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SINGLE-SHELL TANK RETRIEVAL SELECTION AND SEQUENCE

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Abstract: This document provides an example single-shell tank (SST) retrieval sequence evaluated in response to Hanford Federal Facility Agreement and Consent Order milestone M-45-02M, "Submit annual biennial updates to SST retrieval sequence document (Agreement Appendix I. Section 2.1.2), Double-Shell Tank space evaluation document and Ecology concurrence of additional tank acquisition."

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SINGLE-SHELL TANK RETRIEVAL SELECTION AND SEQUENCE

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LIST OF TERMS

Abbreviations and Acronyms

BBI	Best-Basis Inventory
BDGRE	buoyant displacement gas release event
BVS	Bulk Vitrification System
CH2M HILL	CH2M HILL Hanford Group, Inc.
DBVS	Demonstration Bulk Vitrification System
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	State of Washington, Department of Ecology
EPA	Environmental Protection Agency
HFFACO	*Hanford Federal Facility Agreement and Consent Order*
HTWOS	Hanford Tank Waste Operations Simulator
MRS	mobile retrieval system
MS	modified sluicing
NEPA	National Environmental Policy Act
ORP	U.S. Department of Energy, Office of River Protection
PFP	Plutonium Finishing Plant
RPP	River Protection Project
RWL	remote water lance
SpG	specific gravity
SST	single-shell tank
TOE	total operating efficiency
TRU	transuranic waste
Vacuum	vacuum retrieval system
WMA	waste management area
WTP	Waste Treatment and Immobilization Plant

Units

Ci/gal	curies per gallon
Kgal	kilogallons (1,000 gallons)
Kgal/year	kilogallons per year
Mgal	million gallons

1.0 INTRODUCTION

This document is provided in accordance with Hanford *Federal Facility Agreement and Consent Order* (HFFACO; Ecology et al. 2003) milestone M-45-02M, "Submit biennial update to SST retrieval sequence document (Agreement Appendix I. Section 2.1.2), Double-Shell Tank space evaluation document and Ecology concurrence of additional tank acquisition." This report satisfies all the requirements of milestone M-45-02M except for providing an estimated schedule for SST retrievals. Retrieval schedules cannot be determined until a startup date for the Waste Treatment and Immobilization Plant (WTP) is formally established. The full text of milestone M-45-02M can be found in Appendix A.

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this document, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of chapter 70.105 RCW and its implementing regulations but is provided for information purposes only.

1.1 DOCUMENT OVERVIEW

This document presents a tank retrieval selection and sequencing evaluation developed in accordance with criteria in HFFACO Appendix I. The pool of tanks selected for retrieval, retrieval method(s), estimated duration, and estimated waste volumes to be generated during retrieval and transferred to the double-shell tanks (DSTs) are provided.

Section 2, Single-Shell Tank Retrieval Pool, discusses the pool of single-shell tanks (SSTs) to be used for selecting and sequencing the next several years of tank waste retrieval activities. The SSTs in the retrieval pool were selected to meet the primary objective of maximizing risk reduction through the retrieval of mobile, long-lived radionuclides or potential airborne contaminants and principal nonradiological hazardous constituents in a manner that is sensitive to waste treatment facility requirements and infrastructure constraints.

Section 3, Single-Shell Tank Retrieval Sequence, discusses a retrieval sequence that selects from tanks in the SST retrieval pool, taking into consideration DST space and waste compatibility plus the closure of waste management areas and resource optimization. The retrieval methodologies to be employed and estimated waste volumes to be generated during retrieval are also provided.

Section 4, Double-Shell Tank Space Evaluation, evaluates DST space availability resulting from the SST retrievals identified in Section 3. The DST space evaluation is based on the results from a Hanford Tank Waste Operations Simulator (HTWOS) model run.

Section 5, Double-Shell Tank Space Options, describes DST space-saving options that affect receipt and storage of SST waste. Four DST space-saving options were implemented to complete HFFACO milestone M-46-21 in December 2005, including:

- Increase the DST fill height in AP tank farm,

- Concentrate supernatant waste to a specific gravity (SpG) above 1.41,
- Use "restricted" space in WTP staged feed tanks, and
- Maintain a common 1.2 million gallons of emergency storage space for both Tank Farms and WTP activities.

Further measures that could be used to provide additional space for SST waste retrieval are discussed in Section 5.2.

1.2 EVALUATION METHODOLOGY AND ASSUMPTIONS

This evaluation uses the HTWOS model for the prediction of tank space and depiction of tank farm processing events. The HTWOS model simulates the waste storage, retrieval, and treatment processes planned for implementing the River Protection Project (RPP) mission. Modeling assumptions start with the mission requirements from major agreements and commitments, such as the HFFACO, along with other key assumptions. The HTWOS uses information about waste properties, tank system configurations, desired end states, target milestones, and other parameters associated with particular waste processing scenarios to produce a variety of outputs. These model outputs are used to evaluate the relationship between SST waste retrieval and DST space demands, and for developing future plans for accomplishing the RPP mission.

The following inputs and assumptions were used to develop this document:

- No definite date for the WTP startup was assigned.
- Projected volumes and sequences for the receipt of new waste into the DST system will be consistent with recent field experience regarding SST waste retrievals and non-Tank Farm waste generators (e.g., Plutonium Finishing Plant [PFP]).
- The Demonstration Bulk Vitrification System (DBVS) will be refurbished as the Bulk Vitrification System (BVS) and its operation extended[1] using additional waste retrieved from tank 241-S-109 (S-109) and waste retrieved from tank S-105.
- Recent tank waste inventory data were used as input to the modeling. The inventory data accounts for the retrieval of wastes from tanks C-106 and C-203 to the limits of technology, and the ongoing retrieval of wastes from tanks C-103, C-201, S-102, and S-112 (see RPP-27459, *Double- and Single-Shell Tank Inventory Input to the HTWOS Model – 2005a Update* for further information).
- The durations for the retrieval of SST wastes were based on the status of current retrieval projects and on the experience gained from recent retrieval activities for tanks S-102 and S-112, and for the C-Farm tanks.
- The durations for the retrieval of wastes from tanks S-105 and S-109 were based on the processing rates for the DBVS and the BVS.

[1] This assumes that all necessary permit updates, National Environmental Policy Act (NEPA) analyses, modifications, and approvals will be obtained to support the refurbishment and extended operations. No decision regarding refurbishment will be made until appropriate NEPA analyses are completed.

- The durations for the retrieval of wastes from the remaining SSTs were based on the design capacity of modified sluicing systems[2] and adjusted to account for the following:
    - Ramp-ups and ramp-downs in retrieval system operating efficiency during the start-up of each retrieval effort and near the end of waste retrieval,
    - Total operating efficiencies (TOEs) that can be achieved during the performance of simultaneous retrieval operations,
    - Retrieval operations will be performed on 10 or 15 shifts per week rather than on round-the-clock operation (21 shifts per week),
    - Additional efforts may be required to retrieve hard heels from some of the tanks. Tanks that may require hard heel removal are identified in Appendix B, and
    - Resource-leveling will be used to maintain trained staff and retrieval equipment up to the WTP startup.
- A maximum level of 1.235 Mgal for each of the AP-Farm DSTs.
- The emergency DST space allocation is 1.235 Mgal.
- The 242-A evaporator will be operated to maximize the waste volume reduction while still meeting waste transfer and DST waste storage specifications for solids loading and avoiding the creation of buoyant displacement gas release event (BDGRE) conditions.

[2] Estimated retrieval rates for vacuum retrieval systems (Vacuum) or mobile retrieval systems (MRS) are currently slower than desired. Retrieval technology development work is planned to enhance those technologies and increase the retrieval rates to be consistent with those of the modified sluicing systems.

2.0 SINGLE-SHELL TANK RETRIEVAL POOL

In order to appropriately select SSTs for retrieval activities, a number of objectives and parameters must be balanced. This section discusses these objectives and parameters as well as the criteria used to identify candidate tanks that make up the tank pool. While the individual tanks in the tank pool did not change for this biennial update, the factors used to select the original tank pool are discussed here to show how the original tank pool was developed. Revision 0-A of this document (RPP-21216, *Single-Shell Tank Retrieval Selection and Sequence*) provides additional discussion of the selection of the pool tanks. Since there has been no significant change to the evaluated tank parameters, the previous evaluation and methodology are presented here simply as a point of reference.

2.1 SELECTION FACTORS

The SSTs in the retrieval pool are selected based upon a set of primary objectives and on the consideration of additional objectives. The primary objectives are to maximize the reduction of short- and long-term risk to human health and the environment and to optimize waste feed so as to maintain efficient WTP operations. The additional objectives (e.g., optimizing use of DST space, resource leveling) include factors that provide for more efficient tank farm operations. Each is discussed in the following sections.

2.1.1 Human Health and Environmental Risk Reduction

Radioactive Concentration – Short-term risk to human health and the environment is measured in terms of radioactivity per gallon of tank waste. Radioactive concentration is expressed in terms of curie content – the higher the curie content, the more risk to human health and the environment and vice versa. The most effective method to reduce the curie content within the SST system is to retrieve those tanks with the highest curies per gallon ratio. Retrieving tanks with the highest activity per gallon will provide for optimum curie content reduction.

Groundwater Risk – Groundwater risk analysis measures the long-term risk and increased cancer risk based on a groundwater ingestion path (see RPP-8554, *Single-Shell Tank Retrieval Sequence and Double-Shell Tank Space Evaluation*, for further details about the groundwater ingestion path). Certain isotopes if released to the environment pose a greater risk to human health and the environment because of their propensity to migrate through soils and into the groundwater. Contaminants of concern that comprise the significant portion of groundwater risk include ^{14}C, ^{79}Se, ^{99}Tc, ^{129}I, and ^{238}U. Retrieving tanks with the largest inventory of these isotopes will, therefore, provide maximum groundwater risk reduction.

Airborne Risk – Analysis of airborne risk is focused on measuring long-term risk using a post-well driller intruder scenario (see RPP-8554 for further details about this scenario). Twenty-one isotopes generate the most significant portion of airborne risk including: ^{94}Nb, ^{126}Sn, ^{232}Th, ^{238}U, ^{237}Np, ^{236}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{244}Pu, ^{241}Am, ^{242}Am, ^{243}Am, ^{243}Cm, ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{247}Cm, and ^{248}Cm. Retrieving tanks with the greatest potential risk to human health and the environment from these isotopes will therefore provide maximum long term airborne risk reduction.

2.1.2 Maintain Efficient WTP Operations

Balance WTP Feed – As provided in Appendix I, Section 2.1.2 of the M-45-00 milestone, a primary criterion for selecting SSTs in this sequencing document is to balance waste feed delivery to the WTP and thereby optimize its performance. Balancing waste feeds means providing sufficient low-activity and high-level wastes to avoid outages in any of the WTP processes. Previous life-cycle mission evaluations such as those in ORP-11242, *River Protection Project System Plan*, identified a potential for "starving" the high-level melter operations because of insufficient staged sludge available in the early years of operations. It is, therefore, necessary to identify SSTs containing high-level waste sludges and sequence their retrieval to have balanced feed available in the DSTs for delivery to the WTP.

Shorten WTP Mission – Any SST wastes that could be retrieved, treated, and disposed without requiring WTP processing potentially reduces the volume of feed to the WTP and shortens the WTP mission. Tanks identified as potential transuranic (TRU) packaging or supplemental treatment demonstration candidates fall into this category. Choosing to retrieve these tanks may have the added benefit of requiring little, if any, DST space prior to the start up of the WTP. However, wastes will not be retrieved and packaged as TRU until regulatory uncertainties have been resolved and a suitable packaging facility has been permitted.

2.1.3 Additional Objectives

Waste Management Area (WMA) Closures – Early closure of an entire WMA is a concept that has been highlighted during recent HFFACO negotiations. The concept would involve retrieving all of the SSTs within a WMA and allow closure of supporting systems and ancillary equipment leading to closure of an entire WMA. This has the advantage of providing tangible closure progress while waiting for the WTP to become operational. Retrieving all tanks within a selected WMA (for example, all of the C-Farm tanks) supports the WMA closure concept.

Optimize DST Volume – The DST space is limited until the WTP becomes operational and SSTs selected for early retrieval must be chosen to make optimal use of the limited DST space. The SST retrievals consuming the least amount of DST space used are preferred when the other factors are considered nearly equal.

Resource Leveling and Infrastructure Utilization – Tank retrieval involves unique equipment, infrastructure support and well trained crews operating in close coordination with overall tank farms operations and upgrade projects. The complexity of moving equipment and retraining crews to new areas suggests that significant efficiencies may be gained by retrieving SSTs in the same area using the same primary and infrastructure equipment that was used for the higher priority tanks. The schedule and resource limitations may suggest that in some cases it makes operational sense to retrieve tanks that may not necessarily rank high in the other factors.

2.2 METHODOLOGY

This section describes the overall methodology used to determine the SST retrieval pool. First, an evaluation of all SSTs against the primary selection criteria was performed. Best-Basis Inventory data (Tank Waste Information Network System) were collected for all SSTs and then sorted and ranked for each of the three short-term and long-term risk reduction categories (radioactive concentration, groundwater risk, and airborne risk). While the efficient WTP operations criteria (balance WTP feed and shorten WTP mission) cannot be numerically ranked, specific tanks were identified that met the objective of the criteria. Tanks with significant high level sludge quantities were identified as meeting the balance WTP feed criterion. Tanks that were candidates for direct TRU packaging were identified as meeting the shorten WTP mission criterion. (TRU tanks will not be retrieved and packaged as TRU until regulatory uncertainties have been resolved and a suitable packaging facility has been permitted.)

Then the tanks were evaluated against the additional objectives (WMA closure, optimize DST volume, and resource leveling and infrastructure utilization). The SSTs were numerically ranked by their estimated DST volume needed for storage. Tanks that could be grouped together based on estimates of a common use of resources or equipment were identified as meeting the resource leveling and infrastructure utilization criteria. When all of the tanks in a defined WMA ranked high in most of the other categories they were identified as meeting the WMA closure criteria.

An initial tank screening was completed to identify tanks ranked in the top 50 of each ranked category, and identify tanks that met the criteria for the other non-ranked categories. It should be noted that because the DBVS is only planning on a partial retrieval of tank S-109 and full retrieval or near-term tank closure actions are not planned, it was not included in the tank pool. All SSTs were identified in a matrix with the eight selection factors to develop a visual image of the selected tanks.

Tank selection was then adjusted to provide a balance of tanks ranked high in the environmental risk reduction factors and the qualitative operational factors. HTWOS runs were completed to validate that the bulk of the retrievals were logistically achievable and effectively used the available DST space (RPP-21216). The tank pool data were then compiled in graphical form to provide a visual tool that helps distinguish between preferred and non-preferred tank groupings. To simplify the presentation, a "star" was used to distinguish a group of tanks where more than half the tanks in that grouping ranked in the top 50 (or met criteria for non-ranked factors) for each factor considered. This "Star Chart," which represents the tank pool, is presented in Figure 2-1. Appendix A of this document contains the complete list of SSTs and their relative ranking against the four quantitative selection factors.

2.3 SUMMARY

A review of the SST retrieval pool reveals a balanced mix of tanks that optimizes early risk reduction, provides for early closure of an entire WMA, and allows for efficient use of resources and common retrieval systems. Additionally, there are enough "extra" tanks to provide the flexibility to support a robust strategic plan that accommodates differences in actual versus

planned DST available space, retrieval technology effectiveness, or unforeseen operational restrictions.

Figure 2-1. Single-Shell Tank Retrieval Pool Selection Criteria

	Risk Reduction			Efficient WTP Operations		DST Space Utilization		
Tank	Curies per Gallon	Short Term Risk (ground water)	Long Term Risk (airborne)	Balance WTP Feed	Shorten WTP Mission	Resource Leveling/ Infrastructure	Optimize DST Volume	WMA Closure
A-102 A-106	☆		☆			☆	A-102	
AX-101 AX-102 AX-103 AX-104	☆	☆	☆			☆	AX-102 AX-104	
C-101 C-102 C-103 C-104 C-105 C-106 C-107 C-108 C-109 C-110 C-111 C-112 C-201 C-202 C-203 C-204	☆		C-101 C-102 C-103 C-104 C-105 C-107	☆		☆	C-106 C-111 C-201 C-202 C-203 C-204	☆
S-102 S-103 S-105 S-107 S-112	S-107	☆	☆					
SX-101 SX-105 SX-106 SX-108 SX-110 SX-115	☆	SX-101 SX-105 SX-106	☆			☆	SX-115	
U-112 U-201 U-202 U-203 U-204	U-112					☆	☆	
B-201 B-202 B-203 B-204					☆		☆	
T-104 T-110 T-111 T-112 T-201 T-202 T-203 T-204					☆		☆	

☆ indicates more than half the tanks in a group are ranked in the top 50 for the selection criteria

Individual tank listing indicates the specified tank is ranked in the top 50 for the selection criteria

✧ B and T Farm tanks are potentially classified as transuranic (TRU) and will not be retrieved and packaged as TRU until all regulatory uncertainties have been resolved and a suitable packaging facility has been permitted.

3.0 SINGLE-SHELL TANK RETRIEVAL SEQUENCE

Eighteen of the SST retrieval pool tanks, listed in Figure 2-1, are identified as the "committed tanks." This term means that there are HFFACO milestones satisfied by completing the retrieval of waste from these tanks. The committed tanks include tanks S-102 and S-112, and all of the C-Farm SSTs.

Table 3-1 provides an example retrieval sequence for SST waste retrievals for the committed tanks. The retrieval sequence provided in Table 3-1 is referred to as an example sequence because it was chosen to demonstrate the viability of retrieving the committed tank pool tanks. In accordance with HFFACO Appendix I, Section 2.1.2, "the pool of tanks selected by this document will be used as the starting point for selecting and scheduling the following two years' tank waste retrieval activities."

This HTWOS model run evaluates the DST space demand needed to support the retrieval of wastes from 18 committed tank pool tanks, the retrieval of a portion of the waste from the DBVS feed tank (tank S-109) and the retrieval of a portion of the waste from another pool tank (tank S-105) before the start of WTP operations. Wastes from the remaining tanks in the SST retrieval pool are projected to be retrieved later in the RPP mission because of transfer or operational constraints or in deference to other mission goals.

Table 3-1. Example Single-Shell Tank Retrieval Sequence.

Order	SST	Retrieved To	Modeled Retrieval Duration (Days)[1]	Planned Retrieval Technology	Current Waste Volume[2] (Kgal)	Projected DST Volume Impact (Kgal)	DST Volume Impact Post-Evap (Kgal)
1	C-106	—	Completed	—	—	—	—
2	S-112[3]	SY-102	Completed 136	MS RWL	— 31	— 360	— 318
3	C-203	—	Completed	—	—		
4	S-102[4]	SY-102	1,145	MS	341	1,016	685
5	C-202[5]	AN-106	42 [Completed]	Vacuum	1	12	2
6	C-201	AN-106	145	Vacuum	1	12	1
7	C-103[4]	AN-106	205	MS	75	168	83
8	C-204	AN-106	87	Vacuum	2	24	3
9	C-108[4]	AN-106	202	MS	66	163	96
10	S-109[6]	SY-101 DBVS	4 748	MS	533	314 None	213 —
11	C-109[4]	AN-106	311[7]	MS	63	161	91
12	C-101	AN-101	224	MRS	88	244	153
13	C-102[4]	AZ-101	434[7]	MS	316	357	355
	S-109	BVS	359	MS	N/A	None	None
14	C-104[4]	AN-101	335[7]	MS	259	413	303
15	C-105	AN-101	183	MRS	132	229	147
16	S-105[6]	SY-101 BVS	4 1403	MS	406	260 None	162 None
17	C-110	AN-106	220	MRS	178	394	233
18	C-112[4]	AY-101	222	MS	104	200	136
19	C-107[4]	AY-101	320	MS	247	345	274
20	C-111	AY-101	133	MRS	57	194	82

BVS = Bulk Vitrification System DBVS = Demonstration Bulk Vitrification System Kgal = kilogallon
MRS = Mobile Retrieval System MS = Modified Sluicing RWL = Remote Water Lance

Notes:

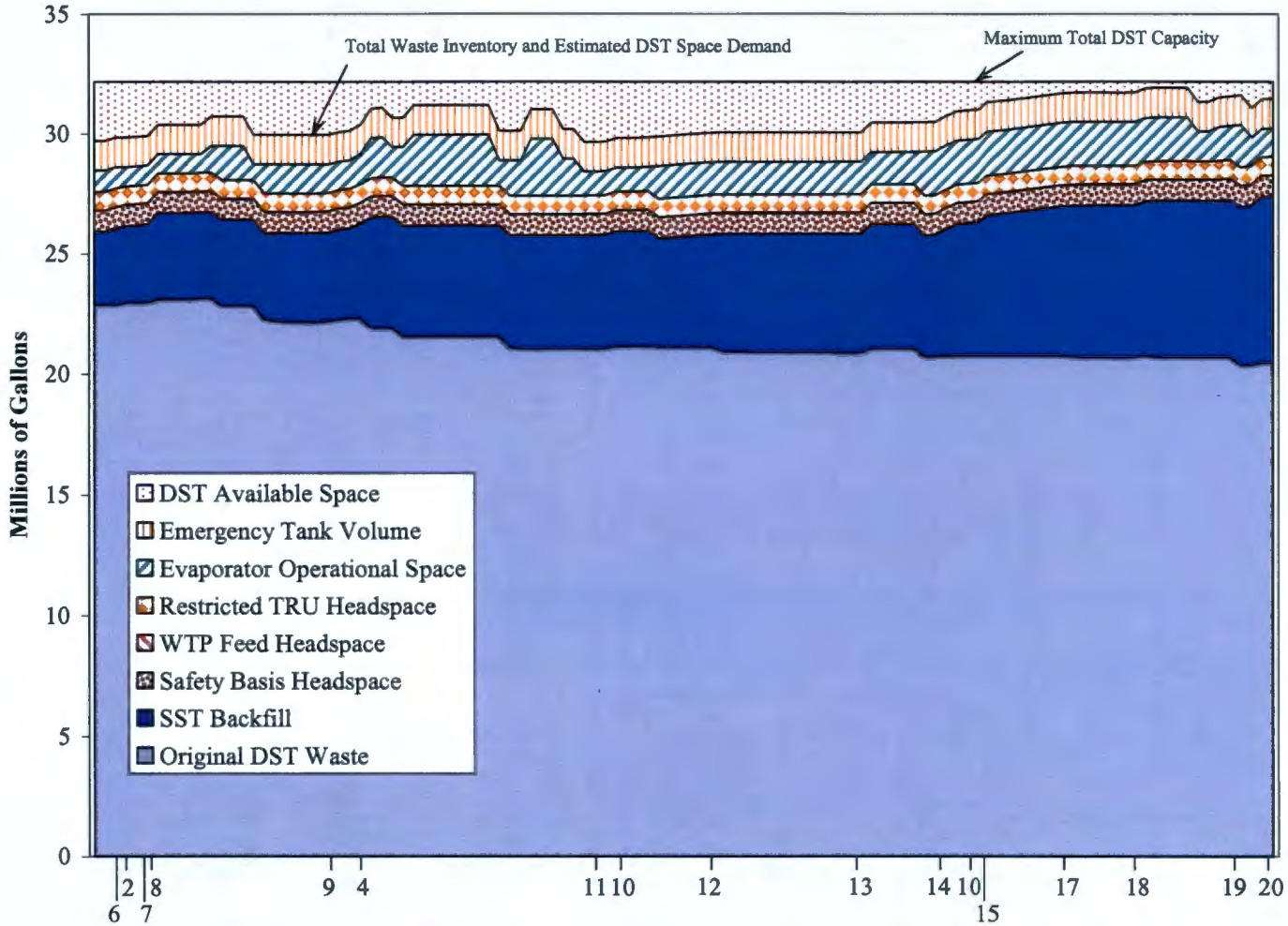
1. The retrieval of waste from tanks C-103, C-201, S-102, and S-112 is currently in progress. The modeled durations for tanks C-103, C-201, and S-112 were established in January 2006 and may not reflect the latest status of retrieval efforts in those tanks. The modeled durations for tanks S-105 and S-109 are based on projections of glass production.
2. Current waste volume data from HNF-EP-0182, *Waste Tank Summary Report for Month Ending June 30, 2005*, Rev. 207.
3. Retrieval of waste from tank S-112 to satisfy HFFACO milestone M-045-03C was completed in May 2005. Efforts to retrieve the remaining waste from tank S-112 using a remote water lance (RWL) were initiated on November 18, 2005.
4. Gray shading indicates which tanks are assumed to be retrieved using modified sluicing with supernate recycle. The use of recycled supernates needs to be approved by the State of Washington, Department of Ecology and the Environmental Protection Agency (EPA) on a tank by tank basis.
5. Tank C-202 is depicted as both modeled and completed because the retrieval of waste from that tank was initiated and completed between the effective date for the inventory used in HTWOS and the issuance of this document. The 42 day duration reported for C-202 is based on the difference between the actual start and finish dates of the retrieval effort.
6. Only part of the waste from tanks S-109 and S-105 will be retrieved for use as feed for supplemental treatment before the start of WTP operations. The remainder will be retrieved later in the mission.
7. The modeled durations for tanks C-102, C-104, C-107, C-109, and C-112 includes additional efforts for the removal of a hard heel.

4.0 DOUBLE-SHELL TANK SPACE EVALUATION

Current estimates indicate that approximately 4.9 Mgal of DST storage capacity will be needed for the waste retrieved from 18 of the SST retrieval pool tanks (the committed tanks), and for the portions of waste retrieved from another pool tank (tank S-105) and from a non-pool tank (tank S-109) prior to the startup of the WTP. Wastes will be retrieved from tanks S-105 and S-109 as feed to supplemental treatment facilities and those retrieval efforts will generate some waste that has to be sent to the DST system. Retrieval of all of the wastes from tanks S-105 and S-109 is not anticipated to be completed prior to WTP startup.

Figure 4-1 shows how the total DST space will be used to support SST waste retrievals prior to the startup of the WTP, and the space usage reflects the space optimization efforts discussed in Section 5.1. There is sufficient space in the DST system to support retrieval of waste from the C-Farm SSTs and from tanks S-102, S-105, S-109, and S-112 as can be seen in Figure 4-1. Table 4-1 provides the definition of the different space allocation categories used in Figure 4-1. The text following Table 4-1 explains the basis for each of the categories in a little more detail. The x-axis of Figure 4-1 identifies the relative sequence for the completion of SST waste retrieval up to WTP startup. The numbers on the x-axis of the plot correspond to the SST retrieval order shown in Table 3-1.

Figure 4-1. Total Double-Shell Tank Volume.



Note: The x-axis identifies the relative sequence for the completion of waste retrieval from the SSTs listed in Table 3-1 up to WTP startup. The numbers on the plot correspond to the order numbers in Table 3-1 and those order numbers were assigned based on the waste retrieval start dates.

Table 4-1. Double-Shell Tank Space Allocation Criteria.

Category	Criteria
DST Available Space	Unallocated space (i.e., the leftover space).
Evaporator Operational Space	Space above waste in DSTs used to support 242-A Evaporator operation (i.e., dilute waste receivers, the evaporator feed tank, and the evaporator bottoms receiver tank).
Emergency Tank Volume	1.235 million gallons of available space that could be used to receive waste in the event of a leaking DST or emergency returns from the WTP.
Restricted TRU Space	Space above the TRU solids in tanks AW-103 and AW-105.
WTP Feed Head Space	Space above waste specifically identified as an early WTP feed source or in tanks used to deliver feed to the WTP throughout the whole mission.
Safety Basis Headspace	Space in tanks that cannot be used because of a safety issue associated with the waste.
Original DST Waste	Waste in the DST system before July 2003.
SST Backfill	SST waste retrieved into the DST system after June 2003.

Notes:
See the discussion immediately following for further explanation of the categories.

The DST space category identified as Original DST Waste represents the space occupied by waste that was in the DSTs as of June 30, 2003. The DST space category identified as SST Backfill represents the DST space occupied by waste retrieved from the SSTs since June 30, 2003. Between June 30, 2003 and the starting point for this analysis, the volume of waste in the DST system increased by about 2.3 Mgal due to receipt of retrieved SST waste (primarily) and due to receipt of new wastes from non-tank farm sources such as 222S Laboratory and PFP (HNF-EP-0182, Rev. 183 and Rev. 207).

The DST space category identified as Safety Basis Headspace represents unfilled space in a DST containing waste that has an associated safety issue. For example, in Waste Group A tanks (tanks AN-103, AN-104, AN-105, AW-101, and SY-103), the current waste conditions pose the potential for a spontaneous BDGRE involving flammable gas (RPP-13033, *Tank Farms Documented Safety Analysis*) if additional waste were transferred into those tanks.

The DST space category identified as WTP Headspace represents the unfilled space in a DST containing waste specifically identified for delivery to the WTP as waste feed. Currently, those tanks are AN-102, AN-107, and AY-102. Other DSTs will be allocated to this category when wastes are staged for compliance verification sampling or when the tank is filled with waste before delivery as feed to the WTP.

The DST space category identified as Restricted TRU Headspace represents the unfilled space above the TRU waste in tanks AW-103 and AW-105. Double-shell tanks identified as containing TRU waste will not be retrieved and packaged as TRU until regulatory uncertainties have been resolved and a suitable packaging facility has been permitted.

The DST space category identified as Evaporator Operational Space represents the unfilled space in DSTs used to support the 242-A Evaporator operations, which includes any DSTs used to

receive dilute waste or to stage (sample) dilute waste to the evaporator, the DST used to provide a feed stream to the evaporator, and the evaporator bottoms receiver. The DSTs allocated to this category change over time as wastes are transferred around the DST system.

The DST space category identified as Emergency Tank Volume represents 1.235 million gallons of available space that could be used to receive waste from other DSTs in the event of a leaking DST, or from the WTP in the event of emergency returns from the WTP. The emergency space allocation is not associated with a specific tank but is distributed throughout the DST system. The value for the emergency space allocation is based on the maximum volume of waste that could be stored in an AP-Farm DST (OSD-T-151-00007, *Operating Specifications for the Double-Shell Storage Tanks*).

The DST space category identified as DST Available Space represents any unfilled space not allocated to another purpose listed above, and as such represents the space available to support SST retrieval or the receipt of new wastes into the DST system.

5.0 DOUBLE-SHELL TANK SPACE OPTIONS

5.1 IMPLEMENTED DOUBLE-SHELL TANK SPACE OPTIONS

Four DST space optimization efforts from RPP-7702, the *Tank Space Options* report, have been implemented to complete HFFACO milestone M-46-21, "Complete Implementation of Double-Shell Tank Space Optimization Study Recommendations (Tank Space Options Report, Document No. RPP-7702, April 12, 2001)." The four efforts are discussed below.

1. Share DST reserve emergency space.

   Tank Farms now shares emergency space with the WTP. This emergency space is reflected in Interface Control Document 19 (24590-WTP-ICD-MG-01-019). HNF-3484, the *Double-Shell Tank Emergency Pumping Guide,* has been updated and reviewed by the State of Washington, Department of Ecology (Ecology). The Emergency Tank Volume space category shown in Figure 4-1 reflects the allocation of space equivalent to only one DST (1.235 Mgal) as emergency space.

2. Use previously "restricted" space within DSTs containing WTP staged feed.

   Restrictions on use of staged feed tank space were rescinded in External letter 04-TPD-024, 'Contract No. DE-AC27-99RL14047 – Response to Request for U. S. Department of Energy (DOE), Office of River Protection (ORP) to Rescind Direction on "Configuration Control of Waste Feed Delivery Tank Contents"' (04-TPD-024 – Letter). CH2M HILL Hanford Group, Inc. (CH2M HILL) has incorporated changes into HNF-SD-WM-OCD-015, the *Tank Farm Waste Compatibility Program*, for approving transfers into formerly restricted WTP feed tanks. The current model reflects the consolidation of waste in tank AP-101 with waste in tank AY-102, the blending of AZ-101 supernate with other supernates to reduce the sulfate concentration, and the retrieval of C-104 waste into AN-101. These transfers can be seen in Figure 5-1.

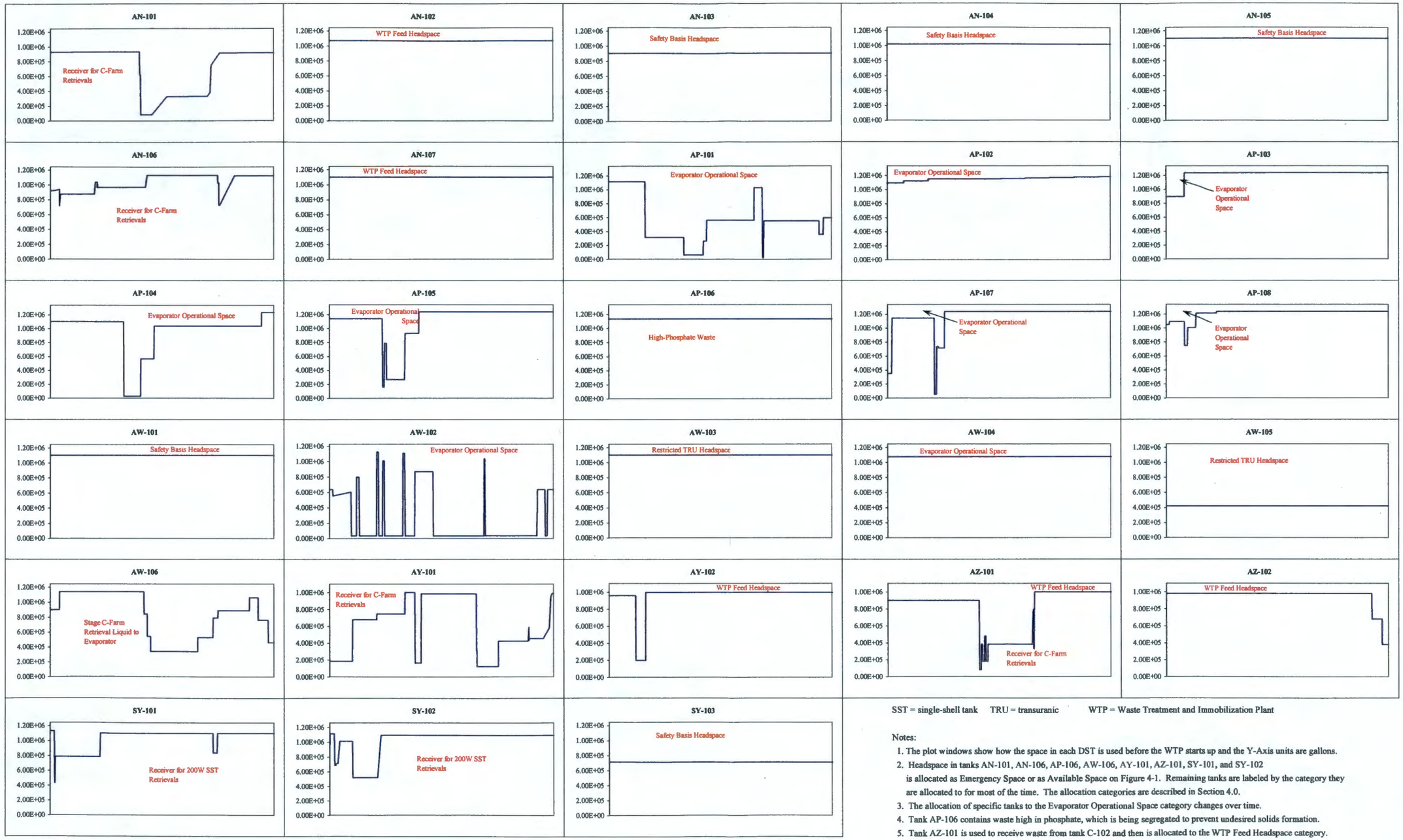
3. Concentrate evaporator slurries to a higher SpG (greater than 1.41.SpG).

   Past evaporator campaigns 2003-03, 2003-04, 2004-01 and 2005-01 have concentrated wastes to SpGs of 1.46, 1.42, 1.43, and 1.42, respectively. To make the 4.9 Mgal of space available for retrieving waste from the twenty SSTs discussed in Section 3.0, approximately 6.9 Mgal of waste from eight DSTs are modeled as being concentrated to a SpG of 1.43. This removes about 3.7 Mgal of water and leaves about 3.2 Mgal of concentrated waste to be stored in the DST system. The changes from moving and concentrating the DST wastes can be seen as a comparison of the initial and final SpGs in Figure 5-2.

4. Raise the allowable tank levels.

   Controls needed to increase the fill height in all of AP tank farms have been placed within OSD-T-151-00007 for use during "top-off" transfers into AP tank farm. The

Figure 5-1. Double-Shell Tank Volume Plots.



SST = single-shell tank TRU = transuranic WTP = Waste Treatment and Immobilization Plant

Notes:

1. The plot windows show how the space in each DST is used before the WTP starts up and the Y-Axis units are gallons.
2. Headspace in tanks AN-101, AN-106, AP-106, AW-106, AY-101, AZ-101, SY-101, and SY-102 is allocated as Emergency Space or as Available Space on Figure 4-1. Remaining tanks are labeled by the category they are allocated to for most of the time. The allocation categories are described in Section 4.0.
3. The allocation of specific tanks to the Evaporator Operational Space category changes over time.
4. Tank AP-106 contains waste high in phosphate, which is being segregated to prevent undesired solids formation.
5. Tank AZ-101 is used to receive waste from tank C-102 and then is allocated to the WTP Feed Headspace category.

Figure 5-2. 200 Area Double-Shell Tank (DST) Waste Contents

DSTs as of 10/1/05

SST-Retrieval-Pool-Case_02-13-2006 data on 10/1/2005

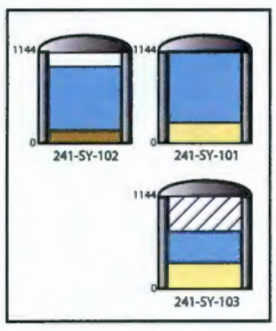
DSTs after S-102, S-112 and C-Farm Retrieval (Projected)

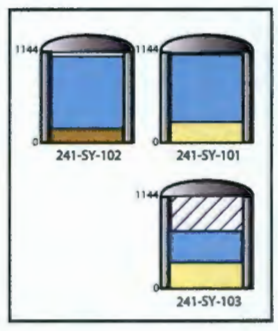
SST-Retrieval-Pool-Case_02-13-2006

SY-Tank Farm- 1977

3 @ 1,144 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-SY-101	251	883	1.27
241-SY-102	157	813	1.25
241-SY-103	318	397	1.46





SY-Tank Farm- 1977

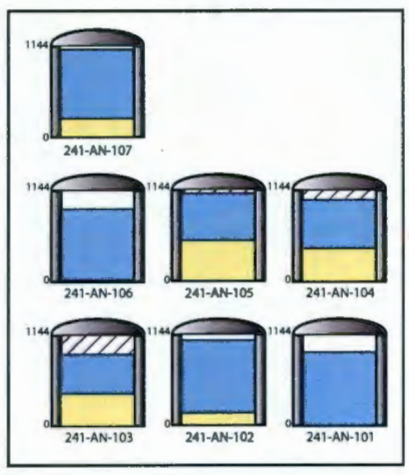
3 @ 1,144 Kgal Operational Capacity, Double-Shell

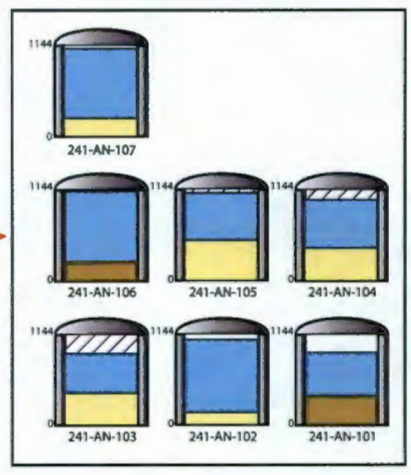
Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-SY-101	255	849	1.26
241-SY-102	174	919	1.23
241-SY-103	318	397	1.46

AN-Tank Farm- 1981

7 @ 1,144 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AN-101	0	926	1.42
241-AN-102	154	916	1.44
241-AN-103	404	499	1.46
241-AN-104	414	607	1.52
241-AN-105	509	588	1.49
241-AN-106	18	894	1.09
241-AN-107	230	871	1.43





AN-Tank Farm- 1981

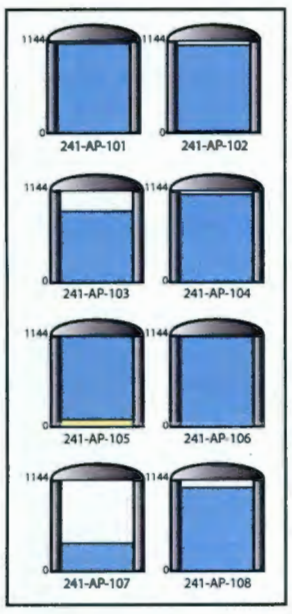
7 @ 1,144 Kgal Operational Capacity, Double-Shell

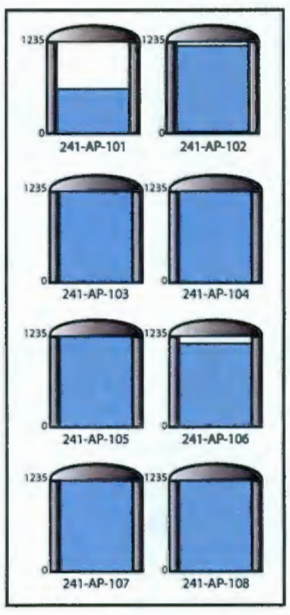
Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AN-101	366	549	1.18
241-AN-102	154	916	1.44
241-AN-103	404	499	1.46
241-AN-104	414	607	1.52
241-AN-105	509	588	1.49
241-AN-106	241	885	1.10
241-AN-107	230	871	1.43

AP-Tank Farm-1986

8 @ 1,144 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AP-101	0	1115	1.31
241-AP-102	23	1071	1.39
241-AP-103	0	894	1.34
241-AP-104	0	1100	1.27
241-AP-105	89	1050	1.27
241-AP-106	0	1136	1.21
241-AP-107	0	351	1.28
241-AP-108	0	1050	1.41





AP-Tank Farm-1986

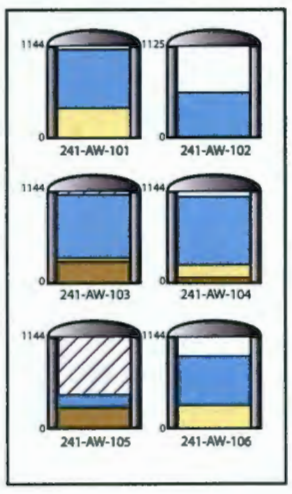
8 @ 1,235 Kgal Operational Capacity, Double-Shell

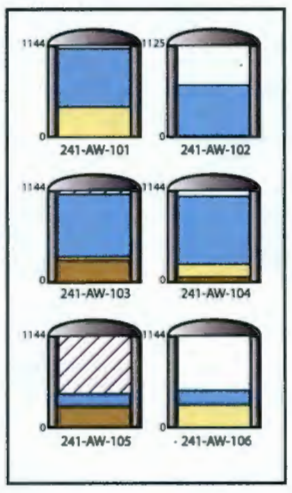
Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AP-101	0	599	1.42
241-AP-102	23	1156	1.36
241-AP-103	0	1235	1.36
241-AP-104	0	1235	1.42
241-AP-105	1	1234	1.45
241-AP-106	0	1136	1.21
241-AP-107	0	1235	1.42
241-AP-108	0	1235	1.42

AW-Tank Farm-1980

1 @ 1,125 Kgal Operational Capacity, Double-Shell
5 @ 1,144 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AW-101	371	732	1.54
241-AW-102	7	548	1.24
241-AW-103	313	787	1.28
241-AW-104	223	851	1.31
241-AW-105	264	157	1.05
241-AW-106	283	616	1.30





AW-Tank Farm-1980

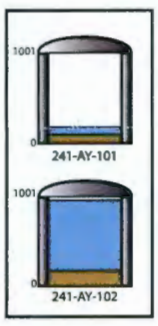
1 @ 1,125 Kgal Operational Capacity, Double-Shell
5 @ 1,144 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AW-101	371	732	1.54
241-AW-102	7	628	1.17
241-AW-103	313	787	1.28
241-AW-104	223	851	1.31
241-AW-105	264	157	1.05
241-AW-106	283	182	1.21

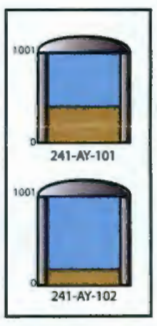
AY-Tank Farm- 1971-76

2 @ 1,001 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AY-101	96	89	1.22
241-AY-102	170	791	1.12



WTP commissioning tank



AY-Tank Farm- 1971-76

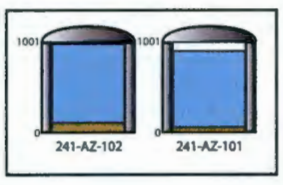
2 @ 1,001 Kgal Operational Capacity, Double-Shell

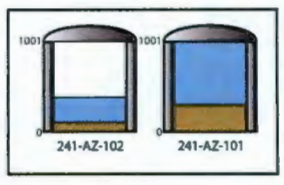
Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AY-101	402	589	1.11
241-AY-102	170	828	1.30

AZ-Tank Farm- 1975-76

2 @ 1,001 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AZ-101	52	849	1.25
241-AZ-102	105	876	1.13





AZ-Tank Farm- 1975-76

2 @ 1,001 Kgal Operational Capacity, Double-Shell

Tank	Kgal Solids	Kgal Supernatant	SpG (Liquid)
241-AZ-101	299	698	1.25
241-AZ-102	105	276	1.13

LEGEND

Sludge | Saltcake | Supernatant | Available Space | Restricted Space

Figure updated 2/13/06

CH2MHILL Hanford Group Inc.

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increased space made available in six of the AP Farm DSTs (tanks AP-102, AP-103, AP-104, AP-105, AP-107, and AP-108) will be used to receive concentrated waste from future evaporator runs before the WTP starts up. The increased space made available in tanks AP-101 and AP-106 is not used before the WTP start up because of a need for operational flexibility (AP-101) and waste compatibility concerns (high-phosphate waste in AP-106).

In total, these actions have provided approximately 2.4 Mgal of additional DST storage space for waste retrieval and established the basis for concentrating retrieved waste thereby using less space.

Concurrently, SST retrieval plans have evolved to reduce the required DST space through an increase in the amount of high-curie concentration SST sludge waste retrieved, a reduction of the amount of SST salt waste retrieved, and the use of recycled DST liquids for sluicing. In addition, plans are continuing to demonstrate a supplemental treatment technology to avoid the need for DST space, if successfully deployed.

5.2 FUTURE DOUBLE-SHELL TANK SPACE CONSIDERATIONS

5.2.1 Potential Double-Shell Tank Space Options

As noted in Section 4.0, the DST system has sufficient space to receive and store the waste from WMA C, S-102, S-105, S-109, and S-112. If additional SST waste is to be retrieved into the DST system before the WTP becomes operational, new space savings measures may be required. Out of the eight options identified in Table 4-2 of RPP-7702, the following options remain available for creating DST space or avoiding the need for DST space in the future.

1. Utilize alternate storage for emergency reserves. This includes the restricted space over TRU waste in AW-103 and AW-105.
2. Utilize double-contained surface storage.
3. Construct new double-shell tanks.
4. Avoid using DST space (supplemental treatment).

Previous space evaluations relied on the startup of the WTP and supplemental treatment to provide DST space relief and thereby support continued SST retrievals. The recent uncertainty associated with the WTP start up suggests other DST space relief methods may need to be implemented to avoid temporarily curtailing SST retrievals while waiting for WTP start up. Deployment of supplemental pretreatment capacity along with supplemental treatment can allow SST retrievals to continue. Building additional DSTs would provide additional tank space but would be expensive, take approximately seven years, and be counter productive to the objective of closing the tank farms and reducing the Hanford footprint. Currently, there are no plans in the RPP baseline to build additional DSTs. Temporary use of an appropriately upgraded and permitted SST for selected storage missions could provide additional tank space that would allow SST retrieval momentum to be maintained. A recent evaluation of SST waste staging

(RPP-RPT-25589, *Evaluation of Alternatives to Support Temporary Waste Staging Needs*) provides insight into potential temporary SST storage missions. Further evaluation of additional DST space saving options may be warranted.

5.2.2 Double-Shell Tank Space Required for Continued Retrieval

Ecology has expressed interest in continuing the retrieval of additional high-risk SST waste from the pool of tanks, identified in Section 2.0, after the retrieval of waste from the WMA-C tanks has been completed. Inspection of Figure 2-1 reveals that two A-Farm tanks (A-102 and A-106) and the four AX-Farm tanks would be the next logical candidates when prioritizing the pool tanks for retrieval based on risk reduction. About 1.8 Mgal of DST space was estimated to be needed to support the retrieval of approximately 620 Kgal of waste from tanks A-102 and A-106, and the four AX-Farm tanks.

The retrieval of approximately 24.6 Mgal of waste from all the remaining SSTs (after tanks A-102 and A-106, and the four AX-Farm tanks) would yield approximately 101 Mgal of waste volume that must move through the DST system. The 101 Mgal of waste will be transferred out of the DST system to feed the WTP and supplemental treatment processes. Should this retrieved waste need to be stored in the DST system, the volume could be reduced to approximately 53 Mgal by concentrating the liquid phase.

6.0 REFERENCES

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APPENDIX A.

HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER MILESTONE M-45-02M

APPENDIX A

Hanford Federal Facility Agreement and Consent Order Milestone M-45-02M.

The text of Hanford *Federal Facility Agreement and Consent Order* Milestone M-45-02M is provided below for information.

"This provides for a biennial update of a SST retrieval sequence document that will define the tank retrieval sequence, selection criteria and rationale, reference retrieval method(s) for each tank, and the estimated retrieval schedules. The retrieval sequence document will list retrieval methodologies to be employed and estimated waste volumes to be generated during retrieval (to be transferred to the DSTs or other available safe storage). The report will also list tank selection rationale based on the primary objective of maximizing risk reduction through the retrieval of mobile, long-lived radionuclides or potential airborne contaminants and principle nonradiological hazardous constituents in a manner which is sensitive to waste treatment facility requirements and infrastructure constraints. The sequencing will also take in consideration DST space and DST waste compatability [sic] when selecting the SST retrieval sequence. Tank selection for retrieval will take into consideration the closure of waste management areas and resource optimization. The biennial updates will be submitted to Ecology for approval as Agreement primary documents.

This also provides for a bienniel [sic] update of the double shell tank space evaluation document. This new milestone replaced milestone M-31-02 and subsequently M-46-00L, M-46-00L, and M-46-00M, etc. A tank volume projection report shall be submitted on a bienniel [sic] basis to Ecology and EPA. This report shall include discussions covering all assumptions which form the basis of the projection. The report shall include or shall be accompanied by DOE's plans for acquisition of additional tanks based on the tank volume projection. Ecology concurrence of additional tank acquisition within 60 days. Within 60 days of receiving the DST tank space evaluation document, the three parties shall meet to establish new milestones, if required, for acquisition of additional tanks."

APPENDIX B.

SINGLE-SHELL TANK RISK RANKING AND PROJECTED DOUBLE-SHELL TANK SPACE DEMAND

APPENDIX B.

SINGLE-SHELL TANK RISK RANKING AND PROJECTED DOUBLE-SHELL TANK SPACE DEMAND

Table B-1 provides a listing of the risk ranking categories and ranking values for the waste in the single-shell tanks, along with the projected space demand from this analysis and identification whether additional efforts will be needed to remove a hard heel of waste to meet the Tri-Party Agreement goals for waste retrieval. The risk and tank ranking values are the same that were published in the previous revision of this document and are provided for the reader's information.

Table B-1. Tank Ranking by Data Category. (4 Sheets)

Tank	Rank by Ci/gal	Rank by Groundwater Risk	Rank by Airborne Risk	Rank by Estimated DST Space Used (least to greatest)	Projected Double-Shell Tank Space Demand (Kgals)	Hard Heel Removal is Projected to be Needed (Yes or No)
A-101	49	25	46	106	888	No
A-102	24	74	42	35	65	No
A-103	58	49	57	108	892	No
A-104	2	97	16	37	247	No
A-105	4	60	6	41	217	No
A-106	13	62	9	67	381	Yes
AX-101	40	43	55	123	996	Yes
AX-102	10	104	58	34	50	No
AX-103	16	48	20	61	232	Yes
AX-104	1	58	14	25	94	No
B-101	11	102	13	60	402	No
B-102	128	132	143	32	102	No
B-103	127	124	114	45	209	No
B-104	114	84	106	93	611	Yes
B-105	124	110	118	121	817	No
B-106	113	105	127	53	317	Yes
B-107	75	88	68	75	None	No
B-108	129	122	141	62	514	Yes
B-109	27	113	122	82	891	Yes
B-110	109	82	78	3	None	No
B-111	46	55	74	4	None	No
B-112	108	94	144	29	135	No
B-201	143	146	100	5	None	No
B-202	141	130	126	12	None	No
B-203	144	143	120	10	None	No
B-204	145	144	117	9	None	No

Table B-1. Tank Ranking by Data Category. (4 Sheets)

Tank	Rank by Ci/gal	Rank by Groundwater Risk	Rank by Airborne Risk	Rank by Estimated DST Space Used (least to greatest)	Projected Double-Shell Tank Space Demand (Kgals)	Hard Heel Removal is Projected to be Needed (Yes or No)
BX-101	15	133	72	44	1,137	No
BX-102	28	137	33	59	1,128	No
BX-103	22	128	18	43	644	Yes
BX-104	41	75	50	68	1,601	Yes
BX-105	69	89	102	46	1,432	Yes
BX-106	57	98	95	42	184	Yes
BX-107	126	64	96	89	1,979	Yes
BX-108	64	115	133	36	207	No
BX-109	88	107	132	64	349	Yes
BX-110	111	53	108	94	605	No
BX-111	110	51	123	85	523	No
BX-112	118	90	92	54	730	Yes
BY-101	50	18	94	137	1,283	Yes
BY-102	105	37	89	109	913	No
BY-103	83	15	79	134	1,284	No
BY-104	45	20	75	124	1,241	Yes
BY-105	93	54	44	144	1,474	No
BY-106	66	8	105	132	1,333	No
BY-107	62	41	115	97	860	No
BY-108	77	50	110	88	527	No
BY-109	56	45	98	96	724	Yes
BY-110	68	29	90	120	1,013	Yes
BY-111	106	35	82	116	1,328	No
BY-112	100	33	86	118	1,253	No
C-101	20	114	41	84	244	No
C-102	35	111	4	90	413	Yes
C-103	5	83	3	99	168	No
C-104	32	61	2	110	357	Yes
C-105	18	59	7	86	229	No
C-106	8	119	66	26	None	No
C-107	9	66	5	102	345	Yes
C-108	53	108	136	72	163	No
C-109	14	78	101	76	161	Yes
C-110	130	79	104	77	394	No
C-111	7	112	65	49	194	No
C-112	12	63	51	79	200	Yes
C-201	81	135	107	15	12	No
C-202	63	136	119	16	None	No
C-203	119	125	128	20	None	No
C-204	115	127	146	17	24	No
S-101	30	44	32	129	3,081	Yes
S-102	78	36	70	100	1,016	Yes

Table B-1. Tank Ranking by Data Category. (4 Sheets)

Tank	Rank by Ci/gal	Rank by Groundwater Risk	Rank by Airborne Risk	Rank by Estimated DST Space Used (least to greatest)	Projected Double-Shell Tank Space Demand (Kgals)	Hard Heel Removal is Projected to be Needed (Yes or No)
S-103	61	30	64	95	1,298	Yes
S-104	38	68	34	122	3,301	No
S-105	117	5	38	135	162	Yes
S-106	85	16	97	136	1,378	Yes
S-107	42	73	8	104	5,578	Yes
S-108	80	10	22	141	1,710	Yes
S-109	120	12	88	115	1,710	Yes
S-110	59	23	37	127	1,646	Yes
S-111	43	27	112	111	981	Yes
S-112	104	26	29	148	360	Yes
SX-101	31	42	24	119	1,167	Yes
SX-102	47	22	49	130	930	Yes
SX-103	48	19	27	140	1,686	Yes
SX-104	37	40	12	133	2,574	No
SX-105	52	34	21	107	981	Yes
SX-106	76	7	45	113	975	No
SX-107	21	95	54	70	1,809	No
SX-108	6	106	10	63	175	No
SX-109	33	65	40	114	2,444	No
SX-110	29	99	80	52	475	No
SX-111	26	86	53	73	1,804	No
SX-112	23	100	61	58	1,331	No
SX-113	107	93	134	31	469	No
SX-114	34	72	60	87	2,636	No
SX-115	3	134	31	19	32	No
T-101	102	69	93	56	276	No
T-102	74	92	121	40	188	Yes
T-103	17	117	69	30	187	No
T-104	142	121	76	2	None	Yes
T-105	86	76	83	50	None	Yes
T-106	116	118	129	28	155	No
T-107	87	67	87	80	None	No
T-108	133	126	139	24	17	No
T-109	138	129	140	48	140	No
T-110	132	131	109	7	None	No
T-111	140	87	62	1	None	No
T-112	125	141	113	8	None	Yes
T-201	146	147	103	6	None	No
T-202	147	149	131	14	None	No
T-203	148	148	124	11	None	No
T-204	149	145	130	13	None	No
TX-101	25	85	35	65	148	Yes

Table B-1. Tank Ranking by Data Category. (4 Sheets)

Tank	Rank by Ci/gal	Rank by Groundwater Risk	Rank by Airborne Risk	Rank by Estimated DST Space Used (least to greatest)	Projected Double-Shell Tank Space Demand (Kgals)	Hard Heel Removal is Projected to be Needed (Yes or No)
TX-102	90	46	59	91	557	No
TX-103	92	56	71	81	372	No
TX-104	36	80	99	51	116	Yes
TX-105	95	3	17	145	1,516	No
TX-106	84	24	39	131	941	Yes
TX-107	60	81	52	38	88	No
TX-108	91	57	73	74	322	Yes
TX-109	123	70	77	103	458	Yes
TX-110	98	14	25	138	1,190	No
TX-111	99	28	36	126	910	Yes
TX-112	96	2	15	147	1,684	No
TX-113	131	1	85	149	1,991	No
TX-114	101	11	23	142	1,422	No
TX-115	94	4	19	143	1,454	No
TX-116	122	32	47	146	1,742	No
TX-117	112	38	43	139	1,267	No
TX-118	65	47	1	101	679	Yes
TY-101	134	109	91	69	1,946	No
TY-102	121	103	137	55	195	No
TY-103	97	77	84	66	973	No
TY-104	82	101	116	39	347	No
TY-105	73	71	125	78	1,078	No
TY-106	67	123	142	27	252	No
U-101	19	120	135	33	73	No
U-102	44	31	48	105	783	Yes
U-103	79	21	63	112	1,082	Yes
U-104	51	96	81	57	580	No
U-105	71	6	11	128	946	Yes
U-106	54	52	26	71	402	No
U-107	103	13	28	117	809	Yes
U-108	72	9	30	125	1,166	Yes
U-109	89	17	111	98	998	Yes
U-110	55	91	67	83	2,007	No
U-111	70	39	56	92	555	Yes
U-112	39	116	138	47	552	No
U-201	135	138	148	23	40	No
U-202	139	139	147	21	40	No
U-203	136	140	149	18	40	No
U-204	137	142	145	22	30	No

Ci/gal Curies per gallon