86,181,804
104	T -102	0.01		TX-111	6.89e+08	BY-109	2,344,686	88,526,490
105	T -103	0.01		T -108	6.84e+08	BY-103	2,370,708	90,897,197
106	T -105	0.01		U -102	5.74e+08	C-102	2,504,216	93,401,413
107	T -106	0.01		TY-102	5.57e+08	SX-106	2,538,392	95,939,806
108	T -108	0.01		T -203	5.08e+08	BY-111	2,569,158	98,508,964
109	T -109	0.01		S -103	4.74e+08	BY-105	2,608,056	101,117,020
110	T -112	0.01		S -106	3.99e+08	S-105	2,738,246	103,855,266
111	TX-101	0.01		B -109	2.69e+08	S-111	2,855,718	106,710,984
112	TX-102	0.01		TX-108	2.03e+08	TX-110	2,883,643	109,594,627
113	TX-103	0.01		B -106	1.98e+08	TX-106	2,929,134	112,523,761
114	TX-104	0.01		T -102	1.67e+08	S-102	3,004,140	115,527,900
115	TX-106	0.01		C -109	1.58e+08	SX-102	3,012,936	118,540,837
116	TX-107	0.01		B -203	1.19e+08	SX-104	3,022,383	121,563,219
117	TX-108	0.01		U -112	9.11e+07	S-106	3,132,573	124,695,793
118	TX-109	0.01		TX-115	8.81e+07	S-109	3,363,384	128,059,177
119	TX-110	0.01		T -109	7.59e+07	TX-113	3,364,821	131,423,998
120	TX-111	0.01		T -202	5.08e+07	TX-114	3,410,504	134,834,502
121	TX-112	0.01		TX-112	3.91e+07	SX-103	3,476,976	138,311,478
122	TX-113	0.01		U -109	3.81e+07	BY-106	3,606,370	141,917,849
123	TX-114	0.01		U -105	2.62e+07	TX-116	3,610,053	145,527,901
124	TX-115	0.01		TX-103	1.14e+07	S-108	3,614,597	149,142,499
125	TX-116	0.01		C -202	1.12e+07	S-112	3,807,406	152,949,904
126	TX-117	0.01		C -201	4.07e+06	TX-117	3,809,334	156,759,239
127	TY-101	0.01	Ferro.	TX-117	1.68e+06	SX-105	3,910,643	160,669,881

Table 4-3. Sequences for Initial Single-Shell Tank Retrieval System Tank Selection Study Sensitivity Analysis. (5 Sheets)

Seq #	Interim storage risk (LANL 1995)			Inhalation hazard (Boothe 1995)		Minimum volume (Shelton 1995)		
	241-Tank #	p-rem/yr	Watch List	241-Tank #	Nonmobile ALIs	241-Tank #	Dilute volume (gal)	Cumulative volume (gal)
128	TY-102	0.01		C -203	1.12e+06	TX-105	3,950,623	164,620,504
129	TY-103	0.01	Ferro.	TX-116	1.03e+06	AX-101	3,963,399	168,583,903
130	TY-104	0.01	Ferro./Org	TX-105	4.56e+05	TX-115	4,143,695	172,727,598
131	TY-105	0.01		BX-103	2.34e+05	TX-112	4,215,219	176,942,817
132	TY-106	0.01		TX-101	1.82e+05	A-101	5,071,712	182,014,529
133	B -201	0.03		TX-102	6.51e+04	B-201	92,144	182,106,673
134	B -202	0.03		TX-104	6.01e+04	B-202	88,219	182,194,891
135	B -203	0.07		U -103	3.64e+04	B-203	154,629	182,349,520
136	B -204	0.06		U -201	1.48e+04	B-204	136,782	182,486,302
137	C -201	0.22		U -202	1.38e+04	C-201	8,016	182,494,318
138	C -202	0.22		U -203	1.27e+04	C-202	4,058	182,498,376
139	C -203	0.22		TX-106	7.17e+03	C-203	20,288	182,518,664
140	C -204	0.22		U -106	6.39e+03	C-204	8,693	182,527,357
141	T -201	0.01		U -204	3.97e+03	T-201	79,576	182,606,932
142	T -202	0.01		C -204	3.95e+03	T-202	59,815	182,666,747
143	T -203	0.01	Org.	A -105	3.05e+03	T-203	99,336	182,766,084
144	T -204	0.01	Org.	TX-107	2.17e+02	T-204	107,881	182,873,965
145	U -201	0.08		U -104	3.04e+01	U-201	266,668	183,140,633
146	U -202	0.08		B -201	0.00e+00	U-202	165,019	183,305,652
147	U -203	0.08		T -201	0.00e+00	U-203	194,218	183,499,869
148	U -204	0.08		T -204	0.00e+00	U-204	44,898	183,544,768

ALI = Annual Limit of Intake. LANL = Los Alamos National Laboratory.

CUMULATIVE NUMBER OF TANKS RETRIEVED
(Sensitivity Analysis)

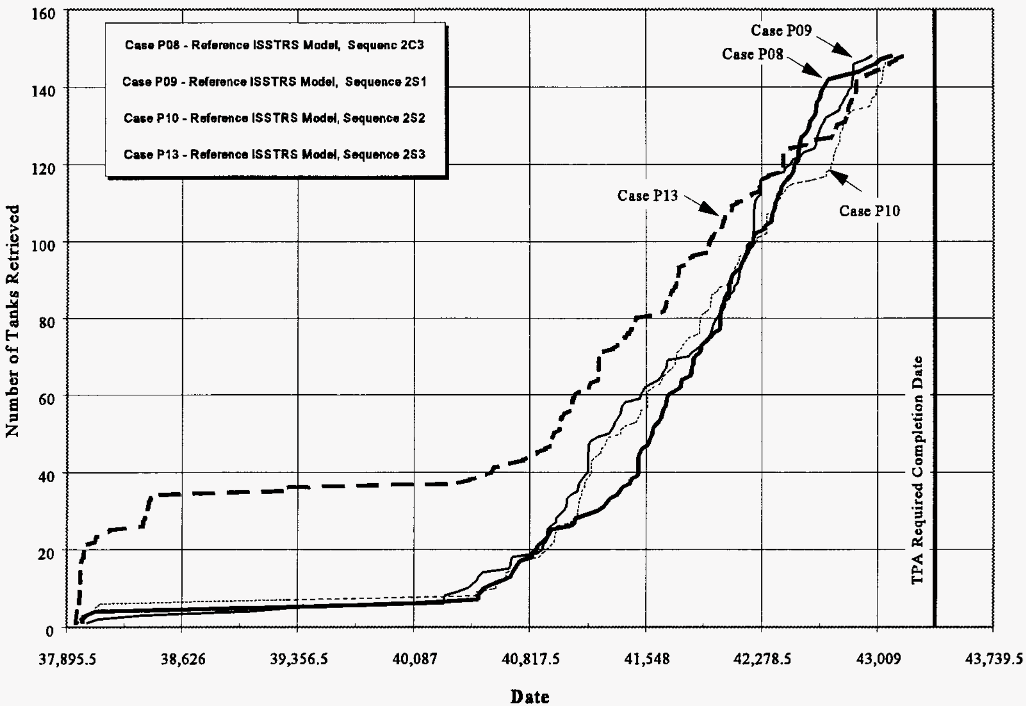
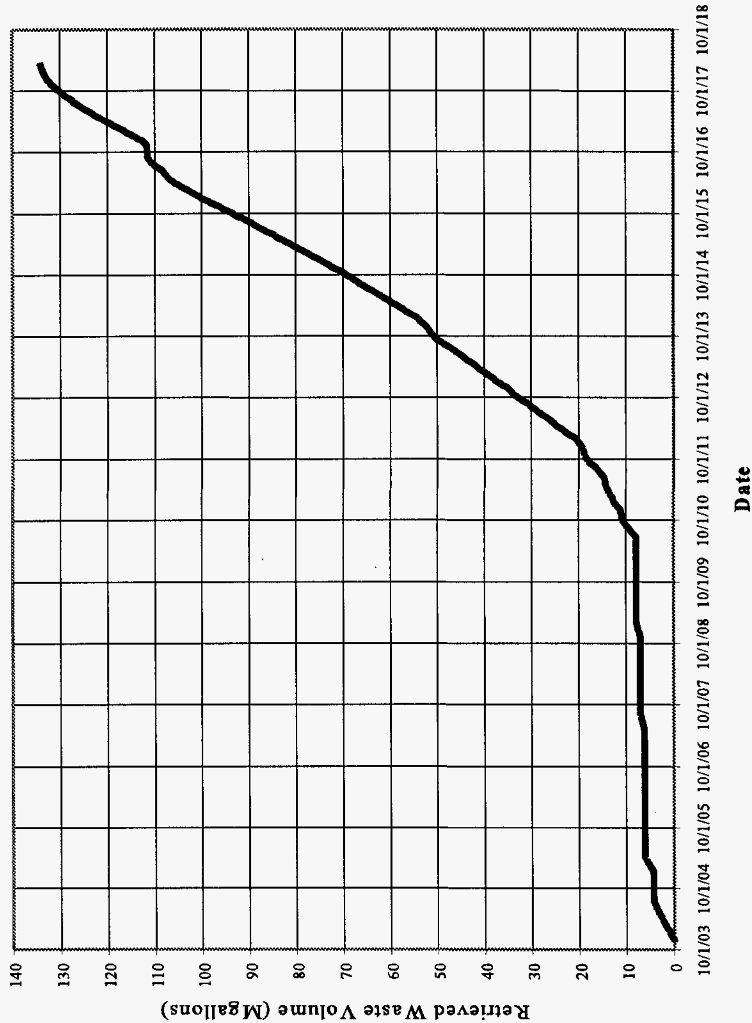


Figure 4-4. Cumulative Number of Tanks Retrieved - Sensitivity Analysis.

Figure 4-5. Retrieved Waste Volume - Case P13.



This section identifies and evaluates alternative approaches for retrieving 35 tanks during Phase I. When the evaluation is complete an approach will be selected and an assumed sub-set of tanks for Phase I retrieval identified. The ISSTRS tanks will be selected from this sub-set of tanks.

Alternative approaches evaluated were as follows:

1. Retrieve waste from tanks in all four quadrants. It is assumed that this approach will require the construction of waste receiver facilities and long transfer lines to support retrieval from the northeast and northwest quadrants. It is also assumed that tanks in the southeast and southwest quadrants can be retrieved directly into a DST. Case P11 verified that at least 35 tanks can be retrieved concurrent with Phase I using this approach.

2. Retrieve waste from tanks in three quadrants. This approach is the same as Approach 1 except it constructs a waste receiver facility for either the northeast or northwest quadrants and, thus, would have lower construction costs.

3. Retrieve waste from tanks in the southeast and southwest quadrants. This approach will not require the construction of waste receiver facilities and long transfer lines assuming tanks in the southeast and southwest quadrants would be retrieved directly into a DST.

4. Retrieve waste from the southeast and southwest quadrants plus selected tanks from the northeast and/or northwest quadrants using a vehicle waste transfer. Waste in the southeast and southwest quadrants would be retrieved directly into DSTs. Tanks in the northeast and/or northwest quadrants would be retrieved into a vehicle which would then transport the waste to an unloading station in the southeast or southwest quadrants. No waste receiver facilities or long transfer lines would be required.

Retrieval of waste from all four quadrants (Approach 1) would result in the highest Phase I construction costs for northeast and northwest quadrants waste receiver facilities and long transfer lines. Construction of these facilities during Phase I would eliminate the anticipated cost savings of having this work performed by private companies during Phase II. This approach will not be selected as the preferred approach unless none of the other, less expensive approaches can satisfactorily retrieve 35 tanks by September 2010.

The lowest cost option is Approach 3 with direct retrieval to nearby DSTs. Therefore, Approach 3 will be the preferred option if it can successfully retrieve 35 tanks concurrent with Phase I.

The input sequence for Case P12, with the smallest waste volume tanks in the southeast and southwest quadrants first, showed that 35 tanks could be retrieved by October 2010 (Figure 4-6). This would have been acceptable except new program guidance for two assumptions was received at this time.

The first change was that Phase I retrieval must include completion of an entire tank farm by 2010 (TWRS 1996). This was deemed necessary to meet the Tri-Party Agreement requirement to close a farm by 2012. Since Case P12 didn't complete an entire farm, it was not longer acceptable. For testing Approach 3, the AX Tank Farm was selected to be the first tank farm to be closed. This farm was selected since three of the four tanks in this farm were retrieved during Phase I in Case P12 and it contains the smallest total volume of waste in any of the southeast and southwest quadrant tank farms.

Case P14 was run with the 36 smallest tanks in the southeast and southwest quadrant plus tank 241-AX-101 to be retrieved during Phase I. This case successfully retrieved 35 tanks but did not complete retrieval of 241-AX-101. Case P15 was the same as Case P14 except it reduced the number of simultaneous retrieval allowed in each quadrant during Phase I from four to two. It was hoped that this reduction would reduce the periods during which retrieval was shutdown and possibly allow completion of 241-AX-101 retrieval. This change further delayed completion of 241-AX-101. However, it was successful in reducing shutdown time during Phase I (Figure 4-7). It was concluded that Approach 3 would not be satisfactory without additional changes to provide more storage space.

The second assumption change was an increase in the Phase I Privatization processing rate of the demonstration plants. This increase creates more storage space during Phase I and could make Approach 3 acceptable. Case P21 was run to evaluate the effect of the higher Phase I processing rates. This case was successful in retrieving 35 tanks including 241-AX-101 during Phase I. This change increased the volume of SST waste retrieved during Phase I from 30,283 m^3 (8.0 Mgal) (Figure 4-5) to 39,747 m^3 (10.5 Mgal) (Figure 4-8).

Since Case P21 was successful, it was assumed that Approach 3 will be the preferred alternative if it includes an acceptable salt cake demonstration tank and that the ISSTRS tanks will be selected from these 35 tanks.

Figure 4-6. Cumulative Number of Tanks Retrieved - Cases P12 and P14.

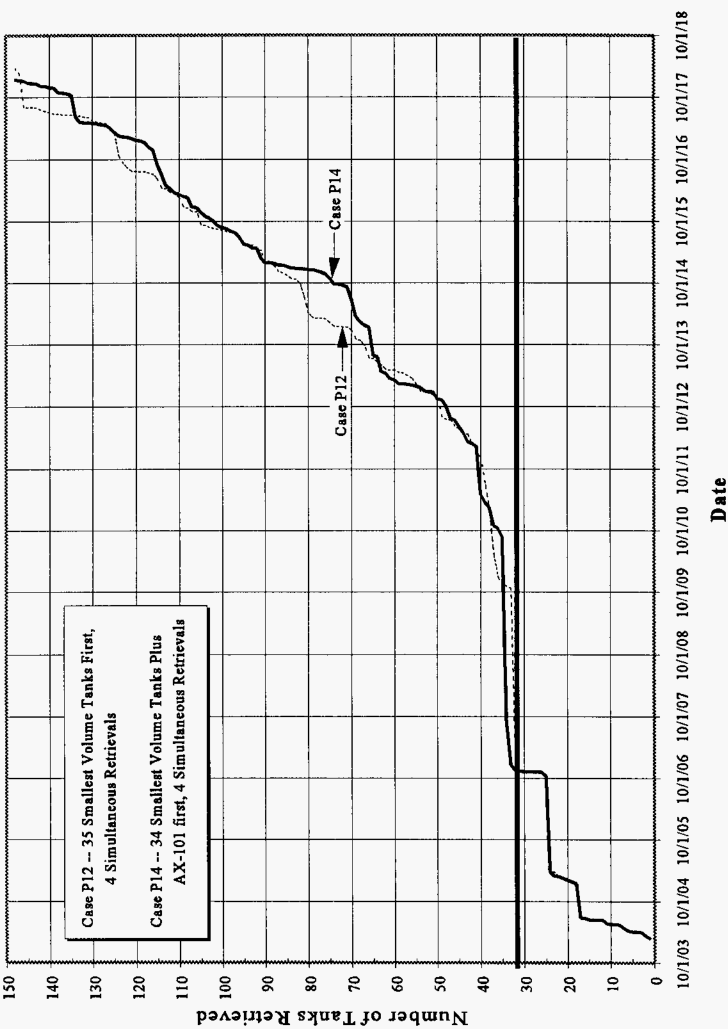


Figure 4-7. Cumulative Number of Tanks Retrieved - Cases P14 and P15.

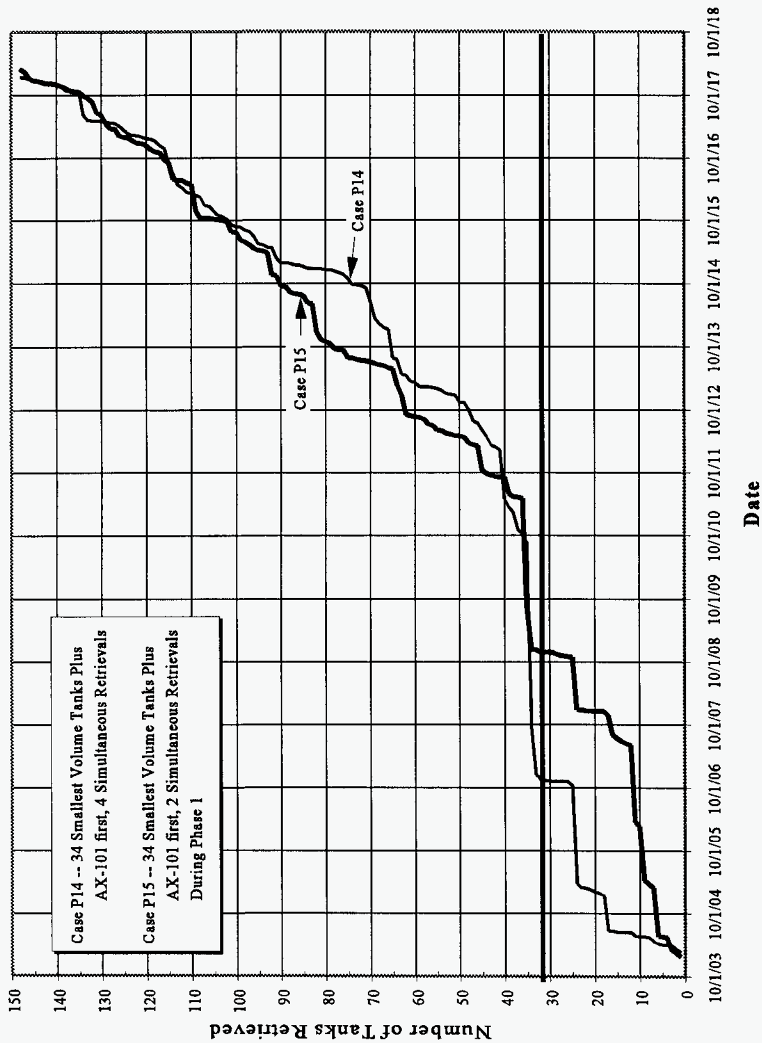


Figure 4-8. Cumulative Retrieved Volume - Case P21.

4.3 SALT CAKE DEMONSTRATION TANK SELECTION

DOE-RL has directed that the SST Retrieval organization plan for a salt cake retrieval demonstration (Bader 1995). The following four criteria were used as minimum criteria for the selection of a salt cake retrieval demonstration tank:

1. **Waste Type**

   Requirement. The salt cake retrieval demonstration tank must contain at least 95 percent salt cake.

   Basis. The purpose of this demonstration is to obtain data on the ability of sluicing to retrieve salt cake. A large quantity of sludge in the tank could seriously affect the test results and it's usefulness for the design of subsequent retrieval systems. The impact of sludge on the test data will be minimal if the waste in the tank is less than 5 percent sludge.

2. **Minimum Waste Volume**

   Requirement. The tank must result in at least 379 m^3 (100,000 gal) of undiluted waste.

   Basis. Reports on past-practice sluicing state that the rate of sludge retrieval decreases rapidly when a tank is nearly empty. This is logical with the amount of waste available for mobilization by the sluicing jet at the point of impact approaching zero. It is therefore assumed that the decreasing rate will also occur with salt cake. To ensure that steady-state operation can be established, the tank must contain at least 0.9 m (3 ft) of waste. This corresponds to 379 m^3 (100,000 gal) of undiluted waste.

3. **Maximum Waste Volume**

   Requirement. The tank must not result in more than 1,893 m^3 (500,000 gal) of undilute waste.

   Basis. DST storage space is and will remain extremely limited until the privatization demonstration plants begin operation in FY 2002. The waste volume projection report (Strode 1995) allows up to 7,571 m^3 (2 Mgal) of waste to be retrieved before the start of demonstration plants. Assuming a 3:1 dilution ratio, no more than 1,893 m^3 (500,000 gal) of salt cake and sludge may be retrieved before the start of the demonstration plants. Therefore, the salt cake retrieval demonstration tank must contain less than 1,893 m^3 (500,000 gal) of salt cake and sludge.

Table 4-4 provides salt cake retrieval demonstration selection data for the 35 small dilute volume tanks in the southeast and southwest quadrants. The tanks are sorted by percent salt cake. Of the tanks only three contain salt cake and only one (tank 241-AX-103) meets the waste type requirement of at least 95 percent salt cake. Fortunately this tank also meets the minimum and maximum dilute waste volume requirements. It is, therefore, recommended that tank 241-AX-103 be used for the salt cake retrieval demonstration.

Table 4-4. Tank Waste Volume Data for Salt Cake Retrieval Demonstration Selection

241- Tank #		Undiluted tank volumes (000,000 gal)			241- Tank #		Undiluted tank volumes (000,000 gal)		
		Sludge volume	Salt cake volume	% Salt cake			Sludge volume	Salt cake volume	% Salt cake
1	AX-103	2	110	98.21%	19	C -203	5	0	0.00%
2	AX-102	7	29	80.56%	20	C -204	3	0	0.00%
3	A -102	15	22	59.29%	21	SX-107	104	0	0.00%
4	A -104	28	0	0.00%	22	SX-108	87	0	0.00%
5	A -105	19	0	0.00%	23	SX-110	62	0	0.00%
6	A -106	125	0	0.00%	24	SX-111	125	0	0.00%
7	AX-104	7	0	0.00%	25	SX-112	92	0	0.00%
8	C -101	88	0	0.00%	26	SX-113	26	0	0.00%
9	C -103	62	0	0.00%	27	SX-115	12	0	0.00%
10	C -105	130	0	0.00%	28	U -101	22	0	0.00%
11	C -107	237	0	0.00%	29	U -104	122	0	0.00%
12	C -108	66	0	0.00%	30	U -110	186	0	0.00%
13	C -109	62	0	0.00%	31	U -112	45	0	0.00%
14	C -110	177	0	0.00%	32	U -201	4	0	0.00%
15	C -111	57	0	0.00%	33	U -202	4	0	0.00%
16	C -112	104	0	0.00%	34	U -203	2	0	0.00%
17	C -201	2	0	0.00%	35	U -204	2	0	0.00%
18	C -202	1	0	0.00%					

4.4 FINAL INITIAL SINGLE-SHELL TANK RETRIEVAL SYSTEM TANK SELECTION

This section will select three tanks that, together with tank 241-AX-103, will comprise the ISSTRS work scope. There are many possible bases for making this final selection. The four criteria or measures chosen for this selection process are discussed below along with their bases and the results of each.

1. **Tank Condition**

   Measure. SSTRS will retrieve waste from tanks that are not assumed to be leakers.

   Basis. Many of the SSTs are either known to or suspected of having leaked. Iwatate (1995) recommended that "only sound (non-leaking) tanks should be selected for this effort." There are no guarantees that tanks thought to be sound are sound. However, selection of tanks that are not assumed to be leakers will limit the potential for leakage and will allow ISSTRS to address this potential as it was addressed for Project W-320.

   Result. Estimated leakage data for each of the tanks were obtained from Appendix H of WHC-EP-0182-74, *Tank Farm Surveillance and Waste Status Summary Report for October 1995* (Hanlon 1995). Twelve of the 35 tanks are assumed to be sound.

2. **Tank Series**

   Measure. The ISSTRS tanks shall only consist of 100 Series tanks.

   Basis. The SSTs consist of 100 Series and 200 Series tanks. The 100 Series tanks with 23-m (75-ft) diameters and with capacities of 2,006 m^3 (530,000 gal), 2,869 m^3 (758,000 gal), and 3,785 m^3 (1 Mgal). The 200 Series tanks have 6.1-m (20-ft) diameters and a capacity of 208 m^3 (55,000 gal). There are two reasons ISSTRS should be limited to the 100 Series tanks. First, the focus of retrieval development efforts has been on retrieving the larger tanks. The Project W-320 design was based on a 100 Series tank (241-C-106). This design can be easily adapted to any of the 100 Series tanks. A major redesign would be required for the 200 Series tanks. Second, Oak Ridge National Laboratory (ORNL) will be using a light-duty utility arm (LDUA) to retrieve waste from its 7.6-m (25-ft) diameter tanks. The LDUA is expected to clean the tanks to closure-ready conditions whereas sluicing has not been able do so. It would be prudent to delay retrieval of the 200 Series tanks until LDUA results from ORNL data are available.

   Result. Tank series is indicated by the first digit of the tank number and all tanks with numbers greater than 200. This reduced the list of possible tanks for ISSTRS to 8 tanks.

3. **Long-Term Hazard**

Measure. The ISSTRS tanks should be in the top 86 tanks that are identified as requiring retrieval for compliance with the intent of the Tri-Party Agreement (Boothe 1995).

Basis. Boothe (1995) suggests that the intent of the Tri-Party Agreement can be satisfied by retrieving 86 of the SSTs. The current Tri-Party Agreement requires retrieval of waste from all the SSTs. However, it would be judicious to only retrieve the tanks identified for retrieval in this report to ensure that tanks will not be retrieved unnecessarily if a future decision is made not to retrieve waste from all the tanks. Keeping these tanks out of the ISSTRS work scope will provide an additional two years to make this decision.

Result. The eight tanks were sorted by hazard ranking. Since the hazard analysis (Boothe 1995) recommended that only 86 tanks be retrieved, tanks with a hazard ranking greater than 86 were eliminated. Only one of the eight tanks was eliminated leaving seven as possible ISSTRS tanks.

4. **Interim Storage Risk**

Measure. The four tanks with the highest interim storage risk (McFarlane 1995) will be preferred for ISSTRS.

Basis. ISSTRS also should reduce the short term, interim storage risk (i.e., risk to the public and the environment from the continued storage of waste until the waste is retrieved). This interim storage risk has been evaluated and quantified in a LANL Probabilistic Risk Assessment (MacFarlane 1995). No study has identified either a acceptable or a desirable level of interim storage risk. However, short term risk reduction is a site value and thus, tanks with the highest interim storage risk should be retrieved as early as practical.

Result. Final selection was made by ranking the seven tanks by storage risk. The three highest ranked tanks (241-C-103, 241-A-102, and 241-C-105) were selected for ISSTRS.

Two of the selection criteria (tank condition and tank series) are absolute criteria in that they are either met or not met. Tanks that don't meet these criteria will be eliminated from further consideration for ISSTRS. The following evaluation is summarized in Table 4-5.

Table 4-5. Initial Single-Shell Tank Retrieval System Tank Selection Summary.

	241-Tank #	Dilute volume	Cumulative volume	Tank condition	Hazard ranking (Boothe)	Storage risk ranking	Previously sluiced	Watch List
	Salt cake retrieval demonstration							
	AX-103	582,191	582,191	S	94	21	Y	H2
	High storage risk (LANL 1995)							
1	C -103	488,292	1,070,483	S	29	1	Y	Org.
2	A -102	188,894	1,259,377	S	4	3	Y	
3	C -105	764,481	2,023,859	S	1	7	Y	
	Retrieval required (Boothe 1995)							
4	C -107	699,773	2,723,632	S	32	11	N	
5	C -112	318,103	3,041,735	S	68	13	N	Ferro.
6	A -106	513,032	3,554,767	S	10	16	Y	
7	C -108	224,499	3,779,265	S	59	24	N	Ferro.
	100 Series tanks							
8	C -109	190,746	3,970,011	S	116	25	N	Ferro.
	Sound tanks							
9	U -201	266,668	4,236,680	S	137	66	N	
10	U -202	165,019	4,401,699	S	138	67	N	
11	U -203	194,218	4,595,916	S	139	68	N	
12	U -204	44,898	4,640,815	S	142	69	N	
	Leakers							
13	AX-104	37,496	4,678,310	L	31	22	Y	
14	C -202	4,058	4,682,368	L	126	28	Y	
15	C -201	8,016	4,690,384	L	127	27	Y	
16	C -204	8,693	4,699,077	L	143	30	Y	
17	C -203	20,288	4,719,365	L	129	29	Y	
18	A -104	69,470	4,788,835	L	12	14	Y	
19	AX-102	166,157	4,954,992	L	52	20	Y	Org.
20	C -111	195,266	5,150,258	L	65	26	N	Ferro.
21	SX-110	384,737	5,534,996	L	17	55	N	
22	U -112	387,073	5,922,069	L	118	65	N	
23	C -101	391,775	6,313,843	L	50	23	Y	
24	U -110	447,585	6,761,428	L	38	50	N	
25	C -110	475,461	7,236,889	L	54	12	N	
26	SX-107	594,708	7,831,597	L	23	52	N	
27	SX-111	613,991	8,445,588	L	15	56	N	
28	SX-113	9,853	8,455,442	L	64	61	N	
29	SX-115	75,956	8,531,398	L	44	62	N	
30	U -101	77,086	8,608,484	L	100	63	Y	
31	A -105	101,521	8,710,005	L	144	15	Y	
32	U -104	136,285	8,846,289	L	146	64	Y	
33	SX-112	435,710	9,282,000	L	30	57	N	
35	SX-108	648,654	9,930,654	L	22	53	N	

4.5 ROBUSTNESS

The final step in the selection process was to determine the robustness of the selection (i.e., the sensitivity of the selection to changes in criteria). Criteria changes used for this evaluation were for interim storage risk or long-term hazard only. In addition, the cost effectiveness of the selection was evaluated by looking at the qualitative assessment of the cost savings associated with limiting ISSTRS to a single tank farm unit.

Storage Risk. Of the 35 tanks from which the ISSTRS tanks were selected, the three with the highest storage risk are shaded in Table 4-5. Since these are the tanks selected for ISSTRS there would be no impact on the tank selection.

Long-Term Hazard. Of the 35 tanks from which the ISSTRS tanks were selected, the three with the highest hazard rankings are shaded in Table 4-5. Two of the three tanks would remain in the ISSTRS work scope. The only change would be the replacement of 241-C-103 by 241-A-106. Since 241-C-103 is ranked as having the highest storage risk, it is not desirable to change the tank selection.

Cost. The ISSTRS tanks are in three different tank farms leaving the appearance that considerable savings could be achieved by retrieving tanks from only one tank farm. This evaluation will not consider the retrieval of tanks in a different quadrant since this prevent the use of significant portions of the Project W-320 piping and increase ISSTRS costs. As a result retrieval from other quadrants cannot reduce ISSTRS costs and, thus, will not be considered further in this evaluation.

The two remaining alternatives were to select tanks that are all in the C Tank Farm or all in the A/AX Tank Farms. Combining the A and AX Tank Farms as assumes that one set of retrieval pipes is sufficient to support retrieval from both the A and AX Tank Farms.

First, ISSTRS cannot be limited to just the C Tank Farm since it doesn't contain a tank that is acceptable for the salt cake retrieval demonstration. As a result retrieval cannot be limited to only the C Tank Farm.

For this evaluation, it is necessary to establish a baseline pipe routing to the sluicing receiver in the AN Tank Farm (Certa 1995). There are two viable approaches to sluicing waste from the A/AX Tank Farm unit and C Tank Farm to the AN Tank Farm. One option is to connect piping from the A/AX Tank Farm unit to the W-320 piping near the AY Tank Farm. This piping would then be connected to the AN Tank Farm. A valve pit would be required at the piping junction.

The second option would be to route the piping from the A/AX Tank Farm unit directly to the AN Tank Farm. Piping from the C Tank Farm would use a portion of the W-320 piping which would be connected to the AN Tank Farm. The length of piping needed to get from the A/AX Tank Farm unit to the AN Tank Farm is approximately the same as getting to the AY Tank Farm. It is not obvious which of the two routings will be preferred without performing a detailed engineering study.

Either of the two routings could be used if ISSTRS were limited to the A/AX Tank Farm unit. The only cost savings would be the elimination of the the valve pit. This savings would be small when compared to the total project cost.

Direct routing to the receiver tank would eliminate the need for ISSTRS to construct the piping from the W-320 piping to the AN Tank Farm and the pipeline construction cost savings would be considerable. Of the 35 tanks from which the ISSTRS tanks were selected only 3 non-leakers are located in the A or AX Tank Farms. Therefore, limiting retrieval to these 2 farms would either require retrieval of an assumed leaker with greater risk to the environment or tanks with larger waste volumes which would preclude Tri-Party Agreement target milestone compliance. Current guidance is that neither option is acceptable. As a result, limiting retrieval to a single tank farm is not an acceptable option.

These evaluations show that the ISSTRS tank selection is robust. Tank selection may vary slightly for major changes in the selection criteria, however, changes in the tank selection are not warranted. Therefore, the recommend tanks for ISSTRS are 241-AX-103 (salt cake demonstration), 241-A-102, 241-C-103, and 241-C-105.

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5.0 RECOMMENDATIONS

The following recommendations are based on the selection process:

1. ISSTRS shall provide the retrieval systems and infrastructure upgrades necessary to retrieve waste from four SSTs.

2. Retrieval during Phase I shall be limited to 35 SSTs in the southeast and southwest quadrants (The A, AX, C, S, SX, and U Tank Farms) containing the minimum dilute waste volumes.

3. The salt cake retrieval demonstration tank shall be 241-AX-103.

4. ISSTRS work scope shall include tanks 241-A-102, 241-C-103, and 241-C-105 in addition to the salt cake retrieval demonstration tank.

6.0 CONCLUSIONS

The tank selection process has resulted in the following conclusions:

1. The baseline waste processing rates must be increased for SST retrieval to comply with the Tri-Party Agreement Milestone M-45-05 completion date.

2. The Tri-Party Agreement Milestone M-45-05 target milestones associated with retrieval during privatization Phase I can only be met by the retrieval of tanks containing small dilute (i.e., "as retrieved") waste volumes.

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7.0 REFERENCES

42 USC 6901, *Resource Conservation and Recovery Act of 1976*, et seq.

42 USC 6921, *Superfund Amendments and Reauthorization Act of 1986*, et seq.

Bader, C. P., 1995, *Tank Waste Remediation System (TWRS) Guidance for Update of the Multi-Year Program Plan (MYPP) - Supplemental Guidance for the Disposal Program*, 95-PRI-073, U.S. Department of Energy-Richland Operations Office, Richland, Washington.

Boomer, K. D., S. K. Baker, A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M Marusich, R. J. Parazin, An. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, and C. E. Worcester, 1993, *Tank Waste Technical Options Report,* WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Boothe, G. F., 1995, *Remediation and Cleanout Levels for Hanford Site Single-Shell Tanks,* WHC-SD-WM-TI-711, Westinghouse Hanford Company, Richland, Washington.

Certa, P. J., 1995, *Preliminary Retrieval Sequence and Blending Strategy,* WHC-SD-WM-RPT-167, Westinghouse Hanford Company, Richland, Washington.

Certa, P. J., 1996, *Low-Level Waste Feed Staging Plan*, WHC-SD-WM-RPT-224, Westinghouse Hanford Company, Richland, Washington.

Crawford, G. L., 1995, *Initial Single-Shell Tank Retrieval System Mission Analysis Report,* WHC-SD-WM-MAR-009, Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1995, *TWRS Privatization Request for Proposals DRAFT,* DE-RP06-96RL13308, U.S. Department of Energy-Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Fowler, K. D., 1995, *Tank Farm Waste Transfer Compatibility Program,* WHC-SD-WM-OCD-015, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1995, *Tank Farm Surveillance and Waste Status Summary Report for October 1995,* WHC-EP-0182-74, Westinghouse Hanford Company, Richland, Washington.

Hertzel, J. S., 1996, *Initial Single-Shell Tank Retrieval System Mission Analysis Report*, WHC-SD-WM-MAR-009, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Iwatate, D. F., 1995, *Operational Tank Leak Detection and Minimization During Retrieval*, WHC-SD-WM-ES-377, Westinghouse Hanford Company, Richland, Washington.

MacFarlane, D. R., and D. W. Stack, 1995, *Probabilistic Safety Assessment for Retrieval of Hanford Single-Shell Tank Wastes*, TSA-11-95-108, Los Alamos National Laboratory, Los Alamos, New Mexico.

Manuel, , A. F., Lamberty, S. L., and Stegen, G. E., 1996, *Phase I High-Level Waste Pretreatment and Feed Staging Plan, WHC-SD-WM-ES-370,* Westinghouse Hanford Company, Richland, Washington.

Shelton, L. W., 1995, *Chemical and Radionuclide Inventory for Single and Double-Shell Tanks,* Letter 75520-95-007, Westinghouse Hanford Company, Richland, Washington.

Strode, N. M., 1995, *Operational Waste Volume Projection,* WHC-SD-WM-ER-029, Rev. 21, Westinghouse Hanford Company, Richland, Washington.

Thomson, J. D., 1995, *Decision Management (Interim),* TSEP-07, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

TWRS, 1996, *Tank Waste Remediation System Fiscal Year 1997 Multi-Year Work Plan WBS 1.1*, WHC-SP-1101, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Wittman, R. S., 1996, *TWRS Baseline Dynamic Simulation Model of Tank Waste Retrieval Sequence*, Internal Memo to J. D. Thomson, Westinghouse Hanford Company, Richland, Washington.

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